

Economic and Environmental Impact of RRFB Nova Scotia's Programs

Submitted to:

RRFB Nova Scotia

Submitted by:

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EXECUTIVE SUMMARY

INTRODUCTION

RRFB Nova Scotia is a not-for-profit corporation that works in partnership with Nova Scotians to improve the province's environment, economy and quality of life by reducing, reusing, recycling and recovery resources. Since established in 1996, RRFB Nova Scotia has been globally recognized as an innovator in waste diversion solutions and a champion of recycling. RRFB Nova Scotia operates under five specific mandates, including:

- Operate a Deposit-Refund System for Beverage Containers
- Develop and implement industry stewardship agreements
- Support municipal waste diversion programs across the province
- Promote the development of value-added manufacturing
- Develop education and awareness programs.

This study undertakes the following.

- Assessment of economic and environmental impacts associated with the operation of the Deposit-Refund System for Beverage Containers and the Used Tire Management Program
- Impacts associated with support for municipal waste diversion programs
- Impacts of value-added manufacturing and research and development
- Impacts of education and awareness programs.

IMPACTS OF BEVERAGE CONTAINER AND TIRE RECYCLING PROGRAMS

Economic impacts

The annual reports of RRFB Nova Scotia and detailed financial information for program spending over the twenty-year period (1997 – 2016) were the starting point for analysis. A study undertaken in 2013 documented how expenditures flow through RRFB Nova Scotia and the ENVIRO-DEPOT™ network. Interviews were conducted with tire program stakeholders to understand the nature of their activities.

The table below indicates the 1997 and 2016 values for each economic indicator (all estimates include direct and spinoff impacts), and the difference between these represents growth. The twenty-year total is the cumulative sum of annual data over the period.

The avoided landfill costs are based on a recent analysis in Nova Scotia conducted by PHA Consulting Associates that included: annualized capital required for landfill construction and closure, annual equipment costs, and annual operational costs. The collection costs are based on the annual data call information that municipalities report to Nova Scotia Environment.

Total Economic impacts and avoided landfill and collection costs of combined beverage container and used tire programs over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|----------------------------|-----------------|------------|--------------|--------------|---------------|
| Economic Impacts | | | | | |
| Employment | Person Years | 200 | 794 | 594 | 12,405 |
| Income | \$000s | 7,132 | 27,855 | 20,724 | 423,531 |
| GDP | \$000s | 9,442 | 36,795 | 27,353 | 555,593 |
| Provincial Revenue | \$000s | 2,096 | 8,188 | 6,092 | 124,509 |
| Avoided Collection* | | | | | |
| Recyclables cost | \$000s | 1,640 | 5,147 | 3,507 | 81,257 |
| Avoided Landfill** | | | | | |
| Landfill capital | \$000s | 360 | 1,131 | 771 | 17,868 |
| Equipment | \$000s | 38 | 120 | 82 | 1,892 |
| Operations | \$000s | 246 | 774 | 528 | 12,219 |
| Landfill subtotal | | 646 | 2,026 | 1,380 | 31,979 |

Source: NSF-ESD NSIO 2010 model

* Based on Nova Scotia Environment's Datacall

**Based on Nova Scotia averages from PHA Consulting Associates

Highlights:

- **Jobs:** Now 794 jobs (person-years) in Nova Scotia each year related to beverage container and used tire recycling, and the equivalent of 12,405 full-time jobs created over 20 years.
- **Income:** Now \$27.9 million in salaries and wages each year related to beverage container and used tire recycling, and \$423 million earned over 20 years.
- **Gross domestic product (GDP):** Now over \$36.8 million added to Nova Scotia's economy each year, and over \$555 million added since programs began.
- **Avoided collection costs:** Beverage container and used tire recycling saves \$5.1 million in collection costs annually totaling \$81.3 million over 20 years.
- **Avoided landfill costs:** Beverage container and used tire recycling saves \$2.0 million in municipal landfill-related costs annually totaling \$32 million over 20 years.
- **Growth:** Average annual growth of economic impacts is 14.9%, and for avoided costs is 10.7% since 1997.

Environmental impacts

The environmental impacts are particularly important since these highlight the greatest value of RRFB Nova Scotia's programs – how recycling avoids environmental impacts associated with otherwise using virgin materials for product manufacturing. Focusing on savings of landfill space and greenhouse gas (GHG) emissions avoided, the analysis shows how valuable beverage container and tire recycling is in Nova Scotia.

Landfill and GHG savings of RRFB Nova Scotia's beverage container and used tire recycling programs over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|--------------------------|---------------------|--------|--------|--------|---------|
| Landfill | | | | | |
| Space savings | m ³ | 4,733 | 14,921 | 10,188 | 242,366 |
| Energy | | | | | |
| GHG savings ¹ | t CO ₂ e | 11,572 | 40,959 | 29,386 | 565,196 |
| Cars off road | # | 1,962 | 6,158 | 4,196 | 97,221 |
| GHG value ² | \$000s | 347 | 1,228 | 881 | 16,955 |

Sources: 1. Environment Canada GHG Calculator for Waste Management, 2. British Columbia Carbon Pricing (\$30/tonne),

Highlights:

- **Avoided landfill space:** Landfill space saved by recycling beverage containers and used tires grew from 4,733 m³ in 1997 to 14,921 m³ in 2016. The 20-year total space saved is over 242,000 m³, equivalent to 97 Olympic-sized swimming pools.
- **GHGs avoided:** Recycling beverage containers and used tires in Nova Scotia saves 40,959 tonnes of GHG emissions each year, equivalent to removing 6,158 cars from the road, and worth \$1.2 million under carbon pricing. The 20-year total is worth \$16.9 million.
- **Growth:** Average annual growth of GHG emissions avoided is 12.7%.

IMPACT OF DIVERSION CREDITS, ENFORCEMENT FUNDING AND EDUCATION FUNDING PROGRAMS

To assess benefits associated with RRFB Nova Scotia's municipal funding programs, interviews were conducted with six municipal/regional representatives who manage the use of Diversion Credits Funding, Enforcement Funding and Education Funding, for their regions. Over the last 20 years, these programs have provided municipalities with support for their waste management infrastructure and delivery of waste management programs.

It is evident that the funding has played an important role in the delivery of waste diversion programs across the province. In terms of economic impacts prolonged lifespan of landfills will result in significant savings to taxpayers. These programs have also generated various employment impacts through the hiring of enforcement officers and education programmers.

Related to environmental impacts, waste disposal rates have decreased significantly over the last 20 years. Enforcement activity has improved compliance in separating materials at curbside and is resulting in prolonging the life of landfill facilities. The sharing of knowledge and advice with various segments of the community and general public has also improved recycling practices.

LITTER ABATEMENT

RRFB Nova Scotia provides annual funding to support two province-wide litter abatement programs. Adopt-A-Highway and the Great Nova Scotia Pick-Me-Up, delivered by Clean Foundation, receive the funding.

Through the Adopt-A-Highway program over 70,000 bags of garbage and 4,200 bags of recyclables have been collected from the 12,000 km of adopted roadways. The Pick-Me-Up program has removed an additional 35,400 bags of litter.

IMPACTS OF PROMOTION OF VALUE-ADDED MANUFACTURING AND RESEARCH AND DEVELOPMENT

RRFB Nova Scotia provides funding to support research and development and commercial projects for new products, processes, equipment technologies and market opportunities that can, in turn, lead to increased solid waste diversion. To assess this program a series of case studies were undertaken.

With any comprehensive research and development program the ultimate objective is to commercialize the research outcome. RRFB Nova Scotia business development funding program demonstrates success in this regard.

A project with Louisbourg Seafoods' is an example where a research project aimed at creating value added bioproducts from processing waste has resulted in diverting material from the waste stream. The shrimp shell drying operation has the possibility of diverting 400 tonnes of shrimp shell waste per year from landfill,

1. BACKGROUND

1.1 INTRODUCTION

RRFB Nova Scotia is a not-for-profit corporation that works in partnership with Nova Scotians to improve the province's environment, economy and quality of life by reducing, reusing, recycling and recovery resources. Since established in 1996, RRFB Nova Scotia has been globally recognized as an innovator in waste diversion solutions and a champion of recycling. RRFB Nova Scotia operates under five specific mandates, including:

- Operate a Deposit-Refund System for Beverage Containers
- Develop and implement industry stewardship agreements
- Support municipal waste diversion programs across the province
- Promote the development of value-added manufacturing
- Develop education and awareness programs.

This study undertakes the following.

Assessment of economic and environmental impacts associated with the operation of the Deposit-Refund System for Beverage Containers and the Tire Management Program.

Formal economic impact analysis provides the following for each program:

- Employment – direct and spin-off impacts
- Income – direct and spin-off impacts
- Gross domestic product – direct and spin-off impacts
- Provincial tax revenues recovered – direct and spin-off impacts.

The economic analysis also examines avoided costs (savings) including:

- Avoided collection costs
- Avoided landfill costs (including capital, equipment, and operations).

The environmental impact analysis for programs is based on the following:

- Landfill space avoided
- Greenhouse gas emissions avoided

In addition, for the beverage container program only, the environmental impacts were further analyzed to demonstrate:

- Energy savings from use of recycled inputs for manufacturing
- Air pollutants avoided by using recycled materials for manufacturing.

Impacts associated with support for municipal waste diversion programs.

The economic and environmental impact of select regional funding programs including:

- **Diversion Credits** – Funding averaging approximately \$4.7 million annually over the last 20 years. This funding provided to municipalities is intended to support waste management infrastructure and the delivery of waste management programs.
- **Enforcement Funding** – Annual funding of \$700,000 to support the enforcement activities of municipalities/ regions across the province. Funding supports the employment of enforcement officers who ensure compliance with municipal and provincial waste management regulations.

Impacts of value-added manufacturing and research and development

To analyze the economic and environmental impacts related to this program, seven (7) case studies were prepared for specific projects funded by RRFB Nova Scotia. Three of the projects were completed under the Research and Development Program, one was a Student Research Grant, and the Value-Added Manufacturing (VAM) program accounted for another of the case studies. Finally, two of the case studies documented findings from projects that were first initiated under Research and Development and subsequently, based on their potential, they received additional support from VAM. These provide good examples of how the program is successful in commercializing innovative approaches to waste management in Nova Scotia.

Impacts of education and awareness programs

A budget of approximately \$1.5 million supports the delivery of regional and provincial community outreach programs, advertising campaigns, school-based initiatives and website programming. The economic and environmental impacts of the following two programs/ initiatives are documented.

- **Regional Education Funding** – Funding of \$635,000 annually to support the educational outreach provided by municipalities across the province. Funding supports the employment of waste reduction educators who visit schools, businesses and community groups.
- **Litter Abatement Funding** – RRFB Nova Scotia supports two litter abatement programs in the province. Adopt-A-Highway receives \$38,000, which represents their entire annual budget and the Clean Foundation receives \$37,000 to support several waste related initiatives, including The Great Nova Scotia Pick-Me-Up.

2. APPROACH / METHODOLOGY

2.1 ECONOMIC IMPACTS

2.1.1 Approach

Estimating economic impacts involves two components: 1) a formal economic impact analysis based on expenditure patterns, and 2) avoided costs of otherwise collecting and landfilling recyclable materials. The approach to each component is outlined below.

