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How to Increase Recycling Rates of Residential Waste in the
United States

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How to Increase Recycling Rates of Residential Waste in the United States

A thesis submitted to the Faculty of Barry University
in partial fulfillment of the requirements
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by

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During the past 20 years, most US households did not engage in any type of program to manage their waste. Consequently, the United States' wealth and prosperity generated the problem of waste production during the 1990s. The economist Michael McDonough discovered that the US waste production has an 82% correlation to the US economic growth. As a household's income increased, their waste production also increased. As a result, household waste was deposited in landfills, causing many areas to be confronted with a growing scarcity of landfill capacity. A great way to solve this problem of waste production is by recycling, as it removes potentially useful materials from waste and processes them into the production of new products. Therefore, the primary purpose of this study is to identify the appropriate tools and incentives the American government can implement to increase recycling rates of residential waste.

This study demonstrated that improvements in landfill and combustion waste taxes and waste collection charges can potentially increase the recycling rates of residential waste in the United States.

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How to Increase Recycling Rates of Residential Waste in the United States

INTRODUCTION

During the past 20 years, few US households engaged in any type of waste management program (Kinnaman 219). Consequently, the United States' wealth and prosperity generated an increasing problem of waste during the 1990s (Biswas, Abhijit, et al. 93). Household waste was deposited in landfills because most households did not engage in recycling. As a result, many areas were confronted with a growing scarcity of landfill capacity (Kinnaman 219; Folz 336). Therefore, it is important for a country to have the appropriate tools and incentives to efficiently manage large amounts of waste. However, before enacting governmental incentives to increase recycling rates, the American government needs to be aware of the factors that encourage and inhibit consumers to take pro-environmental actions. It is important to understand what the public is willing to pay (or do) to improve the environment in order to identify which governmental incentives will contribute to the increase of recycling rates. Therefore, this research not only investigated appropriate tools and incentives the American government can employ to boost the recycling rates of residential waste, but this research also built upon important prior research to understand consumers' behavior towards recycling of municipal waste exclusively. The following section defined what the procedure of recycling entails and how it is beneficial in many ways.

Statement of Purpose

What is recycling?

Recycling is the process of using existing products or materials that have already served their purpose in the production of new products. This entails collection and

separation of potentially useful materials that are otherwise considered waste, and have traditionally been disposed of by means of incineration (burning) and land filling (United States Environmental Protection Agency, "Recycling Basics"). Rather than employing these methods of disposal, recycling processes the potentially useful materials into the production of new products. Recycling benefits the natural environment, but it is also beneficial for people. The importance of recycling can be observed in many different ways. Recycling products made from raw materials preserves the environment, for instance, by reducing the rate at which trees are harvested. Recycling saves energy. It takes less energy to process recycled materials than to process untreated materials, which in turn decreases pollution (Hennepin County Public Works). For instance, it takes 90 percent less energy to manufacture an aluminum can from recycled aluminum, about 75 percent less energy to manufacture paper from recycled paper and paperboard, and it requires about 50 percent less energy to manufacture a glass bottle from recycled glass (Hennepin County Public Works).

Less pollution promotes societal health and in turn boosts the economy (R. W. Beck, Inc). Recycling helps one save money. One can lessen one's expenses by selling recyclable materials to organizations that are willing to buy them, or by simply using products that are themselves recycled. For example, at home, one can recycle natural waste such as eggshells, vegetables, and fruit peelings and use them to fertilize plants, rather than purchasing fertilizer. Finally, recycling is important because it reduces waste in landfills. If one does not recycle, then more and more garbage will go to landfills until there is no place left to put any more. One must recycle in order to avoid landfills in one's backyards.

There are two types of approaches used to reach a logical true conclusion, inductive reasoning and deductive reasoning. This research, used the inductive, social scientific approach. Inductive reasoning is a scientific method used to form hypotheses and theories (Bradford). Inductive reasoning, sometimes called the bottom-up approach, detects patterns and regularities from a set of observations or data, developing various general conclusions or theories. In order to develop recycling programs that will increase the recycling rates of residential waste, it is important to understand consumers' behavior towards recycling. Therefore, the following section is the literature review, where four theories that investigate the relationship between consumers' intention to perform a certain task and their actual behavior are introduced.

LITERATURE REVIEW

Theories

Two approaches to understanding recycling are the sociological theory and green consumerism. The sociological theory is as a set of interrelated ideas that allow for the organization of knowledge about societies and social behavior (Keel). Subsequently, this knowledge is used to explain aspects of the social world and enable prediction about future events (Keel). Thus, the sociological theory is able to provide a better understanding of the societal implications and limitations of environmental management. Similarly, green consumerism is also concerned with the study of consumer behavior and describing who green consumers are. Therefore, green consumerism refers to the purchase and use of eco-friendly products that minimize damage to the environment, such as recycling of household waste (Discovery Communications). Consumers can behave in a more environmentally-friendly way by changing the patterns through which

they acquire, use, and dispose of products. Thus, the sociological theory, together with green consumerism, explains society's behavior towards recycling and allows one to predict future behaviors.

In the article, "Green Buying: The Influence of Environmental Concern on Consumer Behavior," Tina Mainieri et al. state that consumers must adopt environmentally sound behaviors in order to sustain the environment. Thus, the article studies the factors that influence environmentally conscious behavior. The independent variables in this study includes awareness about the environmental impacts of products, specific environmental beliefs of consumers, several general environmental attitude scales, demographic variables, and several pro-environmental behaviors other than buying behavior. Therefore, these independent variables predicted the purchase of products that are environmentally beneficial which is called green purchasing.

Consequently, this article's research questions consist of the following: What knowledge and beliefs do consumers have regarding environmental products? What are green buying habits? What are general environmental attitudes? What are the factors that influence environmentally conscious purchases? The article uses both quantitative and qualitative methodologies, such as questionnaires, descriptive findings, statistical analysis, and subgroup comparisons. The findings show that the surveyed householders did not display their environmental concerns in their purchasing behavior, even though they expressed generally favorable environmental viewpoints. Therefore, these respondents do not translate their pro-environmental beliefs into action. Hence, the results confirm that specific consumer beliefs cannot be the best predictors of several pro-

environmental behaviors and of general environmental attitudes (Mainieri, Barnett, Valdero, Unipan, and Oskamp).

In the following article, “True Green Consumers: An Investigation of Consumers’ Genuine Willingness to Share Environmental Responsibility,” Samar Baqer indicates that the emergence of ecological consumers was due to the awareness of ecological deterioration. The purpose of the study was to identify the profile of true green consumers based on external factors. This article investigates environmental attitudes among consumers in the United States, Kuwait, and Turkey. However, for the purpose of this research, the consumer attitudes of Americans will be the focus. The independent variables of the article are environmentally conscious consumers who are devoted to green products, as well as the impact of external factors, such as government, business, and media support. The results of this study show a positive effect between the external factors and the creation of true green consumers in the three countries.

