
# Nova Scotia Environmental Goals and Sustainable Prosperity Act
# Economic Costs and Benefits for Proposed Goals

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Ecology Action Centre

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## *Acknowledgements*

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# Summary

The Nova Scotia Environmental Goals and Sustainable Prosperity Act (EGSPA) was enacted in 2007. The Ecology Action Centre (EAC) has participated in the development of EGSPA through collaboration and recommendations of goals and strategies over the life of the Act. This report explores select climate goals that EAC proposes be part of a renewed EGSPA.

EAC is seeking the best strategies for Nova Scotia to avoid the environmental and economic consequences of overshooting 1.5°C, or 2°C warming (UNIPCC, 2018), and meeting the challenges of decoupling the provincial economy from carbon-based energy sources. The following six (6) goals focused on reducing greenhouse gas (GHG) emissions are assessed in terms of associated costs and benefits:

- **Goal 1: Reducing GHG emissions 50% below 1990 levels by 2030 –** Meeting this goal would put Nova Scotia in line with its fair share of emissions reductions to keep global warming below the Paris Agreement's target of 1.5°C. This overarching goal is met through goals 2-5.
- **Goal 2: Supplying 90% of NS electricity needs with renewable energy by 2030** – Dramatically decarbonizing Nova Scotia's electricity grid by displacing coal, oil and large biomass with wind, hydro, solar, small scale biomass, and community-scale projects.
- **Goal 3: Making 100% of social housing Net-Zero Energy Ready (NZER) by 2030–** Saving energy and making people more comfortable in their homes by reducing energy consumption in existing social housing by 60% or more, and ensuring all new construction is built to NZER standards.
- **Goal 4: – Tripling energy efficiency in the electricity sector by 2030** – Saving money and avoiding the need for new electricity system infrastructure by increasing the level of total electricity system efficiency to 3% a year.
- **Goal 5: Reducing car dependence, and electrifying personal and public transport** – This goal includes public transit and active transportation promotion, battery electric buses (BEBs), higher occupancy vehicles, and promotion of hybrid and electric vehicles.
- **Goal 6: Growing Nova Scotia's green economy** – Meeting goals 1 through 5 will substantially increase the economic prosperity of the green economy in Nova Scotia and aim to create over 15,000 green jobs per year in the province by the year 2030.

Nova Scotia's total GHG emissions in carbon dioxide equivalents (CO2e) for 1990 were 19.6 million tonnes (ECCC, 2018), and by 2016 were reduced to 15.6 million tonnes (down 20%). As of 2019 a further reduction of 5.8 million tonnes is needed to achieve the 50% goal by 2030 (Goal 1) of 9.8 million tonnes. This report indicates the following GHG reductions that are possible through each goal analyzed in this report.

| Goal | Mt GHG avoided |
|---|---|
| 1 - Reducing GHG emissions by 50% | **5.80** |
| 2 - 90% of electricity with renewables | **5.36** |
| 3 - 100% of eligible social housing NZER | **0.02** |
| 4 - Increase electricity efficiency to 3% per year | **0.57** |
| 5 - Reducing car dependence & electrification | **0.48** |
| Sub-Total (Goals 2 - 5) | **6.43** |

Mt = million tonnes

The specific measures related to each goal are described in the report along with the investments required based on year by year implementation from 2019 to 2030. The sub-total (55% for Goals 2-5) moves beyond the 50% reduction target (Goal 1) and towards the net-zero emissions benchmark needed by 2050. Some reductions are already underway and other measures will be undertaken by residential, industrial, commercial and institutional sectors. In particular, other measures for oil and gas, building construction and renovation, commercial and industrial transportation, and other sectors are not included in this report.

The combined investments outlined in this report all contribute to Nova Scotia's "green economy" (Goal 6). The one-year economic impacts in 2030 are shown in the table below, and the report also includes the cumulative economic impacts from 2019 to 2030. Not all impacts are "new" as some involve "green" shifting from carbon-based economic activities to businesses and jobs based on renewable energy and energy efficiency.

**Economic impacts for in 2030 (single year)**

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| Output | $912 | $277 | $235 | $1,425 | $1,880 |
| GDP | $487 | $161 | $169 | $816 | $1,033 |
| Income | $357 | $115 | $52 | $524 | $676 |
| Jobs (FTE) | 11,124 | 1,883 | 1,974 | 14,980 | 17,282 |
| Fed tax* | $44 | $16 | $8 | $68 | $89 |
| Prov tax* | $47 | $20 | $12 | $79 | $0 |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

The $816 million in added-value to Nova Scotia will include $524 million in salaries and wages for about 14,980 full-time equivalent workers. The gross domestic product (GDP, added-value), jobs, salaries, and tax revenues for government will be sustainable based on renewable energy resources and energy savings for Nova Scotians. The cumulative 12-year total impacts (below) represent the return on all investments up to 2030 that meet the goals.

**Economic impacts for 2019-2030 (12-year total)**

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| Output | $10,949 | $3,323 | $2,825 | $17,096 | $22,561 |
| GDP | $5,839 | $1,936 | $2,022 | $9,797 | $12,392 |
| Income | $4,284 | $1,381 | $624 | $6,289 | $8,117 |
| Jobs (FTE) | 133,483 | 22,590 | 23,685 | 179,759 | 207,384 |
| Fed tax* | $523 | $187 | $100 | $810 | $1,064 |
| Prov tax* | $569 | $235 | $145 | $948 | |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

Every step forward on this path should be taken with affordability and local benefits at the forefront of the solutions proposed for a prosperous green economy in Nova Scotia.

# Introduction

## 1. Background

The Nova Scotia Environmental Goals and Sustainable Prosperity Act (EGSPA) was enacted in 2007. The two overarching objectives of the Act are to:

1. Establish clear goals that foster an integrated approach to environmental sustainability and economic well-being; and
2. Work towards continuous improvement in measures of social, environmental and economic indicators of prosperity.

Twenty-five goals were initially established. They are revisited periodically to evaluate progress and set targets for the province.

The Ecology Action Centre (EAC) participates in a Roundtable of stakeholders established by the Province to engage on EGSPA. The Ecology Action Centre (EAC) has participated in the development of EGSPA through collaboration and recommendations of goals and strategies over the life of the Act. This report explores select climate goals that EAC proposes be part of a renewed EGSPA that are relevant to the Act's objectives.

## 2. Motivation

Although EGSPA goals touch on a wide range of environmental and economic opportunities, the focus here is on reducing greenhouse gas emissions (GHG=Carbon dioxide equivalents CO2e) since there is a pressing need to reduce GHGs more quickly than previously thought.

In October 2018, the United Nations Intergovernmental Panel on Climate Change (UNIPCC) released the Special Report on Global Warming of 1.5°C. This report underscores the importance of avoiding 2°C warming compared to pre-industrial levels and keeping the increase to within 1.5°C. This report differs from previous ones by explicitly stating a specific need for developed countries to take. It also highlighted a need to reduce 45% of human-caused GHG emissions, from 2010 levels, by the year 2030 in order to reduce the risk of long-lasting and irreversible changes to ecosystems. According to the IPCC analysis, keeping below 1.5°C will also require measures beyond 2030 to reach net-zero emissions by 2050. Although the IPCC refers to 2010, EGSPA refers to 1990 as a base year.

EAC is seeking the best strategies for Nova Scotia to help avoid the environmental and economic consequences of overshooting 2°C warming, and meeting the challenges of decoupling the provincial economy from carbon-based energy sources in a just and inclusive way.

EAC also sees the considerable economic, innovation and entrepreneurial opportunity from implementing the solutions that are necessary to meet this challenge. These necessary, transformative changes to our economy will create many thousands of jobs, and has the opportunity to not only reduce emissions, but to be a viable action plan for sustainable local economic prosperity for all of Nova Scotia.

Every step forward on this path should be taken with justice, inclusion, affordability and local benefits at the forefront of the solutions proposed for a prosperous green economy in Nova Scotia.

