City of Roseville
2017 Year-End Recycling Report

(651) 222-SORT (7678)
www.eurekarecycling.org

Our mission is to reduce waste today through innovative resource management and to reach a waste-free tomorrow by demonstrating that waste is preventable, not inevitable.

This year-end report contains information on several areas that Eureka Recycling tracks to monitor the success of Roseville's zero waste recycling program over the course of each year. As a non-profit social enterprise organization we believe tracking and reporting this data is an essential way to ensure program transparency. It also gives Eureka Recycling and city staff the tools needed to successfully manage the program.

This report covers the following categories of information:

Introduction

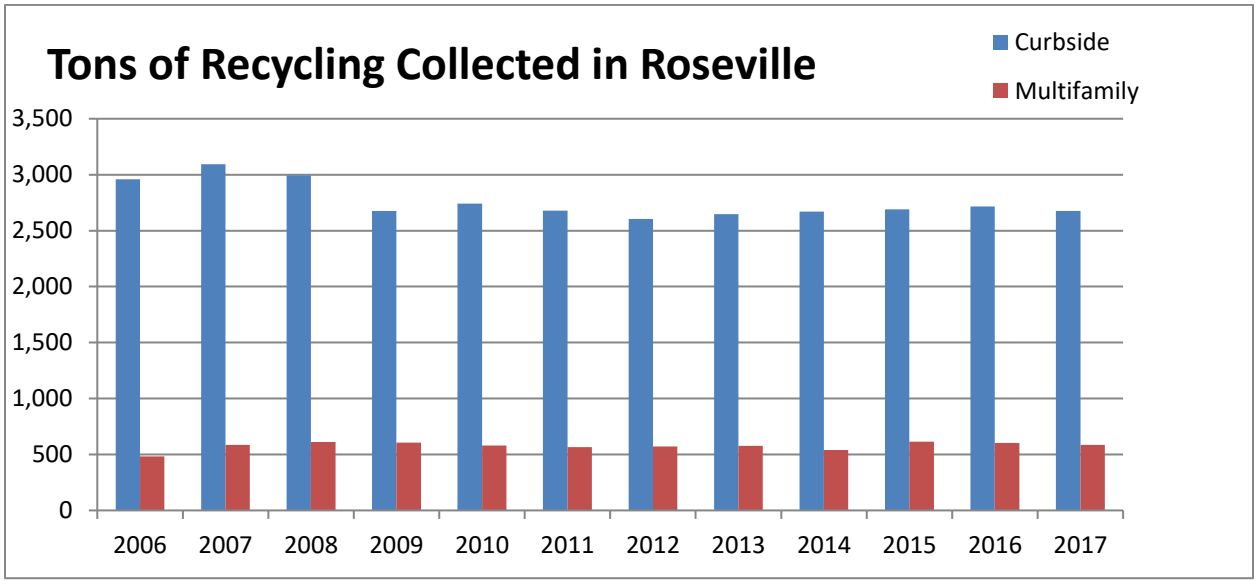
The recycling program in Roseville continues to function smoothly. Participation continues to be at or among the highest in Ramsey County at 93%. Despite the continued lightening of packaging, the tons of recycling collected in Roseville in 2017 stayed steady with only a small 2% decrease.

Market prices showed improvement throughout the first three quarters of 2017 with Roseville receiving just over $40,000 in revenue. The last quarter of 2017 saw market prices sharply fall resulting in Roseville paying just over $4,000 in processing fees that were not covered by the revenue from the sale of materials. More details on the cause of this drop in market prices and the implications for 2018 can be found in the Markets Update section of this report.

In addition, there continues to be a significant and positive environmental impact from the recycling efforts of Roseville residents. More details on these and other aspects of the program can be found within the pages of this report.