Formal economic analysis

The annual reports of RRFB Nova Scotia and detailed financial information for program spending over the 20-year period (1997 – 2016) were the starting point for analysis. A study undertaken in 2013 documented how expenditures flow through RRFB Nova Scotia and the ENVIRO-DEPOT™ network. Interviews were conducted with tire program stakeholders to understand the nature of their activities.

This foundation of information allowed the expenditures to be allocated in the Nova Scotia Finance-Economics and Statistics Division (NSF-ESD) Nova Scotia Input-Output model (NSIO, 2010 version). The model produces the required conventional economic indicators including:

- Employment in person-years (PY)
- Income (salaries and wages)
- Gross Domestic Product (GDP)
- Provincial revenue (income and sales tax revenues).

The model outputs are organized according to the two core programs: beverage container recycling, and used tire management. For each program the impacts are divided into three components: direct; spinoff; and total impacts. Direct impacts are those that result directly from the expenditures on, or purchases of, goods and services in Nova Scotia. Spinoff impacts are the sum of indirect impacts (due to inter-industry transactions) and induced impacts (those caused by household spending and re-spending). Total impacts are the sum of direct and spinoff impacts.

Avoided costs

The formal economic analysis examines what actually happens in the economy as a result of beverage and used tire recycling programs. Examining avoided costs considers what would have happened if recycling programs did not exist, and what savings are occurring. The historical alternative to recycling was landfilling as part of the waste stream. The focus here is on what costs would be occurring if landfilling occurred instead of recycling. The materials would be collected and brought to landfill. This would incur a range of costs including:

- Collection costs
- Landfill capital for construction and closure
- Landfill equipment costs
- Landfill operating costs

Collection costs for different materials are reported by municipalities annually through Nova Scotia Environment's datacall. Provincial average collection costs for recyclables are applied to the volume (tonnage) of materials diverted from landfill through the beverage container and tire programs. Landfill costs in Nova Scotia were assessed in September 2011 by PHA Consulting Associates for facilities across the province. Average costs per metric tonne of material are available for capital (i.e. landfill construction and closure), equipment, and operations. The provincial averages are applied to the tonnages of recyclable materials (beverage containers and tires) diverted from landfills to estimate the annual avoided costs.

2.2 ENVIRONMENTAL IMPACTS

2.2.1 Approach

The environmental impact analysis focuses on the beverage container program and the used tire program. The environmental indicators included in the analysis are:

- Landfill space avoided
- Greenhouse gas (GHG) emissions avoided

Additional analysis for beverage container recycling includes the following:

- Energy savings from use of recycled inputs for manufacturing of material
- Air pollutants avoided by using recycled materials instead of virgin materials for energy generation.

Several of the above indicators have been converted to measures that individuals can more easily relate to, including GHG emissions in terms of cars off the road. The approach for calculating the above noted indicators is the same for both the beverage container and used tire programs. The analysis for both the beverage container and used tire programs begins with the number of units of both material types collected each year in Nova Scotia.

Landfill space

The amount of space that each unit of material would occupy in a landfill is used to estimate the total landfill space that would be needed each year. The calculations were based on work done by Morrison and Hershfield for their report to the British Columbia Government in 2014.¹ Low, medium, and high estimates were developed in B.C. and the medium values are used in this report for Nova Scotia. Volume estimates are reported in cubic metres (m³) but these are translated into "Olympic-sized swimming pools" to help appreciate the volumes involved.

Greenhouse gas emissions

The greenhouse gas emissions avoided by recycling occur because much less energy is needed to transform material into a new product than to gather/mine and manufacture from virgin materials. Environment Canada maintains a GHG Calculator for Waste Management² that provides

¹ Morrison Hershfield, *Assessment of Economic and Environmental Impacts of Extended Producer Responsibility Programs in BC*. 2014.

² Environment Canada, 2013. GHG Calculator for Waste Management (online: <https://www.ec.gc.ca/gdd-mw/default.asp?lang=En&n=D6A8B05A-1>)

material-specific estimates of energy savings and GHG reduction from recycling. The Environment Canada measures are applied to Nova Scotia materials recycled on a tonnage basis to produce estimates of savings. The metric tonnes of GHGs avoided are converted to an equivalent number of cars removed from the road to help appreciate the scale of emissions. Carbon pricing is increasingly relevant and the B.C. carbon price (\$30 per tonne) is applied to signal the imminent value of GHG reductions in economic terms. Another measure is the Social Cost of Carbon (SCC), which reflects the damages within Canada that one tonne of GHG is likely to trigger. Environment Canada estimates the SCC for use in regulatory initiatives such as vehicle efficiency standards or coal fired power regulations.³ The SCC for Canada was \$28 (in \$2014), and this is surely being re-visited in light of Canada's recent commitments to global GHG reductions and federal announcements supporting carbon pricing.

Energy savings

For beverage containers only, the energy saved by using recycled materials in product manufacturing is converted to electricity for illustration of the energy savings involved. Manufacture of products actually involves other forms of energy including fossil fuels that would have other environmental impacts. The conversion to electricity equivalents in kilowatts (kW) also facilitates conversion of energy savings to other measures, such as the number of residential homes removed from the power grid, and electrical bill savings in dollar terms.

Air pollutants

For beverage containers only, the energy savings in electrical terms brings into focus the environmental impacts of energy generation, particularly air pollution from oil and coal-fired facilities in Nova Scotia. Again, this does not imply that electricity is the sole form of energy or that the manufacturing takes place in Nova Scotia, but this helps the general public appreciate the connection between recycling and reduced energy consumption. Nova Scotia Power provides air emissions for its electrical generation facilities in gigawatts (GW)s and these measures can be applied to the energy avoided in using recycled instead of virgin materials. The results for mercury (kg), SO_x (tonne), and NO_x (tonne) are not easily appreciated, but these are converted to dollar values based on studies in Canada of health costs and mitigation costs associated with these air pollutants (Mathews and Lave, 2000; Diener, 2001).

³ Canada Gazette, 2011.

3. IMPACTS OF BEVERAGE CONTAINER AND TIRE RECYCLING PROGRAMS

3.1 ECONOMIC IMPACTS

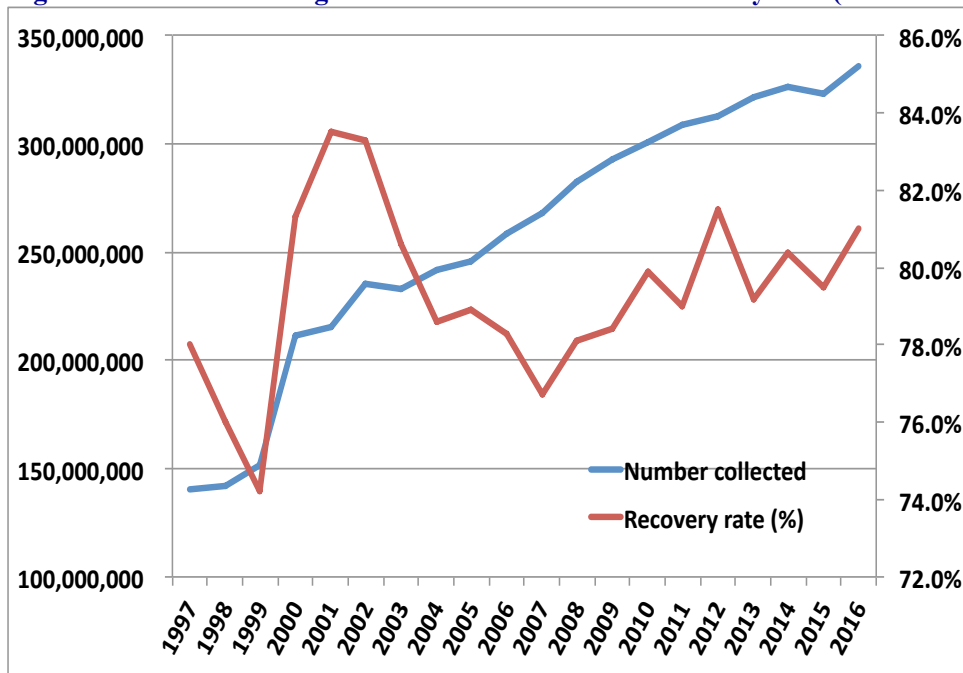
The 20-year economic and environmental impact estimates are built on data from RRFB Nova Scotia’s annual reporting of material processing and financial information from the beverage container and used tire programs. The economic impacts of RRFB Nova Scotia’s programs and activities are distributed across a range of industries in Nova Scotia. The environmental benefits are shared by all Nova Scotians and extend beyond the provincial borders.

3.1.1 Beverage Container Program Economic Impacts

RRFB Nova Scotia operates the deposit-refund system for all non-refillable, ready-to-serve beverage containers, excluding dairy products. Under the Solid Waste-Resource Management Regulations, all beverage distributors register with RRFB Nova Scotia and remit the deposits. Currently, there are 111 beverage distributors and 38 liquor distributors selling approximately 143,500 products in Nova Scotia.

Beverage containers are collected through the network of Enviro-Depots, which are independently owned and operated in 77 locations. One additional location is owned and operated by RRFB Nova Scotia. Our province boasts an impressive recycling rate, consistently averaging approximately 80% over the last 20 years. This is one of the highest recovery rates in Canada.

Figure 1: Annual beverage containers collected and recovery rate (1997 – 2016)

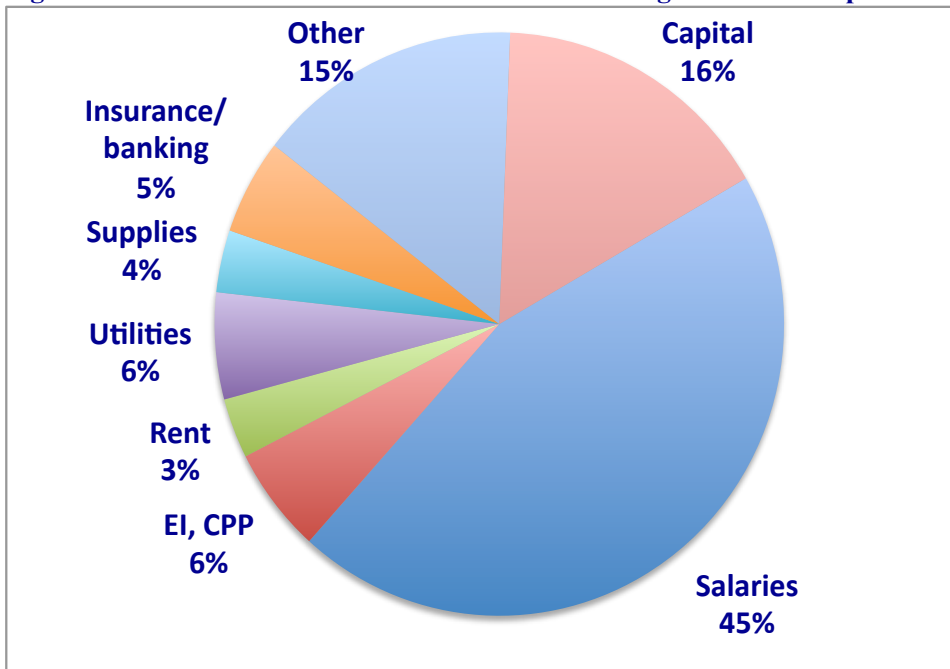


Source: RRFB Nova Scotia

The economic impacts from the Deposit-Refund System of Beverage Containers start with the deposit everyone pays when they purchase a deposit-bearing beverage container. The first step is to look at how RRFB Nova Scotia spends the deposit revenues, and the second step is to examine the funding disbursed to the ENVIRO-DEPOT™ network to cover their costs for receiving and handling returned beverage containers.