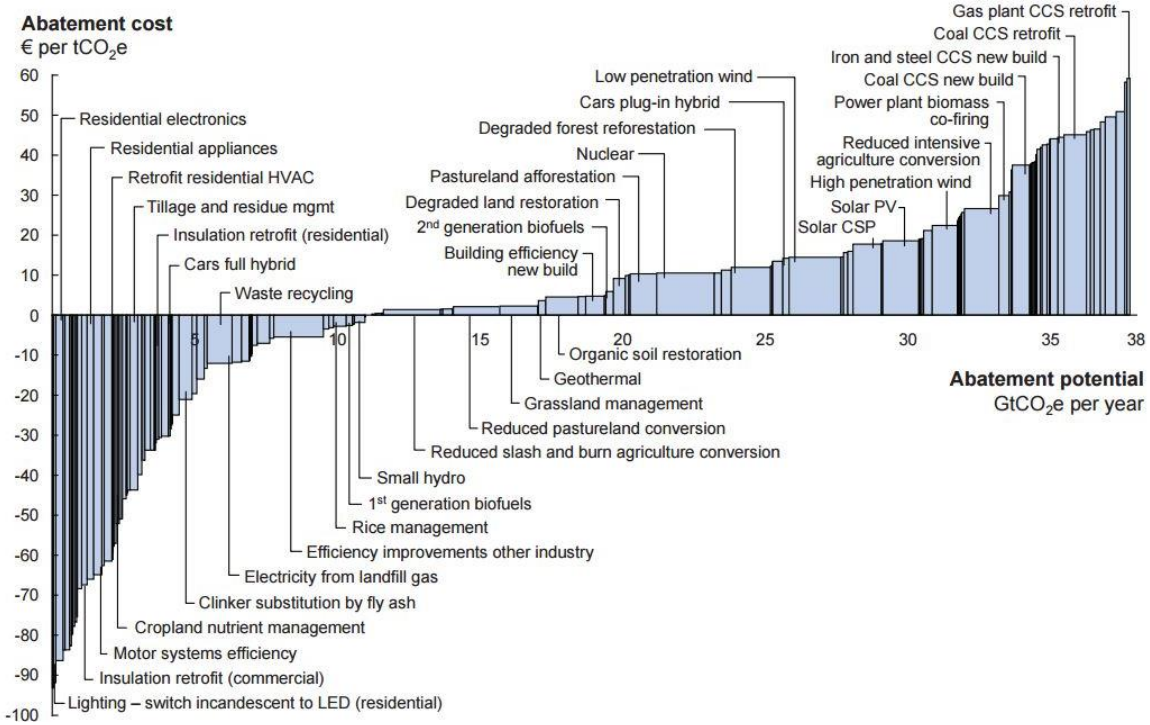
## 3. Cost-effective strategy

GHGs are primarily emitted from human activities that directly or indirectly involve the burning of fossil fuels (e.g. coal, oil, natural gas). Recognition for the need to reduce GHG emissions has grown substantially in recent years, and it is important to prioritize the range of GHG reduction measures in terms of their costs and benefits to identify the most cost-effective strategies. At the intersection of economic and environmental objectives is the concept of marginal abatement cost curves (MACC), shown in Figure 1.

Each bar in Figure 1 represents an initiative that can reduce GHGs. Starting on the left are measures such as replacing incandescent bulbs with LEDs, insulating commercial buildings, increasing the efficiency of motors, which reduce costs while also reducing GHGs. Measures in the middle are break-even measures such as using biofuels, and small hydro-electricity development. Finally, measures on the right-hand side, including biomass power plants, and carbon capture and storage for a number of fossil-fuel burning facilities are measures which have a higher cost associated with reducing GHGs.

The bars below the zero line represent measures that save money while reducing GHGs, and the bars above the line will incur a cost to reduce GHG emissions. The height of each bar (y-axis) represents the marginal cost per tonne of GHG reduction. "Marginal cost" or "net cost" is used because there would have been a cost to continue with current (business as usual) technologies and this is accounted for in the cost to make changes. The figure below is meant to be illustrative of different carbon reduction activities, while the exact magnitudes change over time and with geographical location.

**Figure 1: Illustrative global GHG abatement cost curve beyond business-as-usual, 2030**




*Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below 60 Euros per tCO2e if each is pursued aggressively.*
*Source: Global GHG Abatement Cost Curves v2.0.*

The width of each bar above represents the amount of GHG reductions in gigatonnes (Gt) of carbon-dioxide equivalent ($CO_2e$) that each measure can achieve. Narrow bars achieve smaller gains and wide bars achieve bigger gains in GHG reductions. Many measures must be taken together in order to achieve deep reductions in GHG emissions.

Since EGSPA aims to meet economic and environmental objectives, organizing the range of GHG reduction measures using a MACC figure like this is highly appropriate. The measures that are below the line clearly meet both economic and environmental criteria (saving money while reducing GHGs), and the ones that offer the greatest gains above the line (widest bars) should be among priorities as well. The majority of the measures along the curve are easily recognized by Nova Scotians since many are already underway in the province. The challenge is to move quickly and effectively to fully capture the potential value in each bar.

The MACC example above is only illustrative of global measures to reduce GHG emissions. The particular measures, costs, and potential to reduce GHG emissions are different in every jurisdiction, and Nova Scotia has its own specific circumstances. The curve is also changing over time as the costs of different technologies and their ability to reduce GHGs improves. In general, measures move to the left as their costs come down, and bars widen as the ability of each measure to reduce GHGs is enhanced. An excellent example of this is wind power generation where the costs of installed wind energy ($/MWh) have reduced dramatically in the last decade to become the lowest-cost energy to install in Canada (CANWEA, 2018). Battery technology is another example where rapid improvements are making hybrid and electric vehicles, both large and small, much more capable and affordable.

## 4. Green economy strategy

Cost effectiveness is one way to prioritize GHG reduction initiatives, but this treats each cost equally when, in fact, some initiatives will have much greater benefits for Nova Scotia's economy than others. Here we ask questions like "how much will Nova Scotia's economy grow?", "how many jobs will be created?", and "what tax revenues will be generated to governments?". Some examples help illustrate how GHG reduction initiatives offer different benefits for the economy.

LED lights are one of the most cost-effective initiatives (far left of Figure 1). When a consumer purchases a household LED, the retail store will earn a margin on the sale (e.g. 10-20%), but most of the sale revenue goes to the manufacturer. Since Nova Scotia imports household LEDs manufactured elsewhere in Canada or other countries, most of the money leaves the province. However, the Nova Scotia firm, LED Roadway Lighting, sells LED street lighting and commercial lighting and subsequently sales revenues from LED street and commercial lighting in Nova Scotia stay in the province. Furthermore, supporting the success of this company allows them to compete in other provinces, states and countries around the world that are converting their systems to LEDs. When Nova Scotia becomes a manufacturer and exporter of energy efficient technologies, more income, jobs, and tax revenues are captured in the province. Converting to household LEDs is still a great initiative, but it has a smaller impact on the Nova Scotia economy than some other initiatives.

Another prime example involves new construction and retrofitting homes and buildings to be much more energy efficient. The principle aim is to reduce heating requirements (and some cooling in summer) to avoid GHG emissions from electricity, oil, or natural gas energy sources. These types of measures appear in Figure 1 in a couple places, both above and below the zero line. Nova Scotia has several window and door manufacturers, and wood products needed for retrofits and new construction are generally available from within the province. Both the labour required for

construction and renovation (supplied by Nova Scotians) and the reduction in demand for heating helps to keep money in the province. Electricity generation currently involves imports of coal, oil, and natural gas. Heating systems reliant on oil and natural gas also involve the import of those fuels. Making the switch to purchase Nova Scotia products and labour versus importing fossil fuels is a major benefit to the provincial economy. Furthermore, engaging entrepreneurs and fostering innovation, within the province, in areas that could support the achievement of these goals, is a major economic opportunity for the province.

## 5. EAC goals in this report

Because many GHG reduction measures are becoming highly cost-effective and there are significant opportunities to grow Nova Scotia's "green economy", EAC is focusing on the most promising six goals that combine renewable energy, energy conservation, energy efficiency energy conservation, energy efficiency, renewable energy, and electrification measures to position Nova Scotia as a leader in GHG reductions.

The six EAC 2030 goals assessed in this report are:

- **Goal 1: Reducing GHG emissions 50% below 1990 levels by 2030 –** Meeting this goal would put Nova Scotia in line with its fair share of emissions reductions to keep global warming below the Paris Agreement's target of 1.5°C. This overarching goal is met through goals 2-5.
- **Goal 2: Supplying 90% of NS electricity needs with renewable energy by 2030** – Dramatically decarbonizing Nova Scotia's electricity grid by displacing coal, oil and large biomass with wind, hydro, solar, small scale biomass, and community-scale projects.
- **Goal 3: Making 100% of social housing Net-Zero Energy Ready (NZER) by 2030–** Saving energy and making people more comfortable in their homes by reducing energy consumption in existing social housing by 60% or more, and ensuring all new construction is built to NZER standards.
- **Goal 4: – Tripling energy efficiency in the electricity sector by 2030** – Saving money and avoiding the need for new electricity system infrastructure by increasing the level of total electricity system efficiency to 3% a year.
- **Goal 5: Reducing car dependence, and electrifying personal and public transport** – This goal includes public transit and active transportation promotion, battery electric buses (BEBs), higher occupancy vehicles, and promotion of hybrid and electric vehicles.
- **Goal 6: Growing Nova Scotia's green economy** – Meeting goals 1 through 5 will substantially increase the economic prosperity of the green economy in Nova Scotia and aim to create over 15,000 green jobs per year in the province by the year 2030.

