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# Consumer Recycling: History, Policy, and the Seattle Zero Waste Plan

## 1. SUMMARY

We begin this paper with a discussion of the context of recycling, its importance and history. We then review different policy options to increase recycling among consumers, and examine portions of the Seattle Zero Waste Plan, providing a case study of municipal recycling policies supported by environmental benefit-cost analysis. We conclude by highlighting several promising policy options, alongside cautions about the limits of recycling and the necessity for environmental valuation in the policy process.

## 2. INTRODUCTION

### *Shifting incentives to recycle throughout history*

Recycling in its most basic form can be traced back to 400 BC. During the imperial Byzantine era, inhabitants inside the boundaries of modern Turkey recycled glass. Romans similarly recycled bronze coins into statues ("History of recycling", n.d.). Especially in times of war, inspired by shortages of metal for weapons, people would melt down jewelry to provide raw materials for weapons production. It is, perhaps, inaccurate to define these actions as full-fledged "recycling", since only basic physical changes happen in the process of simply melting coins or jewelry for re-use in the production of statues or weapons. But these early actions are the origins of the large range of recycling technologies developed in the course of human history.

Before the industrial revolution, recycling was an attractive way to avoid the high costs of obtaining primary materials for use in production. Through recycling was more attractive than primary extraction of resources, simple reuse of materials was the first course of action, taking priority in people's minds. The ease of reuse meant that large-scale adoption of recycling lagged. For example, metals like bronze and aluminum would be considered for reuse again and again; but people did not give further thought to finding more advanced methods, to process materials other  than metals. They lacked incentive, creativity, and knowledge to consider, for example, the application of chemicals in recycling materials. Nevertheless, compared with historic times, people in pre-industrial times did make important improvements in recycling techniques. In some parts of Europe, for instance, the brick-making industry was a pioneer in recycling, finding that the use of trash (such as dust and ashes from coal fires) was much cheaper than the transportation costs associated with importing sand and soil from other countries ("History of recycling", n.d.).

During the mass production occasioned by the industrial revolution, particularly between the years of 1760 and 1820, economies of scale meant that the marginal cost of producing large amount of metals and other materials became extremely low (“History of recycling”, n.d.). This altered incentive cause people to lose their interest in waste management. Recycling and the development of recycling technologies was once again stagnant.

The arrival of World War II, however, rekindled waste management concerns. People’s enthusiasm for recycling during World War II resulted from two factors: the budget constraints of war, and social demands to exhibit patriotic attitudes through frugality, including recycling. Shortages in weapons and commodities made people’s lives very hard, both in Europe and America. It became necessary for people to reuse and recycle materials. The more important reason for recycling, however, was patriotism. Some governments, especially in developing countries like China, urged people to donate their metal commodities to help to solve shortages felt on the warfront. People thought their recycling actions and their use of recycled materials at home would translate into the availability of more materials to send to the overseas warfront, leading to a greater chance at winning the war. Despite the importance of this patriotic surge in recycling, this variety of incentive is so rare that it cannot be counted on normally to promote recycling. No one would hope to increase recycling by initiating a war or invasion, to increase general patriotism.

After World War II, for some developing countries and countries lacking natural resources (such as China and Japan), deficiencies in natural resources and financial constraints spurred them to continue the recycled programs implemented during the war, and in fact to promote recycling further. For other countries, though, and particularly for the United States, post-war growth and profits contributed to yet another lapse of interest in recycling. Recycling stagnated until 1960s, when pioneers of the environmental movement started to increase people’s awareness toward recycling. For the first Earth Day of United States, 22 April, 1970, the recycling symbol was developed by a young college student, Gary Anderson (Fleron, 2006). Symbols like these were part of educational campaigns to increase recycling by changing attitudes.