TONS OF MATERIAL RECYCLED

Total tonnage collected in Roseville in 2017 was 3,262 tons. This represents a small (2%) decrease over the previous year. This is something to be proud of considering the continuing trend towards the lightening of individual products and packaging that make up recycled materials. Recycling rates are measured by weight industry wide, but that metric doesn't tell the complete story. Manufacturers are continuing to find lighter and lighter weight packaging options. Products once bottled in glass are now bottled in plastic or aluminum. Aluminum and plastic bottles are getting thinner and lighter. Also, fewer and fewer households subscribe to physical newspapers and magazines, opting instead to get their news and entertainment on computers, tablets, and phones. Roseville's 2% decrease very likely represents an increase in terms of actual volume of material residents are recycling, because it takes more material to create a ton now than it has in the past.



PARTICIPATION

Roseville is one of the few cities in the metropolitan area in which the actual city-specific participation trend information is gathered and made available. 93% participation is among the highest of any city in Ramsey County that Eureka has data for.
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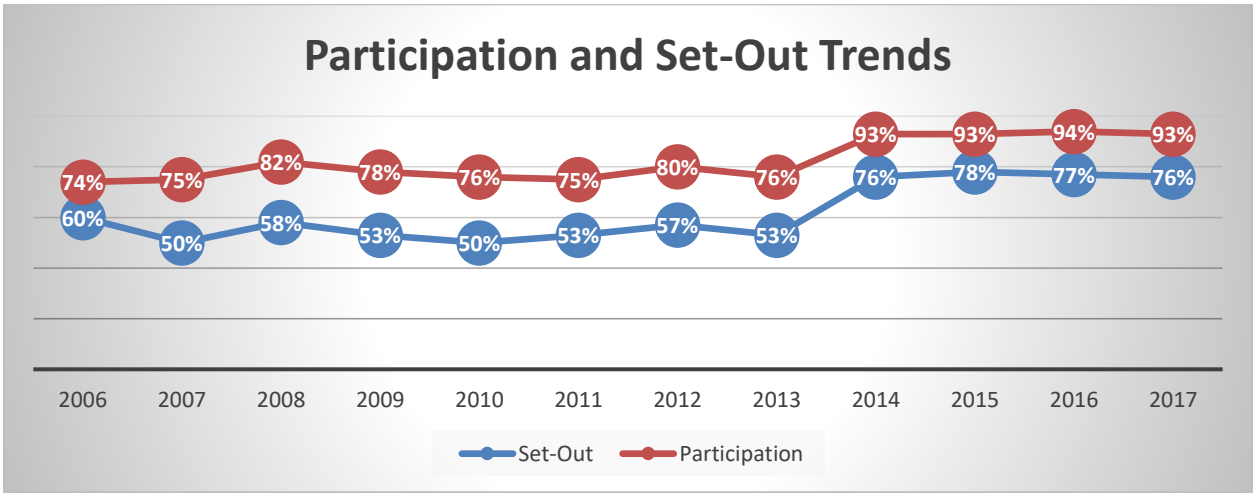
In previous years the study was conducted manually with staff going out to the routes before the truck collected and counted the set-outs, marking on a map which houses were setting out material and which were not. This was done in one 200-250 household sample section in each route with the same section being used each year. This method yields information to study the trends year to year in the number of people that set out in any given week and also the percentage of households that participate in the program at all.

In early 2017 Eureka began using a new routing and customer service software called Fleetmind. With this new system we can actually use the truck doing the collection to count the set-out at each address to complete the study. This new method of collecting participation information should make the process of monitoring who is participating in the program easier and more accurate as a human being making marks on a map is less accurate than a computer counting tips.



Eureka Recycling conducted the annual participation and set-out rate trend study in the fall of each year. (See Appendix C for the definitions, and methodologies of the participation, and set-out rate studies.)

COMPOSITION OF MATERIALS

Each year Eureka Recycling conducts a composition of the material collected in Roseville.

While this is certainly not an industry standard, Eureka Recycling believes that this information is important for cities to have as they plan their budgets, make decisions on their education and outreach work plans and communicate with residents about what to recycle and the success of their program overall.

