

# Plastic Recycling Options at UNBC - Summary of ENGR 300 Student Reports

April, 2025

## Estimated plastic waste at UNBC

- Amount: 0.4 - 1 t/month
- Predominant plastics: PET, LDPE, PP
  - (based on a single survey of a recycling bin)

## Plastic Recycling Objectives

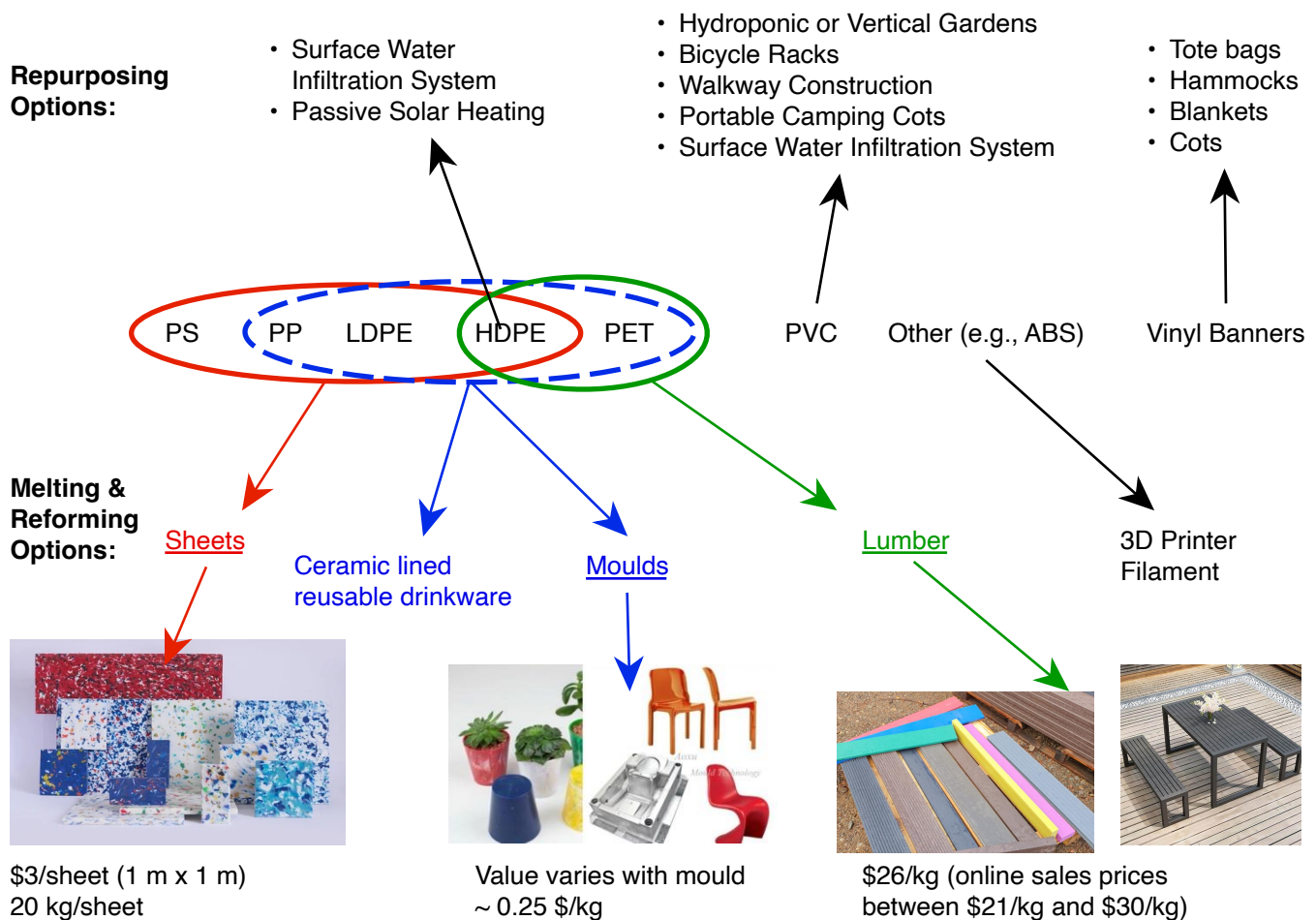
- Increase student involvement in recycling programs.
- Recycle at least 50% of plastic waste at UNBC, prioritizing plastics that are not currently recycled.
- Recycled products should have a minimum useful life 10 years and be recyclable at end-of-life.
- Provide a recycling collection system that maintains a 90% student satisfaction survey for simplicity and usability.
- Net operating cost to UNBC should be less than the cost of current plastic removal program.

