Case Study on Mobile EPS Processing Pilot (#1086)

December 2021

Second Wind Recycling

Abstract

EPS (Expanded Polystyrene) has traditionally been a costly, problematic material to recycle due to its light weight and bulky volume. This makes it expensive to transport. Additionally, EPS breaks apart easily during collection and processing, resulting in very low yields and cross contamination in curbside and other collection programs. EPS also requires extensive sortation which drives processing costs up to a very high level.

A mobile EPS densifier has the potential to minimize some issues that have kept some municipalities from adding this material to their program. To that end, this pilot evaluated the use of a mobile unit that travelled from depot to depot in the southwest Ontario corridor to a) manually control the quality of collected EPS to meet end market specifications and b) reduce hauling costs through densification into blocks prior to transport to the end market.

About Second Wind Recycling

This project was undertaken by Second Wind Recycling (SWR). Based out of St. Thomas, SWR launched operations in 2019 as a mobile EPS densification and hauling service for municipal and IC&I clients in Southwestern Ontario. SWR company currently serves 17 municipalities and a growing portfolio of industrial and commercial clients. For municipal clients, EPS is collected from the public, at depots, transfer stations and landfills.

SWR's innovative approach strives to eliminate diversion barriers with the goal of making EPS recycling both environmentally and economically attractive to recycle. The company's mobile service travels to collection sites where it reduces the bulky material by fifty times its weight. SWR then delivers it to end markets to be incorporated into new durable products.

Currently, only clean, white, product packaging EPS is accepted.

https://www.secondwindrecycling.com/

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1 Background

There are several reasons Expanded Polystyrene (EPS) isn't easily recycled:

- It is bulky and light, containing 98% air (European Manufactures of Expanded Polystyrene; https://eumeps.org/what-is-airpop). Unless it is pre-processed, moving the material to distant recycling facilities is very expensive given that only about 800-1000 lbs. can fit in a 53' semi-trailer.
- The material is prone to breaking up into small pieces and individual beads so if it's put in a blue box or mixed at a MRF it can easily contaminate other materials.
- Dirt and other materials cling to it as a result of moisture and static electricity.
- While bailing can be used to compact the material it isn't without issues. Bailing can't be done in any bailer, bales are prone to flaking and are odd shaped and bailing only reduces the material to a small share of what a densification system can.

2 Project Goal

The goal of this pilot study was to investigate the benefits of a mobile densification service in reducing barriers to municipal EPS diversion for 'clean, dry & white packaging (e.g., no food or beverage takeout containers). To accomplish this, the project entailed an investigation of the following:

- Test the viability of the technology.
- Determine an optimal service territory for a mobile densification service.
- Examine volumes and quality control issues with a source separated, depot drop approach to post-consumer EPS collection.
- Identify a standard mass-volume metric for post-consumer EPS.

3 Project Partners & Households Served

The pilot project launched in December 2019 with four original participating municipalities:

- St. Thomas
- Tillsonburg
- Woodstock
- Oxford County

Additional municipalities were added in 2020 and 2021 and are listed in Table 1 and represented on Figure 1.

Table 1: Additional Municipalities Included in Study

Municipality	Date Added
Brant County (2 sites)	June 1, 2020
North Perth County	October 1, 2020
Brockton, Hanover, Kincardine, South Bruce and Arran Elderslie	December 1, 2020
Saugeen Shores and Northern Bruce Peninsula	January 1, 2021
The Town of Blue Mountains and Huron-Kinloss	June 1, 2021
Meaford	October 1, 2021
West Grey	November 1, 2021