Type of Material	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	**2017**
	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	% of Total Tonnage	**% of Total Tonnage**
Total Annual Tons	3,441	3,681	3,556	3,281	3,322	3,244	3,173	3,225	3,212	3,305	3,320	**3262**
Papers												
News Mix	63.98%	56.46%	66.00%	61.65%	59.68%	51.53%	56.86%	54.40%	56.27%	54.08%	50.00%	**35.63%**
Cardboard	6.71%	13.23%	4.50%	5.48%	7.34%	10.33%	9.09%	8.78%	8.59%	7.35%	12.80%	**11.32%**
Mixed Paper	4.06%	7.81%	3.20%	5.50%	5.68%	7.64%	6.59%	3.49%	5.32%	5.12%	5.15%	**14.66%**
Milk Cartons & Juice Boxes	Not collected	Negligible	Negligible	Negligible	0.02%	0.03%	0.47%	0.07%	0.31%	0.19%	0.19%	**0.22%**
Textiles	0.40%	Negligible	Negligible	0.02%	0.02%	Negligible	0.20%	0.09%	0.11%	0.16%	0.23%	**0.01%**
Residual	0.24%	0.11%	0.50%	0.06%	0.07%	0.27%	0.19%	0.07%	N/A	N/A	N/A	**N/A**
SUB-TOTAL	75.40%	76.60%	74.20%	72.72%	72.81%	69.79%	73.40%	70.39%	75.92%	72.02%	73.52%	**61.84%**
Total Glass	14.89%	15.15%	16.70%	17.54%	17.31%	18.08%	16.94%	18.78%	17.58%	21.36%	19.52%	**22.17%**
Steel Cans	2.64%	2.00%	2.40%	2.43%	2.65%	2.49%	2.38%	3.30%	2.09%	2.12%	1.39%	**1.88%**
Aluminum	1.48%	1.10%	1.40%	1.40%	1.43%	2.10%	1.37%	1.99%	1.13%	0.98%	1.04%	**1.34%**
Total Plastics	4.70%	4.01%	4.60%	5.75%	5.67%	6.94%	5.63%	7.29%	6.13%	6.09%	5.24%	**5.16%**
Residual	0.89%	0.15%	0.70%	0.17%	0.12%	0.60%	0.28%	1.74%	N/A	N/A	N/A	**N/A**
SUB-TOTAL	24.60%	22.40%	25.80%	27.28%	27.19%	30.21%	26.60%	33.10%	26.93%	30.55%	27.19%	**30.55%**

* Recycling collected in Two Sort System from 2006-2013. Single sort began in 2014

Increases in Cardboard

The 2017 composition study revealed the continuation of the increase of the percentage of cardboard. This is linked to a sustaining increase in online shopping and rapid delivery offered by shipping companies. It has been named the “E-Commerce Effect.” More people are buying more things online. This creates an increase in the amount of cardboard boxes households have to recycle each week.

From a zero waste perspective this suggests the need for factors that balance this increase in consumption. More is not necessarily better unless the products we are manufacturing and purchasing have been designed to be:

- Durable and last a long time
- Repairable if they break
- Exchanged to others when they are no longer needed and not thrown away
- Made from materials that are free of toxins
- Completely re-usable, recyclable or compostable at the end of their lifecycles
- Made by local businesses that keep the revenue from the sale of these products within the local economy creating local living wage jobs

Non-Preferred Items and Residual Rates in Single-Sort Recycling Programs

"Non-Preferred Items" refers to items that are not accepted in the program but end up being mistakenly put in carts. There may, in some months, be markets for recycling but we do not accept them in the program because they are not compatible with a mechanically sorted curbside recycling program. These are items that cause damage to machinery or hazards to staff in MRFs. Eureka has begun to sort and measure these items as they appear more regularly in cart based collection systems where the driver cannot see the items before they end up in the truck. The best method of reducing these materials is to do additional education to let residents know they should not place them in with their recycling.

"Residual" refers to the amount of material collected from residents that is not actually recycled. In 2017, the residual rate increased for the second year in a row. Although still good at under 8% for a single sort MRF, it does indicate more effort may be needed to keep non-recyclable items out of the recycling.

