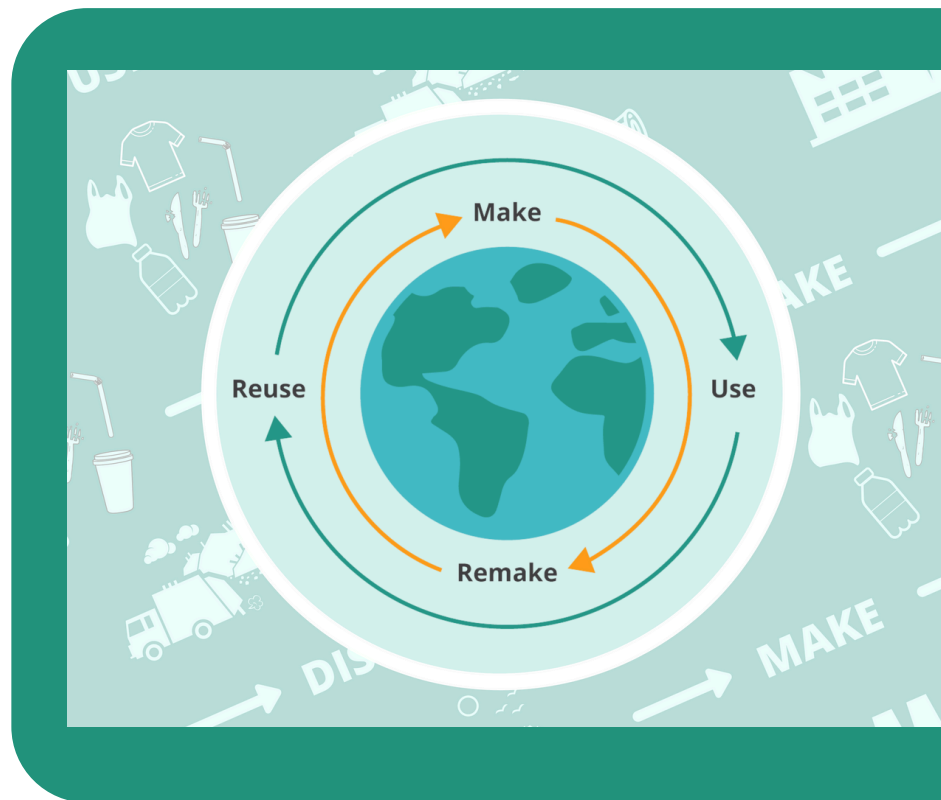


A Guide to  
**Eco 360:**

# Activity 10: Plastic Waste to Energy



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# Land Acknowledgement

In the spirit of respect, reciprocity and truth, we acknowledge and honour Moh'kinsstis, and the Treaty 7 region of Southern Alberta where this pilot project was conducted. This land is the traditional Treaty 7 territory of the Blackfoot Confederacy; Siksika, Kainai, Piikani, as well as the Tsuut'ina and the Îyâxe Nakoda Nations. This territory is home to the Métis Nation of Alberta, Region 3 within the historical Northwest Métis homeland.

With gratitude, we acknowledge the land and the Indigenous people that have taken care of it since time immemorial, and continue to honour and celebrate this territory.



# Backgrounder: Plastic Waste Solutions

## Introduction

To address the issue of plastic waste in our economic system, we need to think of ways to utilize plastic items after use instead of throwing them into landfills. In a circular economy for plastics, we can re-imagine ways how:

- Plastic items can be **eliminated** from our systems where there is no need for them
- Plastic items can be created for **reuse** – by designing them in such a manner that ensures they can be reused, recycled or composted
- Plastic items **circulated** within our economy and out of our environment by repurposing the materials used in the plastic products and packaging

Corporations, governments and consumers should work together to move towards a circular model for the economy that employs these principles. By eliminating unwanted and unnecessary plastic items, corporations can play the part in reducing avoidable plastic from the system.

