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Thinking Sensibly about Recycling and the Environment

By David Seymour

About the Author

David Seymour directs the Centre's Saskatchewan office. He holds degrees in Electrical Engineering and Philosophy from the University of Auckland, where he also taught Economics. After working as an engineer in New Zealand he is applying his passion for sound policy analysis to policy issues on the Prairies. In his first two years working for the Frontier Centre, David has carried out extensive media work, presenting policy analysis through local and national television, newspapers, and radio. His policy columns have been published in newspapers in every province as well as the *Globe and Mail* and the *National Post.* David has produced policy research papers on telecommunications privatization, education, environmental policy, fiscal policy, poverty, and taxi deregulation. However his major project with the Frontier Centre is the annual Local Government Performance Index (LGPI). The inaugural LGPI was released in November 2007 and comes at a time when municipal accounting standards in Canada must improve if the municipal government sector is to reach its potential as an economic growth engine for Canada.

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Executive Summary

Environmental concern is a powerful political motivator that influences public policy, and recycling is often presented as a solution to some environmental concerns. It is important, therefore, to use logical processes with quantitative data to evaluate the reality of these concerns and the effectiveness of recycling at addressing them;

- Recycling must be put into perspective with the other two R's—reducing and reusing. In contrast, these two waste-reduction strategies highlight the fact that recycling is actually an industrial process. It may or may not yield a net saving of resources, but it always consumes some resources in the course of saving others;
- Specifically, recycling promises to alleviate the problems of landfill pollution and space occupation, of raw-material extraction that damages the environment, and of resource depletion that can lower future living standards;
- An analysis of the landfill problem finds that over the next 100 years we should expect landfill to occupy less than 1 per cent of 1 percent, or one-ten-thousandth of Canada's total land area. This assumes current waste production per capita and population both double over that period. Further, the Union of Concerned Scientists, among others, has stated the pollution threat from landfills is negligible. Finally, areas used for landfills are not necessarily "lost" forever; they are often redeveloped as useful land.
- For an example of extraction impacts a forestry case study finds that Canadian forestry is sustainable, forest cover is stable, fires and parasite infestations disturb more forest each year than does harvesting and paper production does not account for the majority of forest harvesting. If all paper recycling ceased, harvesting activity would have to increase by a maximum of one-sixth; yet the potential for more reductions in harvesting from more paper recycling seems minimal.
- The contention that our standard of living is tied to resource depletion is unfounded given the ability of technological innovations to provide the same or better usefulness from fewer or different resources. This does not mean that innovation is a complete solution to resource depletion, but it is a very powerful one. Correspondingly, recycling may be a net reducer of consumption, but it is not a complete solution to resource depletion.
- The decision to recycle more or less material ultimately depends on the values placed on different types of resources, including land for landfills, people's time, and energy and commodities.
- The best guide to the most valuable combinations of resources, and therefore optimal recycling, is to acknowledge the prices that people put on different goods. If recycling is profitable because the resources it consumes are worth less than the landfill space and new materials it saves, more recycling should be done. If not, less should be done.

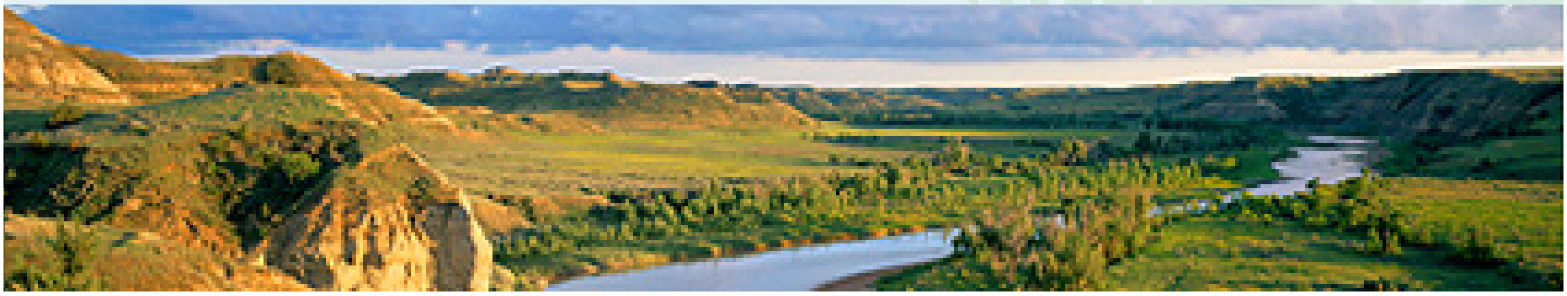
- The prices of different waste disposal options almost invariably include the price of complying with environmental regulations. Preventing environmental harm by regulating potential harms at their source and then allowing waste disposal options based on the price of complying with those regulations is preferable to the belief that recycling universally saves resources, as it allows real environmental harms to be more directly addressed. It also allows price signals to function within waste-management systems.
- Governments involved in waste management should use contestable and transparent processes to ensure the most cost-effective waste-management solutions are used. This provides an incentive to make better use of resources according to the prices society places on them.

Introduction

The process of recycling has become integral to the waste-management strategies of cities and countries. Almost all governments in the developed world are involved in promoting, subsidizing or providing recycling services as part of waste management, and sometimes all of the above. Recycling is underwritten the belief that it addresses environmental concerns.

Given its ubiquity in public policies concerning waste disposal and the environment, it is important for policy makers who want to maximize human welfare to have a clear understanding of what problems recycling should solve and how effectively it solves them.

> ***Regulating potential harms at their source and then allowing waste disposal options based on the price of complying with those regulations is preferable...***



Defining Environmental Concern

Environmental concern is one of the most powerful political motivators of the early 21st century. For example, in successive Gallup polls for the past two decades, one-half to two-thirds of Americans have said they prefer environmental protection at the expense of sacrificing economic growth.[1] Almost all political parties devote part of their manifesto to environmental policy, and entire political parties have been elected to various parliaments on green platforms.[2] Meanwhile, a new industry has sprung up to sell alternative products said to be more environmentally friendly than conventional ones. Corporate advertising is awash with claims that the company in question is careful to do business in an environmentally friendly way. Considering the weighting that environmental concern is given, it is worth defining what, exactly, the concern is.

Generally, concern is "an uneasy state of blended interest, uncertainty, and apprehension" or "matter for consideration."[3]

In the context of the environment, it usually means people are worried that one or several of three things will happen because of human activity:

- The environment will become uninhabitable for humans;
- The environment will remain habitable but will no longer be able to provide sufficient resources for our current way of life;
- The environment will lose intrinsic value although people will continue to inhabit it at some level of comfort.

All these concerns manifest themselves regularly in media stories about the environment, in the campaigns of environmental lobby groups and in public opinion surveys. For example, media stories regularly report that human impact on the environment will result in the following:

- changes in climate that will lead to adverse weather events, such as hurricanes, that will destroy property or make agriculture non-viable, promote disease or limit access to fresh water;
- critical resources such as oil will run out;
- changes in land use will destroy habitat and lead to species extinction. This might have a cascading effect that will lead to collapsing eco-systems.

All of these concerns are important for two reasons. First, it is possible that some or all of them could come true, resulting in adverse effects on people's way of life. Second, even if all of these are exaggerated and impossible, the level of public concern around them means they must be examined. This paper examines the potential and the reality for recycling to alleviate environmental concern.

The Potential of Recycling

In view of the environmental concern defined above, recycling is often presented as a way to reduce the possible impact of human activity on the environment. Various proponents of recycling often claim that recycling will do one or more of the following:

- Reduce the amount of space required in landfills, and reduce the harmful ecological impact of landfills;
- Reduce the need to extract new raw materials and therefore the effects of extraction;
- Provide a source of raw materials that is independent of natural reserves and therefore expand the amount of resources available for consumption.

There are so many potential positives to recycling that it seems hard to imagine any arguments against it. However, before committing to recycling simply because of these goals, it is logical to apply two tests:

1. How useful is the goal?
2. How successfully does recycling achieve the goal?

In order to apply the second test, it is worth putting the recycling process into perspective against two other waste-reduction strategies with similar aims.

The Three R's – Putting Recycling into Perspective

Reduce, Reuse, Recycle has been a resource conservation maxim for some time, but it also brings an important feature of recycling into focus. Of the three, recycling is the only one that actually consumes resources.

To define the three:

- Simply reducing consumption means that to the extent it is practiced, no resources are consumed;[4]
- Reusing resources originally acquired for one use does not consume any additional resources. In fact, it has the positive benefit that it can make some new consumption redundant. For example, reusing plastic grocery bags to transport other goods can reduce a person's total consumption of packaging;
- Recycling involves collecting and sorting used materials followed by some form of industrial process that takes a finished product and transforms it into a raw material for further processing into a new product.[5]

It is the industrial process required to transform an old finished product into new raw material that differentiates recycling from the other two R's. To achieve recycling's stated aims, it must fulfill an important condition: The collecting, sorting and reprocessing must have a smaller impact than the alternative of dumping a product and then extracting and manufacturing new materials.

At face value, this condition may seem frivolous. The mere fact that recycling removes the need to dump a product and then extract new raw materials should put its total resource use well ahead of dumping and using virgin materials.