Type of Material	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	**2017**
Non-Prefered Items												
Scrap Metal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.25%	**0.31%**
Bulky Ridgids	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.02%	**0.10%**
SUB-TOTAL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.27%	**0.41%**
Residual												
TOTAL												
Process Residual	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.04%	**1.02%**
Residual - Possitive Sort	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.13%	**6.18%**
Total	**1.13%**	**0.26%**	**1.20%**	**0.23%**	**0.19%**	**0.91%**	**0.47%**	**1.81%**	**2.47%**	**2.55%**	**4.17%**	**7.61%**

For more information on the methodology of the composition analysis done by Eureka Recycling, please see Appendix B.

One of the reasons the residual rate is increasing in the composition study is that Eureka has invested over 2 million dollars over the last two years in additional equipment to continue to increase the quality of the material being sent to end markets. The additional equipment helps to further assure that plastic and aluminum is not ending up in the paper stream.

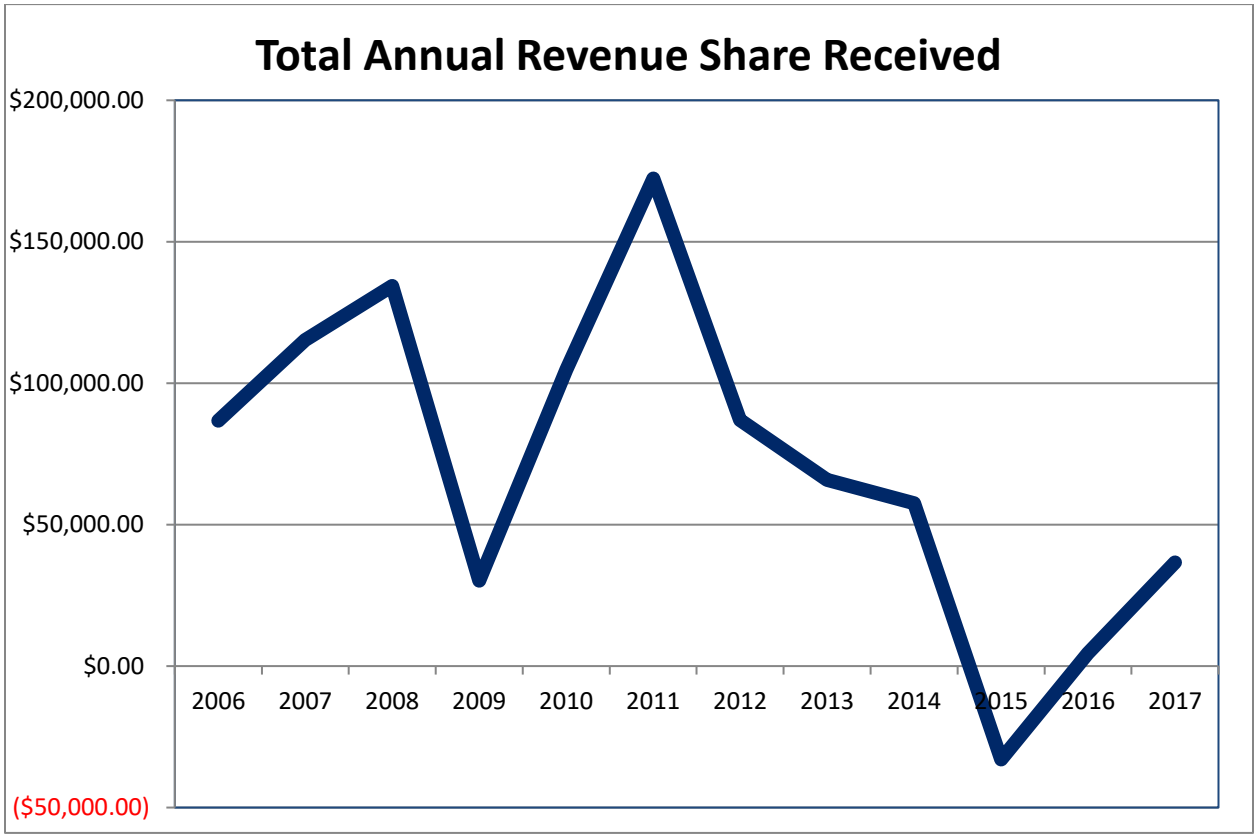
Plastic bags, freezer boxes, black plastic, Styrofoam, and plastic pouches continue to be the most common non-recyclable items in the residual.

