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Changing the Climate Through Recycling

Paper Market Trends

Recycling and climate change

Findings reinforce that community strategy for reducing greenhouse gas emissions starts with recycling and solid waste management programs.

by Lisa A. Skumatz

Jurisdictions across the U.S. are adopting green, or sustainability, goals, and implementing wide-ranging strategies to move toward those goals. Given the traditional information from the U.S. Environmental Protection Agency (Washington) on the sources of greenhouse gas (GHG) emissions, which indicate waste management contributes only about three percent of GHG emission sources, communities and policymakers tend to focus on energy-related programs that represent much bigger sources of emissions.

Based on an analysis of the costs per metric ton of carbon dioxide equivalent ($MTCO_2E$) of GHG emissions avoided, Skumatz Economic Research Associates, Inc.'s (Superior, Colorado) analysis indicates that faster and cheaper progress in reducing GHG could be made if communities take an early focus on solid waste programs. Solid waste programs provide quick and substantial reductions in GHG emissions, while providing a bridge to impacts from energy efficiency and transit strategies.

Emissions from solid waste programs

Solid waste initiatives – whether strategies, policies or programs – work to divert materials from disposal in a landfill or other site to beneficial uses in three main ways:

- **Recycling:** Recycling reduces the use of virgin materials and the emissions generated during their production and transportation, and generally reduces the energy and resource demand, while significantly reducing the processing efforts and costs associated with end-product production.
- **Composting:** Composting avoids anaerobic conversion of compostables in a landfill, thus avoiding the production of significant amounts of methane. Methane has been shown to be 23-times as potent a GHG as carbon dioxide, and has an especially high impact within the first 20 years. Instead, composting uses an aerobic process to produce a usable product, and does not produce methane or harmful GHG constituents.
- **Re-use, waste prevention and source reduction:** Re-use and waste prevention programs reduce the production of new materials, resulting in fewer GHG emissions during mining and input acquisition, production, transportation and, ultimately, disposal at end of a product's life.

The pay as you throw (PAYT) solid waste program is used as an example of the manner in which the impacts on GHGs are calculated. PAYT is a system whereby residents are charged for trash collection service based on the amount of trash set out for disposal (number of cans, size of cans, number of bags, etc.). Research shows that this program has strong diversion impacts, and the programs are widespread. SERA research shows that these programs were established in more than 7,100 U.S. communities in 2006, and available to 25 percent of the U.S. population.

Effects of PAYT on GHGs and BTUs

Since 1994, SERA has been estimating the GHG effects of energy-efficiency programs. Starting in 1999, SERA began estimating the impacts of PAYT programs on GHG emissions. GHG valuation estimates were conducted in 1999 and 2000, and the most recent round of estimates was conducted in 2006, in conjunction with our latest count of PAYT programs around the U.S. The EPA's WAste Reduction Model (WARM) model was used to estimate the effects of the growth of PAYT on GHG emissions. While the WARM model is recognized as an imperfect tool, with a bias toward composting, the use of this tool understates the impacts from solid waste programs, which provides estimates on the conservative side.

Baseline and impact scenarios were modeled using SERA data on tonnage impacts from PAYT, curbside recycling and other tra-

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Table 1 Ranking of cost per $MTCO_2E$ from program alternatives

	Normalized multiplier for cost per $MTCO_2E$	Speed to implement and full-scale implementation coverage
Commercial energy efficiency	1.0 – baseline	1-3 years; fraction of customer base
Residential energy efficiency	3 times as expensive as commercial energy efficiency	1-3 years; fraction of customer households
Wind	7-8 times as expensive as commercial energy efficiency	TBD[1]
PhotoVoltaic	18-25 times as expensive as commercial energy efficiency	TBD[1]
Curbside recycling	0.6-0.7 times the cost of commercial energy efficiency	6 months to 2 years; covers all households in area
Pay as you throw	0.2-0.3 times the cost of commercial energy efficiency	3-9 months after political approval; covers all single-family households

1. These findings will be included in Phase II research being performed by SERA.
Source: Skumatz Economic Research Associates, Inc., 2008.

ditional waste management programs. The WARM model was used to derive the carbon and BTU equivalents, using information from SERA's databases of community programs as inputs. Detailed SERA data on program costs also were used in the computations.

