Policy Brief:
Getting Waste Management Prices Right

Overview

Landfilling carries with it external environmental costs that are not reflected in the price of landfill disposal, while recycling has ecological and sustainability benefits that are not reflected in either recycling market revenues or avoided disposal costs.

Estimates of landfilling total external costs range from more than $3 per ton to nearly $77 per ton, with the most recent estimates placing the costs between $5.38 and $8.76 per ton. Those costs are felt varyingly at local, regional, and global levels.

Recycling provides quantifiable external environmental benefits that have been estimated to have a value, depending upon the type of material, ranging between $18 and nearly $8,000 per ton, or as high as $142 per household per year.

Recycling, in fact, is a prime example of the failure of competitive markets to correctly cost and price goods and services that provide ecological and sustainability benefits. Conversely, landfilling is an example of the failure of competitive markets to correctly cost and price goods and services that are ecologically damaging. As a result, we generally under-invest in recycling and overuse refuse disposal options such as landfilling.

Externalities are considered a classic case of "market failure" and correcting for them so as to help the market "get prices right" has long been considered an appropriate role for public policy. The challenge is to find acceptable policy measures that will offset the free market's failure to achieve optimal pricing and allocate resources efficiently.

This policy brief explores the theory behind certain policy measures and the available data associated with that theoretical approach.

Background

Economic Calculation

The word "economics" is from the Greek, *oikonomikos*, meaning the stewardship or management of the household. The original meaning has a broad sense that extends the concept of household to all of our surroundings. As such, it includes the management and use of the Earth's natural resources.

Ecology has the same root, *oikos* or household, and refers to understanding and managing the relationship between man and our environment. Together economics and ecology guide man's activities to ensure that we have a beneficial and permanent relationship with the environment around us. In its essence, economics involves getting the most out of Earth's resources in a manner that is efficient and necessarily considers that ecological relationship between man and the environment.

Put simply, economic calculation refers to the decision-making ability to allocate scarce resources (capital, natural, and labor) among competing uses. Economic calculation, in its practical application, is to show how much one is free to consume without impairing the future ability to produce and consume.

Economic calculation provides a means to ensure that resources are employed in an economic manner. Wastefulness will be minimized as decision errors are minimized, as well as detected and corrected by the aid of profit and loss accounting.

The central idea of capitalism is that the free market will allocate resources optimally, creating the greatest degree of surplus, which is economic jargon for the combined benefits to both producers and consumers. Decisions concerning how to allocate those scarce resources are driven by the price mechanism.

However, decisions based on price are only optimal if prices are accurate. The price mechanism only works when the costs are paid by the producers of a good and the benefits are provided to the consumers. When this isn't the case, the market is distorted, meaning that the optimal result, the greatest surplus, isn't achieved. Such market failures lead to resource allocation that is suboptimal and create what is known as a deadweight loss, which is a permanent loss of well- being to society that can occur when equilibrium for a good or service is not Pareto optimal (at least one individual could be made better off without others being made worse off).

Externality Theory and Solid Waste Management

Externalities are essentially economic side effects that represent just such market failures. Externalities are costs or benefits arising from an economic activity that affect somebody other than the people engaged in the economic activity and are not reflected fully in prices. Environmental impacts are a common example of externalities and occur when an activity has an impact on the environment, whether positive or negative, and the monetary cost or value of that impact is not included in the transactional cost of that activity. Those who suffer from external costs do so involuntarily, while those who enjoy external benefits do so freely.

Because external costs and benefits are often not included in the calculations of the people making decisions concerning some economic activity, they are a form of market failure that will lead to an inefficient use of resources. If the externality is beneficial, the market will provide too little; if it is a cost, the market will supply too much.

Externality theory can make an important contribution to the design of public policies to protect the environment. First described by British economist A.C. Pigou, when costs or benefits are externalized to society, resources are misallocated. It has been widely recognized that the source of basic economic principles of environmental policy may be found in the theory of externalities. In its most basic form, when environmental impacts or externalities are not internalized, prices are distorted. Price distortion creates incentives for environmentally harmful practices, in the case of external costs, or disincentives for environmentally beneficial practices, in the case of external benefits. In other words, price is not an optimal policy unless it reflects the full social marginal costs and benefits.