Gardner Pinfold conducted a survey of ENVIRO-DEPOT™ operators in 2012-2013 asking them to break down how handling fees are spent. Results shown in the figure below indicate salaries and employer contributions to EI and CPP represent just over half (51%) of all expenditures. The next most important expenditures are for capital (16%), and other items (15%). The “other” category may include contractors, professional services, travel, and other miscellaneous expenses.

Figure 2: ENVIRO-DEPOT™ breakdown of beverage container expenses



Source: Survey of Enviro-Depots by Gardner Pinfold in 2013.

The spending breakdowns provide a basis for allocating the expenditures in the formal economic impact analysis that follows.

The table below indicates the 1997 and 2016 values for each economic indicator (all include direct and spinoff impacts), and the difference between these represents growth. The twenty-year total is the cumulative sum of annual data over the period.

Table 1: Economic impacts and avoided collection and landfill costs of the beverage container recycling program over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|----------------------------|-----------------|------------|--------------|------------|---------------|
| Economic Impacts | | | | | |
| Employment | Person Years | 179 | 711 | 532 | 11,188 |
| Income | \$000s | 6,508 | 24,771 | 18,263 | 378,594 |
| GDP | \$000s | 8,672 | 32,663 | 23,991 | 495,616 |
| Provincial Revenue | \$000s | 1,913 | 7,282 | 5,369 | 111,304 |
| Avoided Collection* | | | | | |
| Recyclables cost | \$000s | 1,539 | 3,245 | 1,706 | 51,724 |
| Avoided Landfill** | | | | | |
| Landfill capital | \$000s | 338 | 713 | 375 | 11,374 |
| Equipment | \$000s | 36 | 76 | 40 | 1,204 |
| Operations | \$000s | 231 | 488 | 257 | 7,778 |
| Landfill subtotal | | 606 | 1,277 | 671 | 20,356 |

Source: NSF-ESD NSIO 2010 model

* Based on Nova Scotia Environment's Datacall

**Based on Nova Scotia averages from PHA Consulting Associates

Highlights:

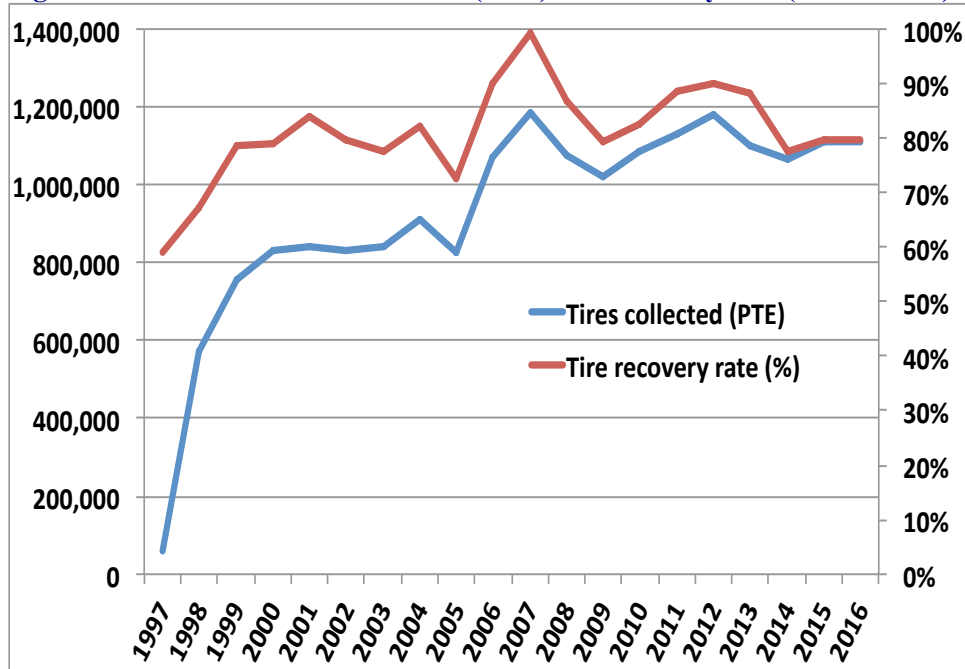
- **Jobs:** Now 711 jobs (person-years) in Nova Scotia each year related to beverage container recycling, and the equivalent of 11,188 full-time jobs created over 20 years.
- **Income:** Now \$24.8 million in salaries and wages each year related to beverage container recycling, and \$379 million earned over 20 years.
- **Gross domestic product (GDP):** Now over \$32.7 million added to Nova Scotia's economy each year, and over \$496 million added since programs began.
- **Avoided collection costs:** Recycling saved \$3.2 million in municipal collection costs in 2016 totaling \$52 million over 20 years.
- **Avoided landfill costs:** Recycling saved \$1.2 million in municipal landfill-related costs in 2016 totaling \$20 million over 20 years.
- **Growth:** Average annual growth of economic impacts is 14.9%, and for avoided costs is 5.5% since 1997.

3.1.2 Tire Recycling Program Economic Impacts

RRFB Nova Scotia operates the province's Used Tire Management Program for on-road passenger tires. Under the Solid Waste-Resource Management Regulations, used tires are banned from landfills in Nova Scotia, and all tire retailers are required to register with RRFB Nova Scotia and collect environmental handling fees. Currently, there are over 850 registered tire retailers in the province.

The environmental handling fees support the costs of collecting and processing the used tires. Since the program began in 1997, Nova Scotians have been responsibly recycling approximately one million used tires each year. Nova Scotians can return up to four regulated tires at a time to any tire retailer in the province for recycling. RRFB Nova Scotia collects the unwanted tires and delivers them to a local processor, who converts them into Tire Derived Aggregate (TDA). TDA is multi-purpose product with a variety of construction and engineering uses, such as drainage around foundations and ball fields, or as the base under new roads.

Figure 3: Annual used tires collected (PTE) and recovery rate (1997 – 2016)



Source: RRFB Nova Scotia; PTE = Passenger Tire Equivalents

To undertake the economic impact analysis of the Used Tire Management Program we had targeted conversations with key stakeholders who provide services under contract with RRFB Nova Scotia for both collection and processing. Two firms undertake the collection of tires from the tire retailers. They provide full time employment for truck drivers as well as contracting out some work to other trucking companies. In turn, they deliver the tires to the processing facility. The processing facility is operated by Halifax C&D Recycling Ltd, and operates under contract with RRFB Nova Scotia.

The table below indicates the 1997 and 2016 values for each economic indicator (all include direct and spinoff impacts), and the difference between these is growth. The 20-year total is the cumulative sum of annual data over the period.

Table 2: Economic impacts and avoided collection and landfill costs of used tire program over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|----------------------------|-----------------|-----------|------------|------------|---------------|
| Economic Impacts | | | | | |
| Employment | Person Years | 21 | 83 | 62 | 1,217 |
| Income | \$000s | 624 | 3,084 | 2,461 | 44,937 |
| GDP | \$000s | 770 | 4,132 | 3,362 | 59,977 |
| Provincial Revenue | \$000s | 183 | 906 | 723 | 13,205 |
| Avoided Collection* | | | | | |
| Recyclables cost | \$000s | 101 | 1,902 | 1,801 | 29,533 |
| Avoided Landfill** | | | | | |
| Landfill capital | \$000s | 22 | 418 | 396 | 6,494 |
| Equipment | \$000s | 2 | 44 | 42 | 688 |
| Operations | \$000s | 15 | 286 | 271 | 4,441 |
| Landfill subtotal | | 40 | 749 | 709 | 11,623 |

Source: NSF-ESD NSIO 2010 model

* Based on Nova Scotia Environment's Datacall

**Based on Nova Scotia averages from PHA Consulting Associates

Highlights:

- **Jobs:** Now over 83 jobs (person-years) in Nova Scotia each year related to used tire recycling, and the equivalent of 1,217 full-time jobs created over 20 years.
- **Income:** Now \$3.1 million in salaries and wages each year related to used tire recycling, and \$44.9 million earned over 20 years.
- **Gross domestic product (GDP):** Now over \$4.1 million added to Nova Scotia's economy each year, and over \$60.0 million added since the program began.
- **Avoided collection costs:** Recycling used tires saves \$1.9 million in collection costs annually totaling \$29.5 million over 20 years.
- **Avoided landfill costs:** Recycling used tires saves \$0.7 million in municipal landfill-related costs annually totaling \$11.6 million over 20 years.
- **Growth:** Average annual growth of economic impacts is 8.9%, and for avoided costs is 5.1% (1998 is used as the base year when program was fully underway).

3.1.3 Total Economic Impacts For Beverage Container and Used Tire Recycling Programs

The table below indicates the 1997 and 2016 values for each economic indicator (all estimates include direct and spinoff impacts), and the difference between these represents growth. The twenty-year total is the cumulative sum of annual data over the period.

The avoided landfill costs are based on a recent analysis in Nova Scotia conducted by PHA Consulting Associates that included: annualized capital required for landfill construction and closure, annual equipment costs, and annual operational costs. The collection costs are based on the annual datacall information that municipalities report to Nova Scotia Environment.