In recent years, recycling education has shifted from a strategy used by activists, to a policy used by regulators, with the same intention of increasing recycling among consumers. This movement from private sector responsibility to government involvement was driven by the increased costs of waste disposal (for example, shortage of landfill capacity), as well as by increase public commitment to environmental health (Kinnaman, 2006). Regulators have added new approaches alongside education. One focus of policies is to increase the ease of recycling, by simplifying collection requirements; another is to raise the cost of waste disposal (Mueller, 2013). Both approaches affect people’s incentives, promoting recycling instead of waste.

In conclusion, by looking through human’s history of recycling, we can find that people in different time periods were driven by different incentives, and engaged in recycling to different degrees. In very ancient times, recycling behavior was mainly driven by shortage of materials and by financial constraints. For some periods (like in World War II) other incentives naturally took priority in people’s minds, and lead them to enhance recycling. Modern regulators recognize waste disposal as a public good, not just the responsibility of private consumers, to be determined by  market forces; so regulators use a combination of methods to increase consumer recycling.

## 3. ECONOMIC ANALYSIS

### *Classifying policies to increase recycling among consumers*

The history of recycling is a window into how recycling has been done in the past and why recycling has been necessary. As we proceed into the future, the task of managing waste becomes increasingly difficult, due to growing population, climbing per capita consumption, and diminishing environmental absorptive capacity. Recycling of waste is needed for a number of different reasons, including to preserve scarce nonrenewable resources and to preserve the integrity of the environment. The ‘public bad’ nature of waste (Smith, 1972; Kinnaman, 2009) suggests that a private market will fail to reach the socially optimal level of recycling. Consumers themselves may be shielded from the end products of their consumption, and so waste management is a major task facing city and county governments. In order to maximize the social benefits of recycling, regulators should consider the use of policies to increase consumer recycling, choosing among existing policy options for those with greatest effect and lowest cost.

Towards that end, Hornik, Cherian, Madansky and Narayana’s research results synthesis (1995) identifies four major determinants of consumer recycling behavior --- Internal Facilitators, External Incentives, External Facilitators, and Internal Incentives. These four types of recycling determinants are then assessed for their degree of influence over recycling behavior. Knowledge of the strength of different recycling behavioral determinants can guide the development of cost effective policies to promote recycling among consumers.

In their review  Hornik et al. (1995) identify Internal Facilitators as the most influential determinant of consumer recycling behavior. Internal Facilitators are defined by as “cognitive variables which enable an individual to recycle” (Hornik et al, 1995: 109). Examples of such cognitive variables would be an individual’s knowledge of recycling programs, or an individual’s awareness and belief in the importance of recycling. Internalization of these cognitive variables could possibly be achieved through consumer recycling education. Mueller’s study of municipal recycling policies in Ontario, Canada (2013) does in fact suggest that recycling education is one of the more effective routes to achieving increase in consumer recycling.

Identified by Hornik et all (1995) as the second most influential determinant of recycling behavior is External Incentives. External Incentives are outside forces induce consumers to recycle. Examples include economic incentives --- such as a per-pound reward for recycling --- and regulations that simply require certain materials to be recycle. Though these type of policies are generally effective, the downside associated with External Incentives is that their impact is temporary. If an economic incentive is in place, people will increase their recycling. However, if that economic incentive is removed, people will decrease their recycling. This can be seen throughout the history of recycling recounted above, as the prevalence of recycling shifted dramatically when the costs of production or the cost of purchasing primary materials changed. The same downside applies to laws and regulations. In order to maximize the benefits of External Incentives, it might be wise to utilize these types of policies in tandem with other policies that cause more long-term changes. For example, increasing consumer awareness of recycling programs and awareness of the importance of recycling alongside an economic incentives to recycle may lead to a huge increase in recycling. The economic incentive will assist in changing initial behaviors; if the economic incentive is later removed, the increase in recycling will drop some, but will not disappear entirely due to the persistence of the effects from Internal Facilitators. An important caution with implementing punitive External Incentives pertains to their capacity to contribute to illegal waste disposal (Onada, 2012).