Landfilling carries with it external costs that are not reflected in the price of landfill disposal, while recycling has ecological and sustainability benefits that are not reflected in either recycling market revenues or avoided disposal costs. Recycling, in fact, is a prime example of the failure of competitive markets to correctly cost and price goods and services that provide ecological and sustainability benefits. Conversely, landfilling is an example of the failure of competitive markets to correctly cost and price goods and services that are ecologically damaging. As a result, we generally under-invest in recycling and overuse refuse disposal options such as landfilling.

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Concerning Landfilling and Recycling

Landfilling

Externalities associated with solid waste management may include groundwater contamination (or risk thereof), air pollution and greenhouse gas emissions, and neighborhood disamenities such as malodors, noise, visibility, traffic, dust, litter, and road damage. Such impacts may be global and/or local and are dependent upon individual landfill characteristics that vary upon a number of parameters including, but not limited to, location, size, and population density.

Government intervention to correct for externalities has often taken the form of regulations to require or prohibit certain behaviors and to require environmental safeguards. Perhaps, the most well known example dealing with solid waste externalities is the Resource Conservation and Recovery Act (RCRA) of 1976, which greatly expanded the role of the Federal government in the field of solid waste disposal. Through RCRA and its subsequent amendments, Congress and the United States Environmental Protection Agency (EPA) established environmentally acceptable practices for landfills across the nation. Congress developed these regulations to minimize environmental impacts and protect human health.

Less frequently utilized are policies that cause prices, through taxes or surcharges, to account for full social costs. Such an approach is known as a Pigovian tax. Solid waste surcharges reflect the latter approach.

An incentive-based policy approach potentially useful to governments is a tax or surcharge set equal to the external marginal cost of solid waste disposal. Once the tax is set optimally, each cost-minimizing entity, public and private, internalizes all social costs of disposing solid waste and can be expected to adopt efficient solid waste management systems. Such decisions would be considered efficient as long as the landfill tax is set correctly. The landfill tax is efficient if set equal to the external marginal cost of solid waste collection, transportation, and disposal. Since the external marginal cost may vary, the optimal landfill tax or surcharge could also be expected to vary.

Existing Studies of Landfilling's External Costs

A number of existing studies have sought to identify the external costs associated with landfilling. Those studies include the following:

- Davies and Doble (2004) estimate the external marginal cost attributable to greenhouse emissions is \$3.27 per ton for landfills without energy recovery and \$2.22 per ton for landfills with energy recovery.

- Defra (2004) estimates the local disamenity cost (odor, visibility, and general disamenities) to range between \$3.05 and \$4.39 per ton.

- Davies and Doble (2004) estimate the costs of waste transportation to landfills (congestion, air pollution, and the increased probability of road accidents) to be \$0.51 per ton for urban landfills and \$1.69 per ton for rural landfills.

- Kinnaman (2005) shows total external costs of solid waste transportation and disposal total to between \$5.38 and \$8.76 per ton, and argues that those costs should be translated into landfill taxes levied at various levels of government depending upon the nature of the external costs. In addition, Kinnaman acknowledges that advocates of recycling suggest the manufacturing of goods using recycled inputs generates less air and water pollution than manufacturing using raw virgin materials and that the optimal landfill tax should also reflect this effect.

- Fullerton (2002), in examining excise taxes on municipal solid waste, posited a total external cost per ton in Michigan of between $12.40 and $76.73, which included both local and global external costs. Identified costs were dependent upon specific landfill characteristics and location and did not include aesthetic costs.

- Stone and Ashford (1991), in a Massachusetts study, provide an external cost estimate of $75 per ton.

- The Tellus Institute (1991) estimated external costs to be $67 per ton for lined landfills with leachate collection systems in California.