Table 3: Total Economic impacts and avoided collection and landfill costs of combined beverage container and used tire programs over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|----------------------------|-----------------|------------|--------------|--------------|---------------|
| Economic Impacts | | | | | |
| Employment | Person Years | 200 | 794 | 594 | 12,405 |
| Income | \$000s | 7,132 | 27,855 | 20,724 | 423,531 |
| GDP | \$000s | 9,442 | 36,795 | 27,353 | 555,593 |
| Provincial Revenue | \$000s | 2,096 | 8,188 | 6,092 | 124,509 |
| Avoided Collection* | | | | | |
| Recyclables cost | \$000s | 1,640 | 5,147 | 3,507 | 81,257 |
| Avoided Landfill** | | | | | |
| Landfill capital | \$000s | 360 | 1,131 | 771 | 17,868 |
| Equipment | \$000s | 38 | 120 | 82 | 1,892 |
| Operations | \$000s | 246 | 774 | 528 | 12,219 |
| Landfill subtotal | | 646 | 2,026 | 1,380 | 31,979 |

Source: NSF-ESD NSIO 2010 model

* Based on Nova Scotia Environment's Datacall

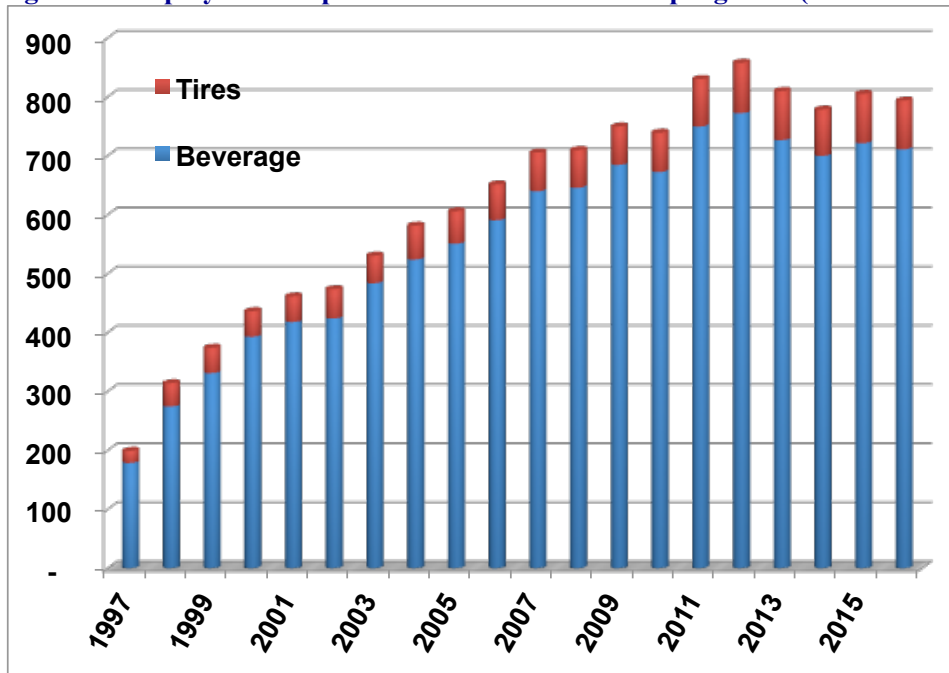
**Based on Nova Scotia averages from PHA Consulting Associates

Highlights:

- **Jobs:** Now 794 jobs (person-years) in Nova Scotia each year related to beverage container and used tire recycling, and the equivalent of 12,405 full-time jobs created over 20 years.
- **Income:** Now \$27.9 million in salaries and wages each year related to beverage container and used tire recycling, and \$423 million earned over 20 years.
- **Gross domestic product (GDP):** Now over \$36.8 million added to Nova Scotia's economy each year, and over \$555 million added since programs began.
- **Avoided collection costs:** Beverage container and used tire recycling saves \$5.1 million in collection costs annually totaling \$81.3 million over 20 years.
- **Avoided landfill costs:** Beverage container and used tire recycling saves \$2.0 million in municipal landfill-related costs annually totaling \$32 million over 20 years.
- **Growth:** Average annual growth of economic impacts is 14.9%, and for avoided costs is 10.7% since 1997.

The following figure helps to appreciate the growth over time, in this case total employment impacts related to beverage programs and tire programs. The trend is the same for the other economic indicators: income, GDP, and provincial revenue.

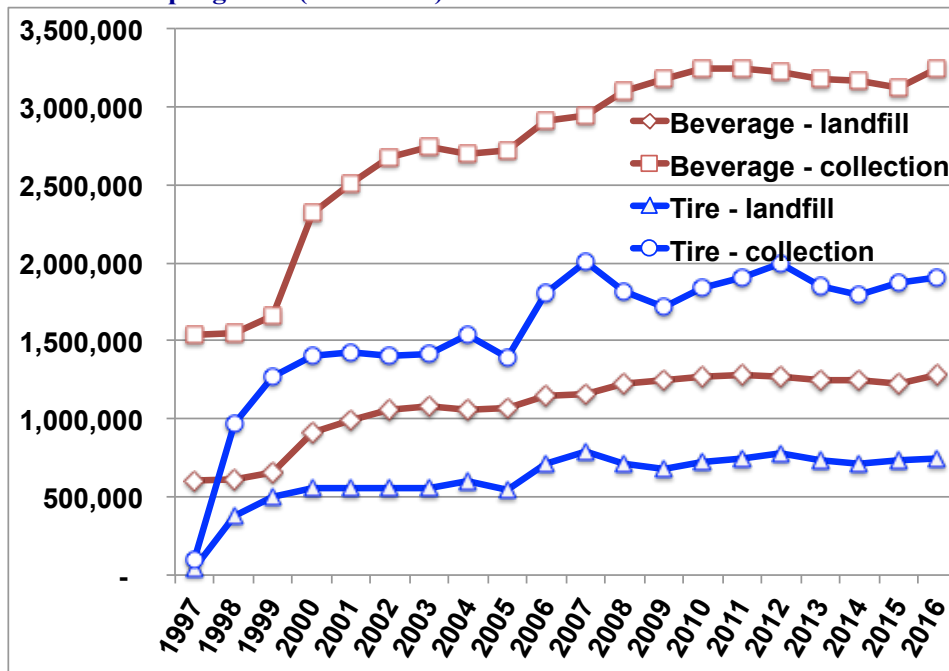
Figure 4: Employment impacts of RRFB Nova Scotia programs (1997 – 2016)



Source: NSF-ESD NSIO 2010 model; Note: Impacts include directs and spinoffs

Unlike the economic impact data that derives from annual report expenditures that rise steadily, the avoided landfill costs stem from the volumes of materials that fluctuate somewhat from year to year (beverage containers and tires). The following figure shows the avoided costs for beverage, tire, and the combined programs to illustrate the twenty-year trends.

Figure 5: Avoided collection and landfill costs for RRFB Nova Scotia beverage container and used tire programs (1997-2016)



*Based on Nova Scotia averages from PHA and Associate, and Nova Scotia Environment's Datacall

3.2 ENVIRONMENTAL IMPACTS

The environmental impacts are particularly valuable since these highlight the greatest value of RRFB Nova Scotia's programs – how recycling avoids environmental impacts associated with otherwise using virgin materials for product manufacturing. Focusing on savings of landfill space, as well as energy and related emissions, the analysis shows how valuable beverage container and tire recycling is in Nova Scotia.

3.2.1 Beverage Container Environmental Impacts

The table below indicates the avoided landfill space and greenhouse gas (GHG) emission savings in the first year (1997), the current year (2016), the growth that has occurred over this period, and 20-year cumulative totals. Environmental impact estimates are conservative since this does not include other environmental benefits of recycling.

Table 4: Landfill and GHG savings of beverage container program over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|-------------------------|---------------------|--------|----------|--------|-----------|
| Landfill | | | | | |
| Space savings | m ³ | 4,347 | 7,660 | 3,313 | 129,632 |
| GHG | | | | | |
| GHG volume ¹ | t CO ₂ e | 11,453 | 38,709 | 27,256 | 530,265 |
| Cars off road | # | 1,841 | 3,882 | 2,041 | 61,886 |
| GHG value ² | \$000s | 343.58 | 1,161.27 | 817.68 | 15,907.94 |

Sources: 1. Environment Canada GHG Calculator for Waste Management,
2. British Columbia Carbon Pricing (\$30/tonne),

The next table indicates the avoided energy use and air emissions in the first year (1997), the current year (2016), the growth that has occurred over this period, and 20-year cumulative totals. This is based on the difference between recycling and use of virgin materials to produce beverage containers. Environmental impact estimates are conservative since this does not include other environmental benefits of recycling.

Table 5: Energy and air pollution savings of beverage container program over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|---------------------------------------|-----------------|--------------|---------------|---------------|----------------|
| Energy | | | | | |
| Electricity saved ¹ | kW | 56,226,053 | 207,907,288 | 151,681,236 | 2,845,124,030 |
| Homes off grid ² | NS avg | 5,095 | 18,842 | 13,746 | 257,839 |
| Energy value ² | \$000s | 6,747 | 24,949 | 18,202 | 341,415 |
| Air pollution | | | | | |
| Mercury avoided ² | kg | 146 | 541 | 394 | 7,397 |
| NO _x avoided ² | t | 108 | 400 | 292 | 5,477 |
| SO ₂ avoided ² | t | 22 | 82 | 60 | 1,124 |
| Value of mercury ³ | \$000s | 8,663 | 32,035 | 23,371 | 438,380 |
| Value of NO _x ³ | \$000s | 381 | 1,410 | 1,029 | 19,294 |
| Value of SO ₂ ³ | \$000s | 36 | 134 | 98 | 1,837 |
| Total value: | | 9,081 | 33,579 | 24,498 | 459,511 |

1. Not all manufacturing with virgin materials uses electricity – for illustration only,

2. Nova Scotia Power,

3. Mathews and Lave, 2000; Diener, 2001.

Highlights:

- **Avoided landfill space:** Landfill space saved by recycling beverage containers increased from 4,347 m³ in 1997 to 7,660 m³ in 2016. The 20-year total space saved is over 129,000 m³, equivalent to 52 Olympic-sized swimming pools.
- **GHGs avoided:** Recycling beverage containers in Nova Scotia saves 38,709 tonnes of GHG emissions each year, equivalent to removing 3,882 cars from the road, and worth \$1.16 million under carbon pricing systems. The 20-year total is worth \$15.9 million.
- **Electricity saved:** If electricity were used to manufacture new products then 208 million kW are saved, equivalent to removing 18,842 Nova Scotia homes from the grid and saving \$25 million in electrical bills. The 20-year total is worth \$341 million.
- **Air pollution avoided:** If fossil-fuel generating plants in Nova Scotia were used to manufacture new products, the combined emissions of mercury, nitrous oxides (NO_x), and sulfur-dioxide (SO₂) would have avoided health and mitigation costs valued at \$33.6 million each year. The 20-year total is worth \$460 million.
- **Growth:** Average annual growth of GHG emissions avoided is 11.9%, and for avoided air pollutants (mercury, SO_x, and NO_x) is 13.5% since 1997.

Compaction trailers improving efficiencies

As Nova Scotia recycling programs evolve, RRFB Nova Scotia continues to find ways to gain efficiencies and reduce environmental impacts. A pilot project in 2012 examined the feasibility of using compaction trailers for transport of plastic beverage containers. By compressing the containers, a trailer can now carry 650 bags of containers instead of 78. This means only one trailer trip is needed instead of six that were required to bring containers from Enviro-Depots around the province to market.

Processing efficiencies were developed at the same time to reduce the number of “sorts” for plastic containers from four down to one. About 75%-80% of plastic bottles now go directly to markets. Building on this success, aluminum containers were added to compaction trailers and this increased the number of bags a trailer could carry from 78 to 300.

- Annual trailer loads avoided: 1,514 trailers
- Annual reduced GHG emissions: 307 tonnes

3.2.2 Tire Recycling Environmental Impacts

The environmental impacts avoided through the tire recycling program are shown in the table below including landfill space savings and GHG savings in the first year (1997), the current year (2016), the growth that has occurred over this period, and 20-year cumulative totals.