The single-use plastic items pose the biggest challenge in addressing plastic pollution. Moving away from single-use plastic items towards designing plastic items that can be reused, recycled and composted is crucial. Cities across the globe have worked towards banning the use of single-use plastic items. On December 20th, 2023, the Government of Canada announced the ban for certain single-use plastic items that are hard to recycle. The ban included plastic shopping bags, single use utensils (plastic straws, spoon, fork, and knife), take out containers, and foam cups.





While there are many plastic clean-up efforts happening around the globe, here are examples of some initiatives working to reclaim plastic waste currently found in our environments (Nature Catalysis, 2019):

- Ocean Cleanup is a private environmental organization that is deploying automated plastic collection units in water bodies for clean-up:

 <https://theoceancleanup.com/>

- Alliance to End Plastic Waste is a non-profit working with various partners in government, non-government sectors, industry and local communities to end plastic waste in environment. They are also working with cities to improve their waste management systems:

 <https://endplasticwaste.org/en>

- 4Ocean is certified B-Corporation, who is also working to clean up the plastic polluting our oceans, while also raising awareness and educating the masses:

 <https://www.4ocean.com/>

One might wonder what can we do with all the plastic when it is collected from our environments—from our oceans and municipal solid waste? The industry is still learning ways to innovate and develop new technologies for dealing with all the plastic waste reclaimed from our environments. Recycling of plastic waste is a common strategy across the globe in dealing with all the plastic waste reclaimed from our environments. There are two ways of recycling plastics—either **downcycling** or **upcycling** them.

The traditional recycling methods involves using mechanical ways or incineration to create new products that are usually of lower quality than the original plastic, which is essentially a form of **downcycling**. Another form of recycling is catalytic recycling of plastic waste, which entails using plastic waste as “feedstock for the preparation of value-added materials” (Nature Catalysis, 2019)—this is a form of **upcycling** as we create products of higher value and quality through this method.



Plastic **repurposing** is also another term sometimes used interchangeably with upcycling – it also refers to using discarded plastic waste to create new products of higher value and quality. These methods allow for plastic materials to be **circulated** within the economy and out of our environments. Here are some innovative examples of plastic upcycling:

### **EcoBricks at Collingwood School Calgary**

Collingwood School in Calgary, Alberta has an innovative project, called the “Eco-Brick Project”. The idea comes from Colombia as a response to help low-income families, especially recyclers, to have a home made out of eco-bricks! Each class at the Collingwood School brings an empty 2L bottle, where students fill the bottle with all the non-recyclable plastic - plastic that usually goes to the landfill. It looks easy but it is not! It requires strong muscles to press the plastic inside the bottle, fill out all the corners and end up with a very hard bottle, like a brick. The students have built a couch, a table and chairs with eco-bricks for the entire school to enjoy. As a result of this project, the school’s waste has decreased 70%.



Source: (Collingwood School, 2020)

Here is a link to the project:

 [https://www.youtube.com/watch?v=ryGwn\\_9Ggns](https://www.youtube.com/watch?v=ryGwn_9Ggns)

### **Green Toys**

Green Toys® is a US based company that creates toys from recycled plastic milk jars. Using a motto of reduce, reuse and recycle, Green Toys® tracks the number of plastic milk jugs reduced as a primary indicator of their impact. Here is a video on their story:



Source: (Green Toys, 2021)

 <https://www.youtube.com/embed/NDUSQrHXiww?autoplay=1>

## Rothy's

Rothy's is a US based retail store that creates women's shoes and bags from recycled plastic. Here is a link to their website:

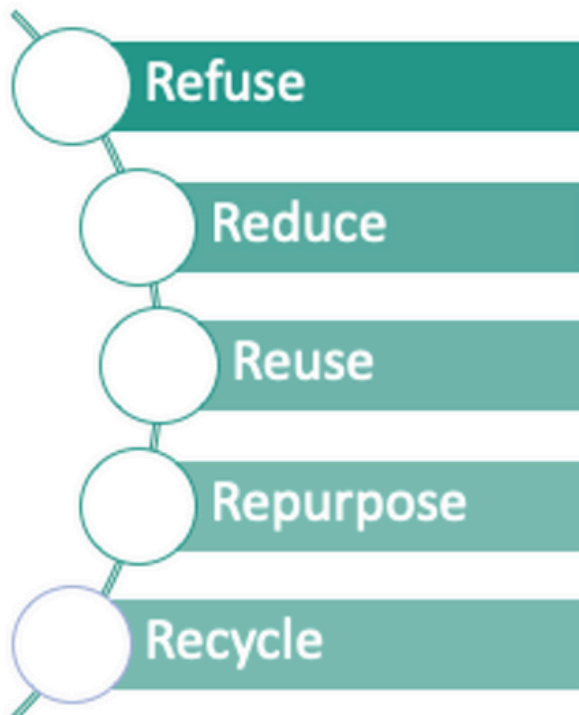
 <https://rothys.com/about>



Source: (Rothy's, 2021)

While companies are doing their part to create a circular economy for plastics, we as consumers can also do our part in adopting the 5 Rs approach, see figure below. Learn more on how you can live sustainably by reducing your plastic footprint by researching ways for applying the 5 Rs model in your lifestyle.

### The 5 R's of Mindful Plastic Consumption



- Refuse to consume plastic by opting for environmentally friendly alternatives
- If you can't avoid certain plastic products, then reduce your consumption of them
- Reuse plastic products that you own as much as possible
- Instead of discarding plastics, repurpose them to make other useful products
- Once you have exhausted all ways to use and reuse the plastic, recycle them

## References

Collingwood School. (2020). EcoBricks Project. Calgary, Alberta.

Green Toys. (2021). *Green Toys*. Retrieved from <https://www.greentoys.com/>

Nature Catalysis. (2019, November 19). Plastic Upcycling. *Nature Catalysis*, pp. 945-946.

Rothy's. (2021). *Rothy's*. Retrieved from <https://rothys.com/>



# Curriculum Connections

## Activity 10: Plastic Waste to Energy

### Alberta

- Social 10-1
  - 3.7 - Explore multiple regarding the relationship among people, the land and globalization (spirituality, stewardship, sustainability, resource development)
- Science 30 Unit D: Waste and the Environment
  - 30-D1.3k - Apply the concept of sustainable development to increasing the efficient use of energy
- Biology 30 Unit D: Population & Community Dynamics
  - 30-D2.1sts - Explain why Canadian society supports scientific research and technological development to facilitate a sustainable society, economy and environment

### Ontario

- Grade 9 Geography
  - E1. The Sustainability of Human Systems: analyse issues relating to the sustainability of human systems in Canada
  - E2. Impacts of Urban Growth: analyse impacts of urban growth in Canada (FOCUS ON: Spatial Significance; Geographic Perspective)
- Grade 9 Biology (B1.2)
- Grade 10 Biology (B1.3)

# Activity 10: Plastic Waste to Energy

## Overall Objective

Learners will learn about chemical conversion of plastic waste into energy. Learners will explore Edmonton's Waste Management Centre, learn how the facility manages its waste and what positive impact it has on the city's environment.

## Materials

- Internet-enabled device
- Topic backgrounder
- Eco 360 notebook (we recommend asking learners to maintain a notebook for this program to write down reflections as they go through the program)

## Time Required

90 minutes

## Learning Outcomes

By the end of this activity, learners will:

- Describe how plastic waste can be converted into energy through chemical conversion
- Be able to describe the benefits and challenges of converting waste to energy
- Describe the role of municipalities in managing waste effectively

## Grade Level

Suitable for Grades 9 to 12

# Activities Outline

## Step One

Watch this video with your learners to learn about how plastics can be used to create energy:

- Beyond Recycling: Recovering the Energy in Non-Recycled Plastics:

 [https://www.youtube.com/watch?v=b5eX-J23\\_oE&feature=emb\\_title](https://www.youtube.com/watch?v=b5eX-J23_oE&feature=emb_title) (5 minutes)

## Step Two

In the previous video, a brief overview of how plastic can be used to create energy is explored. In this next step, introduce the process of Pyrolysis which entails a chemical conversion of plastic waste into fuel.