The third most influential determinant of recycling behavior is External Facilitators. External Facilitators are outside factors that determine the ease of recycling for consumers, for example the frequency of recycling collection, the size of the recycling bins available, and the complexity of the recycling rules. Essentially, if recycling is not overly unpleasant, time consuming, or complicated, more people will be inclined to recycle than if the process was tedious. Policy options that act as External Facilitators include increasing the frequency of collection, making recycling easier through simpler guidelines (single-stream recycling), and increasing the kinds of material that are eligible for recycling. Muller's findings and his review of the literature (2013) suggest that these types of facilitative policies can occasionally be more effective than the punitive policies identified as External Incentives.

The fourth and least influential determinant of recycling behavior is Internal Incentives. Internal Incentives include personal gratification from helping the community, a sense of control, and good feelings that result from recycling. Policy is a bit trickier for this determinant. Media discussion of recycling may be a good way to arouse these kinds of Internal Incentives. Though difficult to promote, the efficacy of this type of incentive is seen can be seen in the history of recycling during World War II, when positive feelings associated with patriotism led, alongside materials scarcity, to a dramatic increase in recycling behavior among consumers.

To summarize, there are a number of policy options available. Increasing knowledge of recycling programs and awareness of the importance of recycling seem to be the most effective policy strategies (Internal Facilitators). To increase initial participation, pairing educations programs with economic incentives or regulations (External Incentives) may prove useful. Supplemental policies might also include making recycling easier (External Facilitators) and increasing social pressure to recycling (Internal Incentives).

***Case study*: *Seattle Zero Waste***

In 2006, Seattle Public Utilities (SPU) commissioned several consulting firms to analyze its current waste management performance, with the particular goals of identifying ways to increase recycling and update waste management facilities (URS, "Volume I", 2007: ES-1). The commissioned study was published in two volumes, informally called the "Zero Waste Study". The first volume of the Zero Waste Study provides policy suggestions, and explains the core principle underlying Seattle's approach to waste management, first adopted in 1998 --- that of "zero waste" (URS, "Volume I", 2007: 2-5). Briefly, the notion of "zero waste" demands reconceptualization of waste as a *resource*, as it would be in an ecological system. The second volume of the Zero Waste Study details the 124 possible and 39 existing recycling programs and strategies considered in the study, including for each policy a description; background; materials involved; implementation timeframe; expected participation and efficacy; diversion potential; cost; environmental benefits (in qualitative terms --- not quantified); action feasibility; risks; assumptions; and references.

Findings from the Zero Waste Study informed the Seattle City Council's development and adoption of the 2007 Zero Waste Resolution, which set new targets for the SPU's waste management program (Council News Release, 2007). In response to the newly passed resolution, and drawing on findings from the Zero Waste Study, the SPU began the process of updating its waste management plan, developed in 1998 and updated previously in 2004 (Seattle Public Utilities, 2012).

The economic analysis for the SPU's Solid Waste Management Plan revolves around a Recycling Potential Assessment Model (RPA), consisting of four phases. The first phase of the RPA model is waste forecasting. Waste stream data is collected by the City of Seattle. Data on the volume and sector sources of waste is collected a daily basis at the scale of individual trucks, and waste is occasionally audited, determining its composition in terms of twenty tracked material types (Morris & Bagby, 2012). The broader waste stream is subdivided into two groups, on the basis of source: residential waste (MSW), and waste from the construction and demolition sector (C&D). Knowledge of the sector sources of waste is valuable policy information, as different sectors manifest different patterns of waste generation and require different waste collection services. Data on the volume and composition of the waste stream is also vital in deciding what recycling facilities will be needed. Combining existing waste stream data with "economic, demographic, price and weather variables" (Morris & Bagby, 2012: D-2), the first phase of the RPA projects figures for waste generation for the next 30 years.

The second phase of the RPA model is recycling tonnage forecasting. Current and potential policies identified by the Zero Waste Study were grouped into different policy scenarios, including a status quo scenario of only existing programs. Waste stream projections from phrase one of the RPA model were input for each of these different scenarios, yielding estimates of how many tons would be recycled under each policy scenario. At this point, the analysis determined that the status quo scenario of existing recycling programs would fail to meet the recycling targets established by the 2007 Zero Waste Resolution (Seattle Public Utilities, 2012: 4-28).