Table 6: Environmental impacts of used tire recycling program over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|-------------------------|-----------------|------|-------|--------|----------|
| Landfill | | | | | |
| Space savings | m ³ | 386 | 7260 | 6875 | 112,734 |
| GHG | | | | | |
| GHG volume ¹ | t CO2e | 119 | 2,250 | 2,130 | 34,932 |
| Cars off road | # | 121 | 2,276 | 2,155 | 35,335 |
| GHG value ² | \$000s | 3.58 | 67.49 | 63.9 | 1,047.95 |

Sources:

1. Environment Canada GHG Calculator for Waste Management
2. British Columbia Carbon Pricing (\$30/tonne)

Highlights:

- **Avoided landfill space:** Landfill space saved by recycling used tires increased from 386 m³ in 1997 to 7,250 m³ in 2016. The 20-year total space saved is over 112,000 m³, equivalent to 45 Olympic-sized swimming pools.
- **GHGs avoided:** Recycling tires in Nova Scotia saves 2,250 tonnes of GHG emissions each year, equivalent to removing 2,276 cars from the road, and worth \$67,000 under carbon pricing systems. The 20-year total is worth \$1.0 million.

- **Growth:** Average annual growth of GHG emissions avoided is 4.8%.

3.2.3 Total Environmental Impacts for the Beverage Container and Tire Recycling Programs

The most substantial environmental benefits of recycling are related to the reduction of virgin materials needed for manufacturing new products. Since recycled materials are easily turned into new product and much less energy is needed to collect the material, process, and form it into new products.

The table below indicates the total avoided environmental impacts for both the beverage container and used tire recycling programs from landfill space and energy savings in the first year (1997), the current year (2016), the growth that has occurred over this period, and 20-year cumulative totals.

Table 7: Landfill and GHG savings of RRFB Nova Scotia's beverage container and used tire recycling programs over 20 years (1997-2016)

| | Functional Unit | 1997 | 2016 | Growth | 20-year |
|--------------------------|-----------------|--------|--------|--------|---------|
| Landfill | | | | | |
| Space savings | m ³ | 4,733 | 14,921 | 10,188 | 242,366 |
| Energy | | | | | |
| GHG savings ¹ | t CO2e | 11,572 | 40,959 | 29,386 | 565,196 |
| Cars off road | # | 1,962 | 6,158 | 4,196 | 97,221 |
| GHG value ² | \$000s | 347 | 1,228 | 881 | 16,955 |

Sources: 1. Environment Canada GHG Calculator for Waste Management,
2. British Columbia Carbon Pricing (\$30/tonne),

Highlights:

- **Avoided landfill space:** Landfill space saved by recycling beverage containers and used tires grew from 4,733 m³ in 1997 to 14,921 m³ in 2016. The 20-year total space saved is over 242,000 m³, equivalent to 97 Olympic-sized swimming pools.
- **GHGs avoided:** Recycling beverage containers and used tires in Nova Scotia saves 40,959 tonnes of GHG emissions each year, equivalent to removing 6,158 cars from the road, and worth \$1.2 million under carbon pricing. The 20-year total is worth \$16.9 million.
- **Growth:** Average annual growth of GHG emissions avoided is 12.7%.

4. IMPACT OF DIVERSION CREDITS, ENFORCEMENT FUNDING AND EDUCATION FUNDING PROGRAMS

To assess benefits associated with RRFB Nova Scotia's municipal funding programs, interviews were conducted with six municipal/regional representatives who manage the use of Diversion Credits Funding, Enforcement Funding, Education Funding, and other similar funding programs for their regions and/or municipalities.

4.1 DIVERSION CREDITS FUNDING

Over the last 20 years, RRFB Nova Scotia has provided average annual funding of approximately \$4.7 million in Diversion Credits to municipalities to support their waste management infrastructure and the delivery of waste diversion programs. The funding is distributed based on municipal diversion rates.

Based on the interviews completed, it is evident that the RRFB Nova Scotia funding has played an important role in the delivery of waste diversion programs across the province. The level of funding can vary depending on the size of the region or municipality. Most recently, the total funding ranged between \$150,000 and \$3,000,000. Municipal representatives who were interviewed reported total waste diversion costs as between \$5 million and \$44 million in 2015, meaning that RRFB Nova Scotia funds accounted for a significant share of total waste management program and delivery costs. The funding reduced the burden on local taxpayers and citizens, as the balance of funds required for waste management are sourced from the municipal tax base and various tipping fees at recycling and composting facilities, landfills and transfer stations.

Most regions or municipalities consider the Diversion Credit Funding received from RRFB Nova Scotia as one of the revenue streams that contributes to offsetting the operating costs associated with waste management and diversion. The funding is usually not targeted to specific projects or programs. Those interviewed offered many examples of how the Diversion Credit Funding supports their programs.

- Curbside recycling programs
- Operation of composting programs and facilities
- Blue bag material separation facilities
- Operation of transfer stations
- Operation of materials recovery facilities
- Payment for contracted services (collection, sorting, composting, recycling, etc.)
- Secondary separation of products such as wood, metal, tires, paints, propane tanks, batteries, and electronics
- Additional support for educational programming
- Household hazardous waste (HHW) mobile events and pickups
- Construction and demolition materials diversion.

4.1.1 Economic Impacts

RRFB Nova Scotia Diversion Credits funding does generate a variety of economic impacts associated with waste management and diversion programs operated by the various municipalities and the regions.

Our conversations with regional and municipal representatives also reveal a variety of associated economic impacts that they observe through the conduct of their programs; of particular note are those associated with the prolonged lifespan of landfills which results in significant savings to taxpayers, avoiding the significant investment required to site and prepare new facilities. Also, some of the facilities supported by RRFB Nova Scotia Diversion Credits funding have led to some regions or municipalities being able to sell services to other non-resident users, which, in turn, reduces the operating cost burden to those groups.

Some of the operators have noted there has been a change in the type of jobs associated with waste management. Higher skills are required, which in turn means staff receive higher compensation. Representatives are also of the belief that RRFB Nova Scotia Diversion Credits funding does, in turn, leverage incremental additional expenditures by municipal units for the purpose of waste diversion and management.

4.1.2 Environmental Impacts

RRFB Nova Scotia's Diversion Credit Funding is recognized by the various municipal representatives as providing the financial capacity to meet the specific goals and targets that have been set for both municipalities and the province as a whole. Waste disposal rates have decreased significantly over the last 20 years and this can be, in part, attributable to RRFB Nova Scotia funding. This impact was noted in the previous section.

This trend associated with decreasing disposal rates will, in turn, save overall landfill space reducing the need to expand existing facilities or establish new ones.

A number of specific observations made by various representatives merit highlighting in this discussion, various quotes include:

“We divert 3,600 to 3,800 tonnes of recycled blue bag material and 4,000 tonnes of organics from landfills each year. Before 2000, everything went to a second generation landfill.”

“The funds received from RRFB are important, and we consider them partners in our waste management program delivery. Unlike some other jurisdictions in Canada, we support municipal program diversion programming. While it's not a lot of money, it is something that is positioned in budgets annually.”

“We have managed to decrease our overall waste generation by 50% over the past 10 years, and have been receiving Diversion Credits funding throughout that timeframe.”

Table 8 provides a summary of the program by region and year from 2008 – 2015. In total, tonnes diverted by year ranged between 302,000 and 361,000 over this period. Total funding was \$3.8 million to as high as \$6.5 million.

Table 8: Municipal Diversion Program Summary 2008-2015

| Year | Total Funding (\$) | Total Diversion (t) | Functional unit | Cape Breton | Antigonish/Pictou | Northern | HRM | Valley | South Shore | Western |
|------|--------------------|---------------------|-----------------|-------------|-------------------|----------|---------|--------|-------------|---------|
| 2008 | \$6,455,000 | 302,477 | t | 35,363 | 22,851 | 23,073 | 160,890 | 21,587 | 24,796 | 13,917 |
| 2009 | \$5,235,000 | 315,968 | t | 32,847 | 23,124 | 26,721 | 168,425 | 24,282 | 26,088 | 14,481 |
| 2010 | \$4,183,000 | 332,141 | t | 38,040 | 24,250 | 27,752 | 174,888 | 25,786 | 26,376 | 15,049 |
| 2011 | \$4,908,238 | 334,188 | t | 34,783 | 24,640 | 24,821 | 180,425 | 26,760 | 27,477 | 15,282 |
| 2012 | \$4,590,252 | 342,118 | t | 40,423 | 21,023 | 26,576 | 181,083 | 30,211 | 27,202 | 15,600 |
| 2013 | \$4,357,758 | 361,489 | t | 36,691 | 24,063 | 34,387 | 192,120 | 29,751 | 28,780 | 15,697 |
| 2014 | \$3,857,440 | 354,369 | t | 31,828 | 26,320 | 33,735 | 188,587 | 29,550 | 29,654 | 14,695 |
| 2015 | \$4,601,761 | 352,305 | t | 23,892 | 26,014 | 34,542 | 196,977 | 28,640 | 28,623 | 13,617 |

Source: RRFB Nova Scotia

4.2 ENFORCEMENT FUNDING

For the last six years, RRFB Nova Scotia has provided \$700,000 annually in regional funding for enforcement and compliance activities related to waste management regulations. The funding is split evenly between the seven waste management regions, resulting in \$100,000 per region. Depending on the structure of the individual region, enforcement funding covers between 60% to 100% of total enforcement spending. To better understand the impact associated with this funding we asked the various regional representatives how this funding has impacted programming in their areas.

Primary use of enforcement funding includes:

- Partial or full coverage of salary and expenditure of one or more enforcement officers
- Curbside auditing
- Monitoring at waste separation facilities
- Auditing at transfer stations
- Enforcement related to illegal dumping incidents
- Travel expenses.

Table 9 presents Enforcement Program Statistics on a regional basis for 2016. In total, it is reported that 15.5 full-time employees are dedicated to enforcement across the regions. A variety of enforcement activities take place ranging from residential site visits to illegal dump investigations to audits at receiving facilities.

Illegal dumpsite reports are followed up by investigation, with 952 in 2015/16. Almost 4,000 audits were conducted that triggered over 1,500 site visits. Overall, in excess of 3,500 warnings were issued with a small number of tickets issued or court actions taken.

Over 1,400 complaints were resolved without penalty.

