

POST-SURVEY ANALYSIS

# STATE OF GARBAGE IN AMERICA — DATA AND METHODOLOGY ASSESSMENT

*Further analysis of the 2003 report confirms that raw tonnage numbers yield the best quality data when calculating the nation's rates of waste generation, materials recycling, combustion and disposal.*

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**I**N January 2003, *BioCycle* published a comparison of waste generation in California and New York by the Earth Engineering Center (EEC) of Columbia University. Surprisingly, the rate of generation of municipal solid waste (MSW) in these states was double the national rate of MSW generation reported in the 2001 study by Franklin Associates for U.S.EPA (0.81 tons /capita). The rate was much closer to *BioCycle*'s 13<sup>th</sup> State of Garbage in America (SOG) survey (December 2001) for the year 2000 that had estimated a national rate of 1.47 tons per capita. An explanation for the discrepancy that was advanced by some at that time was that the Franklin survey did not include construction and demolition (C&D) and some industrial wastes, while EEC and *BioCycle* may have done so.

As a result of the publication of the EEC article in *BioCycle*, the journal invited Columbia University to collaborate in the 2003 *BioCycle* survey. As described in the 14<sup>th</sup> SOG report (see "State of Garbage In America," January 2004), the survey questionnaire asked participants in the solid waste management departments of the 50 states to dif-

ferentiate between MSW and C&D/industrial wastes. A total of 47 states participated in this survey. The three that did not — Alabama, Alaska and Montana — have a population of six million, thus representing about two percent of the U.S. population.

The total MSW generation for the 47 reporting states was 369 million tons, corresponding to 376 million tons for the U.S. as a whole. This number is 35 million tons lower than that reported in the 13<sup>th</sup> SOG, presumably because in the 2003 survey, states were asked to distinguish between C&D/industrial and MSW waste tonnages.

#### **SOG, FRANKLIN-EPA AND BECK-CHARTWELL SURVEYS**

It is interesting to compare the *BioCycle*/EEC survey (reporting 2002 data unless noted by states) and the Franklin/EPA 2001 MSW "Facts and Figures" with a third survey, carried out in 1999 by R.W. Beck and Chartwell Information. (R.W. Beck and Chartwell Information Publishers, "Size of the U.S. Solid Waste Industry", April 2001; study sponsored by Environmental Research and Education Foundation.) Beck/Chartwell surveyed 1,856 companies and 825 municipalities engaged in the collection and processing of MSW (carting, transfer stations, waste-to-energy (WTE), landfills). Therefore, it presents a different viewpoint than the *BioCycle*/EEC survey. Table 1 suggests that the Franklin/EPA study seriously underestimated the tonnages of MSW generated and landfilled in the U.S. (Franklin Associates Ltd. uses a "materials flow method" to estimate MSW generation and management. The methodology is based on production data by weight for the materials and products in the waste stream.)

Unlike the 14<sup>th</sup> SOG survey, the Beck/Chartwell studies did not report the breakdown of solid waste to the traditional categories of MSW, C&D and industrial wastes. As we found in the course of the SOG sur-

**Table 1. Comparison of solid waste and MSW generation in the U.S. (in million short tons).**

	Solid Waste Generated	Solid Waste Recycled	MSW Generated	MSW Combusted In WTEs	MSW Landfilled
BioCycle/EEC 2003 Survey (mostly 2002 data) <sup>1</sup>	483	na	369	29	242
Beck/Chartwell Survey (mostly 1999 data)	545	146 (26.7%) <sup>2</sup>	na	29	346 <sup>3</sup>
Franklin/EPA Survey (mostly 2001 data)	na	na	232	30	131

na = not applicable; <sup>1</sup>47 state reporting; <sup>2</sup>Includes automobile scrap; <sup>3</sup>Refers to all solids landfilled in MSW landfills

vey, however, in many cases it is a difficult task to make this distinction, both for public and private waste management organizations; e.g., the solid waste of a small company may be carted away by a municipal authority, etc. We found that some states counted "C&D recycling" as "MSW recycling," while others did not. These semantic differences complicate comparisons between different states and communities.