Nova Scotia's total GHG emissions in carbon dioxide equivalents (CO2e) for 1990 were 19.6 million tonnes (ECCC, 2018), and by 2016 were reduced to 15.6 million tonnes (down 20%). As of 2019 a further reduction of 5.8 million tonnes is needed to achieve a 50% reduction by 2030 (Goal 1). This report indicates the following GHG reductions that are possible through each goal.

Table 1: Contribution of each goal toward overall GHG reduction target

| Goal | Mt GHG avoided |
|---|---|
| 1 - Reducing GHG emissions by 50% | **5.80** |
| 2 - 90% of electricity with renewables | **5.36** |
| 3 - 100% of eligible social housing NZER | **0.02** |
| 4 - Increase electricity efficiency to 3% per year | **0.57** |
| 5 - Reducing car dependence & electrification | **0.48** |
| Sub-Total (Goals 2 - 5) | **6.43** |

*Mt = million tonnes*
*Note: GHG reduction target in 2030 is versus 2019 emissions.*

The specific measures related to each goal are described in the report, along with the investments required based on year by year implementation from 2019 to 2030. The sub-total (56% for Goals 2-5) move beyond the 50% reduction target (Goal 1) and towards net-zero emissions needed by 2050. Some reductions are already underway and other measures will be undertaken by residential, industrial, commercial and institutional sectors. In particular, other measures for: oil and gas, building construction and renovation, commercial and industrial transportation, and other sectors are not included in this report.

## 6. Benefit-cost analysis concepts

In order to assess the benefits and costs associated with a policy or investment, a benefit-cost analysis is commonly used to assess the merits of the decision. The general approach is to determine what happens if the policy or investment is adopted versus what happens without the change (commonly referred to as "business as usual"). The analysis for each goal in this report uses this approach and the results are calculated as the difference between the two decision paths. For example, there are GHG emissions associated with adoption of battery electric buses (i.e. electricity generation emissions), and there are emissions from diesel buses, so the result of shifting to electric buses is the difference in GHG emissions (i.e. net savings). The same approach is used to assess financial costs, where there are costs associated with each type of bus and we calculate the difference in costs to determine whether there is a net cost or a net savings.

Since benefits and costs occur over time, it is also important to understand how these are handled. Purchasing buses has an initial cost (purchase price) as well as operational costs (maintenance, energy) every year. Costs and benefits are valued differently today than they are in the future. This is linked to the "time-value of money" where money (typically) loses value over time due to inflation, but also due to the possibility of investing it. For instance, you may be able to buy something today for $100 and, due to inflation, the same item costs $102 next year (2% inflation) so you would not be able to claim the same goods for $100. Also, if you have $100 today, you have the option of investing it to obtain $105 instead of just $100 in a year (5% interest). For this reason, we "discount" future costs and benefits when we want to represent them in today's dollars. The discount rate is a percentage used to adjust future values and this report uses a 5% rate based on Treasury Board of Canada Guidelines for Cost-Benefit Analysis. The results for each goal are based on discounted costs and benefits each year to 2030, and there are separate results based on a 20-year analysis (2019 - 2039).

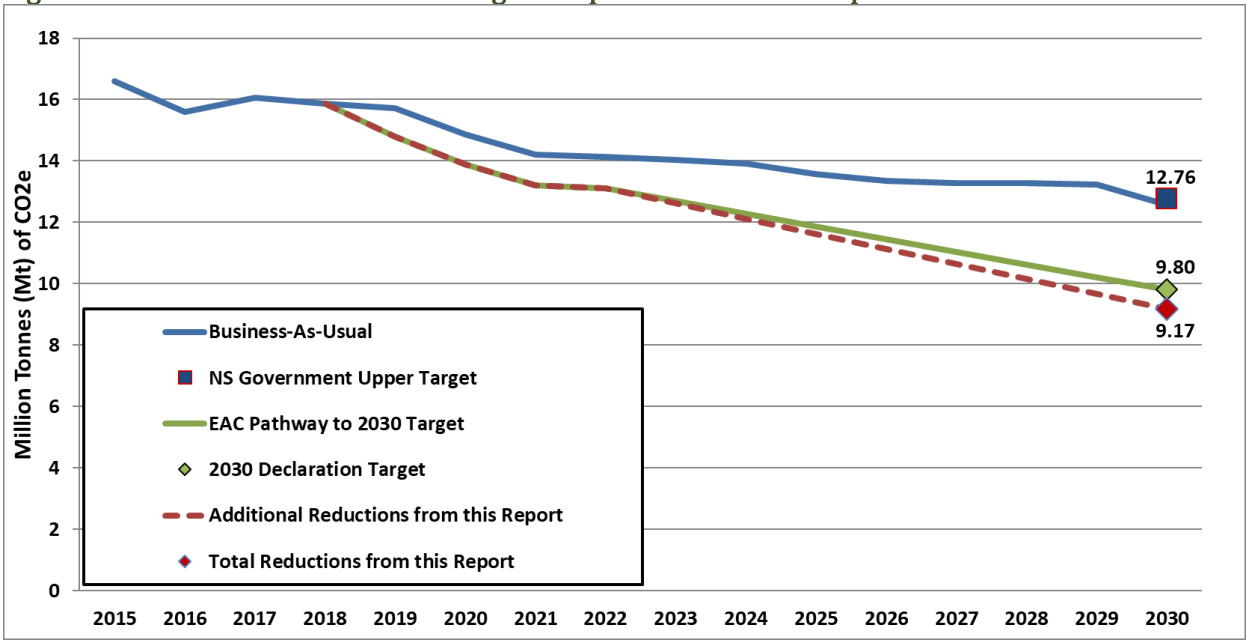
# Goal 1: Reducing GHG emissions 50% below 1990 levels

Nova Scotia's work to reduce emissions in the last 15 years should be celebrated, but much more work is needed considering the context of the climate crises outlined by the Intergovernmental Panel on Climate Change's *Special Report on 1.5ºC of Global Warming*. Nova Scotia's current emissions reductions trajectory does not contribute enough toward Nova Scotia's fair share of the Paris Agreement's goal of keeping global warming below 1.5°C, and misses critical opportunities to grow the prosperous, green economy in the province. Nova Scotia's failure to have legislated climate targets out to the year 2030 will make it difficult for it to contribute its fair share of Paris Agreement emission reductions and remain a leader in the environment.

The New England Governors and Eastern Canadian Premiers Climate Change Action Plan (2001) is the origin for the 2020 EGSPA climate change goal. The 2001 agreement set a commitment to reducing GHGs 10% below 1990 levels by 2020, and a long-term goal of at least 75% below 1990 levels - Nova Scotia surpassed the 2020 target in 2014.

EAC's goal sets a course to at least 50% reductions below 1990 by 2030 – leading to total provincial CO2e emissions of about 9.8 million tonnes (Mt). This level is consistent with Nova Scotia's fair share of emissions reductions to meet the Paris Agreement's target of keeping global warming below 1.5°C, and allows Nova Scotia to benefit from the opportunity of this transition to a prosperous, green economy.

Figure 2: Nova Scotia GHG reduction target and potential from this report




This target is also consistent with the 2030 Declaration, which calls for a justice-based transition to a new green economy in Nova Scotia, while highlighting principles based in the Peace and Friendship Treaties between the Mi'kmaq and settlers, and moving toward economic, environmental and racial justice. The 2030 Declaration (Anon., 2019) has more than 45 organizational signatories from across Nova Scotia including labour unions, student groups, Mi'kmaq groups, faith groups, businesses, anti-poverty advocates, academics, environmental groups, workers and grassroots people.

The exact carbon reduction measures that will lead to this provincial greenhouse gas emissions reduction target are analyzed in Goals 2 through 5 of this report. Encouragingly, the goals analyzed in this report show that emissions reductions of about 56% below 1990 levels by 2030 are possible, providing further opportunity for Nova Scotia to reduce emissions and grow the green economy.