The study conducted by Baqer involves two main hypotheses, each with three sub-hypotheses. The first hypothesis (H1) proposes the following: environmental consciousness will have a relationship with the creation of true green consumers. The second hypothesis (H2) conjectures that external factors have a relationship with the creation of true green consumers. The sub-hypotheses for H1 involves three factors—consumer skepticism, locus of control, and spiritual belief— that affect the relationship between consciousness and the creation of true green consumers. Consumer skepticism is the attitude of doubt that consumers have toward green consumerism due to mixed advertisement messages and companies’ false campaigns. The concept locus of control explains the control consumers have on the external environment. However, when a

person does not control external factors, they will not believe in the effectiveness of their actions in preserving the environment. Lastly, religion might be a source of guidance for environmental protection. For instance, the Bible and the Quran provide guidance for environmental ethics. The sub-hypotheses for H2 involve the same three factors as H1, but it considers how they affect the relationship between external factors and the creation of true green consumers.

Baqer's article uses both quantitative and qualitative methodologies such as surveys, component analysis, descriptive statistics, and comparison analysis. Finally, the results show that the investigation of environmental consciousness and external factors, including the role of government, businesses and media, showed a positive effect on the creation of true green consumers in all three countries. In addition, the factor concerning religious beliefs is the major factor strengthening the relationship between the two independent variables, environmentally conscious consumers and external factors, and the potential for the creation of true green consumers. For instance, Baqer found that the Bible and the Quran provide guidance for environmental ethics. Thus, both H1 and H2 were confirmed through these findings.

In the article, "Changing Garbage Disposal Patterns of Consumers: Motivation, Ability, and Performance," Rik Pieters states that in light of recent waste problems, the focus of research regarding consumer behavior shifted from a study of the purchase of recycled products to the disposal of products after their use. The independent variable is the recent waste disposal problem. Hence, the dependent variable is the shift in the focus of consumer behavior. The research questions for the article are: How do consumers acquire their products? What are the patterns in which the disposal of products occurs?

How do green consumers dispose of their products? And did these disposal patterns change over time?

Pieters' article uses qualitative measures such as descriptions, observations, and comparison analysis of disposal patterns between the past and the present. The article mentions that the three main factors that influence the participation of consumers in waste separation programs are motivation, ability, and the actual performance of consumers. In the past, people did not have the attitude, intention, skills, or knowledge to participate in waste separation programs. However, at the present time people are stimulated to recycle and they have the capacity to act on their motivation. Therefore, these findings confirm that trash disposal patterns of consumers have changed over time.

Lastly, in the article, "Residential Design Implications of Consumers' Recycling Behaviors," Sharon Macy and Jo Ann Thompson mention that other studies found inconvenience is a deterrent to recycling. Therefore, the article's objective is to study how to increase recycling convenience within the home. The independent variables in this study are inconvenience and attitude towards recycling which limits the incentive and ability to recycle.

The research questions related to Macy and Thompson's article are: What are the residential design implications for incorporating recycling within the home? What are consumers' feelings concerning environmental altruism? What are consumers' behaviors toward recycling within the context of situational conditions in the home? And what are consumer's views regarding the convenience of their home's recycling facilities? The methodologies used in the article are questionnaires and descriptive and inferential statistics such as sociodemographics, behavior and situational design factors, altruistic

values, perceived inconvenience, and economic factors. The results support the hypothesis that convenience is a primary factor in the recycling behaviors of highly altruistic individuals. Therefore, including an area for recycling in the kitchen or a space that is easy-to-reach, such as an attached garage, would stimulate recycling behaviors.

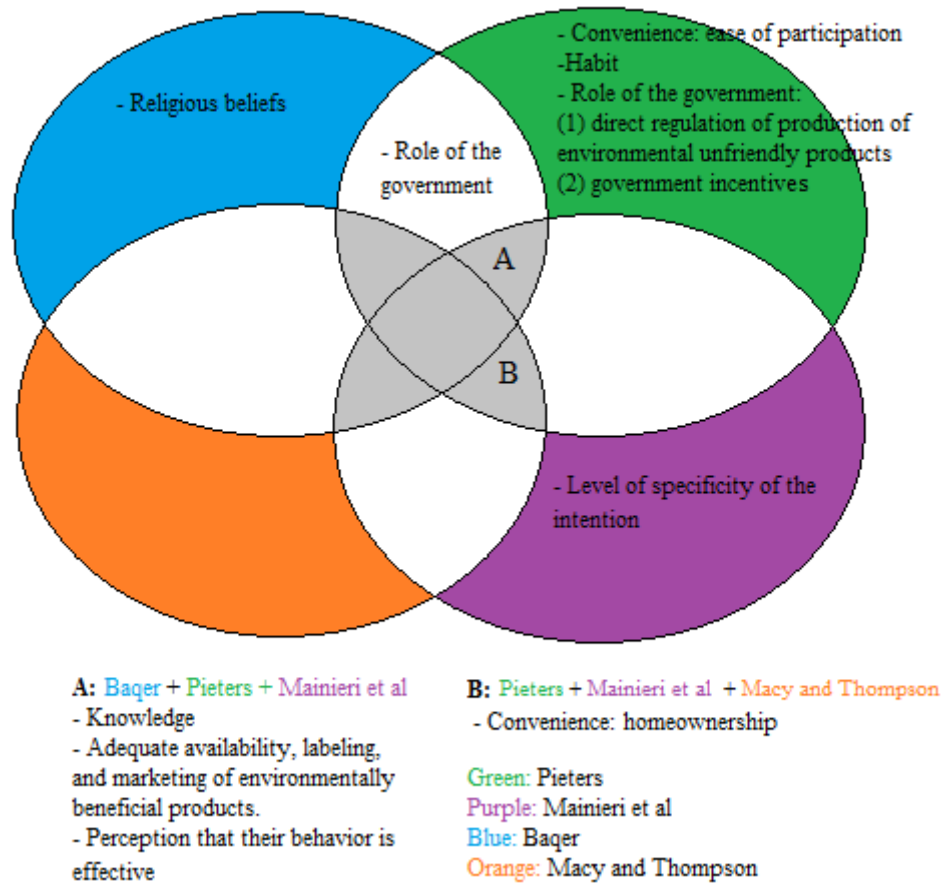
Research Question

Recycling has been a topic of interest in the past few years. Many people have thought about taking environmentally friendly actions in order to protect our environment. However, before enacting governmental incentives to increase recycling rates, the American government needs to be aware of the factors that encourage and inhibit consumers to take pro-environmental actions. As mentioned before, this research uses the inductive approach. For that reason, it would be more appropriate to formulate a research question instead of hypothesis: What improvements in waste collection charges and waste taxes can the American government make to increase recycling rates of residential waste?

Comparison of Previous Studies

Pieters, Mainieri et al, and Baqer offer similar, as well as different, arguments to support the same hypothesis: “Consumers’ intention to participate in pro-environmental programs will lead to actual behavior.” Figure 1 illustrates how the four case studies mentioned above in the literature review relate to one another.