Figure 1: Map of Depot and Landfill Service Sites

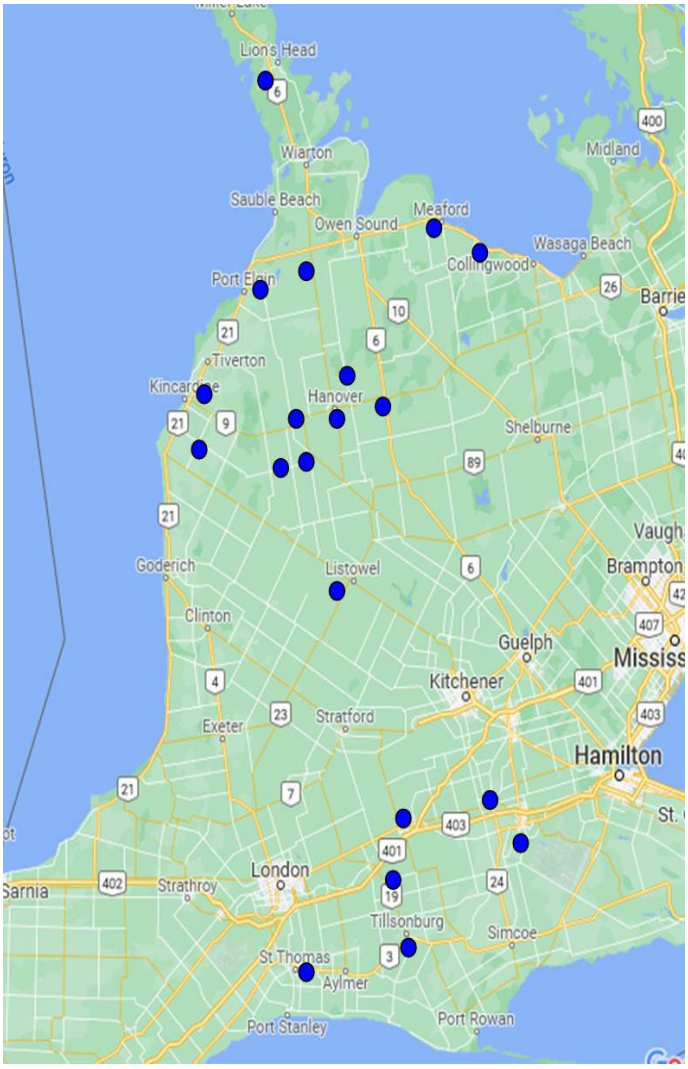


Table 2 lists household served/with access to EPS collection sites for the municipalities participating in this study.

Table 2: Households Served/With Access

Municipality	Households Served/With Access
St. Thomas and partnering municipalities with depot access: Malahide, Aylmer, Central Elgin, Southwold	29,019
Oxford County	20,095
Tillsonburg	7,020
Woodstock	17,151
Brant County	13,315
North Perth	5,098
Brockton	4,252
Hanover	3,404
South Bruce	2,381
Northern Bruce Peninsula	5,069
Arran-Elderslie	3,030
Kincardine	5,883
Saugeen Shores	7,655
Huron-Kinloss	4,037
The Blue Mountains	6,477
Meaford	5,590
West Grey	5,648
Total Households Served/With Access	145,124

Source: Statistics Canada Census Data, 2016

4 Collection

4.1 Service Intervals & Routing

To maximize route efficiency, site visits are typically conducted when a storage structure is approaching capacity. A typical run of three sites ranges from 50 to 100 cubic yards processed over the course of a nine hour day. A large single site processing session can process 80 to 100 cubic yards in six to eight hours.

The routing priority was to service each site prior to being at full capacity and to avoid stops to sites that have a large capacity remaining. However, nearby proximity and the time remaining in a day were also factors in routing decisions. For example, a service stop may be made even if a site has lots of remaining capacity, when it is on route and will fill the remaining time available that day.

The average service interval for participating municipalities ranged from one week to five months as shown in Table 3.

Table 3: : Site, Storage Structure and Average Service Interval

Site	Storage Structure	Average Service Interval
St. Thomas	20’ C-Can	1 Week
Oxford County	40’ C-Can	3 Weeks
Tillsonburg	20’ C-Can	1 Week
Woodstock	20’ Covered Bin	1 Week
Brant County- Paris	20’ C-Can	1 Month
Brant County- Biggars Lane	20’ C-Can	1 Month
North Perth	40’ C-Can	1 Month
Brockton	53’ Storage Trailer	1 Month
Hanover	2 x 53’ Storage Trailer	1 Month
South Bruce- Mildmay	53’ Storage Trailer	2 Months
South Bruce- Teaswater	53’ Storage Trailer	2 Months
Northern Bruce Peninsula (3 Collection sites, 1 service site)	Warehouse	5 Months
Arran-Elderslie	Warehouse	3 Months
Kincardine	53’ Storage Trailer	1 Month
Saugeen Shores	53’ Storage Trailer	1 Month
Huron-Kinloss	40’ C-Can	2 Months
The Blue Mountains	2 x 20’ Walk in Storage Bins	1 Month
Meaford	20’ C-Can	1 Month
West Grey- Bentinck	20’ Covered Bin	1 Month
West Grey- Durham	15’ C-Can	1 Month

Table 4 displays three examples of a typical run day including the distance traveled, fuel costs, the total amount of material processed and a breakdown of quantity of material processed at particular municipalities.