# Goal 2: Supplying 90% of NS electricity needs with renewables

## 1. Background

As of 2017, Nova Scotia utilized coal-fired generation for about 55% of its annual electricity needs, making it Canada's most coal-dependent province. The "Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations" came into force from the federal government in September 2012. The regulations state that coal-fired electricity generating units are the highest emitting stationary sources of GHGs and air pollutants in Canada. These regulations would have triggered the decommissioning of Nova Scotia coal and petroleum coke power stations, but the 2015 "Canada-Nova Scotia equivalency agreement regarding greenhouse gas emissions from electricity producers" allowed Nova Scotia to maintain coal-fired stations as long as an equivalent reduction in GHG emissions could be achieved by other means up to 2030. The decommissioning of coal-fired stations remains as one of the most cost-effective means of achieving large reductions in GHG emissions in the province. The recently released Generation Energy Council Report (2018) reiterates the call for an accelerated nationwide coal phase-out by 2030 (ECCC, 2016).

The current EGSPA target is to generate 40% of electricity from renewable sources by 2020 and this is on track to be achieved and surpassed by Nova Scotia Power (NSP). Nova Scotia has successfully demonstrated the ability to deploy multiple renewable sources of electricity generation capacity. Multiple wind farms through NSP direct investment and community feed-in tariffs (COMFITs), NSP infrastructure investments to bring hydro power from Newfoundland and Labrador (Maritime Link), and solar initiatives by the Province and Halifax Regional Municipality are all contributing.

Achieving the EAC goal will involve the following anticipated additions of renewable electricity capacity and energy efficiency measures:

- **500 MW** of additional industrial wind capacity through competitive RFPs;
- **300 MW** of additional community wind capacity through competitive RFPs;
- **330 MW** of solar capacity (residential, community, institutional and grid-scale);
- **200 MW** of energy storage (grid-scale, residential and commercial);
- **153 MW** of hydro imports from Muskrat Falls through the Maritime Link (NS Block);
- **153 MW** of hydro imports from Muskrat Falls through the Maritime Link (Market Block);
- **200 MW** or hydro imports from Hydro Quebec and through New Brunswick; and
- **3% Energy Efficiency Benchmark by 2030 (**as per goal #4 of this report).

Achieving this level of emissions reductions and renewable energy generation will also require the below changes to the electricity system:

- Decommission 1,234 MW of coal generation across 8 thermal units;
- Decommission 60MW biomass generation at Port Hawkesbury
- Reducing the use of natural gas and oil in the province to 9.0% of total generation;
- Continued investments in transmission and power quality measures;
- Continued grid collaboration between New Brunswick and Newfoundland & Labrador;

## 2. Analysis

The twenty-year analysis begins with the same starting point in 2019 for the base case (business as usual) and policy case (EAC goal). The base case is primarily informed by the Nova Scotia Utility and Review Board (NSUARB) report of July 2018: "Nova Scotia Power 10 Year Outlook". This report

recognizes that discussions regarding energy efficiency investments and the status of coal-fired stations is yet to be finalized.

The federal government finalized its regulations for the phase-out of coal power across Canada by 2030 in 2018. The Regulatory Impact Analysis Statement (RIAS) that accompanied the "Regulations Amending the Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations" (Government of Canada, 2018) provides a cost-benefit analysis of replacing Nova Scotia coal-fired stations with natural gas capacity. Although the EAC goal does not seek to replace any generating capacity with natural gas, the RIAS still provides much of the data needed for this analysis.

Canada's National Energy Board (NEB) estimates annualized costs for electricity generation from different sources including renewables. Since costs continue to drop rapidly for renewables such as wind and solar, the analysis may understate the benefits of the proposed transition.

Table 2: Goal 2 base case versus policy case assumptions and variable settings

| | Base case | Policy case | Sources* |
|---|---|---|---|
| **General** | | | |
| NS population growth | 100.2% | 100.2% | Statcan Census, 2016 |
| | | | |
| **Generation by energy source** | | | |
| Coal and Petcoke | 33.6% | 0.0% | NSUARB, 2018 |
| Natural Gas & Oil | 10.0% | 9.0% | NSUARB, 2018 |
| Solar (Community, Grid-Scale, Residential) | 1.0% | 3.5% | NSUARB, 2018 |
| Large Biomass | 2.5% | 0.0% | NSUARB, 2018 |
| Small Biomass/Tidal/Other | 0.5% | 3.5% | NSUARB, 2018 |
| Existing Wind (Community & Commercial) | 18.0% | 18.0% | NSUARB, 2018 |
| New Community Wind | 0.0% | 7.1% | NSUARB, 2018 |
| New Commercial Wind | 0.0% | 19.0% | NSUARB, 2018 |
| Hydro Legacy | 9.0% | 9.0% | NSUARB, 2018 |
| Hydro Import MF | 22.7% | 22.7% | NSUARB, 2018 |
| Hydro Import QC/NB | 2.7% | 8.2% | NSUARB, 2018 |
| **Costs by energy source** | | | |
| Coal and Petcoke | $0.05 | $0.05 | Lazard, 2018** |
| Natural Gas & Oil | $0.08 | $0.08 | Lazard, 2018** |
| Large Biomass | $0.14 | $0.14 | NEB Canada, 2016 |
| Small Biomass/tidal/other | $0.14 | $0.14 | NEB Canada, 2017 |
| Existing Wind (Community & Commercial) | $0.08 | $0.08 | NEB Canada, 2017 |
| New Community Wind | $0.04 | $0.04 | NEB Canada, 2017 |
| New Commercial Wind | $0.04 | $0.04 | NEB Canada, 2017 |
| Hydro Legacy | $0.06 | $0.06 | Nalcor, 2019 |
| Hydro Import MF | $0.04 | $0.04 | Nalcor, 2020 |
| Hydro Import QC/NB | $0.04 | $0.04 | NEB Canada, 2017 |
| Solar | $0.18 | $0.18 | NEB Canada, 2017 |

*Notes: All values are converted to 2019 CAD using Nova Scotia CPI for all items; Twenty-year net-present values are based on 5% discount rate; Carbon pricing according to Federal Government path starting at $20 per tonne in 2019 with annual increases of $10 per tonne (i.e. $130 in 2030); Decommissioning, refurbishment, and maintenance costs according to Canada Gazette, 2018. *Sources refer to base case values since policy case values are set according to EAC goals and Gardner Pinfold calculations **The midpoints of Lazard's value ranges in U.S. dollars are converted to Canadian dollars at 1US to 1.30CAD for 2018.*

## 3. Results

Decommissioning coal-fired power plants and installing renewable capacity will require a net investment by 2030. This goal results in net annual costs of $6 per tonne of GHG avoided by 2030 and a cumulative net present value (NPV) of costs near $27 per tonne. Once the conversion is complete the long-term costs fall further. These are clearly within the range of incentives that will be driven by long-term cap and trade or carbon pricing paths.

**Table 3: Goal 2 annual and NPV results by 2030**

| Results | |
|---|---|
| **Electricity generation sources by 2030…** | |
| 9% | from natural gas and oil |
| 3.5% | from solar |
| 45% | from wind |
| 39% | from hydro |
| 3.5% | from small biomass, tidal, other |
| **Annual impacts of reaching the 2030 target…** | |
| $21,544,404 | invested in converting to renewables |
| 3,517,915 | tonnes of GHGs avoided per year* |
| $6 | cost per tonne of GHG avoided |
| **Cumulative 12-yr NPV of impacts by 2030** | |
| $568,804,207 | invested in converting to renewables |
| 21,107,492 | tonnes of GHGs avoided |
| $27 | cost per tonne of GHG avoided |

**This is the difference between base case and policy case in 2030, not compared to today.*

## 4. Economic impacts

There are two broad types of economic impacts, namely those associated with the decommissioning of the fossil fuel generation capacity, and those associated with the replacement by renewable energy sources. The decommissioning activities involve capital and operating impacts. The shut-down of facilities involves salvage of assets and otherwise dismantling structures. These capital projects generate economic activity through engineering, demolition, transport, waste disposal, site remediation and potential monitoring. There would have been refurbishment of generating stations, which would have generated economic impacts, but not to the same magnitude as decommissioning. The operating implications of decommissioning relate to foregone fuel purchases, which are mainly imported from international suppliers along with a small amount that comes from the Donkin coal mine in Cape Breton. Since the Donkin mine exports most of its product, the amounts currently delivered to Nova Scotia power could find markets elsewhere.

The installation of renewable capacity, particularly wind, hydro, and solar also involves capital and operational economic impacts. Most of the equipment is imported (turbines, solar panels etc.), but

site preparation, engineering, transmission upgrades, and construction work is primarily done by Nova Scotians with many materials sourced from within the province. The operation does not involve fuel purchase, but there is ongoing maintenance activity.