The results show that, based on the computations of tonnages affected and the WARM model runs, the PAYT programs currently in place in the U.S. are leading to reductions of about three million metric tons of carbon equivalents annually, about 10 million metric tons of carbon dioxide equivalents annually and about 80 million MBTU annually.

The dollar value of the reduced emissions, in terms of carbon dioxide equivalents, can be estimated using prices from the Chicago Climate Exchange (CCX). As of late 2006, the CCX value for metric tons of carbon dioxide was between $4.00 and $4.15. Given the estimated tons of emissions offset, the value of the reduced emissions, due to PAYT, is on the order of $30 to $55 billion dollars annually. Thus, PAYT has significant advantages beyond recycling and equity, including:

- High levels of source reduction
- Recycling and yard debris diversion impacts that provide significant progress toward meeting diversion goals
- Environmental benefits, in terms of GHG reductions, energy conservation and pollution prevention
- Job creation and economic development benefits.

Research suggests strong net positive eco-

nomic and job creation multipliers compared to landfilling. Every switch of 1,000 tons from landfill disposal to recycling has an economic-effect multiplier of about six-to-one, based on input-output analysis conducted at the national level.

Calculating costs and relative costs

These additional benefits can significantly improve the payback from implementing PAYT programs. Using the net costs and the GHG reductions, the costs per $MTCO_2E$ for the program were computed. Using similar assumptions, the costs associated with another key waste diversion program – curbside recycling – were estimated as well.

Comparing the results for the two programs, the cost for achieving GHG reductions were about 2.5- to 3.5-times higher for curbside recycling programs. Note, however, that the most successful PAYT programs are in place where curbside recycling programs also are available. This computation is not meant to suggest an either/or choice, but to allow comparison between benchmark recycling programs with energy-efficiency programs, and suggesting a more unified strategy that uses a mix of programs to achieve GHG reductions.

Based on this information, the question arose: How does this compare with the cost of achieving similar GHG reductions from energy strategies?

SERA gathered information on the costs and typical energy savings from a variety of energy efficiency strategies from around the country. To compute the GHG effects from energy-efficiency programs, SERA's peer-reviewed NEB-It model was used. This model houses an extensive array of published secondary data on emissions from various types of electricity generation plants. Based on generation mix for the utility offering the program, the emissions of a variety of GHG components that are avoided, due to the energy savings from specific programs, were estimated.

Computations of the GHG reductions associated with several program types were conducted:

- Residential energy efficiency programs, based on a range of typical program types
- Commercial energy efficiency programs
- Renewables, including wind and photovoltaic programs.

The figures are presented in terms of relative costs to achieve reductions of $MTCO_2E$ between the different program types. Table 1 summarizes the results of the computations, which show that, for key program types, solid waste programs are a cheaper means of achieving GHG reductions than typical energy-efficiency programs. These results are buttressed by the results from recent work by the EPA. Updated research from the EPA on the sources of emissions show a considerable increase in the contribution of waste to GHG emissions. Rather than three percent contribution from waste sources, the new figure is 38 percent. This change recognizes the fact that, what ultimately ended up as "waste," is actually the culmination of the raw materials, production, transport, consumption and, ultimately, "waste" from goods and products. The EPA work indicates that:

- Avoidance of upstream impacts (production of virgin input materials and production of new goods) have many times the impacts of the landfill-only effects being measured in this report
- If the allocations of GHG to sources presented in Figure 1 are revised to "building energy use," "passenger transport," "food" and "provision of goods and materials" (as shown in Figure 2), solid waste programs are among the most important contributors to GHG.