Beck/Chartwell reported 55 million more tons of solid waste generated than *BioCycle/EEC*. This difference is quite likely explained by the fact that states' data may not capture all the "commercial" wastes handled by private carters. Also, the Beck/Chartwell survey reported landfilling of 346 million tons that includes all materials discarded in MSW-designated landfills, not only MSW. In their study, they reported another 22 million tons discarded in C&D-designated landfills. The only numbers that are consistent among the three studies are MSW tonnage to waste-to-energy plants. This reflects the fact that there are 98 WTEs in the U.S., all of which are highly controlled industrial plants.

Interestingly, on the basis of the Beck/Chartwell survey, the national recycling rate, including C&D and metal scrap from automobiles, was 146 million tons of materials, i.e., 26.7 percent of all reported solid waste. Coincidentally, this figure is nearly the same as the 14<sup>th</sup> SOG MSW recycling rate.

#### ESTIMATION OF PER CAPITA GENERATION

The 14<sup>th</sup> SOG survey calculated per capita MSW generation rates based on states' reported tonnages of MSW recycled, combusted and landfilled. Of the 47 states providing data for the *BioCycle/EEC* State of Garbage In America survey, only California, Georgia and Texas did not provide tonnage of MSW generated. Therefore, the national per capita MSW generation rate — 1.31 tons — was calculated based on 44 states' data. This average generation rate, in combination with the reported tonnages of MSW combusted and landfilled, was used to calculate the tonnages of MSW recycled in Georgia and Texas.

However, due to the size of the population and its impressive attention to waste reduction and recycling, we decided to try to more accurately gauge California's data (rather than using the average 1.31 tons per capita).

The only tonnages reported by the state were the MSW tons to "WTE" and "landfilling." Recycling tonnages were not reported directly — only in the form of a 48 percent "diversion rate." Because of this lack of data, we assigned California the same generation rate as that of the neighboring state of Nevada (1.55 tons per capita). This resulted in a 40 percent recycling rate for California.

It is interesting to note that in 1989, California state law mandated that 50 percent

Because landfills are required to record all incoming tonnages — while recycling facilities for the most part are not — analysis of landfilling provides the most accurate picture of waste management practices in the U.S.

## CORRECTIONS TO STATE OF GARBAGE 2004

**R**EGRETTABLY, there were some errors in our calculations for two states in the *BioCycle/EEC* 14<sup>th</sup> State of Garbage In America report (January 2004). The generated and recycled tonnages calculated for Maryland were too high, which resulted in errors in the landfilling and WTE tonnages. The generated and landfilled tonnages for Oregon were too low. We wish to thank Virginia Lipscomb from Maryland and Peter Spendelow from Oregon for pointing out our mistakes. The original data and the corrected data are shown in the following tabulation:

The 14<sup>th</sup> SOG also reported that there were 107 WTE facilities in the 47 reporting states. The Integrated Waste Services Association (IWSA), which represents the WTE industry

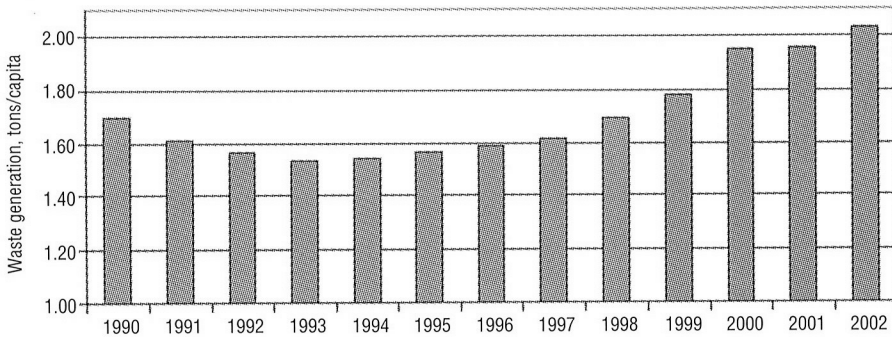
in the U.S., reports that there are only 98 WTE operating facilities in the U.S. The difference is due to the fact that the reporting states included plants that process MSW to Refuse Derived Fuel (RDF) that is then combusted in WTE plants. Also, a few of the plants reported by the states were small incinerators that do not generate electricity.