- Porter (2002) found the external costs of landfilling to be between $3 and $15 per ton and the cost of incineration to be $11 to $20 per ton.

Note that none of the above figures have been adjusted for inflation.

Recycling

It is commonly understood that the use of recycling as a means of solid waste management helps conserve existing landfill space and reduces the need to build new landfills. More importantly, recycling has a significant number of well-known benefits, both economic and environmental.

The recycling industry provides manufacturing jobs and produces valuable final products. Recent studies indicate that recycling and related activities employ more than 1.1 million workers, with an annual payroll of nearly $37 billion.

Recycling reduces energy costs. On average, the energy required to recycle aluminum, copper, iron and steel, lead, zinc, paper, and plastics is 75 percent less than the energy required to produce and refine similar virgin materials.

Recycling also conserves natural resources. For example, using recycled aluminum instead of virgin ore saves 4 tons of bauxite and 1,500 pounds of petroleum coke and pitch for every ton of re-melted aluminum.

Further, recycling has been shown to reduce pollution, such as how using recycled paper instead of virgin materials reduces air pollution by 74 percent and water pollution by 35 percent.

However, the use of recycling as a means of solid waste management has a variety of positive environmental and social impacts that are not reflected in the price of recycling. When such external benefits are not accrued to those materials targeted by those seeking to recycle solid waste, the cost of recycling is overpriced and, therefore, underproduced. Put another way, recycling provides environmental and social benefits for which recyclers are not compensated and, as a result, recycling is underused while less environmentally sound alternatives are overused.

Tools such as Life Cycle Assessment (LCA) and Cost-Benefit Analysis (CBA) can offer analysts and decision-makers important insight concerning the external costs and benefits of solid waste and resource management options.

Life cycle assessment is a 'cradle-to-grave' approach for assessing the environmental impact of a single product or system. An ideal LCA should include all stages in the product life cycle from the gathering of raw materials for production through to the point where all waste materials and emissions are returned to the earth (or air or water). The total cumulative environmental impacts resulting from the product can thus be estimated by summing the environmental impacts from each element of the total system. As shown by a recent analysis of LCA studies, the results from the nine LCA studies, produced in different geographical areas, all indicate that recycling results in less overall environmental impacts than both landfilling and incineration.

Cost-benefit analysis is a decision-support tool that helps decision makers to develop policies providing the highest environmental benefits at the lowest overall cost to society. The CBA method attempts to place a monetary value on the environmental and social impacts of a policy, and add them to its commercial costs. The combined 'present value' cost to society can then be equated with the combined cost of an alternative policy. A recent review of eighteen conclusions from nine different studies found that a majority of the studies determined that recycling is the preferred waste management option.

Existing Studies of Recycling's External Benefits

Studies conducted in the United States are scarce. However, a number of existing studies conducted elsewhere have identified and quantified the monetary value of the external benefits associated with recycling. Those studies include the following:

- A British study "Beyond the Bin: The Economics of Waste Management Options" (Hogg, 2000). This study showed that price of recycling is not adjusted to reflect its benefits (such as jobs created and energy saved). For example, recycling paper brings benefits of between £26.4 ($40.05) and £521.50 ($791.13) a ton. Recycling ferrous metal (e.g. steel, iron) brings benefits of between £49 ($74.33) and £3239 ($4,913.66) a ton while recycling non-ferrous metal (e.g. aluminum, copper) brings benefits of between £315.1 ($478.02) and £5257 ($7,979.03) a ton. The figures in parenthesis are the study values converted to U.S. dollars at the average exchange rate prevailing during the year the study was released.

- An Australian analysis, "Assessment of Kerbside Recycling in Australia" (Nolan-ITU, SKM Economics and ENVIROS/RIS, 2001) shows an average environmental benefit of $71 ($41.38 U.S.) per household per year.

