**Research: Recycling**

**Summary**

Some history [1]:

* January 2018: China set strict cleanliness standards for the material it purchases
  + “Many of the Canadian outfitters that relied on China were left stranded because they couldn’t guarantee the quality of their product”
    - January 2017: exports of plastics and scraps to China = 6700 tonnes; paper-scrap exports = 53 000 tonnes
    - January 2018: exports of plastics and scraps to China = 578 tonnes; paper-scrap exports = 15 800 tonnes

Some quick stats:

* Canada recycles just 9% of its plastics with the rest dumped in landfill and incinerators or tossed away as litter [2]
* The blue box diverts only 8% of Ontario’s material from landfills [1]
* In 2016, more than 3.2 million metric tonnes ended up as garbage [2]
  + 86% went to landfill
  + 4% went to incinerators
  + 1% ended up as litter
  + Most of the wasted plastic comes from offices, institutions, or industries
* In 2017 [2]:
  + Ontario’s Blue Box Program captured 28% of all plastic packaging generated in 2017
* In 2016, the U.S. exported 16 million tons of plastic, paper and metals to China [3]
  + 30% of these mixed recyclables were ultimately contaminated by non-recyclable material, were never recycled, and ended up polluting China’s countryside and oceans [3]
* About 2/3 of Canadian waste ends up in landfills. Much of this is produced by industrial, commercial, institutional, and construction/demolition sectors [1]
  + Serviced by private waste haulers [1]
    - Unless they can make a profit selling the recyclables, they have little incentive to recycle [1]
* In 2011, ¾ of Ontarians considered the weekly act of sorting and disposing as their “primary environmental effort” (according to survey by Stewardship Ontario) [1]
  + Shows interest in recycling on the consumer’s part

Where it gets interesting:

* Recycling is a commodity service [1]
  + After being sorted (plastic, paper, metal, etc), the materials are sold to “end markets” [1]
  + In 2016: blue-box collection in Ontario cost municipalities a total of $347 million [1]
    - Only about $95 million was recovered from sales [1]
* Single-stream recycling (where all recyclables are placed into the same bin):
  + Easier for consumers, but results in about 1/4 of the material being contaminated [3]
    - Plastic recycling presents the biggest challenge [3]
      * Often contaminated by other materials [3]
      * Consumer goods companies are reluctant to buy recycled plastic unless it is as pure as virgin plastic [3]
* The global plastic recycling market is projected to grow by $14.74 billion between now and 2024 [3]
  + Companies are trying to enhance the quality of recycled plastic [3]

Looking at some leaders in recycling:

* Germany [4]:
  + Official statistics claim that 48.8% of plastic waste was recycled
    - BUT the numbers are misleading – they are based on the amount collected, not the amount recycled
    - It is estimated that the real number is closer to 38%
      * Problem 1: poorly sorted plastic (on the consumer’s end)
        + It is estimated that up to 50% of general rubbish ends up in bins designated for plastic
        + This needs to be separated
      * Problem 2: plastic packaging is often made from a variety of polymer types
        + Only single-variety plastics can be recycled
        + Automated facilities are unable to sort food containers made from different types of plastic
        + Results in much mixed-plastic packaging to be discarded
      * Another problem: recycled plastics degrade in quality

Some comments on materials:

* Recycled plastics degrade in quality [4]
* Glass and metal can be recycled indefinitely [3]

On contamination (consumers throwing non-recyclables into recycling bins):

