# Needs Statement

The failure to have recyclables make it into/through the recycling system causes hundreds of tonnes of waste to be added to landfills on a yearly basis, costing citizens millions of dollars a year, an effect that will grow as population increases. A method to increase the number of recyclables making it into/through the system is required.

# Problem Statement

Design a system to increase the number of recycles able to *enter* the recycling stream without being discarded as waste.

***Note:*** *‘enter the recycling stream’ can include residential, public, and/or industrial entry points for the local municipality’s recycling stream. I’m also assuming that our scope is limited to Canadians.*

# Functions + Design Goals

## Functions

The function of the system is to increase the concentration of valid recyclables that enter the recycling stream.

***Note:*** *‘valid recyclables’ means recyclables that will not be sent to a waste facility at any point in the recycling stream.*

|  |  |  |
| --- | --- | --- |
| **Input** | **Function** | **Output** |
| Recycling load at user endpoint | The system increases concentration of recyclables that will not be sent to waste facilities | Recycling load at user enpoint with reduced waste |

## Design Goals

**Safety** – the system should be certifiable by Canadian national safety standards and should meet all requirements by a Canadian accredited certification body

**Environmental impact** –the design packaging and product should be recyclable, and should have low energy consumption

**Public acceptance** – the design should be able to easily fit in the confines of a standard Canadian residence, and should cost a small subset of the Canadian national average spending on household appliances

**Reliability** – the design should last as long as the average household appliance

**Performance** – the design should *significantly* increase the concentration of valid recycling entering the recycling stream

**Ease of operation** – the design should be straight-forward to use, and require little technical knowledge for assembly and operation.

**Parts standardization** – parts should be available for manufacturing in Canada to avoid large emissions from shipping and minimize shipping costs.

# Design Specifications

## Constraints + Objectives

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Specification Type** | **Specification** | **Basis For Measurement** | **Criteria** | **Unit** |
| 1 | Constraint (yes-no) | Design must meet safety standards | Canadian national safety standards for appliances | Does the design meet Canadian national safety standards? | Yes / No |
| 2 | Constraint (inequality) | The design must be environmentally friendly | Amount of recycled material used in product | Product is at least comprised of 70% recycled materials | % of recycled material |
| 3 | Constraint (equality) | The design must be environmentally friendly | Amount of product able to be recycled | Product is exactly 100% recyclable after end of useful life | % of material able to be recycled |
| 4 | Constraint (inequality) | The design must be environmentally friendly | Amount of recycled packaging used | Packaging is comprised of at least 55% recycled materials | % of recycled material |
| 5 | Objective | The design should be relatively cheap | Cost of manufacturing | Design should cost less than $77.60 to produce | $ (CAD) |
| 6 | Constraint (inequality) | The design must fit into the average residence | Dimensions of product | The product must be less than 0.05m^3 | Metres^3 |
| 7 | Objective | The design should last as long as other appliances | Span of useful life of all materials | The product should last at least 13 years | Years |
| 8 | Constraint (inequality) | The design must be more effective than the current average recycling stream | Percentage of recyclables that enter recycling stream | The system must have at least 25% of recyclable materials enter recycling stream | % |
| 9 | Objective | The design should be easy to be adopted by the average consumer | Rating of useability from market research/study | The product should be at least an 7 on a useability scale as rated by 10 non-technical people. | Scale out of 10 |
| 10 | Constraint (yes – no) | The design must have accessible parts | Accessibility of parts from Canadian manufacturers | All parts must be available from within Canada | Yes / No |
| 11 | Objective | The design should be scalable | Intended end user | Intended end-user should be residential, but should scale to industry | ??? |

## Notes and Design Goal Links

[1] **Safety** – Can be found at <https://www.canada.ca/en/health-canada/services/home-safety/electrical-products.html>

[2] **Environmental impact** –The Environmental Defence agency calls for all products to be at least 70% recyclable by 2025. <https://environmentaldefence.ca/plasticsdeclaration/>.

[3] **Environmental impact** –The objectives outlined by Government of Canada is to have products be 100% recyclable by 2025.

<https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/plastics-proposed-integrated-management-approach.html>

[4] **Environmental impact** –The objectives outlined by Government of Canada is to have 55% of packaging be from recycled materials by 2025.

<https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/plastics-proposed-integrated-management-approach.html>

[5] **Public acceptance** – Canadian national average spending on household appliances is $582. If we assume Canadians are willing to spend 1/5 of this on waste management and a profit margin of 50% is assumed, the product has to be produced at a price of less than $77.60.

<https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110022201>

[6] **Public acceptance** – The average garbage can size is 50 litres = 0.05 metres

[7] **Reliability** – The average garbage disposal lasts around 13 years. As such, it is not unreasonable to expect the entire household waste management system to last this long.

<https://www.digitaltrends.com/home/how-long-do-appliances-last/>

[8] **Performance** – Only 25% of recyclables are sent to recycling centers; 75% would be an improvement of 3x.

<https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/plastics-proposed-integrated-management-approach.html#toc2>

[9] **Ease of operation** – Should require little technical knowledge because Canadians are relatively unwilling to adopt new technology.

<https://www.ic.gc.ca/eic/site/062.nsf/eng/h_00109.html>

[10] **Parts standardization** – The design can include wifi/internet access as 99% of Canadians have access to internet.

<https://crtc.gc.ca/eng/publications/reports/policymonitoring/2019/cmr1.htm>