Table 4: Example Day Runs

	August 7, 2020	May 4, 2021	November 10, 2021
Distance	141 km	189 km	259km
Fuel cost	$50 Truck, $20 Generator	$60 Truck, $15 Generator	$85 Truck, $25 Generator
Yards Processed	71	48	73
Location(s)	St. Thomas (30 yards) Woodstock (22 yards) Salford (19 yards)	Paris (15 Yards) Woodstock (23 yards) Tillsonburg (10 yards)	Woodstock (36 yards) Paris (19 yards) Biggars Lane (18 Yards)

4.2 Collection Sites & Storage

The types of collections sites of partnering municipalities included:

- Landfills (with recycling areas): 15
- Transfer Stations/Recycling Depots: 6

Collection sites required a covered shelter for material to be stored prior to service visits. Participating municipalities used existing buildings, C-Can shipping container, or storage transport trailers. Table 3 in Section 4.1 displays the type of storage used by each municipality who participated in the study.

Landfill sites benefit from unintentional diversion of EPS when residents who intend to discard EPS can instead be directed by site staff to a drop off available on site.

4.3 Collection Methods

For the original four municipalities and also the next two additional sites, EPS was collected in 2-cubic yard gaylord boxes within a C-Can container. Boxes were placed along one side of the container, and extra boxes could be popped up if needed as shown in picture 1.

For the Woodstock site, collection was switched to a bag in a gaylord container in a supervised drop off area, as shown in picture 2. Full bags were moved to a covered storage bin.

The rest of the additional sites were set up with 2-cubic yard bags (gaylord liners) and hung on the wall near the front of the C-Can container or storage semi-trailer. Full bags were loose-tied and moved to the back for storage as shown in picture 3.

All but one of the partnering sites currently uses a bagging method.

Of note, the gaylord boxes wore out, were much more expensive than bags and were harder to handle when moving to the densifier. In contrast, bags had the advantage of being able to be stacked two-high in a container to fully utilize the storage space and reduce service visit frequency.

Picture 1: Two-cubic yard gaylord boxes, within a c-can container

Picture 2: Supervised drop-off area (bags in gaylords)

Picture 3: Bagged collection in C-Can, loose-tied full bags at back.

5 Material Volumes & Averages

Pictured below is a full 2-cubic yard box and bag with a block of densified output of the same weight. The reduction ratio is 50:1, highlighting one of the most significant diversion barriers the approach overcomes, resulting in reduced hauling costs of a material that in loose form is mostly air.

Full 2-cubic yard box with a block of densified output of the same weight

Bag with a block of densified output of the same weight

Table 5 shows a monthly breakdown of year one of the pilot of the study partners' diversion volume, rate and yards per household.

The Oxford County collection site was able to track the number of customers dropping off EPS on a monthly basis. In the original pilot year, a total of 1,119 individual drop-offs occurred. With a total of 489.75 cubic yards collected over the year (the collection was suspended for two months due to COVID), an average drop off volume was 0.44 yards of EPS.

Table 5: Pilot Year 1 Volume & Diversion - 6 Original Partners

2019-2020	Volume Diverted (Cubic Yards)	Diversion Rate*	Yards per 1,000 Households	Site/Location Added
December 19	86.5	4%	1.3	St.Thomas, Woodstock, Oxford County
January 20	131	5%	1.8	Tillsonburg Launched
February 20	100	4%	1.4	
March 20	90	3%	1.2	
April 20	49.5	5%	1.7	All sites suspended (COVID) except St. Thomas
May 20	79.25	3%	2.7	3 sites suspended Half Month
June 20	179	7%	2.1	
July 20	215.5	7%	2.5	Brant County launched
August 20	224.5	7%	2.6	
September 20	198	6%	2.3	
October 20	314	9%	5.2	North Perth launched
November 20	347	10%	9.3	
*Only open sites, based on 2 kg/household annual EPS generation average (Source: City of London Roadmap 2.0, The Road to Increased Resource Recovery and Zero Waste, 2013).				

After year one of the pilot, a number of one-time cleanouts of previously collected and stored EPS were conducted for new partners, prior to a new program being launched. This prevented an accurate diversion rate and yards per household metric.

Table 6 shows a monthly breakdown of year two of the pilot of the study partners' diversion volume.