The new results change the apparent hierarchy for GHG sources.

Advantages of solid waste policies in reducing GHG

Three other considerations related to solid waste programs provide important policy implications: Timing, coverage and authority.

Timing. SERA research on PAYT programs shows that these programs can be implemented as quickly as three to nine months. Interviews with more than 1,000 communities with a PAYT component found that programs implemented by cities or haulers were established in this time frame. Some energy efficiency programs can be implemented quickly (e.g., compact fluorescent light bulb exchanges), though a great many programs are administered by large-scale utilities with RFP processes, equipment acquisition and, in some cases, long-lead-time regulatory processes. Certainly some utilities, non-governmental organizations and jurisdictions can implement programs more quickly, but seldom are they as nimble as a PAYT program.

Coverage. When a PAYT or curbside recycling program is put in place, the program typically covers all single-family households, and sometimes townhouses or small businesses. For an energy program, the program is advertised, participants are sought and the program (audits, retrofits, weatherization, equipment replacement, education, etc.) is delivered over time to a fairly limited share of households or business sector clients served by the utility or within the community. The program is not as immediately widespread as most types of solid waste programs, making the impact in solid waste broader and more immediate.

Authority. Communities often have some level of direct control over solid waste serv-

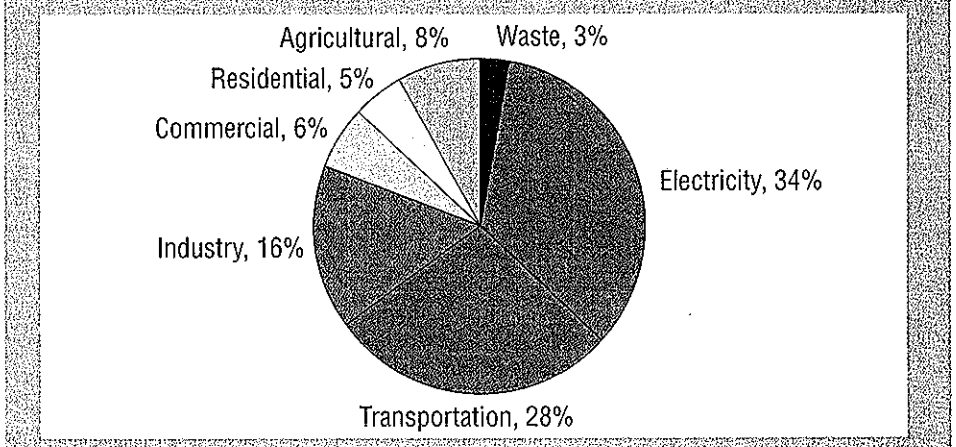
ice, either directly through municipal provision of service or through health and safety powers granted within state statutes. The bulk of energy efficiency programs are delivered through utilities. Those communities with municipal energy utilities have direct authority; however, the vast majority of communities are served by energy utilities over which they only have, at most, indirect influence.

Policy implications

The results of this research indicate that both energy efficiency and solid waste programs are feasible strategies for reducing GHGs and meeting climate-change goals. However, rather than the immediate focus on energy efficiency as the first-tier programs, SERA's research indicates that the EPA pie chart (Figure 1), showing waste management as responsible for only about three percent of GHG emissions, provides a misleading indication of the importance of solid waste strategies in achieving GHG reductions.

SERA's results on costs, coverage and timing indicate that, when governmental authorities – at the local, state or federal level – are considering alternative strategies for reaching sustainability and climate-change goals, solid waste programs should be in the first tier of programs. As the "supply curve" of alternatives for reaching GHG reduction goals is constructed, solid waste strategies will be among the least expensive and most readily accessible. The findings show:

Figure 1 2005 U.S. GHG emissions sources (in percent)