Figure 1: Comparison of Previous Studies



Pieters states that volitional control is one of the factors that connect consumers' intention to perform a certain task with their actual behavior. He explains that volitional control is a person's motivation and ability to actually perform a certain behavior. However, if consumers do not have the ability to perform a behavior, then motivation will not lead to actual performance. Therefore, ability moderates the relationship between motivation and performance. Pieters' study is the only one to introduce the idea that both motivation and ability are determinants to whether consumers actually perform a behavior, but the other three studies follow similar reasoning.

Pieters, Mainieri et al., and Baqer all agree that a factor that effects a person's ability to perform a behavior, and accordingly connects consumers' environmental intentions with their actual behavior, is consumers' knowledge of how to put their behavioral intentions into practice. For instance, a person who intends to participate in a waste separation program, but does not know how, or who has an incorrect knowledge of the rules, will not participate at all or not participate properly (Pieters). Therefore, people's confusion on how to implement their behavioral intentions inhibits pro-environmental behavior (Mainieri et al.). Besides inhibiting pro-environmental behavior, this confusion can also lead to consumer skepticism associated with mixed advertisement messages and companies' false claims (Baqer 40). Pieters, Mainieri et al., and Baqer explain that another method to improve consumers' ability to perform a behavior, and hence ensure that consumers' pro-environment behaviors do not stay behind their intentions, is the adequate availability, labeling, and marketing of environmentally beneficial products. Therefore, proper advertising could help change the misunderstanding people have regarding pro-environmental products and programs.

Mainieri et al., Macy and Thompson, and Pieters all agree that a third factor that affects someone's ability and motivation to perform a behavior is convenience. Macy and Thompson's study was focused on identifying how residential design can influence consumers' recycling behavior. Even though their study was not focused on identifying factors that link consumers' intentions with their actual behaviors, they discovered that convenience influences an individual's recycling behaviors and that ability to store recyclables in one location is very important to increasing consumers' perceived convenience. Therefore, it is important to design an environment that supports recycling

in order to increase consumers' quantity and accuracy in recycling, which in turn could lead to an increase in attitudes toward other pro-environmental actions (Macy and Thompson). Mainieri et al., Macy and Thompson, and Pieters all argue that consumers in apartment buildings will have trouble storing two large containers and will be less likely to engage in pro-environmental action. Therefore, they all state that home ownership is an indicator of performance in recycling programs. Pieters alone identifies another aspect of convenience: ease of participation. For example, the motivation of participation in recycling of household waste will decrease when part of the waste must be brought to a centrally located waste container (Pieters).

Pieters was the only one to notice a fourth ability factor: habit. He argues that in order for consumers to actually participate in pro-environmental programs, they have to be willing to give up their existing habits and embrace new patterns. Otherwise, they may forget the new behaviors or may fall back into the old patterns because they are less costly to maintain. For example, in order to participate properly in a waste separation program, the consumer has to change his or her disposal patterns.

Pieters, Mainieri et al., and Baqer also identified that one of the factors that affect consumers' motivation to actually perform a certain behavior is people's perception that their participation will actually make a difference. Pieters argues that to better understand the motivation behind a certain behavior, a distinction should be made between the costs and the benefits of that behavior. For example, consumers tend to be motivated to spend time and effort to separate their garbage if they perceive that their behavior is effective. If actual recycling does not take place, then the motivation to participate will decrease rapidly and dramatically (Pieters). For example, the motivation to participate in such a

program can decrease when consumers perceive that their contribution to the program would not be enough to benefit the environment when the majority consumers are egoistically taking a free ride and hoping to benefit from the effects of the program without contributing to it (Mainieri et al.). Baqer also states that consumers are willing to spend time, effort, and extra money for a socially desirable concept like environmentalism because of their belief that their actions will improve their future quality of life. Therefore, consumers that are environmentally consciousness, showing concern for the environment, are more likely to participate in pro-environmental activities because of their perception that their actions will put an end to environmental degradation (Baqer 39).

Baqer and Pieters both state that the role of the government can also be a factor for motivation to perform a behavior. However, Baqer does not expand on the specific types of governmental activities that would affect motivation. On the other hand, Pieters argues that government direct regulation of production of environmental unfriendly products and government incentives are motivation factors. By requiring retailers to end the availability of environmentally unfriendly products in favor of environmentally friendly alternatives, pollution will be reduced and product design will be improved to communicate environmental awareness to consumers. Consequently, businesses' concern regarding environmental deterioration will translate into consumers becoming motivated to participate in pro-environmental programs.

Pieters explains that there are positive incentives (such as tax incentives, grants, loans, and subsidies) and negative incentives (such as taxes, fines, special charges and rates, and price increases). Financial incentives are necessary ingredients of

environmental policy because they mainly affect the motivation to demonstrate environmentally friendly behavior.

Baqer is the only one to introduce religious beliefs as another source of motivation for environmental protection. He states that the Bible and the Quran both provide guidance for environmental ethics; therefore, people that follow those beliefs are likely to act in the same manner. Lastly, Mainieri et al. provide a different aspect that does not relate to motivation and ability, but also determines whether consumers' intention to participate in pro-environmental programs is able to predict their actual behavior. They argue that the level of specificity of the intention determines the actual behavior. People's intentions are expected to lead into actual behaviors, only if the behavior is closely related to the specific intention under consideration; the more specific the intention, the more likely that it will actually result in an action. For example, consumers that have a specific intention to buy products that are environmentally beneficial are more likely to buy specific household cleansers, light bulbs, laundry detergents, garbage bags, paper products because they believed that those products are better for the environment.

METHODOLOGY

This research is about the recycling rate of residential waste. Thus, this research will use the ratio level of measurement. This means that this research not only involves the ratio measurement, but it also includes all the qualities of nominal, ordinal, and interval level of measurements. Consequently, this research will measure consumers' attitudes towards garbage by ranking the order of importance towards recycling.

The primary types of methodology used in this research will be the qualitative approach, including both analyzing and constructing case studies. The use of case studies throughout this research will be the most effective method because case studies will help find particular problems with waste management in great detail. This methodology will be used because cases rich in information already exist, from which a great deal can be learned from a few exemplars about the questions at hand. However, case studies will also be conducted in this research using a combination of direct observation regarding household's recycling behavior. This will allow the researcher to get close to the people and situations being studied.