Table 6*: *Pilot Year 2 Volume & Diversion - All Municipal Partners

2020-2021	Volume Diverted (Cubic Yards)	Site/Location Added
October-December 20 (previously collected cleanouts)	718	Hanover, Brockton, South Bruce, Kincardine, South Bruce Peninsula, Northern Bruce Peninsula
December 20	448	Six renewed partners, plus Hanover, Brockton, Kincardine, South Bruce, Arran-Elderslie
January 21	609	Saugeen Shores and Northern Bruce Peninsula launched
February 21	361	Tillsonburg suspended (COVID)
March 21	655.5	
April 21	645.5	Oxford County suspended (COVID)
May 21	727	Oxford County suspended (COVID)
June 21	682	Oxford County suspended; Town of Blue Mountains and Huron-Kinloss launched
July 21	952	
August 21	749.5	
September 21	755.5	
October 21	701	Meaford Launched
November 21	762	West Grey launched

6 Quality Control

Quality control was very site dependent. The location of the collection structure and the ability for staff to communicate with the public impacted the volume of contaminants found in the collection bags.

Because only clean, white rigid, packaging EPS was densified and marketed, municipalities were required to provide staffing assistance in efforts to keep the collection quality controlled (i.e., non-EPS foams, stickers, tape, dirty EPS).

Lessons Learned

- Quality control can be done preventatively by controlling what the public dropped into the collection bags.

- Execution of quality control varies greatly from site to site.
- The term “styrofoam” has a broad and often confused identity in the public mindset. Many people believe it means all foams (e.g., polyethylene, pool noodles, packaging peanuts, etc.).
- Graphic signage of what material is acceptable and what is not should be posted at all sites. That said, it is not always seen/noticed by the public.
- Quality control can also be done responsively by way of site staff removing obvious contaminants from the collection bags prior to a service visit.

Some of the public break up the EPS into very small pieces, likely as a way to fit the material into a vehicle, or store more at home prior to a drop off. This greatly increases the processing time required. Site staff were encouraged to communicate this to people seen with such material.

The final level of quality control took place as material is hand fed into the densification system. The operator inspected each piece of EPS on all sides for the presence of tape, stickers and other materials attached to the foam. Such material was removed if possible, and if not, that section was snapped off, or the whole piece disposed of. Any non-EPS materials or dirty EPS was separated out to be disposed of.

In a typical visit where 16 yards of material have been collected, the range of contaminants was as low as a shoe box of mostly clear tape and white stickers and as much as a yard or two of material like colored and dirty EPS, foam blanket wrapping, and other foams like polyethylene. The hand feeding of the densification system kept these types of materials from contaminating loads but did add to the processing time.

The picture to the right shows a typical amount and variety of contamination per cubic yard collected.

Typical amount and types of contaminants per cubic yard collected

During this pilot study, the average volume of contamination was 9% of all material collected.

Table 7 lists typical contaminants and the amount that was typically present in a service visit.

Table 7: Collection Contaminant Composition

Contaminant	Share of presence by service visit
Stickers and Tape	48%
Soiled/Wet EPS	42%
Polyethylene	41%
EPS bonded with other materials (hard plastics, cardboard)	32%
Food Packaging	28%
Coloured EPS	17%
Extruded Polystyrene	11%
Packaging Peanuts	8%
Polypropylene	7%
Polyurethane	5%

The bottom left photo shows the material sorted and densified at a collection site. It is clean and it is easy to see that non accepted materials have been removed.

The bottom right photo is what EPS material looks like when it goes through a MRF. Because it picks up grit and dust from the sorting belts, it's a bit grey in places. It may also contain non-accepted materials which may result in the end market rejecting this material and landfilling it.

Clean material and ready for marketing

Typical material from a MRF (contaminants)

7 Processing

7.1 Equipment Setup

The densification system was installed in a 20 foot enclosed work trailer that is towed with a pick up truck with a generator in the truck bed. The setup allows for a working area at the rear of the trailer and the capacity to haul up to two days of processed material (200 cubic yards or two semi trailers of loose material, densified to two pallet spaces, each 4 rows high). The setup works well for single day runs with the densified material being offloaded between each run.

7.2 CSA Upgrades

A CSA inspection was conducted on the densification system to ensure the system met the Canadian electrical code.

A number of upgrades were found to be required including breakers, fuses, wiring and a disconnect. Total cost of material upgrades was $391 and the initial and follow-up inspections cost $1,151.