Indeed, examination of recycling on the basis of materials and energy consumed in comparison to other waste-management methods finds that "[v]irtually all studies that have [examined the pollutant emissions of the different waste-disposal strategies directly] have come down decisively on the side of recycling."[6] However, recycling does not necessarily reduce the total ecological impact in as much as it shifts the impact: "[T]here are clear materials and energy conservation benefits to recycling, [but] the picture regarding environmental benefits and risks is complex, especially when specific hazardous pollutants are taken into account."[7]

J. Visali, who is responsible for the quote above, in his paper "The Similarity of Environmental Impacts from All Methods of Managing Solid Waste," goes on to say:

> Comparing the environmental impacts of the four major methods [of waste disposal] is a complex task due to three major factors. First, different methods result in process emissions that are released into different mediums …. Second, different methods of recycling do not affect the same populations and ecosystems due to different locations for processing plant and residue disposal sites …. Third, while different methods can generate similar pollutants, they can also generate different pollutants that have different toxicities and risks.[8]

It is not difficult to imagine how the different effects of recycling could be greater than those of dumping and replacing. For example, examination of paper recycling found it produces more toxic byproducts than does virgin paper production.[9] If this is correct, paper recycling does not so much eliminate pollution as shift it to other processes that may or may not be better for the environment. Some examples show the potential for recycling to waste resources:

- Some municipalities in the United States have encouraged citizens to put used containers through the dishwasher as part of recycling.[10] In this case, any additional dishwasher cycles resulting from the need to wash recyclables must be counted against any resource savings from recycling. Considering the energy, water and chemicals used by dishwashers, is this a good trade off?
- Curbside recycling requires additional trucks to collect separate waste streams. The City of Los Angeles estimated it had to double its number of trucks to collect the separate recycling stream.[11] Were these extra 400 trucks on the road worth any reduction in pollution from substituting used materials for virgin materials in the manufacturing processes?
- In the late 1990s, Saskatchewan inadvertently attracted vast amounts of waste from Manitoba as opportunistic recyclers clamoured to collect the generous 15-cent bounty for each aluminum can. The phenomenon was so great, the province even passed laws allowing police to search vehicles entering the province for illegal recycling.[12] Was this interprovincial hauling an efficient use of resources?

These examples are inconclusive. It is possible that dishwashing containers and storing them for recycling is worthwhile environmentally—meaning that its impact is smaller than dumping and replacing them. It is possible that additional garbage trucks make a smaller environmental impact than dumping goods and then extracting virgin materials. Hauling recycling from Winnipeg to Regina might have been better from the point of view of total ecological impact than dumping it in Winnipeg.

A sensible conclusion, then, is that recycling is often but not necessarily the best way to manage waste. Bearing in mind that, compared to reducing and reusing, recycling is a mixed blessing for those who wish to reduce their overall environmental impact it is worth examining some of the other claimed advantages of recycling in detail.

Compared to reducing and reusing, recycling is a mixed blessing for those who wish to reduce their overall environmental impact...

Recycling and Landfills

Municipalities often justify recycling programs with claims such as the following:

> Ottawa residents generate approximately 330,000 tonnes of waste each year, much of it recyclable. This is equal to filling Scotiabank Place 160 times each year with garbage. By Ottawa residents reducing, recycling and reusing, we stop 1/3 of our residential waste from going to landfills.[13]

In this section, we apply the two tests of pursuing relevant goals and the effectiveness at achieving these goals to the first recycling objective:

Reducing the amount of space required in landfills for waste, and reducing the harmful ecological impact of landfills.

The first claim implicit in the City of Ottawa statement, one commonly found in justifications for recycling, is that landfills take up a lot of space. "A lot of space," however, is a relative term. Because nobody seriously suggests that garbage be dumped in the centre of a major city, the Scotiabank Place comparison is misleading. A more relevant place to start would be Canada's total land area, followed by some even more relevant subsections of it that are close enough to major cities to be landfill sites.

Taking Statistics Canada's 2006 figure, Canadians generated 35-million tonnes of waste[14] and combining this fact with Bjorn Lomborg's assumption of 645 kilograms per cubic metre[15] implies that Canada generates approximately 54-million cubic metres of waste per year.

While that is a daunting figure, it will prove that large numbers, per se, can be meaningless. If this waste were to be buried in a landfill 10m deep (a conservative assumption as some are several times deeper than this),[16] it would require 5.4-million square metres. This is still a daunting figure, but it might be better handled as 5.4 square kilometres or a square 2.3 kilometres on each side.

Canada's total land area is 9,984,670 square kilometres,[17] so that 5.4 square kilometres would be 0.000054 per cent of Canada's land area. That figure is so small as to be meaningless, but it can be made more meaningful and realistic using the following assumptions:

- Over the next 100 years, the Canadian population will double and each person will dispose of twice as much waste per year by the end of the 100 years.[18] This hypothetical increase would be linear and the average national disposal per year for the next century would be approximately 2.35 times what it is now.[19]
- The vast majority of Canada's land area is too far away from major cities to take garbage to or it is not desirable as a landfill location due to environmental or human concerns; therefore, 99 per cent of Canada's land is off limits as a potential landfill site. (For perspective, less than 1 per cent of Canada's area is urbanized and approximately 7 per cent is cultivated.[20])

With these generous concessions, the proportion of land required for landfills becomes a more relevant and meaningful number. We can say that after 100 years, with a highly unrealistic scenario for population and waste-production growth, and 99 per cent of Canada's land area not even considered for landfill use, the total landfill area will amount to approximately 1 per cent of that available remaining 1 per cent space.

To give a more imaginable idea of that space, if Canada were a 5,978m^2 Canadian Football League (CFL) field, fully 5,918m^2 (or 99 per cent) would be off limits for dumping. Of the remaining 60m^2 designated for potential dumping, only 0.6m^2, an area equivalent to a square 77cm on each side, would have been used for landfill after 100 years.

Of course, it is unlikely the entire country would use only one landfill. A more realistic way to envisage land use by landfills is that 100 Post-it notes have an area of approximately 0.6m^2, so 100 years of current landfill use would result in 100 Post-it notes scattered over the football field.

Another way to think of that number is to imagine an average-sized Canadian home of approximately 170m^2 area with a 0.5m x 0.5m (0.25m^2 garbage can). This means approximately 0.15 per cent of the average home is used for garbage-disposal purposes. This is 15 times more than the 1 per cent of 1 per cent of Canada's area that would be used after 100 years of landfilling.

The reality of landfills is hardly a threat to Canada's supply of land compared to the spectre of garbage invading downtown Ottawa. However, even the idea of waste disposal in habitable areas is not as ridiculous as it sounds. Most land used for landfills is not even "lost." Oftentimes it is better known as "reclaimed" land, which becomes very useful. For example, the City of New York is reclaiming the former Fresh Kills landfill on Staten Island, and it will eventually provide a city park that is three times the size of Central Park.[21]

Of course, there is another possible objection to landfilling, which is that regardless of the land area used, it is toxic. Chemicals from garbage leach into the soil and possibly the water supply. Decomposition of rotting material can release poisonous gases that may be hazardous to human health and other aspects of the biosphere.

This charge seems more devastating to landfills than the charge of temporarily using small amounts of land. The City of Ottawa website hints at this danger too when it says:

> "It costs about $89.46 per tonne to collect and landfill Ottawa's trash. At the end of 2004, more than 210,000 tonnes of garbage went to landfill at a cost of $18,829,339. This does not include the monetary and environmental costs of gas build-up and toxic run off created in landfills, or the associated loss of green space." [22]

Much like the allusion to Scotiabank Place being filled with garbage, this imagery contains grains of truth.

Traditional landfills began as tips, places where garbage from a community was simply dumped with little concern for the pollution it caused. Such tips did cause odours and the leaching of dangerous chemicals, and they were no doubt unsightly.

However, these were an improvement on the earlier practice of simply throwing garbage into the street. This amounted to the centralization of a dirty approach to waste disposal. Furthermore, they certainly did not cost $89 dollars per tonne disposed of.

Modern landfilling costs that much because it is a much more sophisticated process. It could be called a triumph of modern environmental engineering, where the unseemly aspects of waste dumping are much better managed. To understand why waste disposal can cost $89 per tonne, it is necessary to look at what modern landfill operations entail. A look at the Ontario regulation 232/98 under the *Environmental Protection Act* finds the following conditions for modern landfills:

> "In addition to codifying many existing approval requirements, the new standards include new and more specific requirements in a number of areas—for example, air emissions control and groundwater protection. The standards cover:
>
> - mandatory air emissions control for sites larger than three-million cubic metres,
> - assessment of groundwater and surface water conditions,
> - design specifications for groundwater protection,
> - buffer areas, final cover design and surface water control,
> - site monitoring, record keeping and reporting,
> - contingency planning for leachate control and
> - financial assurance requirements for private sector landfills." [23]

In other words, modern landfills are far from being festering dumps of waste that are allowed to emit odours and pollute water supplies. Rather, they require site-specific planning that takes into account the vulnerable water systems, use layers of insulation (usually clay or plastic) that protect ground water, have systems for managing the gases from decomposition of waste. They also have contingency plans in the event of a failure of any of these systems. The landfill operators must assume long-term accountability by demonstrating that they have the funds available to deal with the impact of the landfill even after it is closed.