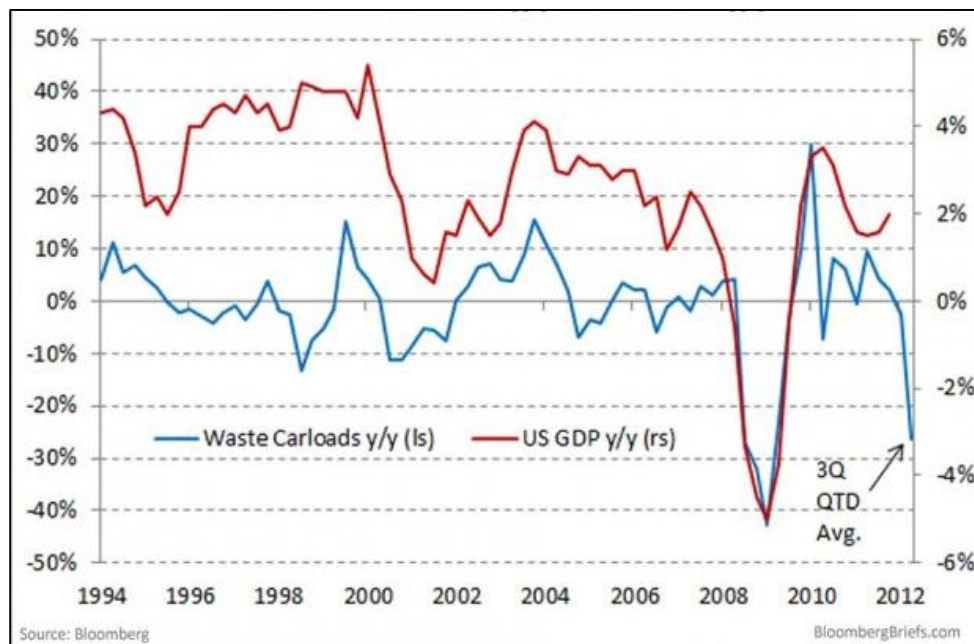
ANALYSIS

As mentioned in the introduction, as a country's wealth and prosperity improves, households will have more disposable income to spend, causing more consumption and, consequently, more waste production. The Bloomberg Economist Michael McDonough studied the correlation of GDP and trash and he discovered a similar positive relationship between a countries' GDP and its total waste production (See Figure 2) (McDonough). The Gross Domestic Product (GDP) is the total annual monetary value of all domestically produced final goods and services (Investopedia). He explains that everything that people throw away, not only consumer products but also buildings being demolished, is correlated to the production and consumption of goods and services. For example, when one buys a new couch, it is usually for the purpose of replacing the old couch, so one might be throwing out the old couch. Also, if one goes out to McDonald's and buys a product, one is likely to throw out something, such as the napkins or the paper wrapped around the burger.

McDonough argues that because the GDP is a factor for determining if a country's economy is strong, it means that significant waste production is an indication of having a prosperous economy (McDonough). In other words, the higher the GDP, the more income a country has, the more products will be consumed, and then the more trash will be thrown away. Furthermore, he claims that by monitoring the GDP and trash one can examine the economy and even be able to identify potential recessions (McDonough).

McDonough discovered that waste has an 82% correlation to US economic growth by examining the Association of American Railroads (AAR) carloads of trash with the U.S. GDP. The US has experienced a GDP decline of approximately 20% between 1994 and 2012 and a decline of waste production of approximately 30% (See Figure 2) (McDonough). From Figure 2, one can see that something is wrong in the economy, potentially, in the underlying economy, and that recent downturns in the waste production is concerning regarding the near term direction of the overall US economy.

Figure 2: AAR Waste Carloads Compared to U.S. GDP



Therefore, this correlation makes it clear that the stronger a country's economic performance, the more important it will be to recycle in order to avoid large amounts of waste production. For that reason, countries need to have the right tools to deal with the increasing amount of waste in order to minimize both the economic costs, and the environmentally negative effects that come with waste. One can argue that recycling is one of the best tools to fight the increase in waste production. Recycling would not only lower the total amount of waste that needs to be disposed of at the end of the waste stream, and reduce both the cost and the environmental damage, but recycling would also lower the need to use virgin raw materials, which reduces the strain on natural resources (McDonough).

Some might say that the problem is that while growth in GDP has a clear relationship with waste production, there is not a clear relationship with an increase in individuals' income and recycling behavior. As mentioned before, based on the data obtained from the researchers' survey, the researcher was able to conclude that high income consumers are more environmentally conscious than low-income consumers (McDonough). This has to do with the fact that as a household's income increases their waste production will also rise. Another reason might be that a higher affluence allows household's to have more leisure to think about recycling. In other words, having higher income could result in a consumer being more environmentally conscious.

According to the "Environmental Kuznets Curve," the waste production will start decreasing after a certain income level. That curve shows that some pollutants, such as waste, follow an inverse-U-shaped pattern relative to a country's income (Abrate and Ferraris). As explained by Graziano Abrate and Matteo Ferraris, "there are several

reasons for the relationship of the income-pollution path which can be classified into three categories: increasing economic scale, structural change and increasing demand for environmental quality as household income increases” (Abrate and Ferraris). Abrate and Ferraris observed that only the second two categories, structural change and increasing demand for environmental quality as household income increases, can explain both the positive relationship (more income, more waste) and the negative relationship (the delinking/decoupling of waste production and income growth) (Abrate and Ferraris). However, due to the fact that economic growth will not solve the problem by itself, efforts need to be taken to solve the environmental problems caused by waste.

Various researchers, including Abrate and Ferraris, believe that breaking the connection between waste production and income growth (delinking) does not automatically occur. In other words, a country’s economic growth will be part of the solution for environmental problems due to waste. However, it will not be the entire solution. Therefore, in order to easily break the connection between waste production and income growth, the government has to provide households with the appropriate tools and incentives that will encourage them to produce less waste and recycle more. These tools and incentives can include waste taxes, waste collection charges, subsidies, and fiscal incentives. This leads to the research question of this paper, namely “What improvements in waste collection charges and waste taxes can the American government make to increase recycling rates of residential waste?”

In a previous section, the researcher explained the benefits associated with recycling regarding the environment and consumers. This section of the paper will explain the economic costs and benefits associated with recycling.

Economic Costs and Benefits

There are many economic benefits of recycling, one of which includes the creation of jobs. Recycling creates new businesses for transporting, processing and selling recovered materials, as well as companies that manufacture and distribute products made with recycled materials. When one recycles, more jobs are created than when one merely discharges one's waste. For instance, dumping 10,000 tons of waste in a landfill creates six jobs, while recycling 10,000 tons of waste creates 36 jobs (Recycling Benefits to the Economy). Jobs in the recycling industry add value to the materials, nothing like jobs in waste disposal.

Consequently, jobs in the recycling industry contribute to a growing labor force of skilled workers, such as material sorters, dispatchers, truck drivers, sales representatives, process engineers, and even chemists. Many of these jobs pay above the average national wage and many are in urban areas where jobs are desperately needed. According to the U.S. Recycling Economic Information Study, there are more than 56,000 recycling and reuse establishments in U.S. and they employ approximately 1.1 million people (R. W. Beck, Inc 2). In addition, wages for workers in the recycling industry are remarkably higher than the national average for all industries. Generally, annual revenues of about \$236 billion are generated in the recycling industry (R. W. Beck, Inc 2). Furthermore, besides the creation of new businesses and jobs, recycling also benefits the economy by being a source of revenue through the sales of materials. There is definitely a market for recyclable materials and the returns on investments in the recycling industry can be fairly high.