- How Waste Plastic is Converted into Fuel | Plastic Pyrolysis:

 <https://www.youtube.com/watch?v=1STaZYZ-P1w> (4:39 minutes)

## Step 3

Converting plastic waste to fuel is an innovative way of dealing with non-recyclable plastic waste that ends in our landfills. However, there are cons to this process. Continue exploring whether it is efficient to convert plastic waste to fuel. Have learners read the following article to explore co-benefits and challenges associated with converting plastic waste to fuel:


- 'Is burning plastic waste a good idea?' article 5-minute read:



<https://www.nationalgeographic.com/environment/article/should-we-burn-plastic-waste>

#### Step 4


Find out how waste is converted into biofuel in Edmonton by watching the following video with your learners:

 [https://www.youtube.com/watch?v=X5SjcPBLFDU&feature=emb\\_logo](https://www.youtube.com/watch?v=X5SjcPBLFDU&feature=emb_logo) (2 minutes)

At the end of January 2024, Enerkem, Edmonton's contracted biofuel plant, closed down earlier than expected. The plant was the first large-scale waste-to-energy facility funded by the Alberta government. Several factors contributed to the closure. Have learners read the news article below to understand why it shut down:

 <https://www.cbc.ca/news/canada/edmonton/waste-to-ethanol-biofuels-plant-in-edmonton-closes-11-years-ahead-of-schedule-1.7102472>

Learners can then conduct research on the future of green energy in Edmonton. Have them explore alternative options and solutions that the city is implementing to address its waste problem. Learners can use these resources as a starting point:

 [https://www.edmonton.ca/programs\\_services/garbage\\_waste/refuse-derived-fuels](https://www.edmonton.ca/programs_services/garbage_waste/refuse-derived-fuels)

 <https://www.cbc.ca/news/canada/edmonton/edmonton-varme-energy-carbon-capture-facility-1.7094171>

After, discuss the following questions as a class or in small groups:

**Note:** Have learners support their answers with points from the news article and their research.

- Why did the plant close down? What were the negatives and positives?
- Thinking about your answers to question 1, how might failures like the biofuel plant affects government funding for future large-scale waste-to-energy plants?
  - List a couple possible reasons why the government might continue or discontinue such funding.
- Does producing a smaller amount of energy mean that the waste-to-energy technology is unrealistic in sustaining large cities and populations? If so, what could be some possible solutions?
- Why do you think Edmonton has contracted a Norwegian company to convert its waste to energy? What makes the Norwegian company different from the previous biofuel plant?

### Step Five

In groups of 3 - 5, ask learners to research the waste management program in their local municipality. Have the learners compare their local management program with Edmonton's. Learners will record their findings in their Eco 360 notebooks. After completing the research, have each group present their findings in class.

### Learner Assessment

Consolidation: Ask learners to answer the following questions individually or in groups:

1. Is waste to energy a sensible solution to combating plastic waste? Why or why not?
2. What role do you think municipalities play in reducing plastic waste problems in their jurisdiction?



## Optional Extension Activity

Educators may also connect with the facility directly to interview them having a set of questions prepared beforehand. Educators may also ask the facility if a virtual tour of the facility can be organized for their class.

Educators can take learners on a virtual field trip from the comfort of their own classroom or homes using the free app called 'Google Expeditions'. Educators can become guides on different locations where learners can feel immersed in VR while using a VR headset that you insert a smartphone into (cardboard viewers work just as well!). There are also options for AR, where headsets are not required, and they can just simply view the guide via their smartphone or tablet device.

- Please watch the video 'How to Use Google Expeditions' as an educator to learn the basic mechanics:

 <https://www.youtube.com/watch?v=pCyCnoSfQvo> (3:57 minutes)

- Once downloaded, search for the Expedition titled 'What Happens to Your Trash and Recyclables?'. This Expedition takes learners to the Sims Municipal Recycling Facility located in New York City, New York where they learn how trash and recyclables end up at important way stations before they make their way to landfills or for reuse in someone else's hands.