Table 9: RRFB Nova Scotia Regional Enforcement Program Statistics for 2015 / 16

| | Functional Unit | Cape Breton | Antigonish | Pictou | Northern | HRM | Valley | South Shore | Western | Total |
|--|-----------------|-------------|------------|--------|----------|---------|--------|-------------|---------|---------|
| Population of Region | # | 133,209 | 72,931 | | 105,945 | 414,370 | 83,156 | 90,751 | 42,306 | 942,668 |
| Full-time Enforcement Employees | # | 1 | 1 | 1 | 3 | 1 | 3 | 4 | 2 | 15.5 |
| Ccomplaints/calls requiring documentation and/or follow-up | # | 294 | 79 | 31 | 261 | 178 | 361 | 1,497 | 329 | 3,030 |
| Illegal dump sites reported | # | 294 | 43 | 109 | 68 | 41 | 153 | 197 | 120 | 1,025 |
| Illegal dump sites investigated | # | 235 | 43 | 116 | 73 | 15 | 153 | 197 | 120 | 952 |
| Proactive residential and/or business site visits | # | 0 | 35 | 616 | 1,036 | 1,305 | 14,100 | 4,633 | 4 | 21,729 |
| Waste management/receiving facility inspections/audits | # | 9 | 138 | 2,560 | 512 | 0 | 238 | 337 | 24 | 3,818 |
| Reactive residential and/or business site visits triggered | # | 0 | 16 | 15 | 166 | 0 | 76 | 923 | 367 | 1,563 |
| Warnings issued | # | 54 | 105 | 53 | 67 | 365 | 2,666 | 139 | 134 | 3,583 |
| Administrative (Bylaw) tickets issued | # | 0 | 0 | 11 | 0 | 0 | 68 | 14 | 0 | 93 |
| Summary of Offence Tickets Issued | # | 1 | 0 | 0 | 1 | 0 | 14 | 2 | 0 | 18 |
| Complaints resolved without penalty | # | 240 | 19 | 0 | 234 | 406 | 253 | 133 | 134 | 1,419 |
| Cased brought before the courts | # | 0 | 0 | 0 | 1 | 0 | 1 | 8 | 0 | 10 |
| Convictions | # | 0 | 0 | 0 | 1 | 0 | 2 | 4 | 0 | 7 |

Source: RRFB Nova Scotia

4.2.1 Economic Impacts

The full analysis of economic impacts associated with the enforcement funding is included in the previous section where direct and spin-off impacts are documented for the province as a whole. Each region did note that one to two enforcement officers or employees are paid with RRFB Nova Scotia funding. Overall, improved compliance is prolonging the life of various landfill facilities.

4.2.2 Environmental Impacts

Regional representatives did elaborate on several general themes related to environmental impacts that can be attributed to enforcement activity. There has been improved compliance with what materials are separated and put at curbside. Regular delinquents have been identified and associated issues resolved. Also, illegal dumping incidents are investigated with remedial measures taken. There has been a reduction in site-specific littering. Enforcement officers have also collected data on bag contents that, in turn, is used to inform education programming as described later. Table 8 reports enforcement program statistics for the year ending March 31, 2016.

A number of specific observations made by the various regional representatives also merit highlighting the impacts associated with enforcement activities.

“Enforcement is the best value for our money. As of 2015, they are able to fund a full-time enforcement position.”

“Curbside audits in the spring and fall, with a noticeable reduction in contamination and increased adoption of curbside sorting.”

“More individual audits and follow-ups are possible with non-compliant businesses or households. These audits are having an impact.”

“We simply wouldn't have an enforcement position without RRFB funding.”

“There are over 44,000 businesses in HRM, but having a specific enforcement officer fully funded by RRFB funding allows our by-law officer to do targeted visits. Have been focusing on industrial parks, and are seeing compliance increase tremendously.”

“If RRFB funding was not there to support education and enforcement, many municipalities in Nova Scotia would not be able to carry them out on their own. Healthcare, education, and policing are all municipal budget line items that take precedence over waste management and diversion. Many municipalities would be forced to give up on education and enforcement without RRFB funding.”

“The enforcement officer position has only existed in the region for 5 to 6 years, and only began when RRFB started contributing enforcement funding. Before this, there was no enforcement officer. Our enforcement officer helps us solve issues upstream before we even start rejecting and returning loads back, which makes the system much more efficient.”

4.3 EDUCATION FUNDING

RRFB Nova Scotia works closely with its partners province wide to encourage Nova Scotians to better manage waste. Most recently in 2015/16, \$635,000 in funding was provided to the seven solid waste management regions. This funding supports the sharing of knowledge and advice with various segments of the community and general public. To better understand the impact associated with this funding we asked the various regional representatives how this funding has impacted programming in their areas.

The use of funding ranged from employing full time waste reduction educators to supporting the delivery of educational initiatives and programs. The duties of waste reduction educators were found to be diverse and could include any of the following functions:

- Educational visits at businesses, public events, and schools
- Curbside monitoring to measure participation and compliance rates for recycling and composting programs
- School education sessions integrated with provincial curricula
- Specific programming targeted at multi-unit residential buildings.

Table 10 shows Regional Education Contract activities that took place in 2015/16 on a region-by-region basis. In total, there were 2,517 visits that took place reaching 94,000 people. The total funding of \$635,000 supported 9,190 hours of dedicated education programming.

Table 10: Regional Education Contract Activity 2015-16

| | Functional Unit | Cape Breton | Antigonish / Guysborough | Pictou | Northern | HRM | Valley | South Shore | Western | Total |
|----------------|-----------------|-------------|--------------------------|--------|----------|---------|--------|-------------|---------|---------|
| Hours | # | 1,255 | 280 | 443 | 1,086 | 3,906 | 887 | 919 | 414 | 9,190 |
| Visits | # | 304 | 81 | 370 | 322 | 736 | 366 | 259 | 79 | 2517 |
| People Reached | # | 10,101 | 5,082 | 13,213 | 16,296 | 34,097 | 4,235 | 7,641 | 3713 | 94,378 |
| Funding | \$ | 90,797 | 21,634 | 32,624 | 73,890 | 255,457 | 60,023 | 64,979 | 35,596 | 635,000 |

Source: RRFB Nova Scotia

4.3.1 Economic Impacts of Regional Education Funding

With RRFB Nova Scotia regional education funding the regions all reported they are able to employ full time education staff. They also noted that without the funding there would not likely be any dedicated waste diversion education taking place in over 50% of the regions contacted.

4.3.2 Environmental Impacts of Regional Education Funding

With the dedicated full-time staff, educators target business, resident and school audiences. This permits a full suite of approaches to be taken informing the greatest number possible on the requirements and benefits associated with waste diversion. Representatives point out the importance of reaching school children as a means to influence all members of a household to improve recycling and composting practices. They do note the belief that this has impacted green bin separation with less plastics being included. Several comments were also offered related to the theme of influencing the future generation.

Another interesting observation related to the role of funding was in promoting partnerships across a region to develop enhanced approaches that improve compliance following the various by-laws and regulations.

Several general comments were provided that related to how the funding provided the necessary resources to undertake educational programs that targeted specific issues and resulted in improved waste management within various municipalities.

One specific comment illustrates the value of the RRFB Nova Scotia funding for education programming purposes:

“Without education and ongoing efforts, we would have never accomplished what we’ve accomplished so far. It’s very difficult to change behaviour, especially in a rural throw it away mentality.”

5. IMPACT OF LITTER ABATEMENT

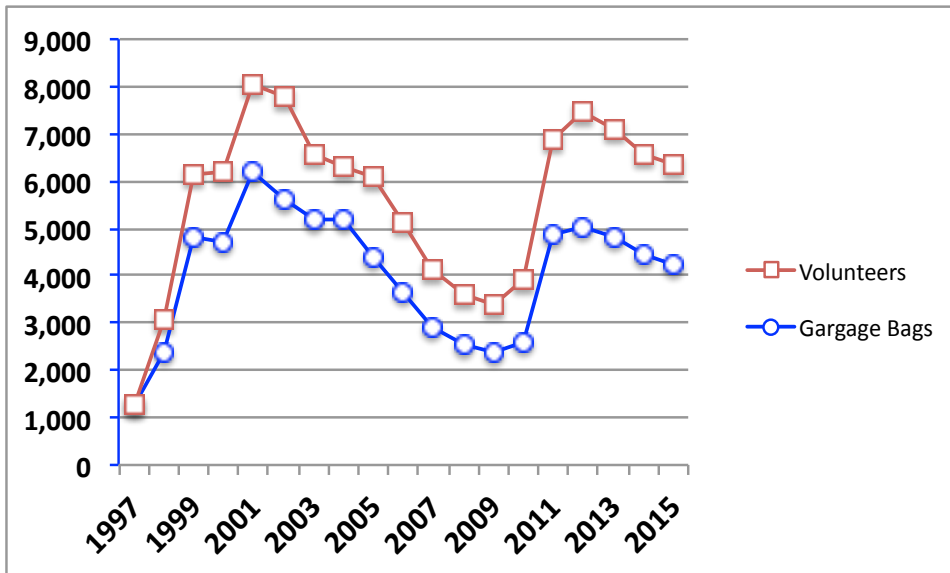
RRFB Nova Scotia provides annual funding to support two province-wide litter abatement programs. Adopt-A-Highway and the Great Nova Scotia Pick-Me-Up, delivered by Clean Foundation, receive the funding.

Adopt-A-Highway

RRFB Nova Scotia has been funding the Adopt-A-Highway program since 1997, and has dedicated an average of \$25,000 per year to the program, for a total of \$467,000. Since 1997, the Adopt-A-Highway program has covered or “adopted” over 12,000 km of highway, collecting over 70,000 bags of garbage and 4,200 bags of recyclables.

An average of 1,700 individual volunteers involved in over 125 groups have assisted with the program per year. This has resulted in over 90,000 hours of time spent removing garbage from highway roadsides for proper disposal or recycling. Figure 6 depicts the number of volunteers and bags of garbage collected over 1997 – 2015.

Figure 6: Adopt-A-Highway, Number of Volunteers and total Garbage Bags Collected, 1997-2015



Source: RRFB Nova Scotia

Clean Foundation

RRFB Nova Scotia has funded the Clean Foundation for waste reduction programming since 1996. RRFB Nova Scotia has funded the Great Nova Scotia Pick-Me-Up with Clean Foundation since 2006. The program is the largest volunteer-based community waste clean-up program of its kind in Nova Scotia. Since 2006, the Great Nova Scotia Pick-Me-Up program has collected over 35,400 bags of garbage and recyclables. The removal of litter has a multiplier effect, since individuals are more likely to litter in areas where there is already garbage on the ground. Over 300 individual pick-up events have occurred each year, with about 19,000 participants per year, resulting in over 3,200 events since 2006.

In addition to the Great Nova Scotia Pick-Me-Up, RRFB Nova Scotia's funding to Clean Foundation has supported the Ship to Shore program since 2008. This program involves delivering educational programming to fishermen, as well as distributing garbage bins for boats to encourage proper disposal of waste while at sea. So far, over 75 bins have been delivered to fishing boats and over 400 fishermen have been directly engaged at over 130 harbours across the province.

Clean Foundation also receives funding for Eddie's Litterless Road Tour. An educator brings Eddie the Puppet to elementary schools throughout the province to educate youth on the importance of recycling, energy conservation, and avoiding littering. Since the program started in 2009, the program has been delivered at 388 schools through 595 presentations to over 33,000 students.

6. IMPACTS OF PROMOTION OF VALUE-ADDED MANUFACTURING AND RESEARCH AND DEVELOPMENT

RRFB Nova Scotia provides funding to support research and development and commercial projects for new products, processes, equipment technologies and market opportunities that can, in turn, lead to increased solid waste diversion.

To assess the economic and environmental benefits associated with this program a number of case studies have been undertaken. The findings associated with each are summarized below.

6.1 RESEARCH AND DEVELOPMENT PROJECTS

RRFB Nova Scotia's Research and Development Program is designed to encourage the development of innovative products or process improvements related to solid waste diversion. Funding support enables researchers to investigate design and develop the following:

- Materials or products that incorporate solid waste resources.
- Technologies that facilitate separation and recovery.
- Identify or develop market opportunities for solid waste resources and/or recycled materials.