- Another European study (RDC, 2003) examined the external benefits of using secondary materials instead of primary materials. It found that, in most cases, the use of secondary (recycled) material provides significant advantages over primary materials. The per ton environmental impact differentials were calculated as follows: Glass: £176.55 ($288.75 U.S.); HDPE: -£1.78 (-$2.91 U.S.); Paper £17.79 ($29.10 U.S.); steel £265.91 ($434.91 U.S.); aluminum: £404.14 ($660.99 U.S.).

- A lifecycle assessment and economic evaluation of recycling (Craighill, 1995) also demonstrated that the recycling system generally performs better than the waste disposal system in terms of contribution to global warming, acidification effects and nutrification of surface water. Using case study analysis, the study performed an economic valuation of the environmental impacts. The analysis produced the following per ton net benefits for recycling: aluminum: £1768.86 ($2,793.03 U.S.); steel: £237.76 ($375.42 U.S.); paper: £226.07 ($356.96); glass: £187.58 ($296.19 U.S.); HDPE: -£2.57 (-$4.06 U.S.); and PET: -£7.28 (-$11.50 U.S.).

Note that none of the above figures have been adjusted for inflation.

Discussion on Solid Waste Externalities

Both theory and existing literature yield two of distinct conclusions pertaining to the external costs of landfilling. First, external costs, beyond those already accounted for by federal and state environmental regulations, likely vary significantly based on landfill characteristics and the characteristics of the area in which the landfill is sited. Second, external costs may be borne locally, regionally, and globally.

Those conclusions have significant ramifications. The most obvious ramification is that an across-the-board surcharge, imposed without regard for site-specific characteristics, is likely neither accurate nor equitable. Because unaccounted for external costs may vary dramatically from facility to facility, based on the host of factors, attempts to account for those costs via surcharges should be conducted with regard to specific site characteristics. By accounting for the various parameters associated with both the subject facility and the host community, surcharges can be applied that are equitable and accurate, and therefore, efficient.

To be consistent with both theory and empirical data, surcharges should be developed on a site-by-site basis or based on broader facility classifications that take into account common characteristics of facility size, type, design, and operational parameters, as well as host community characteristics such as adjacent land uses, local hydrology, population density, local infrastructure, etc. This approach avoids a one-size-fits-all technique and improves the likelihood that surcharges will not undercharge or overcharge for any external costs not already accounted for through environmental regulations. It also allows for that portion of external costs associated with local conditions, particularly disamenity costs and groundwater threats, to be more accurately assessed.

The second significant ramification deals with the fact the external costs may be local, regional, and global. To a large degree, local costs may already be accounted for through host community agreements. However, since Michigan state law neither requires such agreements nor allows local communities to require such agreements, it is unclear how the existing regulatory system would ensure that locally borne, external costs are accurately accounted for and passed along to the community that bears those costs.

The remaining portion of any surcharge revenue (that portion related to regionally or globally borne, external costs) could be channeled to those entities engaged in activities that reduce the creation of those costs. In other words, entities that recycle, thereby reducing landfill-related, global external costs, should be subsidized through the non-local portion of the surcharge revenue.

As indicated in the referenced studies, recycling provides quantifiable external benefits. The study from Australia posits an annual per household environmental value of $41.38. Other studies demonstrate a per-ton, external value for various commodities, with the exception of plastic. For paper, glass, and metal, the per-ton value of those benefits ranges from less than $18 (U.S.) to nearly $8,000. Converting those values to an annual per household figure provides another perspective on recycling's total environmental value. Based on the volume and type of material collected by a typical curbside recycling program, the values from the referenced studies yield an annual per household external value of between $6 and $140.

Based on the information above, externality theory would dictate that recycling activities merit an incentive or subsidy system to ensure that the optimal and efficient amount of recycling takes place. In other words, entities that recycle, thereby reducing landfill-related external costs while yielding the external benefits documented above, should be subsidized. A variety of approaches to subsidize recycling and waste reduction activities have been explored. The most direct methods appear to be a subsidy, on a per capita basis, to municipalities with recycling and waste reduction programs, or on a per ton subsidy to those entities, public and private, that are engaged in recycling.

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