Communities can make money by selling their recyclable materials. There are countries that do not have their own natural resources and forests, but import waste material, such as paper, as raw material for their manufacturing industries (Recycling Benefits to the Economy). For example, countries such as China, South Korea, and Japan import recycled paper or waste paper and are able to depend upon the low-cost, economically viable options of recycling to cope with the shortage of natural resources in some regions (Recycling Benefits to the Economy). Therefore, as the market for recyclable materials increases, the revenue generated within the industry also increases. Thus, recycling is not only good to the environment, but also to one's economy.

In order to identify the improvements in waste collection tools and incentives the American government can make to increase recycling rates of residential waste, one must first know what the researcher means by residential waste.

What is municipal solid waste?

Figure 3: Municipal Solid Waste (MSW)



From the definition given for recycling, it is clear that many types of products and materials can be recycled. However, in this paper the focus lies on municipal waste. Residential waste, also known as municipal waste, is generally considered to consist of a combination of everyday items that are discarded by the public, and general waste gathered

by the municipality. According to the United States Environmental Protection Agency (US EPA), “municipal solid waste (MSW) is household trash comprised of various materials Americans commonly throw away after being used, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, and newspapers (See Figure 3). This comes from our homes, schools, hospitals, and businesses. MSW does not include hazardous or construction waste” (US EPA, "Municipal Solid Waste"). The amount of municipal waste generated consists of waste collected by or on behalf of municipal authorities, and disposed of through the waste management systems. In other words, the focus lies primarily on the type of waste, and not who produced or collected it. Notice that in the following sections waste, residential waste and Municipal Solid Waste (MSW) will be used interchangeably.

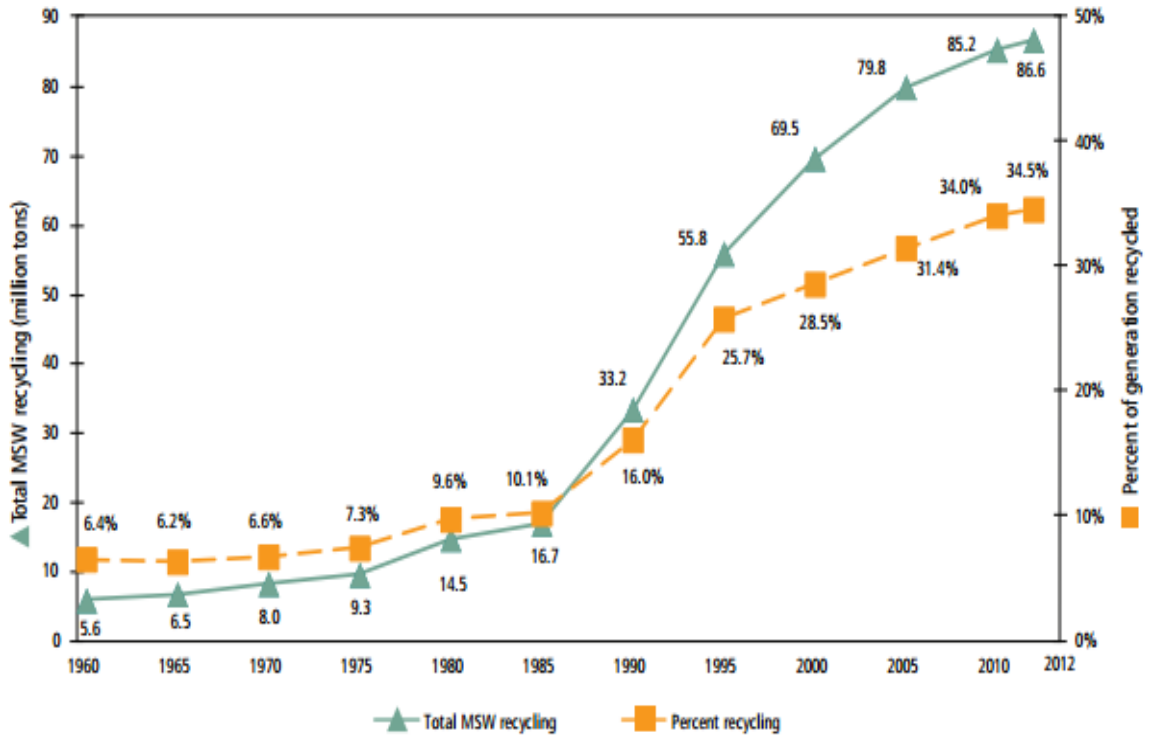
Municipal Waste in America

In 2012, Americans generated about 251 million tons of MSW and recycled and composted almost 87 million tons of this material, equivalent to a 34.5% recycling rate (See Figure 4 and Figure 5) (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012"). On average, Americans recycled and composted 1.51 pounds out of our individual waste generation rate of 4.38 pounds per person per day (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012").

Figure 4: MSW Generation Rates, 1960 to 2012

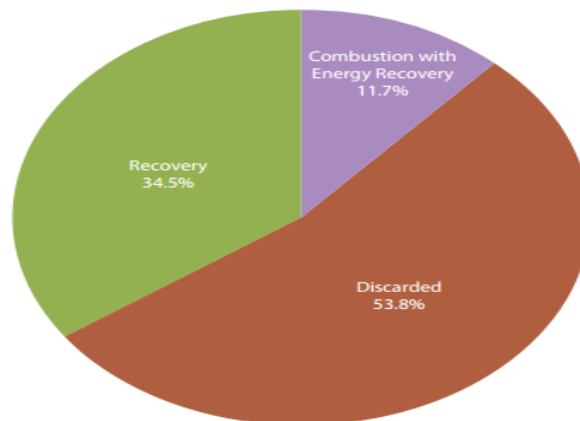


Figure 5: MSW Recycling Rates, 1960 to 2012



Furthermore, in 2012, Americans recovered over 65 million tons of MSW through recycling and over 21 million tons through composting. By subtracting out what is recycled and composted, one is able to determine the amount of MSW that is combusted. The U.S. combusted about 29 million tons of MSW for energy recovery, which entails 2.9 pounds per person per day of MSW discarded in landfills. In 2012, the recycling rate of lead-acid battery recovery was about 96% (2.8 million tons), newspaper/mechanical papers recovery was about 70% (5.9 million tons), and over 57% of yard trimmings were recovered (19.6 million tons) (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012"). Moreover, about 135 million tons of MSW (53.8%) were discarded in landfills in 2012 (See Figure 6) (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012").