Priorities for funding are placed on projects that could lead to significant diversion. The following case study illustrates the types of projects funded and their associated impacts.

6.1.1 Economic and Environmental Impacts of Agricultural Waste Characterization & Recycling Options Study

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| Prepared for RRFB by: | Waste Management Consulting Services, London, ON; on behalf of CleanFARMS, Etobicoke, ON |
| Contacts: | Barry Friesen, <i>General Manager, CleanFARMS</i> |
| Total project cost: | \$30,000 |
| Funding provided by RRFB: | \$10,000 (33.33%) |
| Date of project report: | August, 2012 |
| Use of funds: | The funding provided by RRFB Nova Scotia was used to cover a portion of the costs for a study to determine the amount of agricultural plastics used in the Maritimes. |

Summary

A significant amount of plastics are used on farms in the Maritimes for plastic packaging for farm inputs, including bale and silage wraps, feed and fertilizer bags, agrichemical containers, and plant pots and trays. Other plastics include packaging for products leaving the farm to market, such as produce packaging, and plant pots and trays. This study and report conducted by Waste Management Consulting Services on behalf of CleanFARMS involved developing a waste characterization of agricultural plastics in the Maritimes through research, data collection, and interviews. The study broke down agricultural plastics as inputs and outputs.

CleanFARMS was launched in 2010, and focuses on non-organic agricultural waste. CleanFARMS commissioned a series of waste characterization studies for almost every province in Canada to determine what waste volumes and varieties of waste existed in the agricultural industry in order to best address diversion and management. This study was similar to other provincial waste characterization studies they did across Canada.

6.1.1 Economic and Environmental Impacts of Agricultural Waste Characterization & Recycling Options Study

Key findings & impacts

- Instrumental for CleanFARMS to determine what plastic waste varieties and volumes exist on farms in the Maritimes in order to expand their recycling programming.
- CleanFARMS is now removing more products from the environment that were previously burned or buried on farms.
- 2,124 tonnes of plastic wastes are generated on Maritime farms each year from farm input packaging.
 - 70% of the waste is low-density polyethylene (LDPE) plastic film, used primarily for bale wrapping and silage wrap.
 - 23% of waste is polypropylene (PP), used primarily for woven bags and twine.
 - High-density polyethylene (HDPE) and polystyrene (PS) make up 6% and 1% respectively.
- 1,277 tonnes of plastic packaging wastes are generated by packaging materials used to bring farm output products to the marketplace.
 - 68% of the waste is in the form of LDPE plastic film, used primarily for plastic bags.
 - PS, PP, polyethylene terephthalate (PET), and HDPE make up 16%, 9%, 4%, and 3% respectively.
- Nova Scotia, New Brunswick, and PEI produce roughly equal amounts of agricultural plastic inputs and outputs annually.
- CleanFARMS works with Island Waste Management Corporation in Prince Edward Island to divert bale wrapping and silage wrap from landfills. CleanFARMS does the marketing while the cost of diversion and repurposing is covered by the PEI tax base. CleanFARMS is actively working to implement similar programs in New Brunswick and Nova Scotia.
- Next steps:
 - CleanFARMS expanded their seed bag and pesticide bag collection program to include the Maritimes region. After the study in 2012, they started experimenting with a pilot project to co-collect pesticide bags with seed bags in the Maritimes. A full-scale program was launched in 2016.
 - CleanFARMS' pesticide container reclamation program was expanded to include fertilizer container reclamation in 2013. Containers are collected and washed then turned into farm drainage tile and weeping pipes.
 - The largest sources of plastics still need to be addressed. The government of Nova Scotia is investigating an Extended Producer Responsibility program for packaging that would make industry responsible for their products at the end of life.

6.1.2 Economic and Environmental Impacts of Waste Wallboard and Wood Fiber for Use as an Alternative Dairy Bedding Material Study

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| Prepared for RRFB by: | LP Consulting |
| Funding stream: | Research & Development |
| Contact: | Lise LeBlanc, LP Consulting |
| Total project cost: | \$268,000 |
| Funding provided by RRFB: | \$136,650 (51%) |
| Date of project report: | September, 2013 |
| Use of funds: | The funding provided by RRFB Nova Scotia was used to cover a portion of the costs for LP Consulting to analyse the potential of using waste wallboard and waste wood fiber as a bedding material for dairy cows in the Maritimes. |

Summary

When the study was commissioned in 2012, the majority of dairy farms in Nova Scotia used straw and wood residues such as sawdust and wood shavings for cow bedding material. Wood residues had been growing increasingly more expensive in Nova Scotia, while waste wallboard and waste wood fiber were considered difficult to divert from landfills. RRFB Nova Scotia provided just over 50% of the costs associated with a study by LP Consulting to analyze the potential of utilizing waste wallboard and wood fiber in the manufacture of a cow bedding alternative for the dairy industry.

Key findings & impacts

- Dairy cow bedding manufactured from 75% waste wood fiber and 25% waste wallboard is a feasible alternative to traditional straw and wood residue bedding.
- The alternative dairy bedding is actually more absorbent than traditional bedding, which restricts bacterial growth and absorbs more animal waste.
 - Studies also demonstrated that significantly fewer bacteria grew on the alternative bedding than traditional bedding, which reduces the chance of dairy cow teat infection.
- The spent alternative dairy bedding can provide sulfur (6%), calcium (10%), and organic matter (30%) when used as a soil amendment for farms.
- Waste wallboard and wood fiber bedding is more economical than traditional bedding.
 - At the time of the study, waste wallboard cost 20% less than sawdust and 30% less than kiln-dried wood shavings.
- LP Consulting has worked with Halifax C&D Recycling to commercialize the findings of the study.
 - Upon completion of the study, LP Consulting immediately started a joint venture with Halifax C&D Recycling to start processing, marketing, and selling alternative dairy bedding.
- Old waste wood and wallboard is cleaned and sorted at a facility in Goodwood.
- Halifax C&D Recycling built a new grinding facility in Milford, where waste product is further ground and the final product is created.
- Sales have been steadily increasing since 2012. Halifax C&D now ships 6 to 12 loads of dairy bedding to farms throughout Nova Scotia and New Brunswick per week, and reaches over 40 farms.
 - This equates to 138 to 276 tonnes of dry product diverted from landfill every week.
 - Sales are increasing, and they are also pre-sold for the next year.
- The operations of two Halifax C & D Processing facilities employ 7 full-time individuals.
 - Two individuals are directly involved in processing, as well as a truck driver to haul to and from the processing plant.
 - After sorting and processing, another driver brings the sorted and processed waste wallboard to the cow bedding plant in Milford for further processing, where two full time processors work.
 - Another driver exclusively hauls the finished product to farms.
- LP Consulting has a full-time agrologist who spends 50% of their time managing this program.

6.1.3 Economic and Environmental Impacts of Bioremediation / Composting of Coated Wood and Manufactured C&D Wood Waste Study

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| Contacts: | <i>Paul Arnold, Acadia University</i> |
| Funding stream: | Research & Development |
| Total project cost: | \$127,400 |
| Funding provided by RRFB: | \$66,200 (~52%) |
| Date of project report: | July 2016 |
| Use of funds: | The funding provided by RRFB Nova Scotia was used to cover a portion of the costs for two research projects to explore the bioremediation and composting of 1) painted manufactured and coated wood (MCW) products and 2) other assorted construction and demolition (C&D) products. |

Summary

In 2007, 175,000 tonnes of C&D material was generated in Nova Scotia, and 50% of that material was clean wood, pressure treated wood, creosote timbers, laminate wood, and painted MCW. At the time of the funding proposal in 2011, Envirem Organics was composting wood waste at their 50,000 tonne/year composting facility, then the largest in the province. Envirem Organics sought to expand its composting capacity by exploring other C&D materials that could be composted and diverted from landfill.

Dr. Paul Arnold of Acadia University was commissioned to perform studies to determine whether C&D materials such as pressure treated wood, plywood, hardboard, as well as painted MCW, could be composted safely. His ongoing research is nearing completion, and is examining whether persistent chemicals and polymers found in C&D waste and painted MCW can degrade to sufficient levels through standardized composting practices.

Key impacts

- The project is near completion and so far, tests have shown positive results.
- Several products such as oriented strand board wood, hardboard, melamine, and corkboard have proven that they can be broken down and then composted safely without generating unacceptable levels of polymers or chemicals.
 - A particularly interesting finding is that formaldehyde appears to be oxidized and, therefore, removed due to the high temperatures generated during composting. Formaldehyde is viewed as one of the more noxious chemicals in C&D waste and its removal through composting ensures that it doesn't enter the environment.
- Tests have also been conducted on painted MCW products. Most painted MCW products have proven that they can be broken down and then composted safely.
 - Even lead painted MCW products are generating compost product with acceptable lead levels (lead painted MCW products are becoming increasingly rare over time, which will further decrease this issue).
- Dr. Paul Arnold worked with a graduate student based at McGill for some of the research, particularly in examining polymer levels in compost. The student is now based at the University of Alberta and is actively working with Dr. Arnold to study polymer levels in the composting samples he is generating.
 - New and novel techniques and protocols were developed for picking up signatures of specific chemicals and polymers found in manufactured woods.
 - This may lead to a peer-reviewed published paper that will inform the scientific community and further improve compost waste diversion programs.
- Next steps:
 - More trials will be performed to increase the sample size and validity and confidence of findings.

6.1.3 Economic and Environmental Impacts of Bioremediation / Composting of Coated Wood and Manufactured C&D Wood Waste Study

- A comprehensive report will be generated to summarize findings. The results and report will go to RRFB Nova Scotia and Nova Scotia Environment to inform policy development.
- Currently, painted MCW is disposed of at C&D sites / landfilled. Composting this product will avoid unnecessary landfilling.
- A possible increase in the availability of wood for composting facilities through this project would help composting facilities. Wood waste is a necessary input for composting facilities, but because of competition and increasing prices for waste wood in Nova Scotia, it is becoming harder to secure. The outcome of this project could help alleviate the supply concern by providing an alternative source of carbon and dry matter.
- Waste wood and coated wood could become an important feedstock for composting facilities while reducing the amount of waste that is landfilled in Nova Scotia.

6.2 STUDENT RESEARCH GRANTS PROJECT

RRFB Nova Scotia provides student research grants related to solid waste diversion. The idea is to make use of the knowledge and capacity of universities in Nova Scotia. The program is intended to support student research projects that have the potential to provide a commercial benefit to businesses or municipalities, ultimately leading to increased diversion of materials.

The following case study illustrates an example of a student project and its resulting impacts.

6.2.1 Economic and Environmental Impact of Recommendations for the Collection and Recycling of Spent Residential Compact Fluorescent Bulbs in Nova Scotia Project Report

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| Prepared for RRFB by: | Clean Foundation, Dartmouth, NS |
| Contacts: | Madeleine Crowell, <i>Research Analyst</i> ; Charlyne Robertson, current <i>Waste Program Coordinator</i> ; Ashley David, former <i>Waste Program Coordinator</i> |
| Total project cost: | \$10,300 |
| Funding provided by RRFB: | \$7,810 (68%) |
| Date of project report: | September, 2014 |
| Use of funds: | The funding provided by RRFB Nova Scotia was used to subsidize the costs to undertake and administer the research project, including a student stipend, the use of infrastructure, computers, and internal human resources. |

Summary

The use of compact fluorescent lightbulbs (CFLs) has been steadily increasing in Nova Scotia since the implementation of the federal ban on the sale of incandescent lightbulbs. CFL bulbs contain a small amount of mercury, and as such their diversion from landfills prevents mercury pollution.