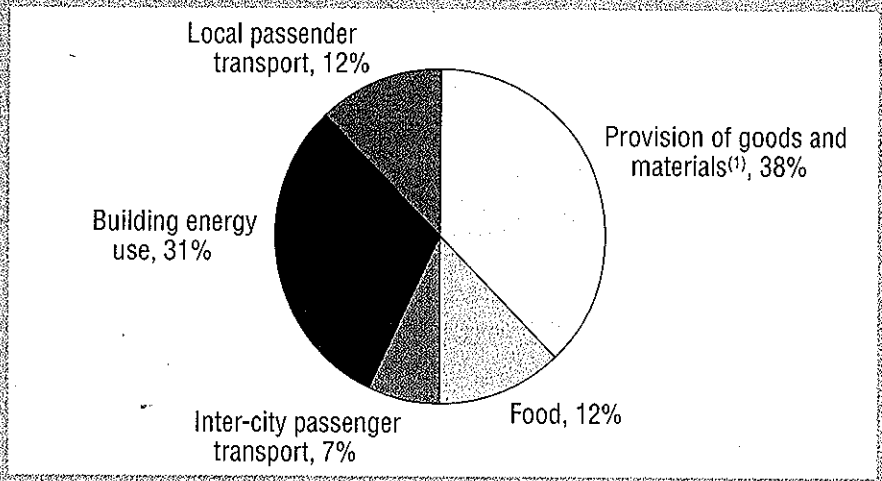


Source: U.S. Environmental Protection Agency, 2008.

- Recycling and PAYT programs are cheaper per $MTCO_2E$ than the standard types of energy efficiency programs
- These programs can be implemented more quickly than standard energy efficiency programs, and much more quickly than many transportation strategies. When implemented, these programs immediately cover all households, not just a fraction of the customer base, as found in most energy-efficiency programs
- Solid waste programs are often more directly in the control of communities and jurisdictions.

When considering the methane impacts of solid waste landfilling, the benefits of solid waste programs are even more dramatic, and are front-loaded in time with the largest impacts occurring in the first 20 years. This enhances the case that solid waste programs should be among the early strategies implemented. If the upstream GHG implications are included, then the adjusted costs for the solid waste program effects on GHG can be

Figure 2 Preliminary 2008 U.S. GHG emissions sources (in percent)



1. The production of materials that ultimately ends up as solid waste.
Source: U.S. Environmental Protection Agency, 2008.

adjusted to fractions of the numbers presented in this paper.

One important component illustrates the principle. Recycling aluminum not only reduces the mining, processing and transportation of ore, but saves 95 percent of the energy required in producing new aluminum goods. The energy savings are many times more important than the landfill diversion impacts of recycling the aluminum.

The updated EPA figures on GHG sources (Figure 2) shows "provision of goods and materials" is the leading contributor to GHG emissions. This indicates the precursors to solid waste – efforts that can be avoided or reduced through recycling, re-use and other solid waste programs – are multiple times more important than the three-percent share indicated in the traditional view presented in Figure 2.

GHG impacts from recycling and solid waste programs can be measured and valued. Most importantly, they can be compared to the cost of achieving similar emissions benefits from other programs. When compared, waste diversion programs clearly should be among the first tier of strategies implemented at the community, county or state level, rather than being secondary strategies.

Communities across the country have reported that they implemented an array of programs in energy, solid waste, water and transportation to reach climate-change goals. One compelling case study demonstrated that, after a five-year audit of progress toward carbon goals, about 40 percent of all the progress, to date, had derived from their solid waste strategies (largely recycling and PAYT). Solid waste was a nearly even contributor with the energy and transport options. Clearly, solid waste is not just a three-percent program.

Armed with this type of information, solid waste planners should make sure they are involved when climate-change strategies are crafted – at the local, regional, state or federal level. We need to make sure the plan includes appropriate focus on solid waste options in the mix. These results indicate that solid waste programs can be a cost-effective, big-bang, and "quick hit" set of strategies toward GHG reductions. Solid waste program staff should not be excluded from the table when GHG strategies are developed – in fact, they should be "up front." **RR**