Figure 6: Management of MSW in the U.S., 2012



Recycling of Municipal Waste

The majority of the waste categories included in the household waste definition can be recycled, with the exception of hazardous, toxic, medical, and construction waste. Electronic equipment, such as mobile phones, computers, drills, and hairdryers, as well as

industrial items such as medical devices and laboratory equipment are defined as Electronic Waste (E-Waste) at the end of their productive life (US EPA, "Waste from Electrical and Electronic Equipment and Batteries"). Since 2003, the US is actively implementing and/or considering implementing regulations aimed at mitigating the ever increasing volume of E-Waste being created. In 2008, the US generated 3.16 million tons of E-Waste (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States").

Glass recycling is done by crushing glass and melting it. The melted glass is then used during the production of new glass. Contrary to the recycling of paper, glass can be recycled over and over indefinitely; whereas, paper can only be recycled up to six times (The Economist). For example, new glass containers are made out of 90% recycled glass from discarded glass food and beverage containers (US EPA, "Glass"). Consequently, it leads to a reduction of energy consumption during glass production of 30%, as well as a very larger reduction on the virgin raw resources used to make glass, such as sand, lime, and soda. Old paper can be used to create new paper. However, as previously mentioned, this process cannot be repeated indefinitely because the fibers in paper are damaged each time they are recycled and become too weak after being recycled for the sixth time (The Economist).

Waste Management in America

In the United States, the Environmental Protection Agency (US EPA) regulates household, industrial, manufacturing and commercial solid and hazardous wastes under the 1976 Resource Conservation and Recovery Act (RCRA) (US EPA, "Hazardous

Waste Data"). Effective solid waste management is a cooperative effort involving federal, state, regional, and local entities (Solid Waste Policy in the United States).

The US EPA 1989 Agenda for Action approved the concept of integrated waste management, by which municipal solid waste is reduced or managed through several different practices, which can be tailored to fit a particular community's needs (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012").

The US EPA has an integrated waste management hierarchy that includes the following four components (See Figure 7): (1) Source reduction (or waste prevention), including reuse of products and on-site (or backyard) composting of yard trimmings, (2) recycling, including off-site (or community) composting, (3) combustion with energy recovery, and (4) disposal through landfilling (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012"). From Figure 7, one can notice that the US EPA has a preference for reuse and recycling options. However, all four components remain important within an integrated waste management system. Each of the four components is discussed individually below.

Figure 7: Waste Management Hierarchy



Source Reduction & Reuse

Source reduction and reuse entails reducing the amount of waste created, reusing whenever possible, and then recycling whatever is left. Source reduction, also called waste prevention, is when the amount of municipal solid waste generated is reduced or materials are reused instead of being disposed of; materials that are recovered from an incident and decontaminated may be able to be reused (US EPA, "Waste Management Options"). Source reduction is perhaps the most important factor in any waste management strategy because it can be seen as the true solution to waste problems. If the amount of waste production is reduced, then all the negative effects waste has on the environment (environmental damage) and on the economy (high disposal costs) are automatically reduced. For instance, reusing these materials protects the environment by saving resources, including energy, virgin materials, and landfill space (US EPA, "Waste Management Options"). In addition, it reduces the economic impact of the affected site. Source reduction can be achieved in a number of ways, such as improving manufacturing methods (the materials, design, and packaging) to reduce their amount or toxicity before they enter the MSW management system or changing the preference of consumers to greener products that have less packaging (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012" 13).

Recycling/Composting

Recycling involves making materials that would otherwise be disposed of as waste into valuable resources for new products. By recycling these materials, one protects the environment by saving resources, including energy, virgin materials, and landfill

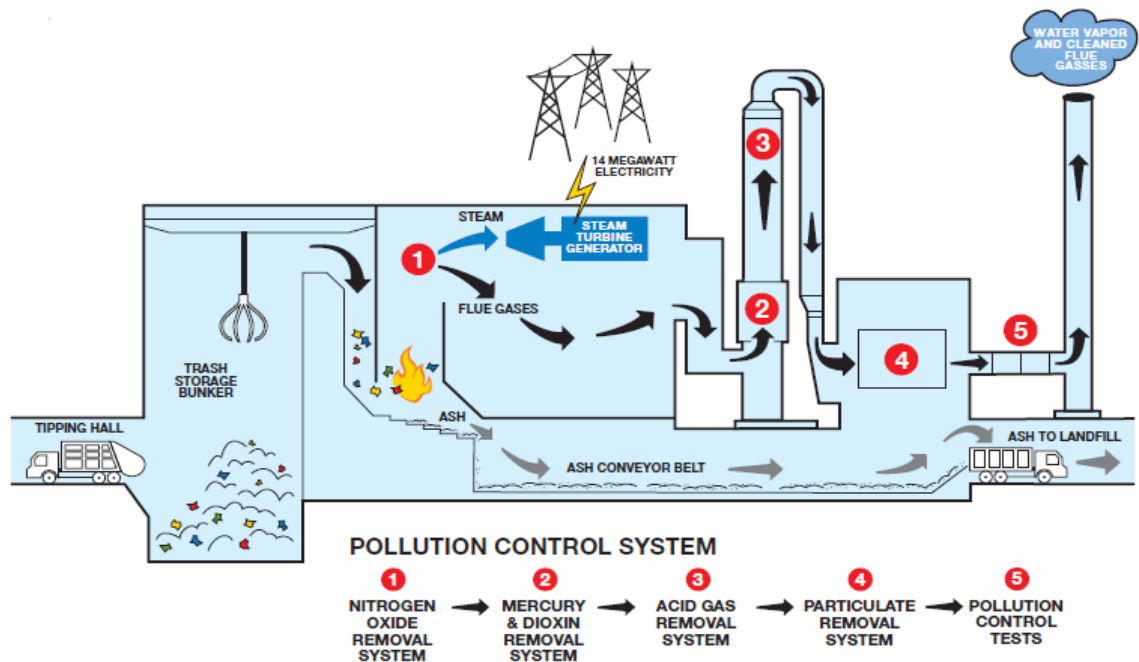
space (US EPA, "Waste Management Options"). If waste cannot be prevented (first component), then instead of being discarded, it should be used for other productive purposes. Therefore, residential and commercial recycling turns materials and products that would otherwise become waste into valuable resources. Materials like glass, metal, plastics, paper, and yard trimmings are collected, separated, and sent to facilities that can process them into new materials or products (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012" 2). For example, recycling (including community composting) recovered 34.5% (86.6 million tons) of MSW generation in 2012 (see figure 6) (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012").

Combustion with Energy Recovery

Combustion with energy recovery, also known as energy from waste or simply incineration, is the act of burning MSW to generate energy. At a combustion facility, MSW is unloaded from collection trucks and placed in a trash storage bunker. After the waste is sorted, it is placed into a combustion chamber to be burned. The heat released from burning is used to convert water to steam. The steam is then sent to a turbine generator to produce electricity. The remaining ash is collected and taken to a landfill. Particulates are captured by a filtering system. As the gas stream travels through these filters, more than 99% of particulate matter is removed. Figure 8 illustrates how the energy recovery process works (US EPA, "Combustion with Energy Recovery"). The quantity of MSW combustion with energy recovery increased substantially from 1990 to 2000 over 13% to 33.7 million tons (US EPA, "Municipal Solid Waste Generation,

Recycling, and Disposal in the United States: Facts and Figures for 2012" 14). After 2000, the quantity of MSW combusted with energy recovery has decreased to 11.7% which is an estimated 29.3 million tons in 2012 (See Figure 6) (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012").