However, as one oft-cited paper argues, even these regulations are probably redundant, at least from the point of view of human welfare. The United States Environmental Protection Agency introduced similar regulations for U.S.

landfills despite having calculated that groundwater pollution from landfills can be expected to lead to 5.7 cancer deaths every 300 years. The author goes on to point out that this is not necessarily because landfills do not pollute groundwater but because the United States' 6,000 or so landfills tend to be a long way away from groundwater that people actually use. The effect of imposing the kind of regulations described above was then calculated to reduce cancer deaths from 7.7 to 3.3 over the next 300 years, or less than one per century.[24] Another author put this figure in context: "[C]ancer kills 563,000 people each year in the US, with about 2,000 deaths caused by merely using spices in food."[25]

The Union of Concerned Scientists published the following summary of the effect of pollution from landfills:

> … [O]rdinary trash [by and large does not pose] a serious health risk to the general public … and whatever risk it does pose will diminish with time as new landfill regulations take effect. Most of the materials discarded in landfills are fairly innocuous—paper, yard waste, construction debris. Even the notorious plastics are safe for precisely the reason they are condemned: They do not degrade over time. A small percentage of truly toxic materials, such as solvents, paints, cleaners, and mercury—and lead-filled batteries … are likely to remain within landfills, especially the modern clay or plastic lined ones. In any case, most curbside recycling programs do nothing to eliminate these hazardous substances from the waste stream, concentrating instead on glass, paper, plastics, and steel and aluminum cans.[26]

Nevertheless, stringent pollution regulations are in place for modern landfills, meaning that landfills are hardly the toxic threat to human health or the environment that some make them out to be.

If the goal is to reduce the tiny amount of land used for landfills or their small and comprehensively managed pollution effects, the goal's usefulness is still ultimately a matter of perspective. If using 1 per cent of 1 per cent of Canada's land area after 100 years of waste disposal and possibly reclaiming that land for better uses than it originally had is seen as a problem, then this goal can still be judged relevant. Similarly, the aim to reduce the impact on human health (we have used cancer deaths from landfill water pollution as a proxy) to an even smaller proportion of total deaths than it is already is relevant. If these goals are to be judged relevant, then it is necessary to evaluate the success of recycling at achieving them.

These land-use figures assume that no waste was recycled. In fact, approximately 22 per cent of Canada's waste (by mass) is recycled.[27] Thus, the net effect of recycling in the football field analogy is that rather than placing 100 Post-it notes on a CFL field after 100 years, Canadians will have placed 78, with recycling alleviating the need for 22 notes. It also implies that every additional percentage point of waste diverted from landfills to recycling amounts to taking one more Post-it note off the football field after 100 years.

In conclusion, the goal of reducing landfill land use through recycling is hardly a relevant one, because the land use involved is so minuscule. The pollution created by landfilling is similarly trifling and well managed in any case. To the extent it is practised, recycling is effective at achieving the goals of pollution reduction and freeing up land, but these goals are nowhere near as urgent as some like the city of Ottawa are wont to suggest.

Recycling and Reducing the Impact of Virgin-Material Extraction

While the claim of reduced landfill costs seems to be the pursuit of an irrelevant goal, that claim is only one of three identified in support of recycling. In this section, we examine the second claim.

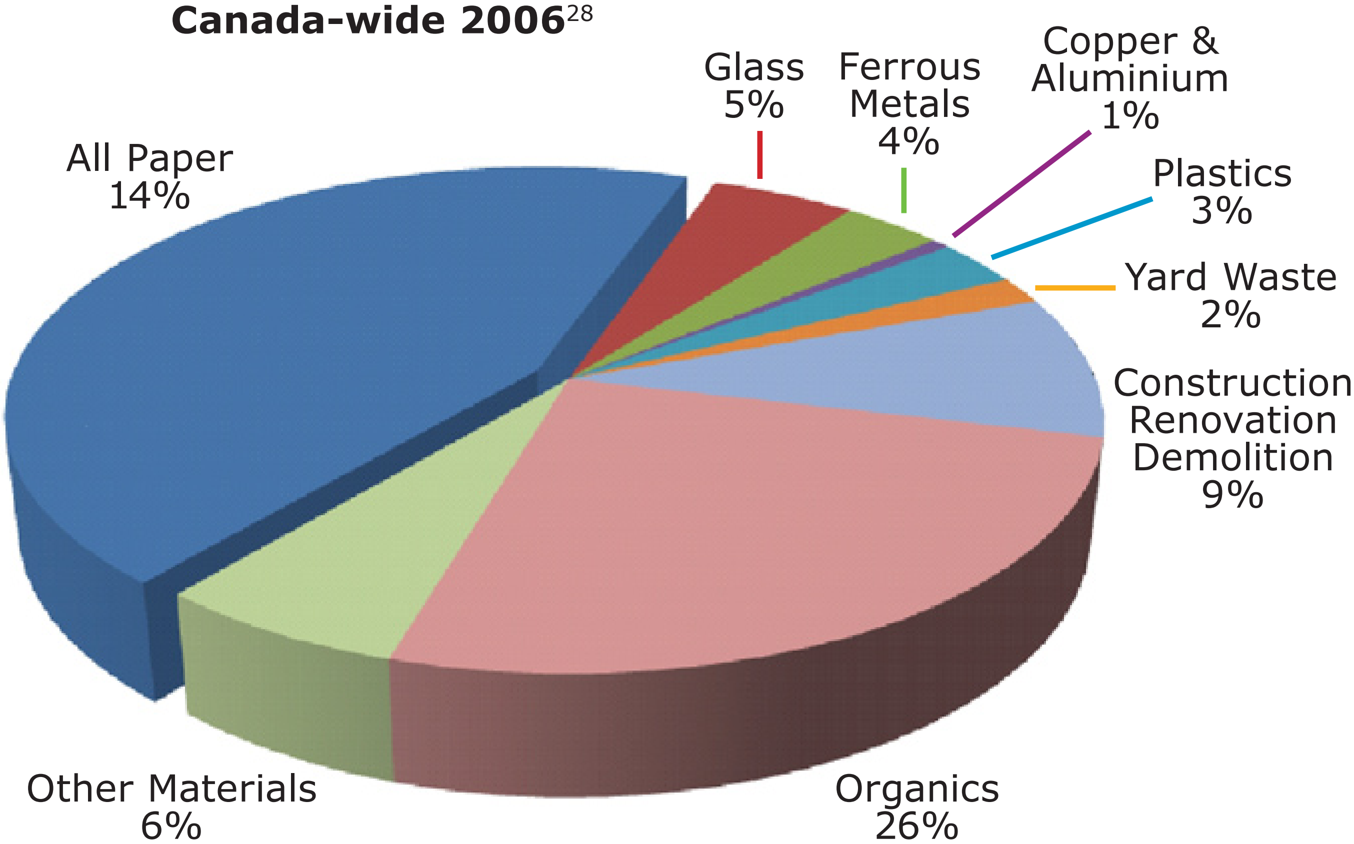
Recycling reduces the need to extract new raw materials and therefore the impact of extraction.

It is worth noting that this is a separate from that of making raw materials available, which will be evaluated in the next section. Instead, this section focuses on the relevance of reducing the impact of material extraction and the effectiveness of recycling at solving that problem. Because different recyclable products contain different raw materials, this question has to be answered separately for the different products that are diverted from the waste stream for recycling.

In each case, there is the obvious comparison of the raw materials saved and therefore the reduction of extraction. The potential savings here represent the relevance side of the recycling question. However, there is also a question of effectiveness; the primary concern around effectiveness is the additional resources that are required for the recycling process and whether or not recycling has a lower ecological impact than the extraction process.

As seen in Chart 1 (below) paper is by far the most heavily recycled type of material at 44 per cent of all recycled material by

Chart 1. Percentage Recycling Material Types By Mass Canada-wide 2006[28]



mass. Organics follow at 26 per cent, then building materials at 9 per cent, glass at 5 per cent, ferrous metals at 4 per cent, plastics at 3 per cent and copper and aluminum at 1 per cent. Paper is the largest contributor, by weight, to recycling. The relevance of extracting resources for paper as an environmental concern and the effectiveness and potential effectiveness of recycling at alleviating the concern will highlight a number of general lessons for recycling as a remedy for concern over resource extraction.

Paper Recycling and Paper-Resource Extraction – A Case Study

The most prolifically recycled material is paper. The 44 per cent figure presented here is actually a conglomerate of three separate subtypes presented by Statistics Canada: newsprint (16 per cent), cardboard and boxboard (19 per cent) and mixed paper (9 per cent).

To evaluate the relevance of recycling to reduce the ecological effect of extraction, it is necessary to quantify the impact to get a sense of the possible reduction.

There are three main components to the paper production cycle, the obvious one being wood products as the main raw ingredient, the others being energy and chemical inputs. The latter two are not examined here, because they appear to be comparable for virgin production and for recycling. In the paper by Visali, referenced in an earlier section, the impact of recycled and virgin production appears to be relatively similar. In other words, while these effects may be judged relevant to environmental concern, they are not decisively helped by recycling.

Similar to the City of Ottawa's imagery regarding the impact of landfills, there is a disconnect between the rhetoric and the reality of paper production's effect on forests. Consumers are often confronted with images of seemingly large areas of clear-cut forests that give the impression forests are being destroyed at an alarming rate. The Greenpeace website is an example.

> "One of the major threats to Canada's Boreal ecosystem is clearcut logging to make disposable products such as toilet paper and facial tissue …. Logging companies are clearcutting Canada's Boreal Forest—destroying one of the planet's last ancient forests."