Engaging with residents through education (including the Guide to Recycling) in-mold labels on all recycling carts, our zero waste hotline, and outreach at many city sponsored events all lead to a lower residual rate. Regular communications makes it easy for Roseville residents to stay informed, and be clear about what is and is not recyclable in their city.

REVENUE

Since 2006, the City of Roseville has received more than $895,000 in revenue from the sale of its recyclables. The materials that Roseville residents set out are valuable. They required tons of natural resources, a great deal of energy, and hours of labor to produce. Much of that value still remains in the items after they are used. Recycling this material captures that value and reinvests it into the next generation of products reducing costs and creating significant environmental benefit. The market for recycled material generates billions of dollars each year in the United States alone. This material is highly sought after by manufacturers who want to make new products out of it.

In 2017, the overall prices paid by end markets for the material recycled in the city's program began the year stronger with the net revenue to the city nearly doubling between the last quarter of 2016 and the first quarter of 2017. However the year ended with the gross revenue being exceeded by the cost of processing. For the entire year the city saw $36,693 in revenue share. This was a significant increase from the $4,535 earned in 2016.



Global, Regional, and Local Market Conditions Affecting Prices

Recycled materials are commodities just like other products such as, corn, cotton, and oil. In our modern global economy things that happen near and far can impact the prices paid for material on the open market. The following are the major factors influencing the prices paid for recycled materials. Some are very local issues affecting glass prices. Others are more global in nature and involve the economies of other countries like China.

Summary of Current Market Conditions

This is a summary of markets and our outlook for 2018 based on discussions with end markets and industry professionals. Please note that, as all projections, these could be inaccurate since recycling markets are now a global commodity that is impacted by many diverse forces including, politics, global economics, pricing around oil, mining, shipping, weather, consumer behavior, and more.

<u>Non-Material Specific Impacts to Markets:</u>

China's National Sword Policy: In the Spring/Summer of 2017 China let the World Trade Organization know that it was going to implement a new policy called National Sword aimed at reducing the amount of contaminated material shipped to their country and improve their own internal recycling infrastructure. We continue to market the vast majority of our material regionally (80-85% in MN), but are still impacted by the price-swings this is causes industry-wide. However, the high quality of our material and the way the City has only added materials with robust markets has helped mitigate these market conditions.

There was a short term spike in fiber pricing over the summer as firms in China rushed to purchase as much paper (especially cardboard) as they could before the policy was implemented. Although the policy is not going to be officially implemented until March 2018, China stopped issuing permits for material in mid-September. This meant that US Mills became flooded with fiber that normally would have been shipped to China. When there is more supply (fiber) than demand (mills that need fiber), prices fall and that is what happened in October when the average price for fiber fell 30 – 50%. In November we've seen cardboard pricing continue to fall 10-15% but fortunately other paper markets have held steady for this month. So far, we have seen most of the impacts of National Sword on fiber pricing but China is also halting the import of mixed plastics. As a result we've seen a slight dip in pricing for tubs and lids (mostly #5 plastics) as US Markets are getting material that was previously going to China. There has also been indication that HDPE and PET pricing could fall if MRFs start sorting more of their plastics and sending the sorted material to US Mills.

In the first months of 2018 we are continuing to see lower prices paid for materials as China continues the National Sword policy. It is difficult to predict when or if China will step back from the quality standards.

An important positive in this policy is that MRFs all over the country are working to change and update their processing systems to improve the quality of the material they are sending to end markets. This is a very good thing and means that more items will get sent to the right markets and more will get recycled. It also means that we will see more of the non-recyclable items pulled out of the recycling and thus higher reported residual rates.

Part of the solution is to make sure that companies that design and sell the packaging we buy take compatibility with existing recycling processes into account when they make the items. It also means that more emphasis will be placed on educating residents. This is because residents play a big role in making sure that only recyclable items end up in their cart. The low cost of oil continues to put downward pressure on the price of recyclable plastics as manufacturers can choose to use virgin oil over recycled content.