7.3 Maintenance

Although the system is within an enclosed trailer, it is more prone to moisture and temperature fluctuations than it would be if it were located in a climate controlled fixed location. This variability can lead to minor variances in the density and form of the densified output. Because of this, monitoring and adjustment of the system's pressure and timing controls is required to ensure proper function is maintained. Monitoring points included:

- Free flow of EPS pieces in the system
- Free flow of output of the densified bricks from the system
- Pressure gauges and voltage displays

Table 8 lists typical equipment maintenance and frequency.

Table 8: Equipment Maintenance & Frequency

Maintenance	Frequency
Vacuuming of bits and dust throughout system	Daily
Vacuuming of radiator	Weekly
Greasing of axles	Weekly
Generator Oil Change	Quarterly
Hydraulic Fluid Change	Annually
Gear Box Oil Change	Annually

7.4 Yards/Hour Average

The densification system was designed to provide the highest processing rate in a machine that could still be made mobile by being housed within the parameters and weight capacity of an enclosed cargo trailer. The average processing rate, including typical quality control and movement between the processing trailer and storage structure was 12 cubic yards per hour. The processing rate varied greatly by the level of contamination and the size of the EPS pieces. Small pieces made for a much slower processing rate, as each piece was inspected individually prior to densification.

Upon completion, the densified EPS was stacked in alternating rows on a 40” x 48” pallet. Between daily runs, the material was offloaded to storage. Partial pallets were combined to make 11 rows high and then shrink wrapped. When 26 full pallets were accumulated, shipment was scheduled. Using a pallet jack in conjunction with a hired forklift, the pallets were loaded to a trailer van. The material was delivered to a selected receiver where it was further processed. End use material possibilities include, but were not limited to insulation, picture frames, mouldings, and synthetic lumber.

7.5 Activity Profile

Once a full time service load was achieved the following activity profile, shown in Table 9, was typical.

Table 9: Typical Activity Profile for Full Time Service Load

Activity	Share of Working Time
Processing	40%
Driving	31%
Densified Material Handling	15%

Activity	Share of Working Time
Maintenance	5%
Rejecting Material (inspection, disposal)	3%
Administration (record keeping, invoicing, correspondence etc.)	3%
Down Time (troubleshooting)	1%
Breaks	1%

8 Municipal costs

8.1 Site Setup

Municipalities must provide a sheltered collection and storage space with a minimum of 150 sq/ft to 300 sq/ft, depending on the number of the households with access. Some sites had a vacant building, C-Can or trailer already available. Others purchased a 20 ft or 40 ft C-Can or semi-trailer with the cost ranging between $3,000 to $7,000 delivered.

An initial supply of collection bags was given to each site by Second Wind Recycling, based on the site's storage capacity. Municipalities bought additional collection bags as needed if bags became worn beyond use. Most bags have been re-usable for at least a year.

8.2 Promotion and Education

Municipalities were solely responsible for promotion and educating the public on the details of the collection process. This was done via municipal websites, waste calendars, press releases, and social media (e.g., Twitter, Facebook).

Second Wind Recycling provided material specifications and pictures for the municipalities to use in the P&E campaign. Some municipalities employed design and marketing professionals and produced materials such as the City of St. Thomas did, pictured at right.

Oxford County Facebook Promotion

"Online shopping often comes with lots of Styrofoam packaging. It's a significant source of waste and takes up a lot of space in the landfill. That's why we're introducing a pilot program for bulky Styrofoam recycling."

"Now, you can recycle Styrofoam for FREE in two convenient locations: the Waste Management Facility in Salford or Woodstock EnviroDepot. A third location at the Tillsonburg Transfer Station will open January 4, 2020. Give your Styrofoam a second chance at life. It could become a park bench, picture frame or decorative molding. Visit www.wasteline.ca for details."

Oxford County Twitter Promotion

"DYK? It takes at least 500 years for Styrofoam to break down. That means the Styrofoam you discard today will be around until the year 2519. Give your bulky Styrofoam a second chance at life. Recycle it, and keep it out of the landfill. www.wasteline.ca"

8.3 Staffing Requirements

Collection sites required staff monitoring and quality control. Two high quality controlled sites reported an average of 5 staff-hours per week spent dedicated to attending to the EPS collection. Duties included moving and replacing full bags, removing obvious contaminants and communicating with the public about the material specifications accepted.

8.4 Operational Cost vs. Municipal Rate Assessment

Municipal operations were factored out of all operation costs by use of travel and volume tracking. (Second Wind Recycling also services private customers whose metrics are not included in this study.)

Table 10 shows operating costs logged during this study.