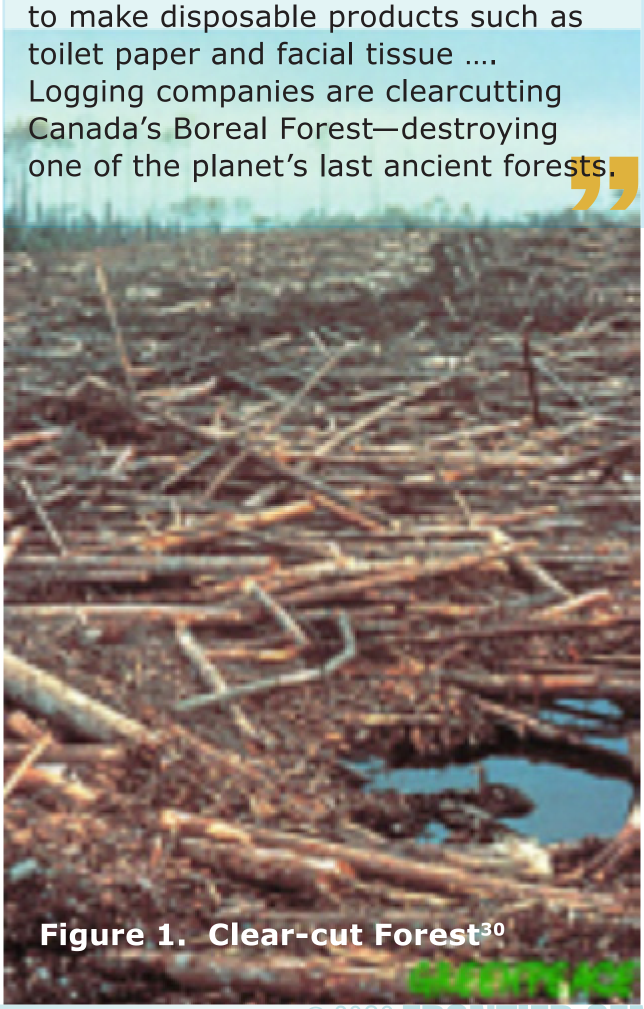


Figure 1. Clear-cut Forest[30]

When one is confronted with this sort of imagery, it is easy to conclude that forest destruction is an urgent threat that is driven by the production of paper products and should be combated through whatever means available. However, as with the landfill example, it is worth looking behind the rhetoric and beyond anecdotes and selective pictures to see numbers that represent the total situation in Canada.

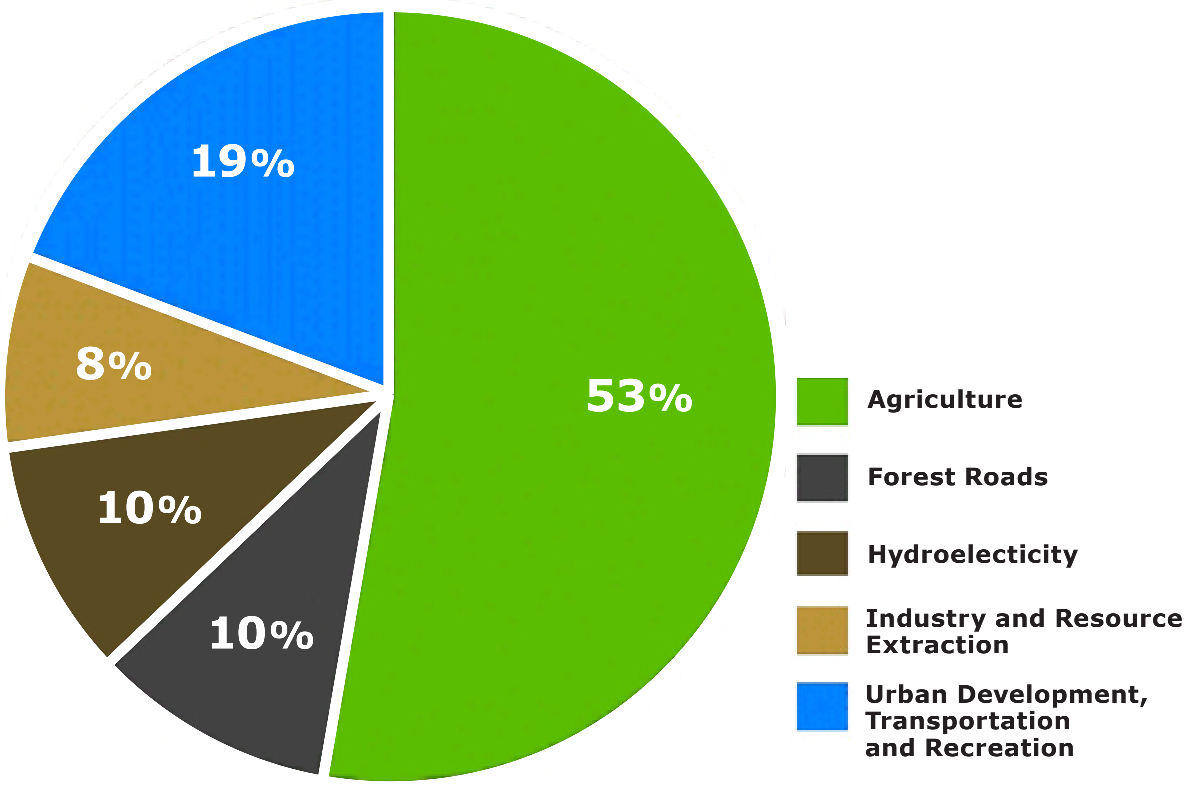
There are obvious questions to ask: How much forest cover exists in Canada? What is happening to forest-coverage levels? What proportion of any changes are due to cutting? What are the cut materials used for? What happens to that space after the forests are cut? What impact does or could recycling have on the answers to these questions?

The first question is the easiest. 44 per cent of Canada's 922,097,000 hectare land area, or 402,085,000 hectares, is covered in forest.[31] Of that, Statistics Canada reports 56,000 hectares, or 0.02 per cent, was deforested in 2005, and this while deforestation rates have declined over the past three decades.[32]

The statement that Canada's forests are being destroyed by forestry may be trivially true, but it is not true in any practical sense.

It is even less true when the reasons for this deforestation are understood. The majority of deforestation is not even motivated by the desire for wood products.

Chart 2. Causes for Deforestation Canada-wide 2005[33]



While deforestation may result in available forest products, much deforestation has other motives, which Statistics Canada has identified as the primary motive in each case.

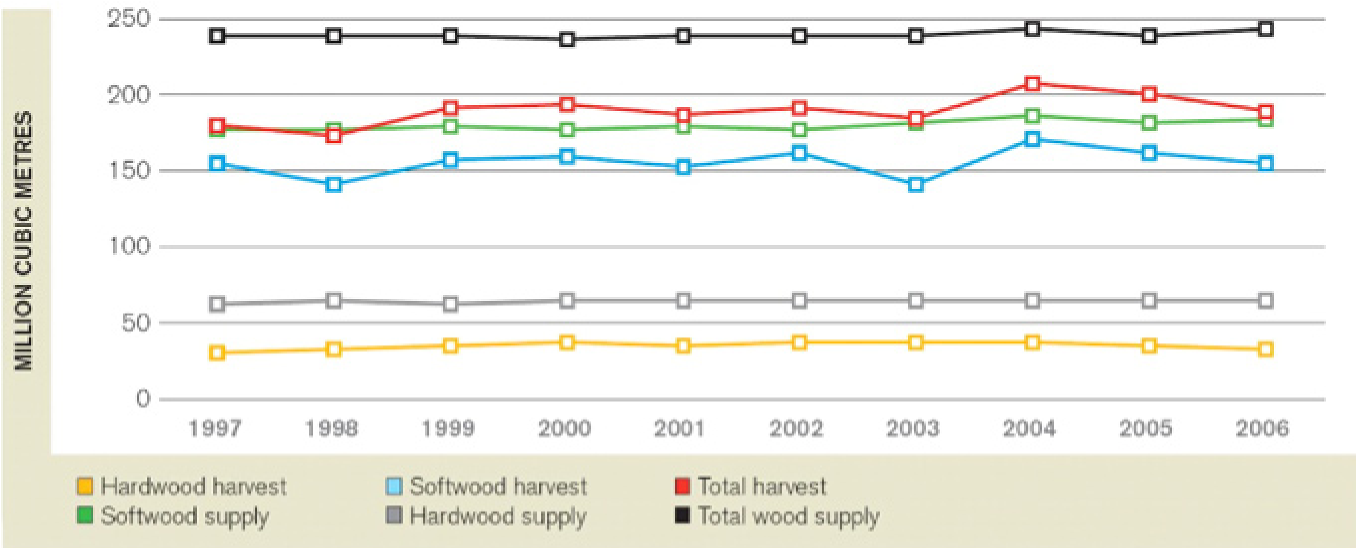
The reason harvesting has such a small impact on deforestation is that tree harvesting is subject to mandatory regeneration. While approximately one-million hectares (approximately 1/3 of one per cent) of Canada's forests are harvested annually, all of this is subject to either mandatory replanting or natural regeneration. Forestry can be viewed as an extractive industry, but it can also be viewed as a form of agriculture involving large plants with long growing times. At the extreme view under the latter paradigm, using forest products increases the demand for forests and therefore people concerned about forests should use more forest products.