Figure 8: MSW Combustion Process



Disposal

The last component to waste management is the final waste disposal. When waste cannot be recycled or reused, it should be disposed. Combustion (component three) is preferred over landfilling because the negative effects on the environment are less, waste can still be safely used as a resource for energy production, and it causes the least environmental damage (US EPA, "Combustion with Energy Recovery"). Landfilling is seen as the least desirable choice for waste disposal, as it can have substantial negative impacts on the environment. Generally, each landfill is permitted or licensed for

particular kinds of waste (US EPA, "Waste Management Options"). A landfill generally cannot accept waste that falls outside the scope of its permit. In addition, some wastes may need to be treated before being disposed of in a landfill. It is important to note that treatment options may generate their own wastes, which may also be disposed of in landfills, when appropriate. Furthermore, in 2012, 134.3 million tons (53.6%) were landfilled or otherwise disposed (See Figure 6) (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012").

American Government Waste Policy Instruments

In this section, the researcher will cover the different tools the American government has at its disposal to influence the behavior of households regarding their waste production. The purpose of disposal taxes is to discourage waste generation and encourage recycling. These include landfill taxes, waste collection charges (variable rate programs), and hazardous waste disposal taxes. As mentioned before, MSW does not include hazardous waste. Therefore, for the sake of not deviating from the research question, only landfill taxes and waste collection charges are discussed in the following section.

Landfill Waste Taxes

Waste taxes are generally applied on the final disposal methods of waste and are one of the economic instruments the government has to reduce the amount of waste production. In the US, there are landfill waste taxes, but there are no taxes on combustion or incineration.

According to the National Recycling Coalition, surcharges on waste delivered to landfills have been imposed in over 20 states. For example, in Pennsylvania, counties are

required to create trust funds to finance the costs associated with closing landfills and to finance these trust funds with disposal fees (United States General Accounting Office 23). The per ton disposal fee is calculated by dividing the estimated cost of closing the landfill by the estimated weight of the garbage that will be sent to the landfill before it is closed. Texas charges a fee of \$1.50 per ton on the disposal of all municipal solid waste (United States General Accounting Office 23). In part, fee revenues are used to fund the state's efforts to control solid waste and to provide grants to local governments and other organizations for recovering resources, minimizing the amount of waste, and developing programs that help enhance the efficiency of solid waste management facilities. A report by the National Recycling Coalition shows that there is a relationship between higher landfill taxes (and higher total landfill charges) being charged by the municipalities and lower percentages of municipal waste sent to landfills. This is because the higher the costs of disposing waste by means of a landfill, the more likely market participants are to find alternative uses for the waste.

Waste Collection Charges

Traditionally, households are charged a fixed price for waste collection (Skumatz and Freeman). This method has both its pros and cons. The benefits of this method are that it is easy to implement, and the administration is also relatively simple. On the other hand, the downside is that it is inefficient with regards to limiting waste production. This is because households do not have any incentives to lower their amount of waste because there is no cost added (marginal cost) for putting more bags for collection. Furthermore, the potential for using the waste collection charges to influence the behavior of households is diminished by the fact that in the U.S. each city (municipality) is in charge

of its own waste collection and can choose to levy a charge to cover the costs (Skumatz and Freeman). However, the benefit of this is that they can choose a waste collection program that best fits their characteristics.

Due to the inefficiency of traditional practices, a growing number of communities started charging for solid waste collection based on the volume generated by the household. Such variable rate programs, also called “pay-as-you-throw (PAYT),” have been implemented to about 25% of the US population and about 26% of communities in the US, including 30% of the largest cities in the US (Skumatz and Freeman). The US EPA is also encouraging variable rates. The agency has held a series of workshops to explain the advantages of variable rate programs, such as that the variable rates change the marginal cost of adding waste for collection from zero to a positive value which should reduce the amount of waste households generate (US EPA, "Pay-As-You-Throw"). In addition, variable rate systems are beneficial for the economy as they lower the total cost of waste disposal further along the waste stream, as there will be less waste generation under the system (US EPA, "Pay-As-You-Throw").

American Waste Collection Programs

There are many types of instruments that can be used with regards to variable rate programs. The first four types are regarded as waste-volume systems, while the last one is regarded as a weight-based system. Below is a summary of the four most commonly used types of programs (L. Skumatz):

Container Programs

Households use the size or number of waste containers as instruments.

Households can choose the number or size of a container to match their predicted weekly

amount of waste disposal. Households that use more or larger waste containers are charged an additional fee (L. Skumatz).

Bag Programs

Households use special imprinted bags as instruments. There are different types of bags for each corresponding waste group targeted by the program. The price of the bag varies depending on the waste type it designated for. Households pay more when they buy more bags but also if they buy more bags of waste streams that are most costly to dispose of or cause more environmental damage. On the other hand, one disadvantage of using bags is that they can tear, especially if handled improperly or opened by animals (L. Skumatz).

Tag and Sticker Programs

Households use a tag or sticker as an instrument. This program works the same way as the bag program. The only difference is that a tag or sticker is used instead of a special bag to signal which type of waste is being disposed of (L. Skumatz).

Mixed Programs

Households use a combination of the fixed-rate collection system and the variable-rate based system. Households get limited services of waste collection for the fixed fee, and if additional services are desired they can be received at a higher cost, such as extra bags or waste containers. Such mixed programs are growing in popularity because they are relatively easy and inexpensive to implement, they provide a stable source of revenue for collection services, they have the potential to reduce illegal dumping, and they offer a pre-specified level of service at a fixed cost to many customers (National Center for Environmental Economics 41).

Weight-Based Programs

Households use the weight of the waste supplied for collection as an instrument. One of the advantages of the weigh-based system is that it has a stronger incentive effect because charging for every additional unit of weight eliminates the incentive to compact trash into containers (National Center for Environmental Economics 43). Another benefit is that households could start considering composting their biodegradable waste either on their own or as a collective group in the neighborhood, which would reduce their waste weight. On the other hand, one disadvantage is that they tend to be technologically much more complicated, requiring that collection trucks carry specialized equipment and increasing the time haulers take to collect waste (National Center for Environmental Economics 43).

DISCUSSION

Policy Advice

Based on the above findings, this final section contains a discussion of the possible improvements that can be made to the policies on landfill waste tax and waste collection charges. So far, the workings of the American waste management system have been explained, as well as two instruments used by the American government, landfill waste taxes and waste collection charges, have been discussed. However, the question remains: what improvements can the American government make to increase the recycling rate of residential waste?