Table 10: Operating Cost Inputs

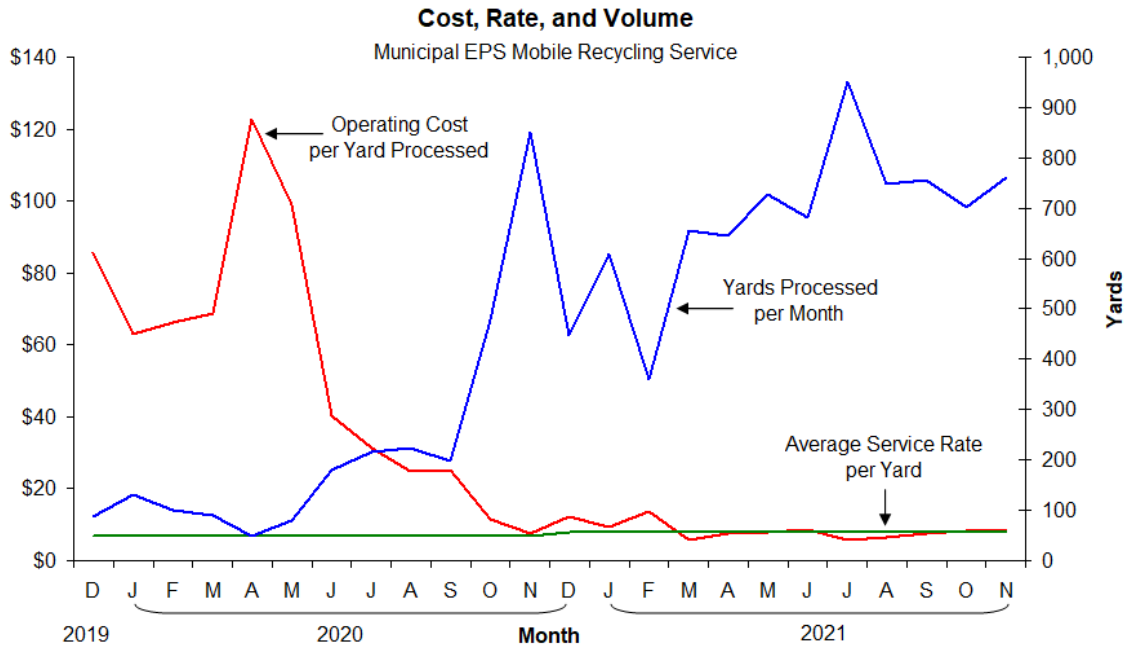
Fixed Costs	Details
Insurance	Truck, Trailer, Liability, Machinery, WSIB
MTO	CVOR, Sticker for 11,000 kg GVWR , Annual Inspections
Storage	For densified material prior to shipments
Staffing	One Driver/Machine Operator, Forklift Operator
Repairs/Maintenance	Truck, Trailer, Generator, Densification System
Communications	Cell Phone, Internet
Capital Repayment	For equipment, based on 10 year repayment at 3%
Variable Costs	
Truck Diesel	Varies by travel distance
Generator Diesel	Varies by processing time
Less Material Sales	
Rebates for Densified EPS	Based on monthly volumes and fluctuating rebate pricing

8.5 Average Service Rate per Yard

Each original municipal partner and any additional partners within a defined service territory were offered the service at a pilot project rate of $7 per cubic yard, with an allowance for an annual CPI adjustment. Additional municipal partners outside of the defined territory were offered variable rates based on distances and volumes. The average rate for year one of the pilot was $7 and $7.90 for year two. The average service rate per tonne for year one was $1,555 and $1,755 for year two.

Figure 2 shows the cost, average service rate per yard and volumes processed plotted throughout the study period. As the volume of material goes up, the operating cost per yard decreases.

Figure 2: Cost, Rate & Volume



Municipal operating costs and revenues first balanced in November 2020 (month 12 of the pilot) when a volume of 850 cubic yards was processed. 123,000 households across 13 municipalities had access to the public drop off sites at this time. The final eight months of the pilot each processed over 600 cubic yards, and each were in close range to balancing revenues and costs.

8.6 End Marketing

Prior to the launch of the company, Second Wind Recycling identified receiving interests from four end markets for EPS. Some of these receivers offered rebates for material meeting specifications. Others would receive material but offer no rebate.

In the first two years of operations, Second Wind Recycling received additional interest from three more receivers. Some of these markets further process and recycle the material in Canada, while others do so in the U.S., Europe, or Asia.

As discussed in Section 6, the highest level of quality control is required to maintain access to the greatest number of receivers.