Long Haul Trucking: Another impact to the recycling market has been a shortage of long haul truckers. This is a difficult job that is not always well compensated. Additionally tighter safety regulations were implemented that require electronic monitoring on all trucks to ensure drivers aren't on the road longer than allowed. Between this and the hurricanes in the fall that increased demand for trucking, all end markets have seen trucking costs increase significantly. This will depress markets that require trucking long distances such as aluminum and tin. Fortunately we have a strong regional demand for PET and HDPE so that part of the sector has been hit less by the market but still may see impacts.

<u>Material Specific Updates:</u>

News, Mixed Paper, OCC: As mentioned previously we have seen markets drop significantly this fall due to China's National Sword Policy. We expect this trend to continue for at least six months and as long as two years. We may see pricing increase after six months if China loosens its regulations in order to get more material or as long as two years if China is able to continue manufacturing without US recyclables – two years is about how long we estimate it will take for new end markets to develop. At this time there is minimal action because investors and recyclers are reluctant to start projects that would fail if China loosens regulations suddenly.

Textiles: In the last few years we have seen the price of textiles drop precipitously as a result of "fast fashion", a trend towards manufacturing cheaper low quality clothing that wears out faster so has a lower reuse value. Because consumers are buying more of this, and discarding more of it, not only does it have a lower reuse value, but the market is flooded with this low quality clothing, reducing the value of all textiles. We expect this trend to continue in 2018.

Aluminum Cans: Most of our markets for aluminum cans are in Tennessee and Kentucky. Because of this distance, this market has been hit by the aforementioned higher cost of long haul trucking.

Steel Cans: The steel industry has been flooded by imported tin from China for the last few years, driving down the value of our tin. We expect this trend to continue though Tin prices are slowly increasing.

HDPE Plastic (Color and Natural) #2: This market has been depressed due to the low price of oil – this will likely continue in 2018. China's National Sword Policy also may depress plastics pricing – see impacts from National Sword for more details.

PET Plastic (#1): Similar to HDPE, PET plastics is depressed due to the low price of oil. There also may be impacts from National Sword on PET pricing.

Tubs and lids (#5 and #4 rigid plastics): Due to China's National Sword pricing we have seen these prices fall in the past year, after they were already low due to low oil pricing. We expect this trend to continue.

Glass: Prices paid for glass remain very low in 2016. The existence of only one processing facility for glass in Minnesota means that the supply of glass is still as high as or higher than the capacity of the local market to process and sell it. As a result, while Eureka is still able to sell and recycle the glass here in a local market the cost of processing and shipping that mixed glass to Strategic Materials Inc. (SMI) exceeds the price paid for it. While the economic value of glass may currently be low there are other benefits to consider. The environmental benefits created by recycling glass are significant as glass can be recycled infinitely creating more benefit each time. In addition, when recycled locally glass supports local economic development and jobs. This shows that despite the currently prices being paid for recycled glass it is still a net positive material.

Why does recycling glass matter?
Without immediate planning and action, some of Minnesota's recycled glass will end up in landfills or dropped from programs all together, and without a long-term solution that requires responsibility and some investment from producers, like bottle deposit legislation, glass may cease to be recycled at all. Glass collected for recycling that needlessly ends up in a landfill will end up costing the cities and their residents more money while reducing their recycling programs' environmental benefits.

There are significant, undisputable environmental and economic benefits achieved from recycling glass. These include energy savings, reduction of air and water pollution, and a reduced need to mine new resources. Furthermore, state, municipal and environmental advocates agree that environmental benefits reduce dramatically the further we stray from the highest and best use of recycled glass, so glass bottles recycled into glass bottles should be the primary goal and then the next best markets for the smaller glass and fines need to be developed. These environmental impacts are the reason Eureka Recycling has been committed to finding a solution to keep bottle-to-bottle recycling viable despite changes in collection methods.

- Glass bottles and jars are 100% recyclable and can be recycled endlessly without any loss in purity or quality.
- Over a ton of natural resources are saved for every ton of glass recycled.
- Energy costs drop about 2-3% for every 10% recycled glass, also called cullet, used in the manufacturing process.
- One ton of carbon dioxide is reduced for every six tons of recycled container glass used in the manufacturing process.

