

# #4 Plastic Recycling Feasibility Study



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**Northern Maine Development Commission**  
**#4 Plastic Feasibility and Impact Study**

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## **Introduction**

This #4 Low-Density Polyethylene (LDPE) plastic recycling feasibility study was initiated by transfer station and landfill managers who are members of the Northern Maine Solid Waste Management Committee (NMSWMC), a sub-committee of Northern Maine Development Commission (NMDC). NMDC applied for and received funding from the United States Department of Agriculture-Rural Development Solid Waste Management Grant Program to undertake the feasibility study which focuses on a number of issues relating to recycling #4 plastics, including the potential amount of product available in the region and the review of solid waste disposal and recycling rates for the various solid waste associations. The intent of the study is to provide transfer station and landfill managers with necessary information to make an informed decision whether or not to recycle #4 plastics at their facilities.

## **Purpose of Study**

The high cost of petroleum products has caused many residents to review their heating options in an attempt to reduce those expenses. According to the Maine Department of Energy, northern Maine's heating season traditionally begins in mid-October and ends at the end of March with residents spending, on average, \$3,170 (850 gallon average) in heating oil. Due to the economics and availability of wood pellets, pellet stoves have become a popular heating option in many homes. For a relatively small investment, residents can heat with locally produced wood pellets with an average estimated savings of approximately \$1,400 per year over oil costs.

As residents increasingly turn to wood pellets, one of the most remarkable changes seen in the waste stream has been the increase in the number of empty #4 LDPE pellet bags showing up at landfills and transfer stations. Likewise, transfer station and landfill operators have received an ever increasing number of inquiries concerning the recycling of these empty pellet bags. Although not as commonly recycled as #1 polyethylene terephthalate (PET) and #2 high-density polyethylene (HDPE), LDPE recycling is gaining traction as its number of post-consumer uses increase.

Different types of plastic resins (PET, HDPE, PS, LDPE, etc.) and different types of plastic containers such as bottles, tubs, cups, etc. generally have different properties such as melting temperature, impact resistance, elasticity, and strength, and therefore cannot be mixed together for recycling purposes. At the present time, most transfer stations and landfills in northern Maine only accept #1 PET and #2 HDPE plastic for recycling as they continually have strong markets. All other plastics, including #4 plastic are either landfilled or incinerated.

## **Northern Maine Solid Waste and Recycling Overview**

NMDC's service area encompasses Aroostook County and parts of northern Piscataquis, northern Penobscot, and northern Washington Counties. The service area consists of 71 communities and 137 unorganized townships with a population of 71,870. Municipal solid waste and recycling operations are available to approximately 30,961 households in the region through fifteen different facilities. Services offered by these programs vary greatly and have

resulted in numerous ways in which municipal solid waste is handled and recycling programs run.

Listed below are the transfer stations, which serve as collection sites for the various communities within NMDC's service area. Included in the table are the annual residential and commercial tonnages handled by the facility. Also included in the list are the two regional landfills located in Aroostook County, Tri-Community Recycling and Sanitary Landfill and the Presque Isle Landfill. Both landfills accept municipal solid waste (MSW), commercial waste and recyclables and dispose of MSW and commercial wastes on site.

<b>2010</b>	<i>Residential Landfilled</i>	<i>Residential Incinerated</i>	<i>Commercial Landfilled</i>	<i>Total Tons</i>
<b>Aroostook Valley Solid Waste Disposal District (1,698)</b> Ashland, Garfield, Masardis, Oxbow, Nashville Plantation	1,007	0	0	1,007
<b>Bridgewater Transfer Station (610)</b> Bridgewater	112.58	0	0	112.58
<b>Danforth Transfer Station (589)</b> Danforth	502.69	0	0	502.69
<b>Grand Isle Transfer Station (467)</b> Grand Isle	No information reported	0	0	0
<b>Pine Tree (8,820)</b> Houlton, Hodgson, Linneus, Ludlow, Carroll, Webster and Lakeview	3,291.83	0	3,879.47	7,171.30
<b>Littleton Transfer Station (1,068)</b> Littleton	492.57	0	0	0
<b>Mars Hill Transfer Station (1,493)</b> Mars Hill	397.38	985.34	0	1,382.72
<b>Monticello Transfer Station (790)</b> Monticello	262.61	0	0	262.61
<b>Northern Katahdin Valley Disposal District (4,681)</b> Amity, Crystal, Dudley, Dyer Brook, Hammond, Hersey, Island Falls, Merrill, Moro Plantation, Mt. Chase, New Limerick, Patten, Smyrna, Webbertown.	0	1,227	0	1,227
<b>Orient Transfer Station (147)</b> Orient	82.17	0	0	82.17
<b>Presque Isle Landfill (14,889)</b> Castle Hill, Chapman, Mapleton, Perham, Presque Isle, Wade, Washburn, T11 R4	9,774.71	0	0	9,774.71
<b>Tri-Community Recycling and Sanitary Landfill (18,345)</b> Caribou, Fort Fairfield, Limestone, Allagash, Blaine, Caswell, Connor, Cyr Plantation, Easton, Hamlin, New Sweden, Stockholm, Westfield, Westmanland, Woodland	13,312	0	0	13,312
<b>Valley Recycling Facility (9,966)</b> Fort Kent, Frenchville, Madawaska, St. Agatha	9,576	0	0	9,576