## Ventilation

- Due to the use of PET plastic in the process and its narrow range between melting and burning temperatures, adequate commercial ventilation will need to be installed in the building.

## Recycling ideas

- grouped by repurposing waste plastics into new uses, and by melting the plastic and reforming into new produces



## Plastic Collection Options at UNBC

### Cleaned & Sorted after collection

- Use current collection system (one bin for flexible plastic, one bin for containers)



Screening: heavily contaminated materials, mixed polymers, or non-recyclables removed



Manual sorting by resin code

Current UNBC collection



### Cleaned & Sorted by students

- rinse station at recycling collection location
- one bin for each resin code (for clean and label free plastics)
- one bin for unsorted & unwashed plastic

*When taught the right information and given the related infrastructure, the labour and energy of sorting and cleaning the waste stream can be left to the hands that used the plastics to begin with —> addresses dirty plastics, resource intensiveness, and throw-away culture simultaneously*

Collection bins by plastic code



## Plastic Types

Code	Plastic	Plastic	Examples
1	PET	Polyethylene Terephthalate	Drink bottles (water, soft drinks), food containers, tote bags, fleece, carpet
2	HDPE	High-Density Polyethylene	Bottles (e.g., detergent), milk jugs, containers, pails, pipe, geo liner, agricultural plastic
3	PVC	Polyvinyl Chloride	Window profile, containers, siding, flooring, pipe, shower curtains, lawn chairs
4	LDPE	Low-Density polyethylene	Plastic bags (e.g., grocery bags), tubing, dispensing bottles, sandwich wraps, flexible lids, lab equipment
5	PP	Polypropylene	Food containers (e.g., yoghurt), straws, dishware, bottle caps, plastic cups, automotive parts
6	PS	Polystyrene	Coffee cup lids, trays, crates, bulk bags, disposable cutlery, clamshell containers, packing peanuts, insulation boards
7	Other	ABS, Acrylic, Nylon, EVA, PC, TPO, TPU, TPE, ...	Polycarbonate sheet, Acrylic sheet, ABS pipe, LEGO