* When unrecyclable items are placed in the box, you “basically end up paying to process [the item] twice” – Jim McKay, who oversees Toronto solid-waste management services [1]
* Contamination can damage other materials, especially in cities where everything goes into the same bin (like Toronto) [5]
  + This can turn tonnes of other perfectly good recyclables into garbage, or at least lower their value and make them more difficult to sell to offset the cost of recycling programs [5]
  + It is estimated that each percent point decrease in contamination could lower recycling costs in Toronto by $600 000 to $1M per year - Jim McKay (general manager of solid waste management for City of Toronto) [5]
  + Furthermore, if the city’s average contamination rate reaches 27%, it will suffer an extra $5M charge [5]
  + “single-stream” programs have the highest contamination [5]
* Food residue can contaminate other materials and make them un-recyclable [6]
  + This is mostly problematic where single-stream recycling is used (i.e. everything ‘recyclable’ goes into one bin on the consumer’s end)
* Common contaminants [5]:
  + Glass and Styrofoam: they break into shards and pieces that contaminate paper and plastic when they get embedded
  + Plastic bags, which often contain food residue
  + (depending on city) black plastic like coffee cup lids
    - Technology at local Canada Fibers plant can’t identify and sort this
* Toronto contamination rates can be 25%+ (2018) [5]
  + They also find items that are hazardous to plant employees: blood bags, IV tubing, needles and sharps [5]
* In comparison [5]:
  + St.John’s and Vancouver have contamination rates of 3-4.6%
    - Keeps costs down and makes it easier to sell recyclables for a higher price
      * St.John’s is able to sell almost all it’s recyclables within Canada
        + How they did it: they no longer accept common contaminants
    - In Vancouver, glass goes in a separate bin, and plastic bags and Styrofoam must be returned to a depot
    - Both cities require their residents to separate paper, cardboard and containers in their curbside recycling, unlike Edmonton and Toronto

Some final thoughts:

* St.John’s is able to have a lower contamination rate, but they did so by no longer accepting glass [5]. This is unfortunate, since glass is indefinitely recyclable [3]
  + Can we find a way to make glass no longer a contaminant? Better sorting earlier in the process so broken shards don’t contaminate other materials?
* Canada Fibers can’t identify and sort black plastic [5] – can we find a way to?
* A need to lower contamination levels – will allow more to be recycled and will result in a higher quality of recycled goods (more appealing to buyers – more profit, more incentive to recycle in the first place)

Psuedo-IEEE References:

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| --- | --- |
| [1] | <https://thewalrus.ca/why-recycling-doesnt-work/> |
| [2] | <https://rco.on.ca/canada-recycles-just-9-per-cent-of-its-plastics/> |
| [3] | <https://blogs.ei.columbia.edu/2020/03/13/fix-recycling-america/> |
| [4] | <https://www.dw.com/en/plastic-waste-and-the-recycling-myth/a-45746469> |
| [5] | <https://www.cbc.ca/news/technology/recycling-contamination-1.4606893> |
| [6] | <https://recyclebc.ca/clean-materials-need/> |

**Extra (Rough) Notes - Breakdown by Source**

NOTE: points highlighted in blue are comments made by me. Everything else is a direct quote or paraphrased.

**Article**: “Some Towns Are Trashing Their Costly, Inefficient Recycling Programs”

<https://reason.com/2019/03/06/recycling-expensive-trash-landfill/>

* Large portion of America’s plastic and paper waste used to go to China
  + There it was recycled into other goods
* Since the end of 2017, China has restricted what they accept – such as waste paper products
* As a result, some American cities and towns are sending everything to the landfill
* Recycling has become EXPENSIVE
  + Far cheaper to bury the trash

Considering a municipal recycling program:

* About 25% of what enters the recycling stream is too contaminated to be useful, according to National Waste & Recycling Association
* You have to collect and transport the recycling (greenhouse emissions)
* Paper has to be pulped – requires heat (coal-powered plant = greenhouse emissions)
* Plastic has to be washed with hot water then melted down

People are not very good at recycling:

* Only about 9.5% of plastic generated in 2014 was recycled that year
  + 15% being incinerated
  + 75.5% winding up in landfills
  + (according to Environmental Protection Agency)