Of course, it might be said that 0.02 per cent is still too much deforestation or that 1/3 of one per cent is too much harvesting. Another way to look at this level of deforestation is to compare the actual cut to the Annual Allowable Cut that government agencies decree can be made without affecting forest sustainability.

As Chart 3 (below) shows, harvesting of both softwood and hardwood in Canada is below the levels that various provincial governments deem to be sustainable.

Chart 3: Annual Allowable Cut Versus Actual Cutting

Estimated Wood Supply and Harvest Levels



Source: National Forestry Database

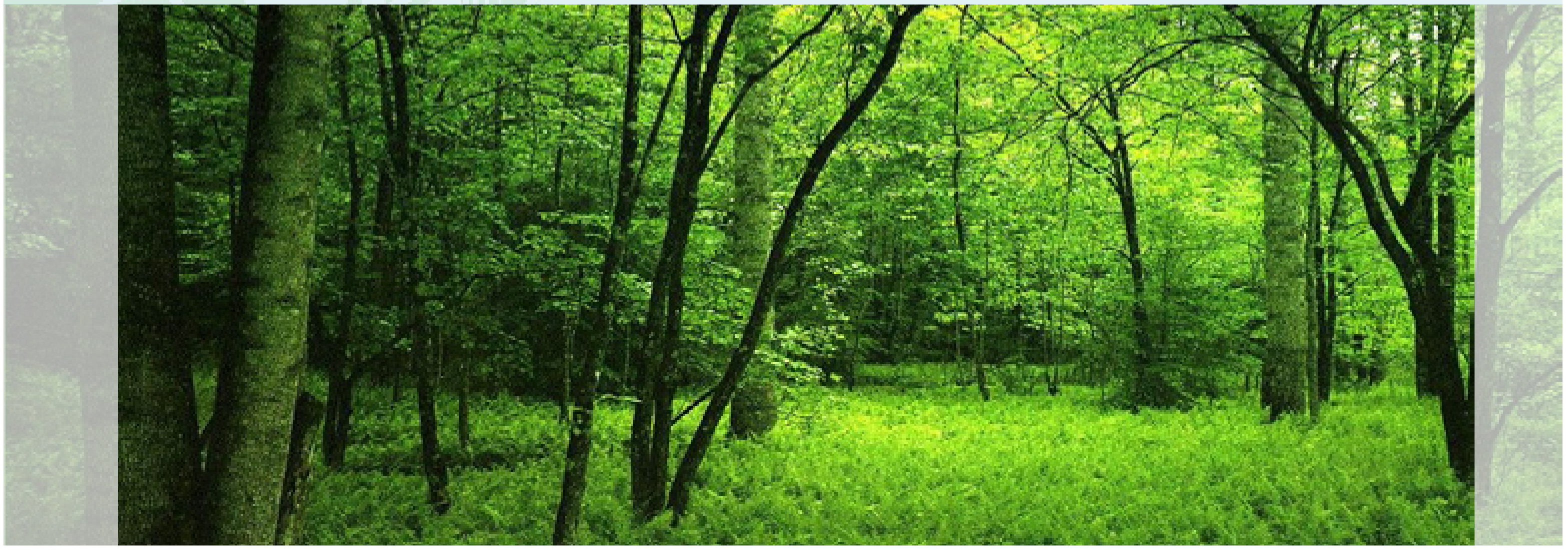
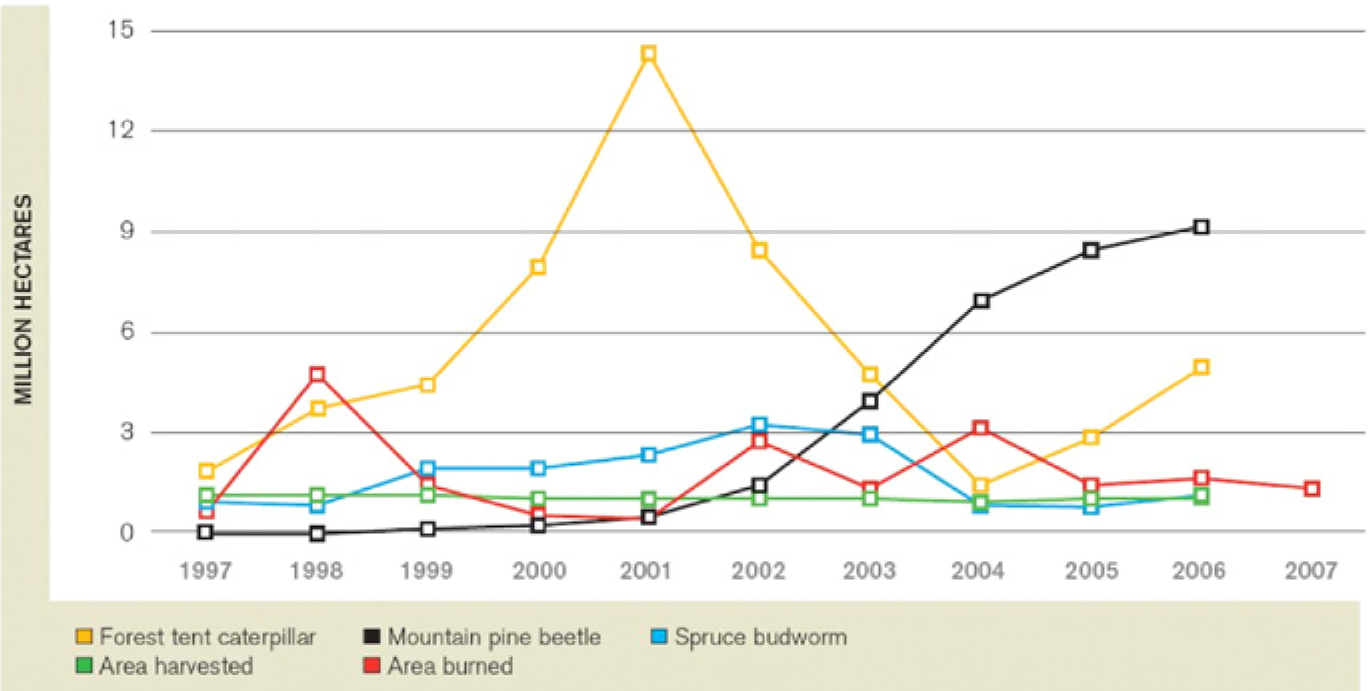


Chart 4: Causes of Forest Disturbance

Area Disturbed by Fire, Insects and Harvesting[34]



Sources: Canadian Interagency Forest Fire Centre and National Forestry Database

Yet another way to look at the effect of harvesting is to compare harvesting impact to the level of disturbance to forests caused by other hazards. As Chart 4 (above) shows, fires and parasites regularly disturb much more forest by area than does harvesting. There is an important question here for those who want to save forests as to where their efforts are best directed.

So far, we looked at the overall environmental impact of forestry; however, the impact of the paper industry is a subpart of this industry. While the above exploration answered how the impact on forests would change if there were no harvesting, there is a sub-question of how would harvesting change if there were no paper industry?

Chart 5: Usage of Trees

Commercially Harvested Trees Usage U.S. and Canada[35]

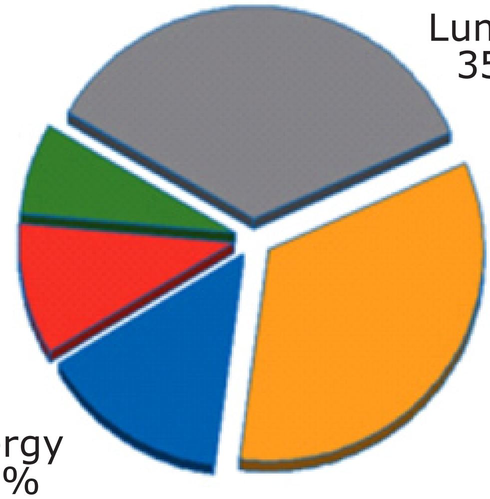


Chart 5 (above) gives a breakdown of Canadian and U.S. tree usage. At one-third of all usage and the second largest of all usage, the production of paper is a major reason for tree cutting, but it is far from the only driver of forest harvesting. In quantifying the impact of paper usage on forestry, figures from the above discussion can effectively be divided by three. Applying these North America-wide figures to Canada, of the 1/3 of one per cent of Canada's forests that is harvested, only one-ninth is attributed to paper harvesting.

In summary, there is a widely promoted perception that Canada's forests are under threat from harvesting for making paper. Like most perceptions, this one does contain some truth. However, to grasp the whole truth of the matter, it is necessary to look behind the rhetoric at the numbers.

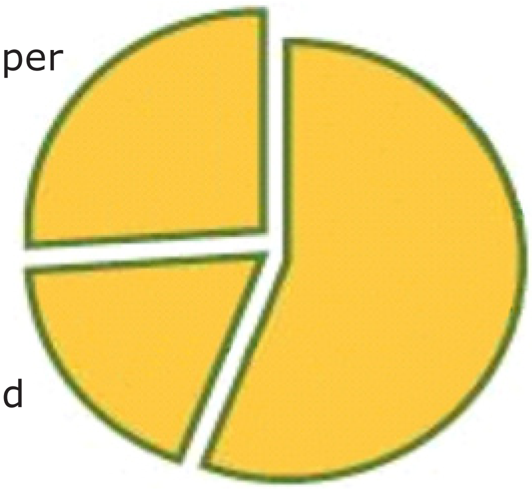
- Canada's forest cover is stable, and the deforestation that is happening is not primarily driven by tree harvesting;
- The harvesting that does occur covers an area of around 1/3 of one per cent of Canada's forests annually, and this level is below the threshold above which provincial authorities would deem unsustainable;
- This harvested area is allowed to regenerate either naturally or with the help of planting, so there is no long term loss from harvesting;
- In comparison, each year, natural factors such as fires and parasite infestations disturb much larger areas of forest than does harvesting;
- Of the 1/3 of one per cent of forest area that is harvested, only one-third are used for paper production. In other words, if no more harvesting for paper production occurred, a 1/9th of one per cent of forest area reduction in harvesting is the maximum reduction that is possible.