<b>Van Buren Transfer Station (2,171)</b> Van Buren	1,255.47	0	0	1,255.47
<b>Weston Transfer Station (228)</b> Weston	129.44	0	0	129.44

The following table shows municipal solid waste (MSW) and recycling volumes generated by communities within NMDC's service area (in tons) in 2010. Northern Maine's communities produce an average of 45,795 tons of municipal solid waste annually. Residents also recycled about 7,858 tons of various products.

<b>2010</b>	<i>Wood</i>	<i>Cardboard</i>	<i>Paper</i>	<i>Co. Ming Cont.</i>	<i>Metal</i>	<i>Single Stream</i>	<i>Plastic</i>	<i>Batteries</i>	<i>Tires</i>	<i>Glass</i>
<b>Aroostook Valley Solid Waste Disposal District</b>	0	80.58	26.79	0	158.26	0	3.61	1.2	49.92	30
<b>Bridgewater Transfer Station</b>	0	9.63	0	0	0	14.32	0	0	0	0
<b>Danforth Transfer Station</b>	0	0	0	0	40	0	0	0	0	0
<b>Grand Isle Transfer Station</b>	320	0	0	0	0	0	0	0	0	0
<b>Pine Tree</b>	0	1167.23	233.93	0	93.63	0	0	0	0	0
<b>Littleton Transfer Station</b>	0	0	0	8.77	30	0	0	0	0	0
<b>Mars Hill Transfer Station</b>	75	101.71	0	0	105.05	38.75	0	0	6.92	0
<b>Monticello Transfer Station</b>	0	3.66	0	0	14.1	7.91	0	0	0	0
<b>Northern Katahdin Valley Disposal District</b>	0	56	59	0	140	0	3	0	0	0
<b>Orient Transfer Station</b>	0	0	0	0	5.37	0	0	0	0	0
<b>Presque Isle Landfill</b>	0	838.5	366.19	0	146.47	0	17.25	2.78	168.73	0
<b>Tri-Community Recycling and Sanitary Landfill</b>	964	574	204	0	347	0	14	0	290	0
<b>Valley Recycling Facility</b>	0	573	185	0	92	0	0	0	0	0

<b>Van Buren Transfer Station</b>	6.5	46.56	8.64	0	85.14	0	2.8	0	23.34	0
<b>Weston Transfer Station</b>	0	0	0	0	8.74	7.62	0	0	1.41	0

The region’s transfer stations dispose of their waste at Tri- Community Recycling and Sanitary Landfill in Fort Fairfield (*Aroostook Valley Solid Waste Disposal District, Bridgewater Transfer Station, Grand Isle Transfer Station, Houlton, Littleton Transfer Station, Mars Hill (CDD only), Monticello Transfer Station, Northern Aroostook Solid Waste Association, Portage Lake Transfer Station, Orient Transfer Station, Sinclair Transfer Station, Tri-Community member communities and Weston Transfer Station*); Presque Isle Landfill (*Presque Isle member communities*); Penobscot Energy Recovery Company (PERC) (*Mars Hill, Northern Katahdin Valley Disposal District, Oakfield Transfer Station, Sherman*); Juniper Ridge in West Old Town (*Construction and Demolition Debris only*), COGERNO in Green River, New Brunswick, Canada (*Valley Recycling Facility, Van Buren Transfer Station, Upper St. John Valley Transfer Station*); or Hemlock Knoll Sanitary Landfill in Lawrence Station, New Brunswick, Canada (*Danforth*). Most waste disposal costs for a municipality are paid for through property taxes, but increasingly municipalities are implementing pay-as-you throw systems to cover solid waste disposal costs. The various solid waste districts/transfers stations pay anywhere from \$50 to \$150 per ton for the disposal of MSW at one of the landfills.