NSP plans indicate about $45 million would have been spent annually until 2030 on refurbishment of coal and petcoke facilities. Instead NSP will annually spend about $84 million on decommissioning activities and $310 million on installing renewable capacity for a total of about $394 million each year to 2030. The provincial and national economic impacts of the combined 12-year spending total of $4.7 billion are contained in the following table.

Table 4: Goal 2 economic impacts for 2019-2030 (12-year total)

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| **Output** | $4,726 | $1,448 | $984 | $7,159 | $9,291 |
| **GDP** | $2,456 | $759 | $614 | $3,828 | $4,847 |
| **Income** | $1,221 | $543 | $263 | $2,026 | $2,615 |
| **Jobs (FTE)** | 20,642 | 10,268 | 7,189 | 38,099 | 48,644 |
| **Fed tax*** | $157 | $75 | $43 | $275 | $363 |
| **Prov tax*** | $186 | $96 | $62 | $344 | |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

# Goal 3: Deep Energy and Resiliency Retrofits for 100% of Eligible Social Housing

## 1. Background

With about 12% of Nova Scotia's GHGs coming from housing and buildings, this sector remains an important focus of GHG reduction efforts. The Pan Canadian Framework on Clean Growth and Climate Change (ECCC, 2016) prepared by federal, provincial, and territorial Ministers of the Environment called for NZER building codes across Canada by 2030. Natural Resources Canada (NRCan) is now signaling a move toward NZER building standards (NRCan, 2019a) and has invested in pilot projects to determine the readiness of construction companies to meet this challenge. This includes the creation of pilot projects for prefabricated exterior wall systems (NRCan, 2018a). The Pan Canadian Framework on Clean Growth and Climate Change is also developing codes for existing buildings, aimed to elevate the energy performance of the existing building stock in Canada.

The National Research Council of Canada writes, "a net-zero energy building is defined as a high performance building that combines superior standards in energy efficiency with renewable energy production to offset all of the building's annual energy consumption. A net-zero energy ready (NZER) building is defined as a high performance building that is built to the same level of energy efficiency as a net zero energy building, but does not include renewable energy production" (National Research Council Canada, 2016). NZER buildings are very energy efficient structures that reduce heating and cooling needs to such low levels that if renewable power (e.g. solar panels) were installed, the building would be a net producer of energy rather than a consumer. NZER homes are up to 80% more efficient than new homes built to current building code standards. Although it is easier to reach NZER standards with new construction, it is also possible to achieve this with renovations. NZER houses, passive houses (www.passivehouse.ca), and deep energy retrofits are related concepts with shared aims.

Inspired by a Dutch model, we propose to perform deep energy retrofits of the social housing stock in Nova Scotia. The Dutch strategy to retrofit existing homes and buildings to achieve Net Zero Energy Ready or even Net Zero standards is called EnergieSprong (or Energy Leap in English). The EnergieSprong model retrofits social housing using prefabricated exterior wall systems, aggregation of projects, and innovative financing. The retrofits take a total of 1-14 days to complete and residents do not need to leave their homes. The resulting performance of homes typically meets Net Zero Energy Ready or Net Zero Standards. The model has successfully retrofit 1,300 units so far. Over the course of four years, the price of the retrofit projects has reduced by 50%, and the length of time to complete a project has reduced from fourteen days to one day. Deep energy retrofits in social housing acts as a catalyst for the deep energy retrofit market.

Social housing in NS is managed by Housing Nova Scotia (HNS), which maintains a large portfolio of properties to provide safe, suitable, and affordable housing for Nova Scotians experiencing low income. Five Housing Authorities across the province administer, maintain, and operate over 11,500 rental units. In 2016, HNS earned a Bright Business Innovation Award from Efficiency Nova Scotia (ENS) for a new passive house design that substantially reduces energy costs and increases affordability for residents. Without increasing construction costs, the annual heating bill is just $245 and the power bill is just $585. On the coldest night of the year the residence can be heated with the equivalent of 1.5 hair dryers. HNS also renovated an existing 15 unit building to meet passive house standards. HNS is currently examining the potential for deep energy retrofits of

representative buildings in their portfolio and preliminary measures are the basis for the following analysis.

Before proceeding, it is important to recognize that HNS does not operate all social housing in the province as some is managed by private and non-profit entities. Also, HNS has currently withdrawn from building new units with the view that private sector and non-profit housing organizations have greater potential to deliver new affordable housing options. HNS emphasized that the budget for maintenance of the existing property portfolio is limited and relies on federal funding sources that are uncertain over longer time-frames. HNS would need to review all units for suitability to NZER upgrades so the following is considered illustrative of costs and benefits involved in transitioning to NZER / passive standards for the same number of units assuming they are similar to the ones involved in the pilot study.

## 2. Analysis

The twenty-year analysis begins with the same starting point in 2019 for the base case (business as usual) and policy case (EAC goal). The base case involves continued maintenance of all units according to current building code standards. Significant renovations to the building envelopes are needed about every 17 years, so 5.9% of the eligible portfolio is renovated each year. The policy case involves renovating eligible units to NZER standards by 2030. This will require 8.3% to be renovated each year, so normal maintenance costs cannot be assigned toward net-zero renovation for all units. Once complete in 2030, there will be a period of at least five years before the next cycle of building envelope renovations would resume.

The annual GHG emissions avoided and heating cost savings are provided by HNS staff from RETScreen Expert software (NRCan, 2019b). The estimated NZER costs and savings are from three sources: 1) Pembina Institute (Pembina, 2018) review of social housing energy retrofits in Canada for multi-unit buildings over 5 stories tall, 2) Sustainable Buildings Canada report (SBC, 2019) on the application of the Netherlands Energiesprong model in Canada, and 3) Housing Nova Scotia pilot study and building assessment input. All sources are adapted to the Nova Scotia context recognizing these are high level estimates that need further study to determine costs, savings, and energy use outcomes that are specific to the HNS building portfolio. The analysis includes buildings with 10 or more units that are 7 stories tall or less (about 2,500 HNS units are excluded) and are based on the following information sources:

- Buildings under 5 stories – renovation costs are adapted from the EnergieSprong case by SBC, including conversations with HNS for guidance.
- Buildings of 5 or more stories - renovation costs are adapted from Pembina Institute case studies in BC, including conversations with HNS for guidance.

For the tallest buildings managed by HNS, it may be more suitable to complete deep energy retrofits that achieve lower greenhouse gas reductions at lower cost. Each building in the HNS portfolio must be assessed individually to determine the most cost-effective solutions.

*Table 5: Goal 3 base case versus policy case assumptions and variable settings*

| | Base case | Policy case | Sources |
|---|---|---|---|
| **General** | | | |
| Housing NS units | 9,015 | 9,015 | HNS, 2019 |
| Years to renovate stock | 17 | 11 | GP estimate |
| % of NZER renos | 0% | 100% | HNS, 2019 |
| Annual % of units with reno | 5.9% | 9.1% | GP estimate |
| **Under 5 story building** | | | |
| Housing NS units | 8,778 | 8,778 | HNS, 2019 |
| Cost of reno | $34,530 | $86,324 | HNS, 2019; SBC, 2019; Altus, 2018 |
| Annual heating savings | $100 | $1,691 | GP estimate |
| GHG savings t/yr | 0.10 | 2.20 | GP estimate |
| **5 or more story building** | | | |
| Housing NS units | 237 | 237 | HNS, 2019 |
| Cost of reno | $39,000 | $97,500 | HNS, 2019 |
| Annual heating savings | $100 | $1,691 | HNS, 2019 |
| GHG savings t/yr | 0.10 | 2.20 | HNS, 2019 |

*Notes: All values are converted to 2019 CAD using Nova Scotia CPI for all items; Twenty-year net-present values are based on 5% discount rate; Carbon pricing according to Federal Government path starting at $20/tonne in 2019 with annual increases of $10/tonne (i.e. $130 in 2030).*

## 3. Results

This goal has a breakeven point in 2030 (12 years) and a payback period in 2036 (18 years). The breakeven point is where the annual savings from reduced heating costs for NZER buildings starts to offset the annual investments in renovations. After this point the savings accumulate rapidly while the annual renovation costs decline. From 2030 to 2038 the $3,037 cost per tonne drops to a $353 cost per tonne and continues to drop thereafter.