## Sample plastic processes machines. Many different models are available

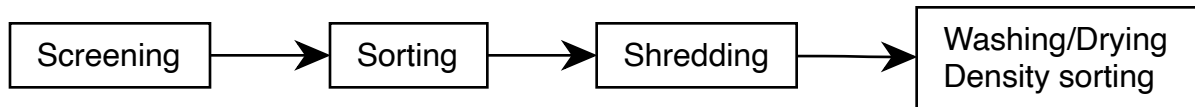
### Machines can also be made DIY

Machine	Sample Costs	Throughput	Power
 <p><b>Shredder - Polyvora</b>  <a href="https://polyvora.io/products/shredder-v4-x?_pos=2&amp;_psq=shredder&amp;_ss=e&amp;_v=1.0">https://polyvora.io/products/shredder-v4-x?_pos=2&amp;_psq=shredder&amp;_ss=e&amp;_v=1.0</a></p>	\$11,000 - \$16,000 USD		
 <p><b>Shredder - Precious Plastics</b>  <a href="https://community.preciousplastic.com/academy/build/shredderpro">https://community.preciousplastic.com/academy/build/shredderpro</a>  <a href="https://bazar.preciousplastic.com/machines/shredder-pro/shredder-pro-fully-built/new-v4-shredder-pro-ce-certified-and-factory-made-with-all-safety-standard-clone">https://bazar.preciousplastic.com/machines/shredder-pro/shredder-pro-fully-built/new-v4-shredder-pro-ce-certified-and-factory-made-with-all-safety-standard-clone</a></p>	\$3,500 \$3,750 \$6,450 \$6,700 + \$800 shipping	50 kg/h 14 kg/h 25 kg/h 25 - 30 kg/h	2.2–3.4 kW 2.7 kW 3.7 kW 4 kW
 <p><b>Washer - Precious Plastics</b>  <a href="https://www.puruimachinery.com/low-price-for-plastic-recycling-machine-pet-bottle-flakes-crushing-and-washing-production-line-product/">https://www.puruimachinery.com/low-price-for-plastic-recycling-machine-pet-bottle-flakes-crushing-and-washing-production-line-product/</a></p>	\$5,000 \$6,750	150 kg/h 55 kg/h	10 kW 2.5 kW
 <p><b>Extruder - Precious Plastics</b>  <a href="https://community.preciousplastic.com/academy/build/extrusionpro">https://community.preciousplastic.com/academy/build/extrusionpro</a></p>	\$3,000 \$3,450	20 kg/h 5 kg/h 4 hour/day max	5 kW 2.2 kW
 <p><b>Extruder Pro</b>  <a href="https://bazar.preciousplastic.com/machines/extruder-pro/extruder-pro-fully-built/extrusion-pro-v4-free-moulds-available-clone/">https://bazar.preciousplastic.com/machines/extruder-pro/extruder-pro-fully-built/extrusion-pro-v4-free-moulds-available-clone/</a></p>	\$6,400 + \$1,000 shipping with Free Lumber Mould	25 - 30 kg/h 4 hour/day max	8 kW
 <p><b>Cooling machine - Precious Plastics</b>  <a href="https://www.preciousplastic.com/solutions/machines/pro">https://www.preciousplastic.com/solutions/machines/pro</a></p>	\$5,000	20 kg/h	
 <p><b>Sheet Press - Polyvora</b>  <a href="https://polyvora.io/products/sheetpress-v4-x">https://polyvora.io/products/sheetpress-v4-x</a></p> <p><b>Press - Precious Plastics</b>  <a href="https://www.preciousplastic.com/solutions/machines/pro">https://www.preciousplastic.com/solutions/machines/pro</a></p>	\$10,500 to \$15,150 USD 1,000 mm x 1,000 mm \$9,750 1,000 mm x 1,000 mm \$5,850 600 mm x 600 mm	5 - 20 kg/h 20 kg/cycle	7.2 kW 15 kW 5 kW

Moulds range in prices from \$1000 (plant pot) to \$40,000 (single piece chair)

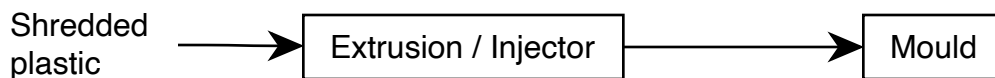
## Processing Steps & Equipment for Melting & Reforming Options

### Preparing plastic

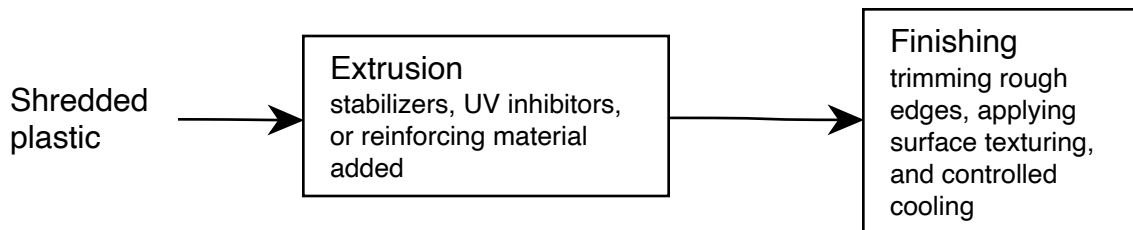


Improper sorting also leads to polymer incompatibility, causing lower-quality recycled products