**(Canadian) Article**: Why Recycling Doesn’t Work

<https://thewalrus.ca/why-recycling-doesnt-work/>

* In 2011, ¾ of Ontarians considered the weekly act of sorting and disposing as their “primary environmental effort” (according to survey by Stewardship Ontario)
  + So there seems to be interest in recycling
* Recycling is a commodity service
  + After being sorted (plastic, paper, metal, etc), the materials are sold to “end markets”
* About 2/3 of Canadian waste ends up in landfills
* Almost 2/3 of Canada’s waste is produced by industrial, commercial, institutional, and construction/demolition sectors
  + Serviced by private waste haulers
    - Unless they can make a profit selling the recyclables, they have little incentive to recycle
* In 2016: blue-box collection in Ontario cost municipalities a total of $347 million
  + Only about $95 million was recovered from sales
* Our blue boxes contain a lot of “lightweight, complicated materials that cost a fortune to recycle”
  + When unrecyclable items are placed in the box, you “basically end up paying to process [the item] twice” – Jim McKay, who oversees Toronto solid-waste management services
* The blue box diverts only 8% of Ontario’s material from landfills
* Residential recycling also has a significant environmental footprint
  + Especially in transportation/carbon emissions (especially in rural areas)
* January 2018: China set strict cleanliness standards for the material it purchases
  + “Many of the Canadian outfitters that relied on China were left stranded because they couldn’t guarantee the quality of their product”
    - Sounds like cleaning the recyclables could be a major factor
  + January 2017: exports of plastics and scraps to China = 6700 tonnes; paper-scrap exports = 53 000 tonnes
  + January 2018: exports of plastics and scraps to China = 578 tonnes; paper-scrap exports = 15 800 tonnes

**Article**: Recycling in the U.S. Is Broken. How Do We Fix It?

<https://blogs.ei.columbia.edu/2020/03/13/fix-recycling-america/>

* In 2016, the U.S. exported 16 million tons of plastic, paper and metals to China
  + 30% of these mixed recyclables were ultimately contaminated by non-recyclable material, were never recycled, and ended up polluting China’s countryside and oceans
* Glass and metal can be recycled indefinitely; paper can be recycled five to seven times before it’s too degraded to be made into “new” paper; plastic can only be recycled once or twice—and usually not into a food container—since the polymers break down in the recycling process.
* Single-stream recycling, where all recyclables are placed into the same bin, has made recycling easier for consumers, but results in about one-quarter of the material being contaminated
  + Plastic recycling presents the biggest challenge because the plastic is often contaminated by other materials and consumer goods companies are reluctant to buy recycled plastic unless it is as pure as virgin plastic
* Global demand for paper and cardboard is expected to grow by 1.2 percent a year, mainly due to the growth in e-commerce and the need for packaging; recycled paper will be essential to meeting this demand
* And the global plastic recycling market is projected to grow by $14.74 billion between now and 2024
  + As a result, companies are trying to enhance the quality of recycled plastic as well as incorporate it into the plastic products they produce
  + Plastic waste, especially PET and HDPE, is being recycled into packaging, building and constructions, electronics, automotive, furniture, textiles and more

<https://rco.on.ca/canada-recycles-just-9-per-cent-of-its-plastics/>

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* In 2016, more than 3.2 million metric tonnes ended up as garbage
  + 86% went to landfill
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* In 2017:
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Looking at Germany:

<https://www.dw.com/en/plastic-waste-and-the-recycling-myth/a-45746469>

* Germany is hailed as the worldwide recycling champion
  + Official statistics claim that 48.8% of plastic waste was recycled
    - BUT the numbers are misleading – they are based on the amount collected, not the amount recycled
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* Problem 1: poorly sorted plastic (on the consumer’s end)
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<https://recyclebc.ca/clean-materials-need/>

* Residual food can contaminate other materials and make them un-recyclable
  + This is mostly problematic where single-stream recycling is used (i.e. everything ‘recyclable’ goes into one bin on the consumer’s end)

<https://www.cbc.ca/news/technology/recycling-contamination-1.4606893>

* Canadians throwing garbage into blue bins – costing recycling programs millions of dollars a year
* Toronto contamination rates can be 25%+ (2018)
* They also find items that are hazardous to plant employees
  + Blood bags, IV tubing, needles and sharps
* Contamination can damage other materials, especially in cities where everything goes into the same bin (like Toronto)
  + This can turn tonnes of other perfectly good recyclables into garbage, or at least lower their value and make them more difficult to sell to offset the cost of recycling programs
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  + Furthermore, if the city’s average contamination rate reaches 27%, it will suffer an extra $5M charge
* The technology at the local Canada Fibers plant can’t identify and sort black plastic
  + Like coffee cup lids
    - This is garbage and acts as contamination
* In comparison:
  + St.John’s and Vancouver have contamination rates of 3-4.6%
    - Keeps costs down and makes it easier to sell recyclables for a higher price
      * St.John’s is able to sell almost all it’s recyclables within Canada
        + How they did it: they no longer accept common contaminants
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