ENVIRONMENTAL BENEFITS

The environmental benefits of Roseville's zero-waste recycling program are quantified transparently using widely-accepted environmental models. This ensures that all residents have a chance to see how their efforts can be measured and quantified.

There are many ways to calculate the benefits of recycling. To better explain these benefits in commonly understood terms government agencies, research scientists, and economists have created several "calculators" to translate the amounts of recycled materials collected, and processed into equivalent positive societal and environmental benefits.

Because of the increasing societal focus on causes of and solutions to, climate change, it has become imperative to measure waste reduction (and all of our activities) in terms of its impact on the environment. This allows us to speak in a common language, understand the impact of our choices, and help us prioritize the personal and policy actions that we take. Many cities around the country work with the International Council for Local Environmental Initiatives (ICLEI) to quantify and now register the climate change impacts of their city. It is also important to calculate the carbon impact of waste reduction as the global effort continues to enact a carbon "cap and trade" system.

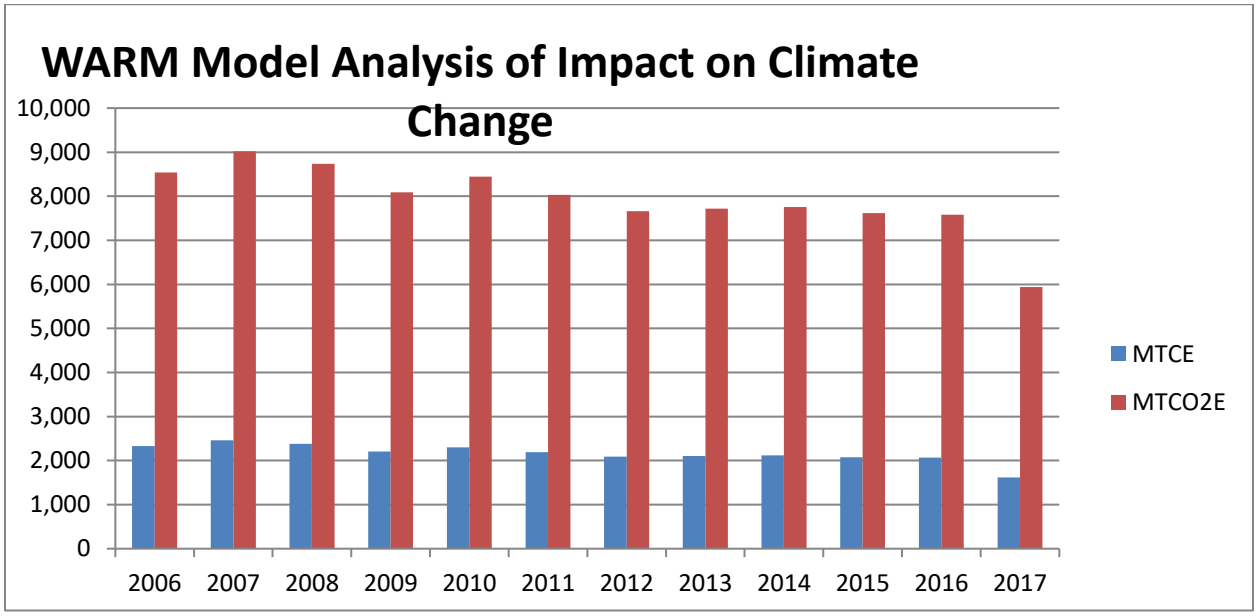
In addition to climate change mitigation, there are other environmental benefits to recycling, including saving energy, protecting air quality, water quality, natural resources, natural beauty, habitat, and human health.

The Environmental Protection Agency (EPA) WARM Calculator

The equations used in environmental calculations try to take into account the "full life cycle" of each material—everything from off-setting the demand for more virgin materials (tree harvesting, mining, etc.) to preventing the pollution that would have occurred if that material were disposed of (burned or buried). Different calculators may include some or all of the many factors that contribute to the "full life cycle" so results will vary from calculator to calculator.