Similar to the story of landfills, the real effects of tree harvesting are small compared to the horrific pictures of destruction that some choose to paint. Therefore, the conclusion is that reducing extraction impact from harvesting trees by recycling paper is not as important a goal as many make out. The remaining question concerns the potential benefits of recycling as far as alleviating this concern, however small it may be.

This question can be framed this way: What marginal difference would more or less paper recycling make to the problem of forest disturbance? Could it be that the previous findings show that recycling is actually the reason forests experience minimal disturbance?

Two subsidiary questions will help answer these broader ones. How much paper is currently recycled, and what could recycling more or less paper mean for levels of tree harvesting?

Chart 6: Canada's Fibre Supply in Paper and Paperboard[36]



As Chart 6 (above) shows, there are three sources of fibre used to make paper in Canada. By far the largest is chips and sawmill residues; in other words, byproducts of other timber production. Recovered paper makes up 27.7 per cent of fibre inputs, with roundwood making up the remaining 13 per cent. The 59 per cent sourced from chips and sawmill residues presumably does not contribute to any additional harvesting, as it makes fuller use of trees already harvested. It can also be assumed that harvesters and sawmillers have every incentive to make use of these byproducts, so an increase in demand for them (say, from a reduction in the availability of recycled fibre) could not yield any additional quantity of chips from trees already being felled.

Concerning the difference made by recycling, the logic presented by these numbers implies that tree usage would have to increase by a factor of approximately 1.4, from 72 per cent of paper production to 100 per cent. Given that paper production currently consumes 34 per cent of tree usage in North America, the removal of recycled paper as an input would equal approximate 13 per cent increase in demand for harvested trees.

All these numbers serve only illustrative purposes, as they could at best be called an informal calculation based on data from differing sources (e.g., some are Canadian and others are North American). Nevertheless, they highlight some conceptual issues regarding the impact of recycling on tree harvesting.

- Approximately one-third of harvested tree outputs in North America are used for paper making;
- Of the total fibre supply for paper making in Canada, just over two-thirds comes from byproducts of other tree products, and just under one-third comes from recycled paper;

- The total consumption of tree products would have to increase by approximately one-sixth if the recycling component of Canada's fibre supply for paper was to disappear.

In other words, recycling currently makes a minor but not insignificant impact on tree harvesting. So much for the status quo. However, what is the potential for greater recycling of paper?

This potential is governed by several constraints: the proportion of paper recovered, its usefulness as a source for different kinds of new paper, and a technical constraint on the number of times that a given fibre can be reconstituted into new paper before the recycling process breaks it.

The cycle for paper production with fibres being fed back into production can be modelled as follows:

$$TPO_{i-1} = R_i + N_i$$

Where

TPO = Total Paper Output

R = Recycled Fibre Input

N = New Fibre Input

i = number of cycles

And

$$R_i = TPO_{i-1} * UR * YR_{i-1}$$

Where

UR = Usage rate, or the proportion of paper from a previous cycle that was recovered.

YR = Yield rate, or the proportion of fibres from the previous cycle that can still be used.

These equations are adapted from an industry report[37] and highlight two realities of paper recycling. The first is that the amount of recycled fibre is constrained by the proportion of paper that can be recovered for recycling. At present this proportion is almost 60 per cent in North America,[38/39] so 40 per cent is immediately lost in each cycle. While this recovery rate has more than doubled since the early 1990s, there are upper limits on this figure. For example, paper used for photographs, books, legal documents and toilet paper generally cannot be reclaimed.

Secondly, the state of current technology means that not all paper can be recovered even if it is recycled. Paper recycling plants use separation processes to bleed out fibres that are too damaged to be used again. Depending on the type of paper product, 70 per cent to 88 per cent of fibres can be expected to survive each sample. This means, for example, that after five cycles at 88 per cent, $0.88^5=0.53$. In other words, if a given amount of paper is recycled five times with an 88 per cent yield of usable fibre from each successive cycle, then by the fifth cycle only 53 per cent of the original amount of paper will be produced.

By putting these two forms of leakage together, it is possible to understand the minimum amount of new fibre that is required to keep a paper-recycling production cycle stable—to ensure the same amount of paper is produced by each cycle.

While technological improvements may increase the number of times a fibre can be used in the recycling process, and higher recovery rates may increase the proportion of paper fibres that become candidates for reuse, neither is currently 100 per cent, and it seems unlikely that either ever will be.

One estimate puts the current requirement of fresh fibre for maintaining the cycle of fresh newsprint at 77 per cent and the best-case scenario with maximum practical recovery would still require 64 per cent of fibre to be sourced from fresh fibre sources.[40] It is worth noting that these calculations vary for different types of paper, but the current rate of recycled fibre usage at 28 per cent is half-way between the current usage rate for newsprint and the upper boundary, suggesting that further improvements will be limited.

In the first part of this case study, we put the impact of forestry on the environment into perspective with numerical analyses of the problem's true size. This second part found that recycling can be very effective at solving that problem, however small or large it may be.

Were it not for recycled fibre, forest harvesting would have to increase, and we estimate very roughly that it would have to increase by about one-sixth. However, the fact that some paper will always leak out of the recycling system due to not all paper being recoverable and fibres becoming fatigued and unusable over successive cycles mean that recycling cannot ever replace the use of virgin materials, and based on current usage rates, it probably cannot displace them too much farther.

Altogether, several lessons on the ability of recycling to attenuate the environmental impact of virgin paper come out of this case study.

- Just as with the notion of landfills that use up space and cause pollution, there can be a serious disconnect between the promoted imagery of resource extraction and the reality that a sober look at the important numerical indicators reveal;
- Also in common with the landfill examination is the fact that the potential or perceived problems are less than might be imagined, because the industry is already bound by environmental constraints relevant to its particular activities;
- To the extent that it is practised, recycling does reduce the impact of resource extraction;
- There are technical and economic limits on recycling processes. Not all materials can be collected, and those that are extracted are not always recyclable for technical reasons. Therefore, recycling is only a partial substitute for virgin material extraction;
- It appears that in the case of paper, recycling is already near its maximum practical limits.

Recycling and Sustaining Access to Resources

Landfill and resource extraction are two of three environmental concerns this paper addresses with respect to the usefulness of recycling. The third environmental concern addressed here is that of recycling.

Recycling provides a source of raw materials that is independent of natural reserves and therefore expands the amount of resources available for consumption.

Inherent in the perception of recycling is the saving of natural resources that would otherwise have been discarded and lost to future consumption. In this view, whether or not to recycle can be seen as a moral choice between a way of life that attempts to continue indefinitely versus one that reduces the resources available for future consumption; the second can be, and often is, equated with living at the expense of future consumption, living standards, and perhaps survival.

In answering two questions, this section examines the claim that recycling sustains access to natural resources. First, how serious is the problem of running out of resources? Second, how effective is recycling at solving the problem to whatever extent it exists.

The problem of running out of resources can be divided into two sections according to the types of materials concerned. For some materials, particularly forest products, it was noted the resources in question regenerate naturally, and so there is no dilemma of consuming now or later. Meanwhile, there are other materials, such as metals, plastics and glass, of which there is a finite supply. In these cases, it could be seen as obvious that consuming virgin materials and dumping them will inevitably lead to society one day lacking access to more of those resources.

However, there is another school of thought, often referred to as the cornucopian view, which holds that natural resources in and of themselves have no value, and we should not concern ourselves with the quantities available. The logic of this argument is that people do not desire natural resources per se, but rather the utility of goods and services that can be produced with as many or as few resources as human ingenuity permits.

The modern cellphone is one device that illustrates the cornucopian view very well. For several hundred dollars, it is now possible to purchase a cellphone that will perform the following tasks:

- Mobile communication by voice, text and video;
- Photography and storage of thousands of photographic images;
- Music storage and reproduction for hundreds of songs;
- Various functions that previously required separate devices. For example, the functions of a calculator and an alarm clock.

The natural resources required for such a phone are trifling; indeed, one of the major goals of cellphone designers is compactness. The amount of natural materials involved, however, is even smaller when compared to what was required only three decades ago to provide the same utility.

- A network of copper wire large enough to transmit voice to every user's location;
- A large amount of film as well as a separate and larger device to take and store photographs;

- Dozens, perhaps hundreds, of vinyl records or cassette tapes to store music, as well as a separate device to reproduce the music;
- Any number of other devices to replace the phone's ancillary functions.

A modern cellphone is an excellent example of how technological innovations can provide the same utility (indeed much greater in this case, when the mobility of communication is considered) from much smaller amounts of natural materials. Google Earth instead of an atlas and online encyclopedias in place of shelves of conventional encyclopedias are other examples.