There are some outlets for densified EPS that pay little to no rebate and those outlets have looser quality specifications. Access to receivers who deliver a rebate, however, allows for a more affordable service cost for the customer.

For municipalities it is important to note that with mobile EPS densifications there is far less handling of the material than with alternative approaches:

- No hauling to the MRF.
- No sorting at the MRF.
- No baling.
- No loading baled material into a tractor trailer.
- No marketing as securing an end market is outsourced.

9 Density Study

A sampling was used to determine an average weight per yard of post-residential EPS. Site staff observed and signed off on the weighing process. Boxes were suspended and connected to a hanging scale, with a tare weight established for an empty box and the rigging materials. Multiple samples were conducted at each of the four original collection sites.

- A sample of 50, 2-cubic yard gaylord boxes were weighed on site prior to densification, for a total of 100 cubic yards sampled.
- Variance in foam piece densities and the air pockets created within the boxes by formed pieces provided a range for what weight of EPS could fit in a cubic yard. Of the 100 cubic yards samples, the lightest yard was 8.2 lbs (3.73 kg) and the heaviest was 12.5 lbs (5.70 kg).
- The average weight per yard of post-residential, depot collected EPS was determined to be 9.9 lbs (4.45 kg).

9.1 Waste Shed Assessment

From section 8.4, a minimum of 600 yards processed per month was required for revenues and costs to hover in a close range. During the period for which this balanced range was achieved, Second Wind Recycling averaged 80% of its working time dedicated to municipal clients. If operations were fully dedicated to only municipal clients the volume mark required may be approximately 750 cubic yards per month. This would require an average of 47 yards per day processed over 16 runs per month.

Other factors to consider in this assessment:

- Over half of the monthly volumes in year two were collected from the municipalities in Bruce and Grey Counties. This required a minimum driving distance of 600 km round trip just to enter the territory.
- If clients were within a tighter waste shed, driving costs and time would be lower, and in turn allow for more yards to be processed per month.

10 Conclusion

A waste shed collecting over 600 cubic yards of EPS per month at an average rate of $7.90 per yard was required to make the service model viable (balancing costs and revenues). This was achieved with a territory serving 123,000 households across 13 municipalities.

An average weight for a cubic yard of post-consumer EPS sampled in the pilot was 9.9 lbs (4.45 kgs).

Quality control for the EPS collection varied greatly. The level of staff attention given to customer drop offs greatly impacted how much contaminated EPS and other materials were commingled with the collection. Contaminants were able to be removed prior to densification, maintaining marketability but added to processing time and costs.

There is a reliable market for high quality densified EPS at this time.

The densification system functions quite well in a mobile set up with only minimal extra attention required to its maintenance.

All participating municipalities elected to continue their service contracts when those contracts were up for renewal.

Appendix: Comparison of EPS Management Approaches in Ontario

Date and Source	Curbside or Depot (e.g., source separated)	Material Management	Materials Targeted	Outcome (e.g., product quality)	Price Points/Cost Drivers
Woodstock - City of Woodstock Depot Upgrade					
Oct 31, 2018 Source	• Depot & Bi-weekly Curbside • 2 stream	• Simple signage was circulated in an advertising campaign. • Source separated at the recycling depot in colour coded & labeled steel bins (tipping bins with lids). • Stored loose in an on-site building. • When full, it is manually loaded into a rear packer truck and transported to a MRF contractor for processing.	• Polystyrene – packaging material. Clean white Styrofoam from appliance or TV packaging. • The market disappeared so EPS is no longer collected through any City run programs. • The City can reinstate it if that were to change.	N/A	• Staffing • P&E on the advertisement • Building updates • Operating equipment (i.e., bins, additional storage)
Niagara - EPS Densifier Niagara Region					
Jun 17, 2017 Source	• Depot & Weekly Curbside • 2 stream	• Installed a Polystyrene Densifier System (PDS) at the MRF. • Initial challenges occurred with the equipment.	• Polystyrene – packaging material, and food grade packaging foam • Investments are not recommended	Photos on page 10, 11 of the report	• Polystyrene Densifier System (PDS) equipment, installation, maintenance expenses • Audits