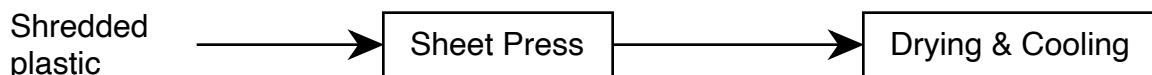
### Moulds



### Lumber



### Sheets



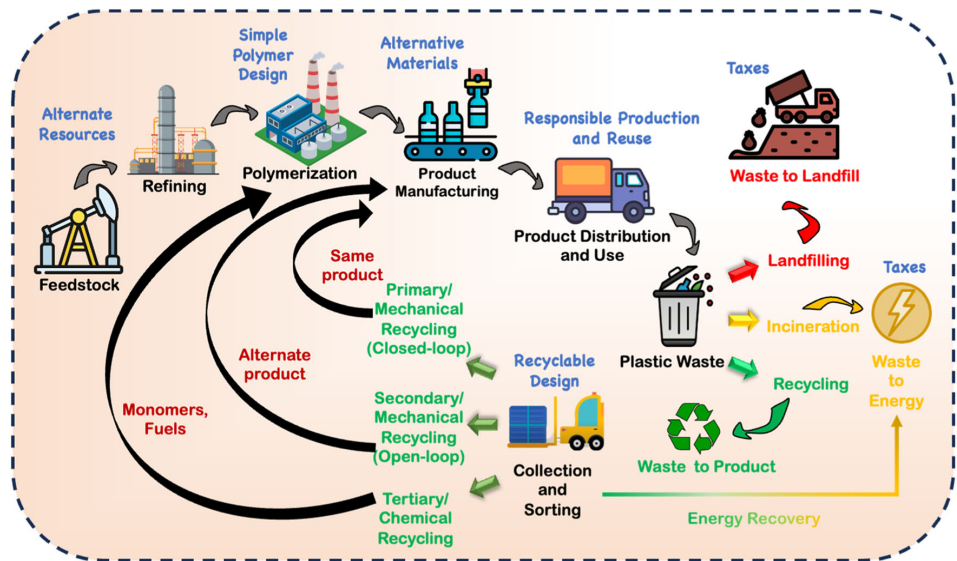
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## Equipment Needed for Repurposing Options

Repurposing equipment needed

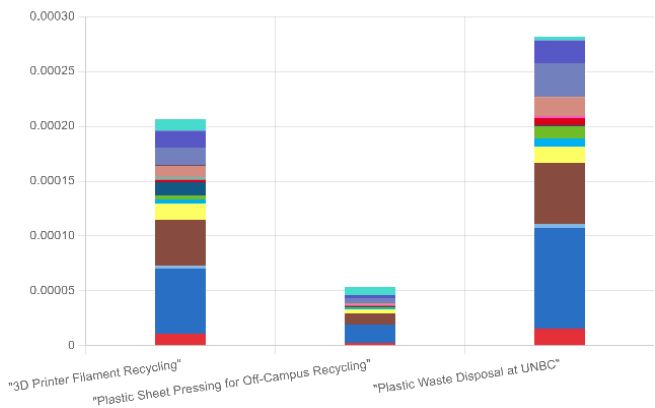
- heavy-duty sewing machine
- outdoor-rated, high-strength thread
- carabiners
- strong rope
- scissors or rotary cutter
- PVC pipe cutter
- water pump and tubing
- net cups and growing medium
- power drill with a drill bit set

Environmental Analysis



Singh and Walker. 2024. Plastic recycling: A panacea or environmental pollution problem. <https://doi.org/10.1038/s44296-024-00024-w>

Select figures from student analysis:



Mechanical recycling results in a decrease in the majority of environmental impacts from waste plastics, including:

- GHG emissions
- Human toxicity
- Material resource
- Ozone depletion

The exception is water consumption, which Increases with mechanical recycling vs alternatives.

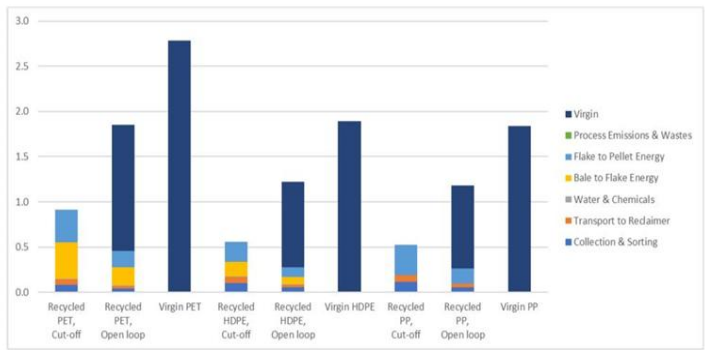


Figure 5: Global Warming Potential Results for Recycled and Virgin Resins [3].

Table 1: LCA comparison of Mechanical and Chemical Recycling Technology

Environmental Impact	Mechanical Recycling	Chemical Recycling
CO <sub>2</sub> e kg/kg recycled product	0.28 kg CO <sub>2</sub> e/kg [4]	1.9 kg CO <sub>2</sub> e/kg [5]
Average Energy Consumption per kg recycled product	0.08 kWh/kg (Table 3)	0.63 kWh/kg [6]