Not only are the amounts smaller in a quantifiable sense, they are also different. The silicon-based memory used to store data in modern electronics is completely different from the media used 30 years ago for storing images and sound. The result is that even total conservation of previous resources would have had no impact on current utility.

While the cellphone is clearly an example of very rapid and recent technological advancement, there is evidence to suggest that it is representative of a broader trend rather than an aberration. Economist Julian Simon, a prominent advocate of the cornucopian view, made the most famous demonstration of this trend.

In line with his principles, Julian Simon challenged environmental scientists at large to bet that the price of any five given metals, over any time period exceeding one year, that they chose would fall in real terms. The implication of falling prices is that the resources became less valuable to people's economic well-being over time. In 1980, three environmental scientists accepted the challenge, the most prominent being Paul Ehrlich. They chose copper, chromium, nickel, tin and tungsten over 10 years. By 1990, all five metals had fallen in price:

- The price of tin went down because of an increased use of aluminum, a much more abundant, useful and inexpensive material;
- Better mining technologies allowed for the discovery of vast nickel lodes, which ended the near monopoly that had been enjoyed by only a few mines;
- Tungsten fell due to the rise of the use of ceramics in cookware;
- The price of chromium fell due to better smelting techniques;
- The price of copper began to fall due to the invention of fibre-optic cable (which is derived from sand), which serves a number of the functions once reserved for copper wire.[41]

The cornucopian view and the evidence behind it show that resources are not running out in the sense of an inexorable drift toward a world where living standards fall in proportion to the remaining resources. However, it might be said that technological improvements and substitute products can slow but not halt the reduction in natural resources, so the problem of resource exhaustion has not been avoided in any ultimate sense.

Another view along cornucopian lines holds that resources dumped today will not be completely lost in the future. There have been a number of attempts at mining landfills for discarded resources. While most of these have been primarily motivated by the need to clean up old landfills that did not comply with new environmental regulations or to reclaim land, many were helped to become profitable operations by revenue from recovered materials.[42]

The concept of landfill mining is another twist in the problem of resource depletion. An obvious response to the claim that this practice is desirable would be that it is essentially recycling with a long and messy storage process for the recycled materials. However, in view of the changing value of raw materials according to the demand for them over different times, it is possible in theory at least that future technology growth will mean it is more efficient to reclaim these resources when the cost is lower relative to demand than it is with contemporary recycling.

In any case, landfill mining removes the objection that non-recycled resources are lost forever. It also has the advantage that it will take place in the future and therefore will be carried out in accordance with demand for materials and with technological efficiencies that cannot be reliably anticipated at present.

If resource depletion can be perceived as a problem of some magnitude, then it is time to assess how well recycling addresses this concern.

As noted earlier, recycling is an industrial process that consumes resources just like any other process. It has been noted that recycling generally saves energy and materials on balance, but it also shifts consumption away from those materials and energy sources saved and toward those that are consumed by the industrial process of recycling.

From this perspective, recycling for resource conservation is similar in concept to the technological innovations that turn record players into mobile phones and books into online atlases. It is only useful to the extent that it preserves resources that will be useful in the future at the expense of those that will not.

From the cellphone example and the innovations that drove down the prices of Ehrlich's chosen metals, it is also clear that identifying which materials are best saved for the future is not an easy task. Innovation is unpredictable by its very nature, and so any attempt to maximize future welfare by saving the most valuable materials will be only as good as the information that is available.

While recovery rates of less than 100 per cent are not a conceptual problem for recycling, they are a practical one. As shown in the tree example, there will always be some resources that are impractical to recover. For this reason, there will always be some leakage from any practical recycling system, further reducing the ability of recycling to reduce resource depletion.

Summary

- Resource depletion is a problem to some extent, but it is wrong to suppose that future living standards are directly tied to currently known reserves. Technological innovation will continue to find new ways to deliver the same or better living standards from less or perhaps different resources even though those resources may not seem valuable now;
- While innovation may not be able to completely prevent resource depletion, neither can recycling. In terms of resource conservation, recycling is a way of further preserving some resources at the expense of others;
- Recycling faces the same challenge as every other industry, which is to identify the materials that will be valuable in the future against a backdrop of uncertain information about future technology and demands for materials.

The Value of Human Time

Another cost that needs to be considered when studying the advantages of recycling or other waste-disposal methods is human time. Under the assumptions initially presented in the previous section, human time should have zero value when used for any activity that even slightly preserves natural resources. This zero value is arrived at by considering that resources are finite and depletion of them will eventually reduce living standards to zero, so any resource-saving activity is a matter of life or death for future generations.

However, the cornucopian view of resource consumption holds that living standards are less tied to the supply of natural resources and more connected to human time and ingenuity available to turn them into useful products. Under this view, human time might improve future access to resources when used for recycling, but on the other hand, it might achieve the same goal better if applied to other economic pursuits that improve the economic use of existing resources. In this view, human time occupied by recycling is not "free" but rather diverted from other activities that might be more effective at improving living standards and addressing environmental concerns.

Human time committed to recycling comes in two forms, the first being professional time within recycling organizations involved with the industrial process of recycling. The second is domestic time required of people to sort garbage to be recycled.

The cost of professional recycling time is incorporated into the price of recycling services. The cost of domestic time can only be hinted at by back-of-envelope calculations; for example, in a famous *The New York Times Magazine* article, John Tierney estimates the costs of human time in recycling:

> I tried to estimate the value of New Yorkers' garbage sorting by financing an experiment by a neutral observer (a Columbia University student with no strong feelings about recycling). He kept a record of the work he did during one week complying with New York's recycling laws. It took him eight minutes during the week to sort, rinse and deliver four pounds of cans and bottles to the basement of his building. If the city paid for that work a typical janitorial wage ($12 per hour), it would pay $792 in home labor costs for each ton of cans and bottles collected. And what about the extra space occupied by that recycling receptacle in the kitchen? It must take up at least a square foot, which in New York costs at least $4 a week to rent. If the city had to pay for this space, the cost per ton of recyclables would be about $2,000. That figure plus the home labor costs, added to what the city already spends on its collection program, totals more than $3,000 for a ton of scrap metal, glass and plastic. For that price, you could find a one-ton collection of those materials at a used-car lot—a Toyota Tercel for instance—and drive home in it.[43]

While there are no certain figures on the cost of domestic time, these should be considered as well as the professional time in comparison to other waste-disposal methods and other methods of addressing environmental concern. Deciding how this time is best used is subjective, complex and subject to uncertainty about future conditions. The next section looks at the role of prices in co-ordinating such tradeoffs.

The Role of Prices in Recycling

So far this paper has evaluated three claims regarding recycling in a way that may seem deeply unsatisfactory from the point of view of finding the optimal way to address the environmental concerns about the impact of landfills and the extraction of raw material as well as resource scarcity. In each case, we investigated the size of the problem in comparison to the popular perceptions of it and found that more often than not, the concerns were exaggerated. Landfills do take up space, but the amount is so small it would be difficult to conceptualize. Extracting trees for paper production does have an ecological impact, but it is conscientiously managed by industry and government and hardly complies with imagery of whole forests being under threat from clear-cutting. Resources *are* used up at some rate, but our consumption of useful things is not directly linked to them. Landfill mining shows the possibility that no resources are lost forever.

Similarly, we have evaluated the impact of recycling on these concerns and found that recycling is a partial, not total, solution to the concern in each case.

A qualitative assessment of the effectiveness of recycling does not answer the question of whether or not it is a useful strategy.

The real problems are quantitative. For example:

- How much land should be used for landfills?
- How much forest should be subjected to harvesting disturbance?
- How much of which resources will be required to sustain a decent standard of living in the future?
- When does it make sense to divert one more tonne of waste from a landfill, and when does it not?
- When does it make sense to recover and recycle an extra tonne of paper instead of using virgin fibre supplies?
- When does it make sense to conserve an additional unit of a particular resource by recycling it for future consumption?

All of these examples are knowledge problems; in other words, the optimal solutions can only be arrived at by applying as much knowledge as possible to each problem. Yet the knowledge required is difficult to assemble for several reasons.

- In part, it is a function of what the ecological systems can sustain. The Annual Allowable Cuts the provincial forest authorities mandated are an example of trying to find such a boundary;
- In part, it is a function of the preferences different individuals have for different resource uses. For example, land that could be used for landfills, or other uses;
- In part, it is contingent on uncertain developments in the future. For example, the silicon chip has made large amounts of previously valuable information-storage material redundant.

Aggregating the dispersed knowledge and preferences that are important to these decisions can be done in two broad ways: through political processes where decision makers are officials elected by either citizen votes or citizen appointees. Alternatively, it can be done via markets and prices, where people bid on resources for the different uses they have, and the prices arrived at indicate the value of their different uses.

As Nobel Economics Laureate Frederic Hayek wrote:

> Fundamentally, in a system in which the knowledge of the relevant facts is dispersed among many people, prices can act to coordinate the separate actions of different people in the same way as subjective values help the individual to coordinate the parts of his plan.[44]

Political decision making has one popular appeal: All voters have an equal influence, i.e., one vote each, whereas in market decision making, bidders with greater resources have a greater influence on the outcomes of different decisions. However, in terms of applying maximum information to decisions about how best to use resources, the greatest strength of political decision making is also its greatest weakness. Because voters get to have the same influence over politically made decisions regardless of how informed they are, political decision making provides the individual with no incentive to become more informed and apply additional knowledge to a situation.