### **History of Solid Waste Management in Maine**

In 1987, Maine faced a solid waste disposal crisis, which became the backdrop for the current waste disposal policies in the state. Maine was faced with a serious potential for landfill disposal capacity shortage as recycling as a waste management strategy was accounting for well under 10 percent of the waste stream. At the time, there were over 300 open, unlined town “dumps” scattered throughout Maine that had been the standard means of local waste disposal for nearly a century.

In 1989, the Maine State Legislature established the goal (MRSA, Title 38, Section 2132) of recycling 50 percent of the state’s annual municipal solid waste that is generated. This goal was set in response to Maine’s anticipated waste management crisis that was being fueled by the increasing amount of municipal solid waste generated within the state coupled with decreasing landfill capacity. The result was skyrocketing solid waste disposal costs for municipalities and businesses. According to Maine State Planning Office (SPO) data, Maine has never achieved its 50 percent recycling goal. However, the state has made significant progress in reducing, reusing, and recycling its municipal solid waste with public recycling services being expanded to serve over 98 percent of Maine’s population. In addition, businesses have adopted and implemented recycling programs that support the state’s objectives.

Also in 1989, to address the looming environmental and financial problems of these ‘dumps’, the Maine Legislature ordered that all unlined ‘dumps’ be closed and replaced with licensed and secure landfills that were supplemented by strategically located transfer stations by 1992. Today, nearly all of the state’s unlicensed, unlined, substandard landfills have been capped and

closed, significantly reducing their impacts on Maine’s environment. The impact of the legislature’s closing of all open, unlined ‘dumps’, and setting the goal of a 50 percent recycling rate, meant that town managers and municipally-run transfers station and landfill operators were required to pay very close attention to the economics and environmental regulations of their solid waste facilities.

According to the SPO, Maine as a whole never achieved the 50 percent recycling goal. In 2011, the State’s overall recycling rate was 39.6 percent, up from 38.7 percent in 2008 and 36.2 percent in 2006. The state remains committed to reaching the stated recycling goal as a means of lessening the need for the construction of additional landfills and reducing overall solid waste management costs to municipalities and businesses. Every ton of solid waste diverted from a landfill is cost avoidance to a municipality’s budget.

Although individual municipalities and solid waste associations are not legally obligated to achieve the 50 percent recycling rate, they are required to demonstrate progress toward that goal. Recycling programs vary from community to community, but overall the recycling program in northern Maine typically recycles all of the common materials generally recycled. At times, these programs offer special programs but as a whole recycling in Maine is market driven. This means that each individual municipality within Maine must decide on their own whether to recycle #4 plastic or not.

### Plastic Recycling Basics

Plastics come in great number of different sizes, shapes, and materials. In 1988, the Society of the Plastic Industry developed the single digit code system of 1 through 7 that people have become familiar with. The codes are based upon the chemical composition of the plastics. The code number is commonly imprinted and bound into the base of the plastic container to make identification somewhat easy. Some plastics, such a plastic bags, may have the code of symbol printed on them and may also be found on the bag’s seam.

Listed below is brief summary of the plastic types, symbols and their relative recyclability.

Number	Name	Symbol	Uses
1 PET or PETE	Polyethylene terephthalate	 PETE	Found in: single use bottle beverages, soft drinks, bottled water, salad dressing bottles. PET can be recycled into: fiberfill for winter coats, carpets, new plastic bottles, and a variety of other products.
Number 2 HDPE	High density polyethylene	 HDPE	Found in: milk jugs, laundry detergents, household cleaners, motor oils, butter and yogurt tubs. HDPE can be recycled into: other jugs and bottles, floor tile, building materials, benches and fencing.

Number 3 PVC	Poly vinyl chloride		Found in: Pipes, fencing, vinyl windows, siding, shower curtains, children's toys. PVC is rarely recycled, but is made into: deck boards, paneling, and flooring.
Number 4 LDPE	Low density polyethylene		Found in: wood pellet bags, dry cleaning bags, squeezable bottles, bread bags. Can be recycled into trash can liners, paneling, composite lumber, and floor tiles.
Number 5 PP	Polypropylene		Found in food bottles including ketchup, syrup, and yogurt, bottle caps, medicine bottles, Tupperware and other house wares.
Number 6 PS	Polystyrene		Found in: disposable plates and cups, packaging material, carry-out container
Number 7 Other	Polycarbonate, polyethersulfone		Found in: hard plastic sports bottles, three and five gallon jugs, DVDs, "bullet-proof" material Polycarbonate is difficult to recycle. The chemical BPA is found in polycarbonate. Has been recycled into plastic lumber.