Date and Source	Curbside or Depot (e.g., source separated)	Material Management	Materials Targeted	Outcome (e.g., product quality)	Price Points/Cost Drivers
		• The PDS is not fully automated. In addition to the manual sorting required to remove the material from the container line, additional labour costs are required to recover and process EPS.	unless there is a guaranteed and strong sustainable market. At the time of submitting this report, the Region has not been able to secure a consistent end market for this material.		• Staffing, additional labour costs for sorting, operating • Processing revenues
Toronto - Toronto's Expanded Polystyrene Densification and Marketing Pilot					
Mar 2018 Source	• Bi-weekly and some weekly Curbside • Single stream	• Manually recovered at multiple points in the MRF. • Larger pieces are captured on the pre-sort and OCC lines. Smaller pieces are handpicked along the PET line. • Positioning sorters along the PET line serves a dual function of capturing small EPS pieces as well as providing	• Polystyrene – packaging material (polystyrene foam blocks), and food grade packaging foam (meat and produce trays, take-out food containers (foam plates, cups, clamshells), and foam egg cartons). • The City will continue to provide samples loads, to	• Sample blocks appear mostly off-white, with grey in areas and small patches of pink and blue. • Cracks in the samples indicate that contamination is present in the material.	• Staffing (training, operations, supervision (documenting data, machine controls, etc.), project planning) • Equipment rental and vendor fees • Operating equipment (i.e., bins, additional storage)

Date and Source	Curbside or Depot (e.g., source separated)	Material Management	Materials Targeted	Outcome (e.g., product quality)	Price Points/Cost Drivers
		quality control for the PET. • For the purpose of quality control hand sorters are positioned at end points on the lines and will remove EPS along with other contamination.	processors that are able to accept them.		
Markham - Town of Markham Polystyrene Densifier					
May 7, 2012 Source	• Depots & Weekly Curbside • Single stream	• Use of a Polystyrene Densifier machine • One operator was designated for most of the materials processing. This individual was able to benefit from the experience and understanding the machines' ability to handle a broad range of polystyrene cushion and food foams.	• Polystyrene – clean loose foam cushion and food foam packaging. • Will continue to use the PS Densifier machine. • A next step to improve its cost-effectiveness would be to expand the machine's hours of use and receive and process more materials.	The quality and consistency of the densified polystyrene logs can vary based upon the polystyrene that is being processed but thus far the recyclers purchasing and using the densified polystyrene logs have been pleased with the product.	• Infrastructure • PS Densifier equipment, installation, maintenance expenses • Transportation (main driver) • Staffing • Materials

Date and Source	Curbside or Depot (e.g., source separated)	Material Management	Materials Targeted	Outcome (e.g., product quality)	Price Points/Cost Drivers
130 - *Densification And Recycling of Post Consumer Polystyrene (PS #6) Packaging In Ontario Municipalities*					
Jan 1, 2010 Source	Interviewed: • City of Kingston • Quinte Region • City of Ottawa • City of Peterborough • County of Peterborough • Niagara Region • Peel Region • City of Hamilton • Town of Markham • York Region • City of Toronto • Durham Region • Northumberland County • City of Kawartha Lakes • Waterloo Region • City of London • Essex Windsor • City of North Bay • Sault Ste. Marie	• If there is no capital cost for PS processing equipment to a municipality, the cost per tonne to recycle PS is reduced and as volumes processed increases, significant additional scrap revenue can be generated	• Expanded polystyrene (EPS) & Rigid polystyrene (RPS) • A municipality is required to process 315 tonnes of PS annually to be cost neutral • A municipality can generate additional scrap revenue by processing more than 315 tonnes of PS annually		• Staffing • Energy use • Capital Costs • Maintenance • A Mobile Recycling System can process approximately 450 kg (1000 pounds) of PS daily and the cost to operate machine is $794 daily.
713 – *Expanded Polystyrene Recycling REOI*					
Apr 23, 2013 Source	HGC Management Inc in Belleville, ON	HGC Management Inc. installed a cold densifier at the facility in Belleville	Expanded polystyrene (EPS)	N/A	N/A

Date and Source	Curbside or Depot (e.g., source separated)	Material Management	Materials Targeted	Outcome (e.g., product quality)	Price Points/Cost Drivers
		and provide a minimum of 150 tonnes/yr of capacity.			
731 - *Processing of Expanded Polystyrene in Accordance with CPIA Recommendations*					
July, 2014 Source	Depot & Curbside	Variables used to develop different scenarios for handling EPS in Ontario include: • Where is EPS collected? • How is EPS collected? • Densification Variables were combined to produce 12 unique scenarios and were the basis for modelling cost ranges.	Polystyrene - expanded polystyrene foam and food packaging.	N/A	• Staffing • Transportation • Capital Cost • Storage & shipment • Densifier