**Table 6: Goal 3 annual and NPV results by 2030**

| Results | |
|---|---|
| **Upgrades by local suppliers** | |
| 9,015 | units upgraded to NZER |
| 33,683 | windows and doors installed by local suppliers |
| **Annual impacts of reaching the 2030 target…** | |
| $15,244,365 | family savings for all units |
| $1,691 | family savings per unit |
| $32,981,129 | total annual savings |
| 15,797 | tonnes of GHGs avoided per year* |
| $2,088 | saved per tonne of GHG avoided |
| **Cumulative 12-yr NPV of impacts by 2030** | |
| $357,617,685 | net investments in NZER homes |
| 117,760 | tonnes of GHGs avoided |
| $3,037 | cost per tonne of GHG avoided** |

**This is the difference between base case and policy case in 2030, not compared to today.*
***It is very important to recognize the 2030 result reflects the up-front investment, and after that 2030 the cost per tonne drops to $353 as savings accumulate to 2038.*

## 4. Economic impacts

The economic impacts of this goal can also be broadly divided according to capital and operational expenditures. The capital impacts are straight-forward since renovations are already carried-out for social housing and moving to NZER standards simply involves more renovation activity. Since many of the materials are available in Nova Scotia (e.g. windows, doors, basic materials) and virtually all of the labour will be Nova Scotian, this represents a substantial economic benefit to the province. The operational impacts depend on the type of energy that will be displaced as a result of the NZER renovations. When an electrically heated home saves on energy there will be reduced demand for NSP electricity. In the case of an oil or natural gas heated home this will reduce imports of fossil fuels from outside the province. Since two-thirds (67%) of HNS units are heated by oil or natural gas, and just 23% are heated by electricity, the economic benefits will certainly exceed losses to NSP. Instead of purchasing imported fossil fuels, households will spend more on Nova Scotia products.

There will be an incentive to convert oil heating systems over to electrical systems and this will partially offset the reduced demand for NSP from existing electrically heated homes. The cost of fossil fuels is rising due to carbon pricing and/or carbon caps in the province, and the emissions intensity of NSP electricity goes down (from pursuing the goals in this report).

Finally, it is important to recognize that the construction and renovation industry in Nova Scotia will build capacity for delivering high performance homes. HNS represents only a small portion of the residential stock in the province that can benefit from NZER renovations. Indeed, Efficiency Nova Scotia delivers the HomeWarming program to other low-income households on behalf of the Province and Nova Scotia Power. Much larger emissions reductions and economic impacts can be achieved province-wide as NZER standards are anticipated in national codes.

Meeting NZER standards involves HNS spending about $47 million more per year on renovations than required to meet current codes, for a total of $560 million by 2030. The household energy savings means that spending on fossil fuels for electricity generation as well as for oil and gas used directly to heat homes, will shift nearly $8.5 million per year and a total of $102 million by 2030 to general household spending in Nova Scotia. The provincial and national economic impacts of the 12-year $662 million spending total are below.

**Table 7: Goal 3 economic impacts for 2019-2030 (12-year total)**

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| **Output** | $662 | $206 | $187 | $1,055 | $1,452 |
| **GDP** | $319 | $107 | $117 | $543 | $730 |
| **Income** | $282 | $74 | $50 | $406 | $513 |
| **Jobs (FTE)** | 7,789 | 1,761 | 1,369 | 10,920 | 12,972 |
| **Fed tax*** | $34 | $10 | $7 | $52 | $67 |
| **Prov tax*** | $37 | $13 | $10 | $60 | |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

# Goal 4: Tripling Nova Scotia's Demand Side Management Target

## 1. Background

The fourth goal of this report works to greatly expand the work being done in energy efficiency (Demand Side Management) in the electricity sector in Nova Scotia. Energy efficiency is the first energy transition pathway in the 2018 Generation Energy Council report. The report indicates that reducing wasted energy in Canada could meet one-third of the country's Paris commitments, delivering savings to Canadians while achieving substantial GHG reductions. The report calls for annual 2% efficiency gains up to 2025, then 3% efficiency gains by 2030 in the electricity sector.

Although this goal only explores energy efficiency for electricity usage, the measures in the Generation Energy Council report also include:

- Freight transport – Bring fleet fuel efficiency in line with global leaders, shift long-distance transport from truck to rail;
- Buildings – Develop building codes for net-zero energy in new construction and high energy efficiency renovations, and label energy efficiency of homes for prospective buyers, renters, and lessors;
- Personal transport – Single passenger trips are halved in all major cities, transit and active transport is promoted and supported through infrastructure investments;
- Industry – 75% of industry energy use is part of an energy management system, and Canada's energy productivity meets or exceeds that of the U.S.; and
- Utilities – regulatory frameworks require utilities to procure energy efficiency and peak demand reductions as a first priority.

The measures underlying this goal for Nova Scotia focus primarily on residential and commercial sectors. The following are excerpted from the Navigant report as included measures:

Residential:

- Efficient Products (Appliance Retirement) - Cash incentive for disposal of old inefficient appliances;
- Efficient Products (Direct Install) - Free installation of low-cost efficiency measures like lightbulbs and hot water piping insulation;
- Efficient Products (Instant Savings) - In-store savings on energy efficient products;
- New Construction (Performance Plus) - Rebates for construction of energy efficient homes;
- Existing Homes (Green Heating) - Rebates for energy efficient space-heating sources;
- Existing Homes (Solar Program) - Rebates for solar photovoltaic panel installations;
- Home Energy Assessment - Subsidized energy assessments and reports for residential homes; and
- Multi- Unit Residential Building (MURB) Program (individual suite measures) - Rebates and financing for energy efficient upgrades to MURBS.

Commercial and Industrial:

- Business Energy Solutions;
- Business Energy Rebates (i.e. commercial kitchens, commercial laundry, commercial refrigeration, motors and variable speed drives, central heating and cooling etc.); and
- Multi-Unit Residential Building (MURB) Program.

## 2. Analysis

Efficiency Nova Scotia (ENS) delivers energy efficiency measures in Nova Scotia including promotion and incentive programs for residential, commercial and institutional sectors. The current (2018-19) annual efficiency is a little over 1%, and goal 4 in this report aims for 3% annual efficiency gains (triple). It is important to recognize that this is only for the electricity sector, and a compound rate where each year 3% efficiency is gained over the previous year, meaning that by the end of 2030, Nova Scotia would have achieved a compound efficiency of 22.3%.

**Table 8: Goal 4 policy case energy efficiency path to 2030**

| 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Target efficiency rate straight-line increase to 2030** | | | | | | | | | | | | |
| 1.0 | 1.2 | 1.3 | 1.5 | 1.7 | 1.8 | 2.0 | 2.2 | 2.3 | 2.5 | 2.7 | 2.8 | 3.0 |
| **Annual energy use starting with 100% in 2018** | | | | | | | | | | | | |
| 100.0 | 98.8 | 97.5 | 96.1 | 94.5 | 92.7 | 90.9 | 88.9 | 86.8 | 84.7 | 82.4 | 80.1 | 77.7 |
| **Compound annual savings vs. 2018** | | | | | | | | | | | | |
| | 1.2 | 2.5 | 3.9 | 5.5 | 7.3 | 9.1 | 11.1 | 13.2 | 15.3 | 17.6 | 19.9 | 22.3 |

*Note: The base case energy efficiency path rises from Navigant, 2019 results in about 13% efficiency in 2030 compared to 2018.*

ENS commissioned Navigant in 2019 to conduct a comprehensive assessment of long-term energy efficiency measures to determine implementation costs and energy savings that would be achieved. The Navigant assessment includes measures that in some years cost from $0.37M/GWh to $0.80M/GWh to reduce energy demand in "base" and "maximum" scenarios. The maximum scenario matches closely with the EAC target with the same cumulative energy savings by 2030, but year to year timing of investments differs slightly. The estimated annual unit cost of DSM measures ranges from $60M to $1.01M per GWh. NSP will save some expenses by not having to generate the avoided energy demand ($104/MWh saved) and by avoiding the need for developing more generation capacity ($193/kW of peak power) in each scenario.