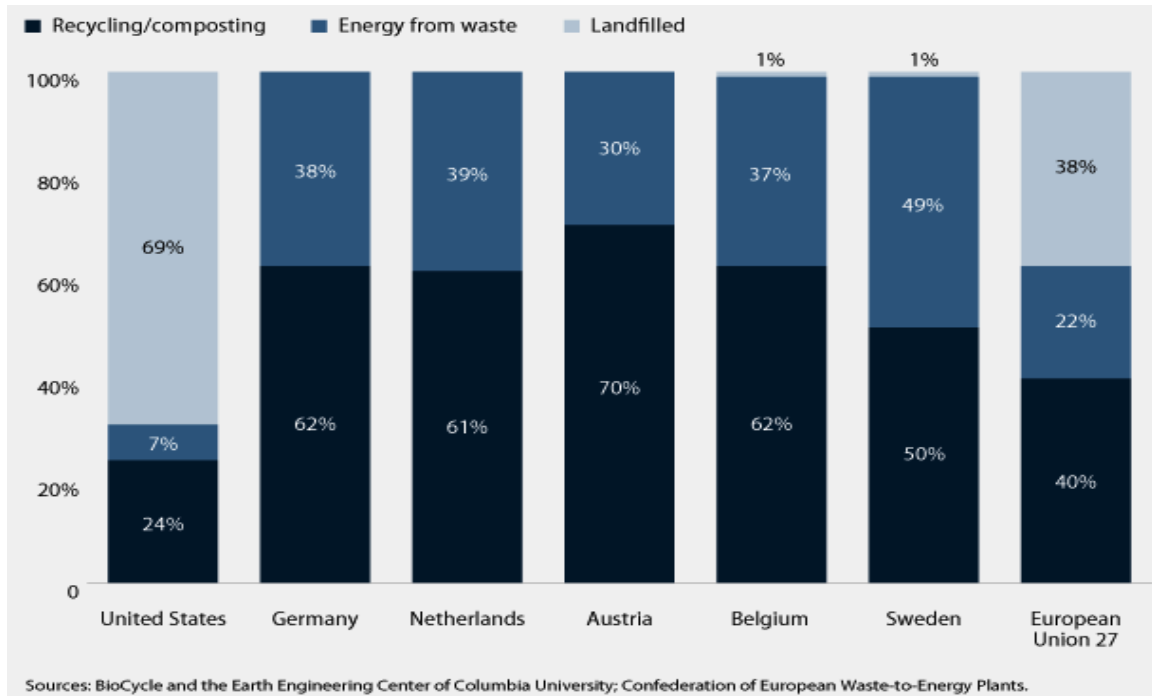
In order to identify what improvements are required to reach these targets, a proper understanding is needed of how well the American waste management systems actually function. Therefore, the researcher will compare the American and European

waste management systems. America is not very creative when it comes to handling waste (Lacey). Even though recycling rates have improved dramatically over the last five decades as states have implemented requirements and consumers have become more aware, the U.S. is still significantly behind leading European countries.

Over the last few decades, the generation, recycling, composting, and disposal of MSW have changed substantially in the US. Solid waste generation per person per day peaked in 2000, while the 4.38 pounds per person per day is the lowest since the 1980s. The recycling rate has increased from less than 6.5% of MSW generated in 1960 to over 34% in 2012 (See Figure 4). Disposal of waste to a landfill has decreased from 89% of the amount generated in 1980 to under 54% of MSW in 2012 (See Figure 6) (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012"). However, 54% is still a significant amount of waste being disposed to landfills.

According to a report by the Center for American Progress (CAP), America dramatically differs from European countries that have gotten serious about recycling and turning their waste into energy (See Figure 9) (Kasper). Even though this data was retrieved in 2013, one can clearly see that land filling is utilized substantially more in the U.S. compared to European countries. Some countries, such as Austria, the Netherlands, and Germany, have virtually eliminated landfilling because of strong recycling and combustion policies.

Figure 9: Management of America's MSW Compared to European Nations



CONCLUSION

It is clear that the increasing rate of waste production is a serious problem, as it can have severe environmental and economic effects. In order to minimize these negative effects, countries must have the appropriate tools to manage large quantities of waste. Recycling can be used as a tool to lessen environmental and economic damage, as it extracts useful materials from waste and reduces the strain on the extraction of virgin raw materials. In order to increase recycling rates, a country must have a well functioning waste management system. The first step in setting up a waste management system is determining the countries' approach to waste management. The American approach to waste management is based on four basic principles: (1) source reduction (or waste prevention), (2) recycling, (3) combustion with energy recovery, and (4) disposal through landfilling. The American waste management system has an order of preference for waste

treatment based on these principles. Source reduction (waste prevention) is most preferred, while land filling as the least preferred method of waste disposal (US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012").

The American government can use tools such as landfill waste taxes and waste collection charges to influence the waste production behavior of households. The potential for using the waste collection charges to influence the behavior of households is diminished by the fact that in the US each municipality is in charge of its own waste collection and can choose to levy a charge to cover the costs. On the other hand, the benefit of waste collection charges is that households can choose a waste collection program that best fits their characteristics. This results in a more efficient system with lower costs. However, this also leads to lower participation rates in variable rate on a national level. In order to improve the waste management systems, efforts need to be made to spread the use of variable rate or pay-as-you-throw (PAYT) systems in more municipalities. Since 2006, PAYT programs are available to about 25% of the US population and about 26% of communities in the US, including 30% of the largest cities in the US. This means that only a small part of the population receives an incentive via waste collection charges to reduce their waste production and recycle more. Implementing PAYT systems in more municipalities should facilitate the separation (delinking) of waste production from increases of households' final consumption expenditure. Therefore, the researcher proposes that variable rate systems should be implemented in more municipalities until nationwide coverage is reached.

Furthermore, the waste taxes on landfilling and a zero waste tax on combustion (incineration) resulted in more waste being combusted. However, the zero waste tax on incineration does not give an incentive to further increase recycling rates. Because combustion and landfilling are the least preferred waste management systems, the American government needs to impose higher taxes on both landfilling and on incineration in order to encourage households to recycle, which is one of the most preferred waste management systems.

Therefore, this researcher proposes a higher waste tax on incineration, as it will result in higher recycling rates because recycling becomes comparatively more attractive. In addition, these tax changes will encourage households to move up the waste management hierarchy.

Additionally, in order to identify what improvements are required to reach these targets, a proper understanding is needed of how well the American waste management systems actually function. America's waste management is very poor compared to the European waste management. The US has a significantly higher rate of MSW disposed in landfills compared to European countries. Therefore, the researcher believes that these tax changes will allow the US to reach the same level of some European countries that eliminated landfilling due to strong recycling and combustion policies.

Overall, it is a continuous process of careful monitoring and evaluation to get a waste management system to have the desired effects. Nevertheless, based on the findings above, there is good reason to believe that the two proposed changes to the policy instruments to impose higher taxes on both land filling and on incineration could have a positive effect on the recycling rates of residential waste.

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