While there are many models emerging to calculate greenhouse gas reductions, the most recognized, and standard model is the U.S. Environmental Protection Agency's Waste Reduction Model (WARM). WARM was designed to help solid waste planners and organizations

track and voluntarily report greenhouse gas emissions reductions from several different waste management practices. WARM, last updated in June 2014, recognizes 46 material types.



MTCE (Metric tons of carbon equivalent), and $MTCO_2E$ (Metric tons of carbon dioxide emissions) are figures commonly used when discussing greenhouse gas emissions. For more information about the process of measuring the environmental benefits of waste reduction, visit http://epa.gov/climatechange/wycd/waste/measureghg.html#click

What do all these numbers mean?

In addition to preventing pollution, an important impact of recycling is that is conserves a huge amount of energy. Making products and packaging from raw materials harvested from nature uses a much larger amount of energy than using recycled materials.

Every manufactured item has the energy used to make it "embedded" into it. Recycling takes advantage of that energy, as it is easier and more energy efficient to make a glass bottle from another glass bottle than from raw materials.

The WARM model and other calculators measure the difference between recycling all these tons of materials and using them to make new products versus sending them to an incinerator and making replacement products from raw materials. This difference is expressed as the amount of CO2 that was not produced because we did not have to make and use all the energy that would have been needed if we used raw materials.

The numbers above help municipalities calculate and track their environmental footprint. For more information about the process of measuring the environmental benefits of waste reduction, visit https://www.epa.gov/warm.

These numbers, however, don't have much meaning to the average person. To help recyclers understand the significance of their actions, the EPA has also developed tools to translate these numbers into equivalent examples that people can more easily understand.

- For example, using the figures above, the EPA estimates that **Roseville would have had to remove 1,251 cars from the road for one year to have had the same environmental impact in 2016 as they did by recycling.** To achieve this, nearly 8% of Roseville's households would have had to give up one car for a year.
- Another way to look at it is that the residents of Roseville saved an amount of energy equivalent to 247,547 backyard barbeques worth of propane.

Although WARM is the most widely peer-reviewed and accepted model, it is considered to have several flaws. Many believe the use of this calculator is conservative, and understates the real impact of waste reduction efforts, but it offers a conservative starting place to measure our impacts and work towards our goals. Even with these conservative calculations, the impacts of Roseville's recycling program prove to be quite significant.

Measuring Environmental Benefits Calculator (MEBCalc^{TM})

Jeffrey Morris, Ph.D., Economist at Sound Resource Management in Seattle, has developed a calculator that begins with the EPA's WARM calculator, and expands upon it to gather information on not just carbon and CO_2, but also several other important environmental and human health indicators. Although not yet widely used, this calculator shows the significant benefits that WARM does not consider.

The MEBCalc^{TM} model expands and shows the benefits other than just energy savings and carbon savings. Recycling materials with zero waste in mind recognizes not just the value in the resource itself, but the contribution to the health of the community when materials are kept out of landfills and incinerators avoiding the toxic and carcinogenic emissions.

Roseville	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Recycling Tons	3441	3682	3556	3281	3322	3243	3173	3225	3212	3305	3320	3262
Carbon Dioxide Equivalent Reduction Metric Tons (eCO_2)	9,437.3	9,619.0	9,683.5	8,814.0	8,739.3	8,425.1	8,106.2	8,478.7	8,386.3	8,159.5	8,088.0	7,301.4
Human Health—Carcinogens Reduction Metric Tons (eBenzene)	1.9	1.9	1.9	1.9	1.9	2	1.8	1.9	1.7	1.7	1.7	1.5
Human Health—Non-Carcinogen Toxins Reduction Metric Tons (eToluene)	4,609.7	5,253.0	4,665.7	4,452.0	4,518.0	4,699.6	4,375.0	4,280.1	3,953.0	3,810.2	4,064.9	3,373.7
Human Health—Particulates Reduction Metric Tons ($ePM_{2.5}$)	4.4	6.6	4.2	4.4	4.8	5.9	5.1	4.2	3.6	3.3	4.4	4.0
Acidification Reduction Metric Tons (eSO_2)	26.9	27	27.3	25.3	25.5	27.1	24.3	25.7	22.7	20.6	22.1	19.5