### Plastic Volumes

There are numerous reports and studies that attempt to characterize the waste stream and its quantity and composition. Each year, the Maine Department of Environmental Protection (MDEP) compiles the *Waste Generation and Disposal Capacity Report*. Data from the report indicated that in 2011, Mainers disposed of 1,070,881 tons of MSW and construction and demolition debris. The Department estimated that 702,202 tons of material was recycled in 2011, or 39.6 percent of the waste stream. The Report also indicated that statewide, 450.90 tons of PETE/PET (#1); 883.57 tons of HDPE (#2); 145.16 tons of PVC (#3) and 288.08 tons of LDPE (#4) plastic were recycled.

In order to determine if recycling #4 plastics in northern Maine is feasible, the first step is to decide if there are sufficient materials available to warrant establishing a recycling program. NMDC staff compiled a list of thirty-six (36) known wood pellet retailers in the region and contacted each via the telephone. Retailers were asked the number of tons of pellets they sold annually.

Nineteen retailers (52.7%) responded to the telephone survey and indicated that they sold approximately 8,687 tons of pellets annually in the region.

It should be noted that the area's three largest retailers did not provide pellet sales information. In an attempt to obtain this information, staff contacted a number of pellet suppliers who estimated that these retailers sell an additional 10,000 to 20,000 tons of pellets. Because this is a large range of product and specific data was unobtainable, staff used three scenarios for the total unaccounted for pellet sales. The optimistic scenario uses 20,000 tons, the moderate 15,000 tons, and the pessimistic 10,000 tons.

## **Plastic Collection and Revenues**

The second deciding factor in the potential development of a recycling program is to determine if markets are available, and if so, is setting up a program a break even or profitable venture for the facility. Staff completed on-line and telephone reviews of what potential markets may be available for #4 plastics. One of the largest purchasers in the world of recycled materials is China. According to the *Washington Post*, since 2007 one of the United State's top exports to China has been solid waste, including items ranging from scrap metal and paper to cardboard and soda cans. The United States sold \$10.8 billion worth of metal and paper scrap to China in 2011 and these exports have become indispensable for municipal recycling programs. In 2011, the United States recycled approximately 52.8 million tons of paper and paperboard with an estimated 15.8 million of those tons being sent to China. Likewise, China imports nearly half of America's recycled plastics, including bottles and containers of all types.

China's purchasing of recycled materials has proven to be particularly worrisome on a number of fronts. Export buying activity has slowed for low-end grades of post-consumer plastics due to recent regulations and China's "Green Fence" policy, a policy that prohibits the import of unwashed post-consumer plastics and other contaminated waste shipments. The effects of China's "Green Fence" are even being felt here in Maine with the decline in the number of markets and the lowering of recycled material prices.

In order to determine what potential markets may be available for northern Maine's facilities; NMDC staff contacted the Maine Resource Recovery Association (MRRA). MRRA staff confirmed that there has been volatility within the recycling markets recently due to China's "Green Fence" which has led to a crackdown on U.S. solid waste imports and has resulted in the decline and slowing of plastic exports to that country. MRRA has been working to identify other markets but has been having difficulties finding viable plastic markets. As of the writing of this report, MRRA has never sold a load of #4 plastic due to weak demand.

There is a bright spot, however. MRRA has recently identified a potential market for the #4 plastic bags. The caveat is the quality of material and the bales must be in excellent condition, cannot be reinforced, contain any nylon, and must be dry and free of any wood residue. MRRA also stated that the bags should not be stored outside. In order to make a load of material, the transfer station and landfill would individually or collectively need to generate 40,000 pounds of pellet bags to make one load. It is, therefore, estimated that there would be slightly less than two loads of #4 plastics generated in the region each year.

According to MRRA, the buyer is willing to pay \$0.09 per pound, minus freight which is estimated to be \$1,500 to New Jersey. For planning purposes, MMRA also recommended using

a sale price of \$0.05 per pound (net). The following tables shows three (3) scenarios from which revenues were estimated for recycling purposes. These scenarios did not take into account the following:

- The cost of setting up and running a new recycling program.
- Storage costs over the time period required to accumulate the required amount of product to ship to the buyer. This includes storage that is under cover in order to ensure that the plastics stay dry.
- Public support for increasing recycling programs and the cost to the consumer.
- If recycling #4 plastic would have a noticeable and measurable impact on the amount of waste delivered to the region's landfills.
- Any costs associated with the modification of hauling contracts in those towns where private hauler are used to collect MSW and recyclables.
- This study did not examine the amount of #4 plastics associated with water softener salt bags.