**Table 9: Goal 4 base case versus policy case assumptions and variable settings**

| | Base case | Policy case | Sources |
|---|---|---|---|
| **General** | | | |
| **Total generation 2030 GWh** | **10,447** | **9,434** | Navigant, 2019; EAC goal |
| **Annual efficiency in 2030** | **1.2%** | **3.0%** | Navigant, 2019; EAC goal |
| **Cumulative efficiency in 2030** | **12.9%** | **22.3%** | Navigant, 2019; EAC goal |
| **ENS cost $M/GWh saved** | **$0.47** | **$0.65** | NSUARB, 2018; GP estimate |
| **NSP annual savings in 2030** | | | |
| **Capacity savings $/kW** | **$193** | **$193** | NSUARB, 2018 |
| **Generation savings $/MWh** | **$104** | **$104** | NSUARB, 2018 |

*Notes: All values are converted to 2019 CAD using Nova Scotia CPI for all items; Twenty-year net-present values are based on 5% discount rate; Carbon pricing according to Federal Government path starting at $20 per tonne in 2019 with annual increases of $10 per tonne (i.e. $130 in 2030).*

## 3. Results

Energy efficiency is another example of making investments that provide a return as the benefits begin to accumulate over time. On the way to 2030 the average cost per tonne of GHG avoided is $37 and by 2030 there is a savings per tonne of $212, showing that energy efficiency measures are

excellent value propositions. Although there are some offsetting benefits for NSP investments in the form of avoided capacity and generation costs, the consumer benefits stand out as the primary gain.

**Table 10: Goal 4 annual and NPV results by 2030**

| Results | |
|---|---|
| **2030 net investments and savings** | |
| $107,513,213 | ENS investments |
| $40,084,166 | NSP capacity savings |
| $105,311,739 | NSP generation savings |
| $172,144,188 | Consumer savings |
| **Annual impacts of reaching the 2030 target…** | |
| $210,026,880 | total annual net savings |
| 280,442 | mt of GHGs avoided per year* |
| $749 | savings per tonne of GHG avoided |
| **Cumulative 12-yr NPV of impacts by 2030** | |
| $173,592,357 | invested in energy efficiency |
| 2,078,475 | mt of GHGs avoided |
| $84 | cost per tonne of GHG avoided |

**This is the difference between base case and policy case in 2030, not compared to today.*

## 4. Economic impacts

This is the most complex goal to evaluate in terms of economic impacts since there are many initiatives involved and they are each different. The nature of the initiatives is briefly described in the Navigant report as follows:

- **Replacement on Burnout:** A measure is installed after equipment fails.
- **Early Retirement:** A measure is installed before the effective life is reached.
- **Retrofit:** An energy efficiency measure that can be implemented immediately. A retrofit measure does not replace existing technologies, but rather improves its efficiency.
- **Dual Baseline:** A dual baseline measure uses a less efficient baseline in the first part of its measure life, resulting in higher energy savings initially, with savings becoming lower at a point later in the measure life.
- **Emerging Technology:** An energy efficiency measure is just entering or about to enter the marketplace and a "Bass diffusion model" is used rather than the traditional payback.
- **Behavioural Programs:** This involves people turning lights off, lower heating temperatures, changing maintenance practices to improve efficiency etc.
- **New Construction:** A measure is installed at the time of construction.

In the Navigant report (2019) "maximum" vs. "baseline" scenario for ENS programs there would be $85 million more spending on incentives, and $23 million more on program delivery in 2030. The additional spending is primarily in the residential sector (80%), the commercial sector (15%), and the industrial sector (5%). ENS incentives may, for example, cover 25% of the costs (e.g. energy efficient appliance, cost of insulation) and the sector participant pays the remaining 75%. The total investment up to 2030 is $3.4 billion, and the provincial and national economic impacts of these efficiency investments are contained in the following table.

Table 11: Goal 4 economic impacts for 2019-2030 (12-year total)

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| Output | $3,365 | $1,219 | $741 | $5,325 | $7,418 |
| GDP | $1,339 | $636 | $462 | $2,437 | $3,424 |
| Income | $1,064 | $440 | $198 | $1,702 | $2,273 |
| Jobs (FTE) | 21,689 | 10,357 | 5,416 | 37,462 | 48,356 |
| Fed tax* | $133 | $59 | $32 | $224 | $303 |
| Prov tax* | $151 | $74 | $45 | $269 | |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

# Goal 5: Reducing Car Dependence, and Electrifying Personal and Public Transport

## 1. Background

This goal is focused on public transportation and private transportation. Public transportation measures include investment in battery electric buses and increased public transit ridership, while private transportation measures involve the adoption of hybrid and electric vehicles, and promotion of higher-occupancy trips and active transport, especially for weekday commuting.

**HRM public transport** - The Halifax Regional Municipality conducted a feasibility study in 2017 to examine partial or full conversion of all 275 conventional diesel buses to battery electric buses (BEBs). The study found that NSP can supply the necessary power and charging stations, and that there is a net savings of $127 million (full conversion) or $163 million (partial conversion) to Halifax Transit over twenty years. Other cities in North America have conducted studies that draw similar conclusions (ETS, 2019; CUTRIC, 2018; TTC, 2019, STM, 2019). In particular, the Toronto Transit Commission (TTC) has stated it will now have a zero emissions fleet by 2040. Globally, China is the leader where Shenzen China moved from 1,000 to 16,000 BEBs (99.5% of fleet) in a 5-year period and there are over 385,000 BEBs in all of China (Electrek, 2019).

**NS private transport** – CleanTechnica tracks announcements from the top 10 global car manufacturers regarding their plans for "green cars" including hybrid, plug-in hybrid, and battery electric vehicles (fully electric):

- **Toyota -** 10 green car models in the early 2020s,
- **Volkswagen -** 50 fully electric models by 2025,
- **Hyundai/Kia -** 38 green car models by 2024-2026,
- **General Motors –** 10 fully electric models by 2020 and another 10 by 2023,
- **Ford –** 40 green car models by 2025,
- **Renault/Nissan/Mitsubishi –** 12 fully electric vehicles by 2022
- **Honda/Fiat/Chrysler –** no major announcements

China, California, and several European Union (EU) countries are driving changes in auto manufacturing by requiring electrification of vehicles. British Columbia passed the Zero Emissions Vehicles Act (2019) including targets for 10% of new car sales in 2025, 30% in 2030, and 100% in 2040 must be zero emissions vehicles (ZEVs). B.C. is currently achieving 4% of light duty vehicle sales (cars and trucks) with incentives under the provincial Green Plan. Quebec is requiring 100,000 EVs on the road by 2030, and EAC's goal is to have 50,000 in Nova Scotia by 2030.

## 2. Analysis

This goal is divided in two parts according to the public and private components. The following table outlines the main assumptions and measures for the base case versus policy case (2030 target). The analysis is contained in a spreadsheet with values calculated annually from 2019 to 2038 (20 years). Although the WSP report considered conversion of all 275 Halifax Transit diesel buses to BEBs, the following accounts for increased ridership by 2030 and includes 421 buses.

Table 12: Goal 5 base case versus policy case assumptions and variable settings

| | Base case | Policy case | Sources |
|---|---|---|---|
| **General** | | | |
| **NS population growth** | **100.2%** | **100.2%** | StatCan Census, 2016 |
| **Vehicles registered, 2030** | **565,214** | **565,214** | StatCan, 2017, EAC target |
| **Private vehicle kms/yr** | **22,000** | **22,000** | NRCan, 2018b |
| **HRM public transport** | | | |
| **Private vehicle use** | **77.6%** | **70.0%** | StatCan Census, 2016 |
| **Bus use** | **12.5%** | **16.0%** | StatCan Census, 2016 |
| **Active transport use** | **9.9%** | **14.0%** | StatCan Census, 2016 |
| **Private vehicle occupancy** | **1.47** | **2.00** | StatCan Census, 2017 |
| **Annual bus fare** | **$936** | **$936** | Halifax Transit, 2019 |
| **Diesel bus annualized cost** | **$181,685** | **$181,685** | WSP, 2017 |
| **BEB annualized cost** | **$172,126** | **$172,126** | WSP, 2017 |

| (Table 12 continued...) | Base case | Policy case | Sources |
|---|---|---|---|
| **NS private transport** | | | |
| **Motor fuel vehicles** | | | |
| Market share | **97.8%** | **64.6%** | StatCan, 2017 |
| gCO2e/km | **207** | **207** | Honda Accord, NRCan, 2018b |
| Annualized capital cost | **$6,127** | **$6,127** | Hughes, 2016 |
| Annual operating cost | **$2,017** | **$2,017** | Hughes, 2016 |
| **Hybrid vehicles** | | | |
| Market share | **2.1%** | **26.5%** | StatCan, 2017 |
| gCO2e/km | **131** | **131** | Toyota Prius, NRCan, 2018b |
| Annualized capital cost | **$5,837** | **$5,837** | Hughes, 2016 |
| Annual operating cost | **$1,069** | **$1,069** | Hughes, 2016 |
| **Battery-electric vehicles** | | | |
| Market share | **0.0%** | **8.8%** | StatCan, 2017 |
| Kwhr/100km | **20** | **20** | Nissan Leaf, Hughes, 2016 |
| Annualized capital cost | **$5,837** | **$5,837** | Hughes, 2016 |
| Annual operating cost | **$575** | **$575** | Hughes, 2016 |

*Notes: All values are converted to 2019 CAD using Nova Scotia CPI for all items; Twenty-year net-present values are based on 5% discount rate; Carbon pricing according to Federal Government path starting at $20 per tonne in 2019 with annual increases of $10 per tonne (i.e. $130 in 2030).*

## 3. Results

Both public and private transportation measures provide immediate savings. The combined total net present value (NPV) by 2030 is $764 million, while avoiding 2.5 million tonnes of GHGs.