This research project examined best practices for recycling CFLs in British Columbia and Quebec, among other regions. At the time of the report, Nova Scotia did not have a government-mandated recycling program for bulbs and lamps containing mercury. The project report's major suggestions included the need for a province-wide CFL bulb recycling program, as well as the

6.2.1 Economic and Environmental Impact of Recommendations for the Collection and Recycling of Spent Residential Compact Fluorescent Bulbs in Nova Scotia Project Report

need to include Extended Producer Responsibility for recycling and mercury diversion programs under the *Solid Waste-Resource Management Regulations* of the *Nova Scotia Environment Act*.

Key impacts

Since completion of the project report in September 2014, the following key impacts have been noted:

- The report and associated presentations by Clean Foundation have informed the socioeconomic and environmental importance of mercury recycling.
- The policy potential of the findings was presented to Nova Scotia Power and the Government of Nova Scotia, recommending the company and Province include “Mercury Diversion Standards” as part of the 2014 amendments to the *Air Quality Regulations* under the *Nova Scotia Environment Act*.
 - Clause 2(fb) added: O.I.C. 2014-469, N.S. Reg. 179/2014
- The report has been widely circulated among government, business, and other organizations seeking to assist with the creation of a mercury diversion program.
- Clean Foundation submitted a proposal to Nova Scotia Power to administer a CFL diversion project. Although it was not the successful proposal, Nova Scotia Power has since introduced a Mercury Recovery Program in Nova Scotia. Scout Environmental has partnered with EfficiencyOne Services to administer and deliver the *Nova Scotia Mercury Collection Program*, active as of February 2016, on behalf of Nova Scotia Power and the Government of Nova Scotia.
 - One of the primary product streams addressed by this program is residential lighting, particularly CFLs and fluorescent lamps, which will be collected and properly recycled.
- Through Scout Environmental and Efficiency One Services, CFLs and fluorescent lamps can be dropped off at a variety of participating retail outlets across Nova Scotia.
- Over two million CFLs are currently in use in Nova Scotia.
 - It is estimated that over 350,000 CFLs reach their end of life and become available for collection and recycling in Nova Scotia each year, and that number will continue to increase for the next few years.
 - An average CFL contains approximately four milligrams of mercury; therefore, diverting 350,000 CFLs from landfills each year is equivalent to diverting approximately 1.4 kilograms of mercury every year.

6.3 VALUE-ADDED MANUFACTURING

Through the Value-Added Manufacturing (VAM) Program, RRFB Nova Scotia provides funding for projects designed to commercialize new technology products or services. The program can include:

- Development of new products from solid waste resources
- Development of new waste resources processes and handling technologies
- Development of new markets for waste resources.

The following case study is a good example of a project funded under this program. It is important to note that our final section also summarizes two additional VAM projects that connect to earlier R&D projects.

6.3.1 Economic and Environmental Impacts of Resource Renovators' Lighting Studio and Radiator Business Program

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| Contacts: | Alison Philbey, <i>Manager, Resource Renovators Inc.</i> |
| Total project cost: | \$42,000 |
| Funding provided by RRFB: | \$20,900 (~50.00%) |
| Date of Approval: | February, 2012 |
| Use of funds: | The funding provided by RRFB Nova Scotia was used to cover a portion of the costs for two initiatives to be explored by Resource Renovators Inc. (RRI): 1) Lighting studio for refurbishing old light fixtures for resale, and 2) equipment to expand their radiator recycling business. It was issued as a five-year forgivable loan under the condition that RRI sell 550 refurbished light fixtures and 510 refurbished radiators over the duration of the loan. |

Summary

RRI is a small business started in 1994 that diverts salvaged building materials away from landfill through dismantling, reusing, repurposing, and refurbishing products. These salvaged products are then sold at their warehouse outlet in Halifax. The business gathers materials from various regions in the Maritimes. RRI was exploring two new business opportunities for expansion and requested funding from RRFB Nova Scotia to move ahead with implementation.

RRFB Nova Scotia provided 50% of funding for a lighting studio and radiator business. The lighting studio was created to salvage old lighting fixtures through refurbishment and replacement of old parts, allowing them to be sold, and therefore, diverted from landfill. The radiator business expansion involved purchasing a sandblaster and pressure testing equipment to avoid the costly outsourcing of these services to contractors. This allowed them to divert more radiators from landfill.

Both business expansion opportunities allowed for an increase in landfill diversion, combined with a considerable increase in value for repurposing light fixtures and radiators.

Key impacts

- Sales in both areas have continued to be strong. Sales have continued to grow every month since the start of the two business expansions.
- The criteria for loan forgiveness was met and exceeded.
- Every item sold in RRI is one more kilogram saved from the landfill. The niche items of refurbished light fixtures and radiators have drawn more customers into their store, which has increased their overall sales as a result.
- The new business expansion has allowed RRI to increase a part-time position to a full-time position, and they now also require a part-time individual to refurbish some lights on an as-needed basis.

6.4 RESEARCH AND DEVELOPMENT FOLLOWED BY VAM

With any comprehensive research and development program the ultimate objective is to commercialize the research outcome. RRFB Nova Scotia business development funding program demonstrates success in this regard. The following two project case studies illustrate this project cycle, as both are two-phase projects. The initial phase relates to the basic research and the second phase advances the concept as a value-added project for commercialization purposes.

6.4.1 Economic and Environmental Impact of Seafood Waste to Bio-products Assessment, Phase One and Two Project Report

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| Prepared for RRFB by: | Verschuren Centre, on behalf of Louisbourg Seafoods Ltd., Louisbourg, NS |
| Contacts: | Adam Mugridge, <i>Manager, Louisbourg Seafoods</i> |
| Phase One: | |
| Total project cost | \$31,000 |
| Funding provided by RRFB: | \$18,000 (58%) |
| Funding stream: | Research and Development |
| Date of project report: | July, 2014 |
| Use of funds: | The funding provided by RRFB Nova Scotia was used to cover a portion of the costs to research and analyses the market potential of seafood processing waste from Northern shrimp for the production of value-added bio-products. |
| Phase Two | |
| Total project cost: | \$263,500 |
| Funding provided by RRFB: | \$72,500 (27.5%) |
| Funding stream: | Value-Added Manufacturing |
| Date of funding memo: | February, 2015 |
| Use of funds: | RRFB Nova Scotia provided a \$72,500 VAM investment (50% of the Drum Dryer, and 27.5% of total project cost) in the form of a \$36,250 zero-interest repayable loan and a \$36,250 conditionally forgivable loan (Louisbourg Seafood's Northsyde Processing must divert 400 tonnes of shell waste a year for five years). |

Summary

The use of seafood processing waste as a feedstock for bio-products can reduce waste and waste disposal costs while creating a new market opportunity for the processing plant. For Phase 1 of Louisbourg Seafoods' work with RRFB Nova Scotia, a study and report was conducted by the Verschuren Centre to examine the feasibility and market potential of using seafood processing waste from Louisbourg Seafoods' Northsyde Processing Limited shrimp processing plant to create value-added bioproducts such as oil and fish meal protein supplements, and chitin and chitin derivatives, among others. This research and analysis component involved a literature review and comparative economic assessment of relevant technologies and market opportunities, which resulted in a suggestion of the best market option to guide an initial business model.

The primary recommendation from the report was for Louisbourg Seafoods to invest in further research and development for the creation of bio-products from processing waste and to explore initiating a pilot project to start the commercialization process at their Northsyde Processing Limited shrimp processing plant.

Phase 2 involved Louisbourg Seafoods moving from research to implementation. Louisbourg Seafoods is working with RRFB Nova Scotia through their Value-added Manufacturing stream to capitalize on shrimp waste as a valuable by-product. Louisbourg Seafoods will construct and operate shrimp shell drying equipment at their Northsyde Processing Limited shrimp processing

6.4.1 Economic and Environmental Impact of Seafood Waste to Bio-products Assessment, Phase One and Two Project Report

plant in North Sydney, Nova Scotia.

Through follow-up research to Phase 1, Louisbourg Seafoods determined that several markets exist for chitin and chitosan derivative supplements. One such market opportunity, Iceland's Primex, expressed interest in purchasing all of their solid shellfish waste if it could be properly separated and dehydrated, to be used to create chitosan-based dietary supplements.

Louisbourg Seafoods submitted an application to RRFB Nova Scotia's Valued-Added Manufacturing funding stream to assist with the production of a shell drying operation.

Key impacts of Phase 1

- Four value-added market options were explored, and it was determined that the market demand for dairy cow feedstock inputs was the most applicable.
- The demand for dairy cow feed supplements such as oil and protein inputs in Nova Scotia is in the range of 18,000 tonnes per year, with a market value of over \$9 million.
- In 2014, Louisbourg Seafoods produced shrimp processing wastes equivalent to 78 tonnes of fish oil, 312 tonnes of chitin and chitin derivatives, and 420 tonnes of protein supplement per year. Collectively, they would have a market value of over \$686,000.
- The net benefit associated with producing these value-added dairy cow supplements from processing waste was just under \$125,000 per year, and would take just over six years to pay back the capital cost associated with the required additional labour and equipment.
- Instrumental in informing a follow-up study, which was independently commissioned through the Verschuren Centre at Cape Breton University.
- The follow-up study further examined the feasibility of using shrimp processing waste as feedstock for bio-products, and identified existing barriers to production. The report was issued in January 2016.
- The Phase Two study determined that much of the extractable value-added product from waste was in liquid waste form, making the process much more difficult.
- The manager expressed that a clean tech solution to waste water will be explored through this phase, since much of the extractable protein, fish oil, and chitin from the shrimp is in liquid form. Implementation will begin later in 2016.
- Three individuals at Louisbourg Seafoods are actively engaged in ongoing studies into potential solutions to maximize the value of shrimp processing waste while reducing disposal levels, as well as the research team at the Verschuren Centre. Plant engineers and production workers are also involved in strategic sessions at the plant level.
- Louisbourg Seafoods has also launched an innovations competition called *Sea Plus Plus*, encouraging individuals to come up with technological solutions to issues facing the fishing and processing industry. One of the focus areas is clean technology to treat processing waste.

Key impacts of Phase 2

- RRFB Nova Scotia provided \$72,500, or 27.5% of the funds associated with financing a shell drying operation at Louisbourg Seafood's Northsyde Processing Limited shrimp processing facility.
- The funding will cover 50% of the cost associated with purchasing a drum dryer.
- An additional four employees will be required to operate the shell drying operation.
- The shell drying operation has the possibility of diverting 400 tonnes of shrimp shell waste per year from landfill, and 50% of the funding provided by RRFB Nova Scotia is conditionally forgivable only if that 400 tonne mark is met for a period of five years.