### **Assumptions and Methodology**

1. Known quality of pellets sold is 8,687 tons (retailer survey return).
2. Unknown quality of pellets sold includes three scenarios of 20,000, 15,000, and 10,000 tons sold annually.
3. Each pellet bag weighs 2.6 ounces (50 bags per ton of pellets sold), equaling approximately 130 ounces, or 8.125 pounds.
4. Knowing that 100% of the product is unlikely to be recycled, staff used Maine's 2011 recycling rate of 39.6 percent as a benchmark as the percentage of material likely to be recycled.
5. Transportation cost for recycled product is \$1,500.
6. Handling costs at recycling center or landfill is estimated at \$0.03 per pound.

## Estimated #4 Pellet Bag Recycling Program Revenues

### Scenario 1 - Optimistic Estimate

Tons of pellets sold (retail survey)	Tons of pellets (estimated for larger retailers not responding to survey)	Total estimated tons of pellets sold	Number of Bags per ton of pellets	Weight per bag (ozs.)	Ounces per ton	Conversion to lbs.	Total #4 Plastic Bag weight volume in region (lbs.)	Estimate of effective recycling (39.6%) in lbs.
8,687	20,000	28,687	50	2.60	130.00	8.125	<b>233,081.875</b>	<b>92,300.423</b>

Estimated lbs. of #4 Plastic available	Buyer price per lb.	Gross Revenue	Minus Transportation Costs	Net Revenue	Net Revenue per lb.	Estimated handling and storage costs @ \$.03 per lb	Net Revenue	Net Revenue per lb.
<b>92,300.423</b>	\$0.09	<b>\$8,307.04</b>	\$1,500.00	<b>\$6,807.04</b>	\$0.07	<b>\$2,769.01</b>	<b>\$4,038.03</b>	\$0.0437

### Scenario 2 - Moderate Estimate

Tons of pellets sold (retail survey)	Tons of pellets (estimated for larger retailers not responding to survey)	Total estimated tons of pellets sold	Number of Bags per ton of pellets	Weight per bag (ozs.)	Ounces per ton	Conversion to lbs.	Total #4 Plastic Bag weight volume in region (lbs.)	Estimate of effective recycling (39.6%) in lbs.
8,687	15,000	23,687	50	2.60	130.00	8.125	<b>192,456.875</b>	<b>76,212.923</b>

Estimated lbs. of #4 Plastic available	Buyer price per lb.	Gross Revenue	Minus Transportation Costs	Net Revenue	Net Revenue per lb.	Estimated handling and storage costs @ \$.03 per lb	Net Revenue	Net Revenue per lb.
<b>76,212.923</b>	\$0.09	<b>\$6,859.16</b>	\$1,500.00	<b>\$5,359.16</b>	\$0.07	<b>\$2,286.39</b>	<b>\$3,072.78</b>	\$0.0403

### Scenario 3 - Pessimistic Estimate

Tons of pellets sold (retail survey)	Tons of pellets (estimated for larger retailers not responding to survey)	Total estimated tons of pellets sold	Number of Bags per ton of pellets	Weight per bag (ozs.)	Ounces per ton	Conversion to lbs.	Total #4 Plastic Bag weight volume in region (lbs.)	Estimate of effective recycling (39.6%) in lbs.
8,687	10,000	18,687	50	2.60	130.00	8.125	<b>151,831.875</b>	<b>60,125.423</b>

Estimated lbs. of #4 Plastic available	Buyer price per lb.	Gross Revenue	Minus Transportation Costs	Net Revenue	Net Revenue per lb.	Estimated handling and storage costs @ \$.03 per lb	Net Revenue	Net Revenue per lb.
<b>60,125.423</b>	\$0.09	<b>\$5,411.29</b>	\$1,500.00	<b>\$3,911.29</b>	\$0.07	<b>\$1,803.76</b>	<b>\$2,107.53</b>	\$0.0351

Based on the three scenarios, total net revenues for the fifteen recycling centers and landfills are estimated from a low of \$2,107 to a high of \$4,038.

## Conclusions

The primary conclusions of the research and analysis completed for the recycling of #4 plastics are:

- The recycling of #4 plastics is not feasible in the region at this time. Even though pellet sales have increased, total tonnages of #4 plastics are insufficient to create and maintain a recycling program.
- Markets are volatile and unreliable. Unless China lifts its “Green Fence” policy, this trend is expected into the foreseeable future.
- Revenues would not cover the costs needed to create and run recycling programs. Due to the requirements of the buyer, significant handling and storage requirements would be needed before any loads were to be purchased. There is insufficient long term storage space at most facilities. Recycling programs would net the region such a small return, even with robust and optimistic recycling programs, that programs could not recover their expenditures.
- Landfill and transfer station operators are unsure how to effectively collect and clean the plastic waste.

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