In the third phase of the RPA model, the strictly financial costs and benefits of the different recycling policy packages were quantified. The costs associated with the policies are, for example, "costs of collection, bin or cart costs, education, and processing costs" (Moriss & Bagby, 2012). The benefits are in the form of avoided costs --- costs that would be incurred by landfilling potentially recyclable material. Presumably, since the model was working with 30-year projections, benefits were subject to some discount factor, but this aspect of the analysis is not disclosed in the study appendix.

Finally, the fourth phase of the RPA model outputs the results of the first three phases. These results are subject to additional analysis, that adds the net environmental benefits of the recycling policy scenarios to their net financial benefits. The environmental costs of recycling are the collection, transport, and processing of eligible materials, while the benefits of recycling are the avoided damages of waste (harmful emissions), and the preservation of virgin materials. Essentially, to analyze environmental benefits, potentially recyclable materials in the waste stream are assessed for their pollution content. For example, potentially compostable food produces methane emissions when it is landfilled, contributing to climate change. Using a proprietary model (the Sound Resource Management Group's MEBCalc™), the emissions avoided by recycling were classified into seven categories, for example "global warming potential" (Morris & Bagby, 2012: D-7); translated into a base unit, for example, $CO_2$; and quantified by referencing existing studies, for example $40 per ton of $CO_2$. This approach to evaluating environmental damages is called benefits transfer, and represents a cheaper alternative to conducting revealed or stated preference studies (Kolstad, 2011). Importantly, many environmental benefits were left unquantified, due to lack of data. Complete data on emissions, the damages done by emissions, and the monetary value of those damages was not available. The "cumulative and interactive" effects of emissions are likewise unknown. Through choice of methods, non-use values were excluded.

The RPA analysis yielded a recommended policy scenario with a net present value of $19,103,333, as well as a suggested schedule for the adoption of these new recycling programs (Seattle Public Utilities, 2012: 4-31).

## 4. CONCLUSION

### *Limitations of recycling*

Recycling is an attractive strategy for waste management, but far from a silver bullet. Attempts to increase recycling among consumers can cause an increase in illegal waste disposal (Onada, 2012), or have a paradoxical "licensing effect", wherein consumers feel good about their efforts recycling and subsequently increase their consumption levels (Caitlin & Wang, 2012). Further limitations on the environmental benefits of recycling are evident when considered in light the materials lifecycle. Materials progress through phases of extraction, production, and consumption, with residuals of consumption and production either discharged into the environment or recycled back into production processes (Field & Field, 2008). This materials lifecycle is subject to the physical laws of thermodynamics, which imply two important limits that pertain to recycling: that every act of material extraction ultimately, inevitably yields waste. which can only be delayed by the recycling process; and that recycling is itself a costly process that results in the dissipation of useful energy (Hanley et al, 1996).

### *Recycling policy implications*

Despite these limitations, recycling is an important component of residuals management --- one strategy, alongside reduction and reuse. This paper presents several insights that may be of use to municipal governments in their efforts to encourage recycling among consumers. We see from Hornick et al (1995) and Mueller (2012) that consumer education and greater convenience of consumer recycling are promising approaches. Again from these sources, we see that combinations of different policies may have positive reinforcing effects, compensating for the drawbacks associated with any single policy used by itself. A further, important insight emerges from review of the City of Seattle's Zero Waste Plan: this insights is that, often, the environmental benefits of recycling are difficult to quantify, and may therefore be left unquantified in the policy process. Failing to quantify the full environmental damages of waste means that the negative externalities of waste, a public bad, are not internalized, and the socially optimal balance of material extraction, consumption, waste and recycling is not achieved. In time, research can possibly provided the data needed for more comprehensive environmental benefit-cost analysis. But in the meanwhile, regulators should be aware of the significant, known undervaluation of environmental damages, and allow for this in establishing policy targets.

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