**Table 13: Goal 5 annual and NPV results by 2030**

| HRM Public Transportation | |
|---|---|
| **Results by 2030…** | |
| 28,522 | fewer vehicles on the road during rush hours |
| 6,801 | more people using public transit |
| 7,717 | more people using active transport |
| 363 | BEBs in service |
| **Annual impacts of reaching the 2030 target…** | |
| $87,561,485 | saved by vehicle owners every year |
| $11,319,838 | net cost for Halifax Transit (including more rider fares) |
| $1,848,721 | spent at local stores for active transport gear |
| **Cumulative 12-yr NPV of impacts by 2030** | |
| $294,924,384 | saved by consumers and transit |
| 245,652 | tonnes of GHGs avoided |
| $1,201 | savings per tonne of GHG avoided |

| NS Private Transportation | |
|---|---|
| **Results by 2030…** | |
| 150,000 | hybrid vehicles registered in NS |
| 50,000 | BEVs registered in NS |
| 27% | hybrid market share in NS |
| 9% | BEV market share in NS |
| **Annual impacts of reaching the 2030 target…** | |
| $112,371,096 | saved by households every year |
| 378,301 | tonnes of GHGs avoided* |
| $297 | savings per tonne of GHG avoided |
| **Cumulative 12-yr NPV of impacts by 2030** | |
| $444,820,333 | saved |
| 2,269,077 | tonnes of GHGs avoided |
| $161 | savings per tonne of GHG avoided |

**This is the difference between base case and policy case in 2030, not compared to today.*

The public transport analysis only focuses on HRM, only on weekday commuting, and only on public transit and active transportation. Additional GHG savings can be achieved across the province with other bus fleets including school buses. According to School Bus Fleet (2014) there are about 990 school buses operating in Nova Scotia. The Lion Electric Company, Micro Bird Company, and Collins Bus Corporation are among the manufacturers now offering electric school buses. Keolis Canada operates school buses in Montreal that now include 14 buses from the Quebec-based Lion Electric Company. Lion delivered another 13 this year (2019) to Ontario for

deployment across the province as part of a pilot study to electrify student bus fleets. (School Bus Fleet, 2018)

## 4. Economic impacts

The public transportation impacts primarily include bus purchases, energy for operating, and maintenance. The net impact of shifting the *existing* fleet to electric buses will not have major economic implications since there are a few costs and benefits that offset one another. Since neither diesel nor electric buses are manufactured in Nova Scotia, the purchase of buses represents an import regardless of type. Electric buses are presently more expensive so this is a drawback, and although prices will drop as manufacturing of electric buses scales-up, price reductions will not likely occur in the 2030 timeframe due to high demand. Electric buses have a longer lifespan so there will be reduced purchases over time. The energy used for diesel buses is imported, whereas electricity is produced in Nova Scotia, and this favours Nova Scotia's economy. Finally, the maintenance for electric buses is reduced so this is a savings per bus to operators.

The major economic shift resulting from the public transportation analysis involves shifting modes from private vehicles to buses and active transportation, as well as increasing the number of passengers per vehicle. This will likely reduce the number of private vehicles sold and on the road, while expanding the bus fleet. Overall this represents a net reduction in vehicle value imported to the province, along with reductions in imported fuels for a combined economic benefit to Nova Scotia. Although important, this report does not include more in-depth research regarding the economic benefits of reduced congestion on roads, health gains from active transportation, reduced air pollution and noise, alleviating parking pressure, and travel time values (VTPI, 2019).

The private transportation component of this analysis involves shifting household purchases from combustion engine vehicles to hybrid and electric vehicles. These cost more to households even when public incentives are offered. These will come down in price over time, but not before the 2030 time-horizon, as demand could outstrip supply for the next decade. These vehicles are also expected to have longer lifespans, greatly reduced fuel costs, and reduced maintenance. The higher price may cause some multi-car families to reduce their number of vehicles. Fewer vehicles may be sold, but the prices will be higher so the economic impact to retailers will be minimal. Again, the energy to drive vehicles will be locally supplied (i.e. electricity) versus imported fossil fuels so the net economic impact to the province is likely to be positive.

Although the economic impacts will flow over time through the utility in electricity demand, it bears mentioning that there will be up-front economic impacts within the 2030 time-horizon given the need to install charging infrastructure for both buses and private vehicles. This ramp-up phase will generate substantial activity for people with installation expertise. Residential installations may employ electricians and construction workers, while bus charging stations will employ transportation engineers, road construction companies, and utility personnel.

The provincial and national economic impacts of the combined 12-year net spending total of $2.4 billion are contained in the following table.

*Table 14: Goal 5 economic impacts for 2019-2030 (12-year total)*

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| Output | $2,196 | $449 | $911 | $3,557 | $4,401 |
| GDP | $1,725 | $434 | $829 | $2,989 | $3,392 |
| Income | $1,718 | $324 | $113 | $2,155 | $2,716 |
| Jobs (FTE) | 83,363 | 203 | 9,711 | 93,278 | 97,412 |
| Fed tax* | $198 | $43 | $19 | $260 | $331 |
| Prov tax* | $196 | $52 | $28 | $275 | |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

# Goal 6: Growing Nova Scotia's green economy

## 1. Background

The combined investments from Goals 2-5 in this report not only achieve critical GHG reductions, but they also build Nova Scotia's "green economy". These jobs are "green" owing to their focus on development of renewable energy resources, saving energy through efficiency and reducing energy consumption. Not all of the jobs are incremental (new additions) since some result from the changing nature of work done by Nova Scotians ("green shifting"). For instance, a utility worker may shift from operating coal fired power plants to decommissioning or installing and operating renewable electricity generation. Bus drivers for a diesel fleet will continue with the electric fleet that is considered "green". There will also be many new jobs, for instance in NZER retrofits and new construction where altogether new skills and work will be in demand. There is a necessary role for public and private sector training to ramp-up along with the new labour force demands.

## 2. Economic impacts

The economic impact results shown here represent the combined results presented under the other goals (2-5). By 2030 the one-year economic impacts will be as shown in the table below, and the cumulative economic impacts from 2019 to 2030 are in the next table.

Table 15: Goal 6 economic impacts in 2030 (one year)

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| Output | $912 | $277 | $235 | $1,425 | $1,880 |
| GDP | $487 | $161 | $169 | $816 | $1,033 |
| Income | $357 | $115 | $52 | $524 | $676 |
| Jobs (FTE) | 11,124 | 1,883 | 1,974 | 14,980 | 17,282 |
| Fed tax* | $44 | $16 | $8 | $68 | $89 |
| Prov tax* | $47 | $20 | $12 | $79 | $0 |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

*Table 16: Goal 6 economic impacts for 2019-2030 (12-year total)*

| ($M 2019) | Direct | Indirect | Induced | Total NS | Canada |
|---|---|---|---|---|---|
| Output | $10,949 | $3,323 | $2,825 | $17,096 | $22,561 |
| GDP | $5,839 | $1,936 | $2,022 | $9,797 | $12,392 |
| Income | $4,284 | $1,381 | $624 | $6,289 | $8,117 |
| Jobs (FTE) | 133,483 | 22,590 | 23,685 | 179,759 | 207,384 |
| Fed tax* | $523 | $187 | $100 | $810 | $1,064 |
| Prov tax* | $569 | $235 | $145 | $948 | |

*Source: Statistics Canada Interprovincial Input-Output Model, 2014 *Tax impacts combine StatCan model results and Gardner Pinfold income tax calculations based on StatCan SPSDM marginal effective tax rates.*

Once the goals are met in 2030 the annual $816 million in added-value to Nova Scotia will include $524 million in salaries and wages for about 14,980 full-time equivalent workers. The gross domestic product (GDP, added-value), jobs, salaries, and tax revenues for government will be sustainable based on renewable energy resources and energy savings for Nova Scotians.

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