On the other hand, market decision making gives every incentive to apply maximum knowledge to decisions. For example, on the commodity futures market, thousands of people speculate every day on the future value of commodities, including metals, energy sources and foods.[45] Traders who believe that demand for a certain commodity will outstrip supply can bid the price higher. If they are right, they will be able to sell their futures for more than they bought them. If they are wrong, they lose. In any case, the commodity futures market is an example of a price-based system that gives people an incentive to apply their knowledge to questions of how valuable resources will be.

More broadly, if we want to know the optimal uses of land and resources according to the dispersed preferences of different people and uncertain future technological capabilities, the price system is the best way to co-ordinate society's activities. If recycling is cheaper as a method of waste removal and resource provision, it generally means that it is using less of the resources that people value for other uses. On the other hand, if it is a more costly alternative, it is probably using more resources.

The Role of Government in Recycling

According to the previous section, governments should have no role in recycling because, being creatures of political decision making, they are inferior to markets at making decisions about the extent to which different resources should be used for different applications.

However, there are times when governments can improve markets, and in the case of recycling, there are two main ways that governments can help with the overall aim of addressing environmental concern through recycling. The first is in dealing with externalities, the second is in assisting natural monopolies.

Externality is the economic concept that some of the total costs or benefits of a transaction between two parties fall on a third party who is unable to influence the decision to carry out the transaction. Pollution is a common form of externality that governments often address. The landfill regulations mentioned earlier are an example of a government action to ensure that the landfill operator and those disposing of waste do not impose the costs of pollution on third parties via ground or water-table pollution.

Similarly, the posting of an AAC for forests is designed to ensure that the forestry industry does not impose additional costs on others through critical eco-system damage.

In both these examples, governments address the environmental concern at its source rather than indirectly by trying to mandate consumption or recycling levels. This direct approach to environmental concerns has two major advantages.

First, it focuses on the actual environmental impact where it occurs. For example, the AAC is based on specific knowledge of forests and what they can sustain. The alternative of mandating a certain amount of recycling of paper may well achieve the same goal of preserving forests or it may not. The second is that within the boundaries set to protect people from externalities, prices can function to identify the best decisions about using resources.

Aside from protecting people from externalities in resource use, governments may also find that they can improve efficiency by regulating natural monopolies in waste collection. Natural monopolies are markets where producers experience increasing returns to scale; in other words, the price of servicing each additional customer is less than that of servicing the previous customer. It is very difficult for new competitors to enter the market; they must pay a high price to serve their initial customers. Existing providers who already have customers can serve prospective customers for a much lower rate than can new entrants to the market who are serving their first customers.

Garbage collection has the features of a natural monopoly. A garbage collection truck that is already servicing 9 out of 10 houses on a street can serve the tenth customer more easily than a new market entrant who currently has no other justification for visiting the street. If the two competitors are garbage collectors for normal disposal and collectors wishing to collect waste for recycling, then the incumbent will have a built-in advantage over the new entrant.

The most common policy responses governments use to mitigate the reduced competition that natural monopolies bring about are to either own the producer companies in the market or to regulate the prices these companies can charge.

If the aim of governments is to ensure a fair marketplace where recycling can compete against other methods of collection for disposal, then the governments might take ownership of the services and choose to provide collection for recycling as well as for other collection methods. Alternatively, they might choose to regulate the industry so that private providers must supply both services. In both cases, however, these interventions, which are effectively subsidies for one of these collection types, should aim only to remediate the effects of natural monopolies; they should not subsidize a collection type beyond correcting natural monopoly imbalances.

High-Performance Government in Waste Disposal

If the best way recycling can address environmental concerns is to minimize environmental impact by responding to what prices reveal about people's preferences for different resource-use decisions within the bounds of regulations designed to alleviate externalities, then governments involved in the production of waste disposal services can take several lessons from this paper.

Governments should not recycle on the basis that they are reducing environmental harm. As demonstrated in earlier sections, the prices of dumping versus the prices for recycling, which include contributions from the sale of recovered materials, are the best guide to optimal resource use according to diverse preferences and uncertain future demands. Other regulations preventing externalities, and catastrophic ecological events mean that the prices of these options include the cost of complying with environmental regulations.

To ensure that their activities reflect the preferences revealed by prices, municipal governments engaged in waste disposal should apply the principles of separation, neutrality and transparency. The Frontier Centre refers to these principles as "High-Performance Government."

Separation

Governments involved in providing a service such as waste disposal often fulfill a dual role on behalf of the citizens they serve. The first role is that of a purchaser who finds a provider to supply a given service. The second role (when services are supplied "in-house") is that of a provider. It is important to recognize that these roles are mutually antagonistic. In the purchaser role, the government is looking to get the highest level of service at the lowest possible cost. However, if a government agency is also the provider, then its interest is to minimize the costs of providing the service while maximizing the price charged to the purchaser.

Because of this conflict of interest, it is important that separate agencies are responsible for representing the purchasing function and the providing function. Without a clear separation between the purchaser and the provider, the same agency is left to represent the interests of both parties. Separation between purchasing and providing agencies means that both the public and the provider have their best interests represented.

Neutrality

Whether or not a government agency provides a service, the agency will always be the purchaser of any government-funded service. So long as waste disposal remains such a service, governments in the purchaser role should be committed to getting the best deal for the public by any means available. So long as there is the possibility that an outside organization could provide a better service than an internal government agency, governments in their purchaser role should remain agnostic about from whom they purchase the service. This is the principle of neutrality.

Neutrality is particularly important in the case of waste disposal when regular disposal and recycling are both viable options. Purchasing decisions should be contestable processes wherein recycling and non-recycling operations can bid for the task of waste removal. This contestability means that the most cost-effective solutions and therefore the ones that use resources most efficiently according to society's price signals will prevail.

Transparency

Arrangements between governments as purchasers and government or non-government organizations as service providers are subject to complex cost structures. These structures may include tax treatments, contingent liabilities, employee benefit liabilities and capital asset liabilities. If the provider that makes the best use of economic resources is to be selected in a neutral and contestable bidding process, then it is important that all potential providers, government and non-government, are fully transparent about their total costs. This means using full cost accrual accounting, so all costs are transparent and visible when arrangements are made.

By applying the principles of separation, neutrality and transparency, it is possible for governments to use prices to access the knowledge of the wider society regarding the best resource-use decisions. In some cases, this may mean that more recycling is the most cost-effective option. In other cases, current levels of recycling may reveal themselves to be a poor use of society's resources. The advantage of applying high-performance government is that the best decisions for reducing resource use and environmental impact are more likely to be found.

Conclusion

Environmental concern is a powerful political motivator and therefore has a powerful effect on public policy decision making. However, as shown in this study, it is important that environmental problems are assessed according to numerical analysis rather than by creative imagery. While landfilling, resource extraction and resource depletion are problems, rarely are they as dire as some, including some governments, make them out to be.

Similarly, while recycling has the potential to alleviate these concerns, it is not the sole solution or even a complete solution. Recycling is an industrial process that produces some goods at the expense of others; as such, it should not be treated as the only or best solution but rather as a method that sometimes makes sense and sometimes does not.

In choosing whether to recycle, it is important to be aware that most processes that affect the environment are already regulated at the point of the effect, so it rarely makes sense to recycle for purely environmental reasons. Recycling can, however, produce a net saving of energy and resources, but identifying the value of these resources is not always easy.

When faced with the challenge of knowing how much certain resources are likely to be worth in the future, one should look to the best indicator available: their price. Prices have the advantage that they are set by bidders who have every incentive to apply the best information they have to determine the future value of resources, including land and commodity supplies, that are affected by decisions to recycle or not.

When government is involved in the waste-management business, it is important that the prices of different waste-disposal options are visible to those who must decide between options. This practice ensures that the decisions are informed by the wider knowledge of society.

Sources

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3. Merriam-Webster Online definition.
4. It is worth noting that reducing the use of a particular resource may not result in an overall reduction in consumption. Often, reduction of one type of consumption merely frees up cash for the consumption of other resources. However this argument could be made for all attempts to save resources.
5. For example, Statistics Canada has defined recycling as "the process whereby a material (for example, glass, metal, plastic, paper) is diverted from the waste stream and remanufactured into a new product or is used as a raw material substitute." Statistics Canada (2006).
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14. Statistics Canada (2006) p. 7.
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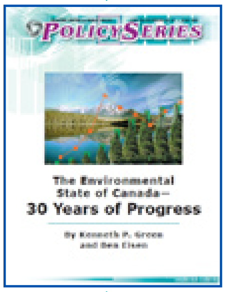

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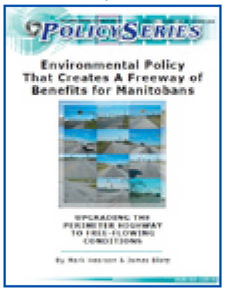

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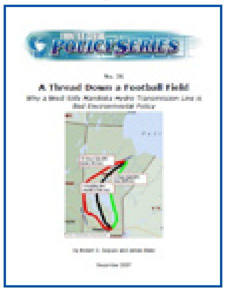

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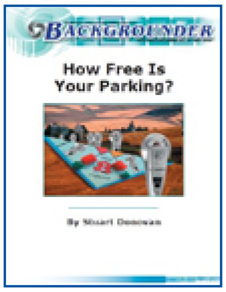

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