The 47 responding states (98 percent of the U.S. population) reported that the MSW to WTEs amounted to 28.5 million tons. IWSA reports that the annual processing capacity of the U.S. WTE plants is 29.4 million tons. As was shown in Table 1 in the accompanying article, this number is in good agreement with the *BioCycle/EEC*, the Beck/Chartwell, and also the Franklin/EPA studies.

#### Corrected data for Maryland and Oregon

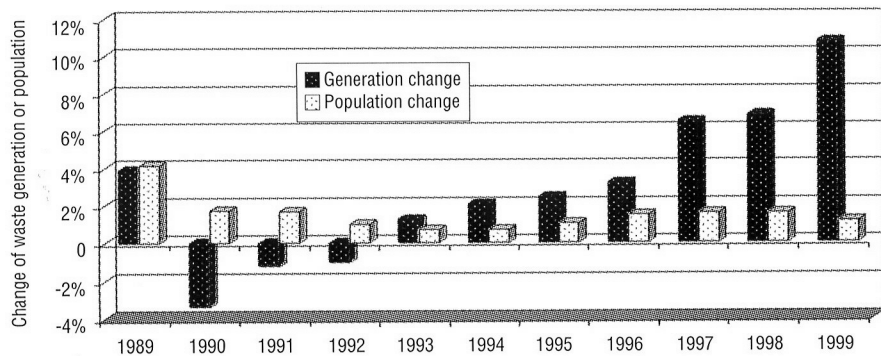
	Maryland		Oregon	
	Original SOG Data	Corrected SOG Data	Original SOG Data	Corrected SOG Data
MSW generated (tons)	8,904,464	7,102,742	4,074,945	4,735,384
MSW recycled (tons)	2,599,675	2,455,843	1,987,246	1,987,246
MSW to WTE (tons)	1,425,915	1,376,460	201,161	201,301
MSW landfilled (tons)	4,878,874	3,270,439	1,886,538	2,546,837
Percent MSW recycled	29.2%	34.6%	48.8%	42.0%
Percent MSW to WTE	16.0%	19.4%	4.9%	4.3%
Percent MSW landfilled	54.8%	46.0%	46.3%	53.8%

**Figure 1. California waste generation per capita, 1990-2002**



Source: California Integrated Waste Management Board

**Figure 2. Percent changes in California population vs. waste generation, 1989-1999**



of waste statewide be diverted from landfills by 2000. The California Integrated Waste Management Board website reports that 37.6 million tons, i.e. 1.07 tons per capita, were landfilled in 2002. The corresponding figure for 1989 was 1.49 tons per capita. Therefore, in one decade, California succeeded in reducing landfilling by 30 percent. On the other hand, the reported rate of MSW generation increased from a low of 1.5 tons per capita, in 1992, to 2 tons per capita in 2002 (Figure 1).

Figure 2 shows the reported annual percent changes in California for waste generation and population from 1989-1999. In the first few years of enactment of the mandatory recycling law, there was a decrease in waste generation. However, since 1992 there has been a rapid increase in waste generation that cannot be explained by the corresponding population growth in the state (one would expect generation and population rate to increase by roughly the same percentage). The darker bar — the percent change in solid waste generation — shows a dramatic yearly increase from 1997 to 1999, the year before California communities were required to meet 50 percent diversion.

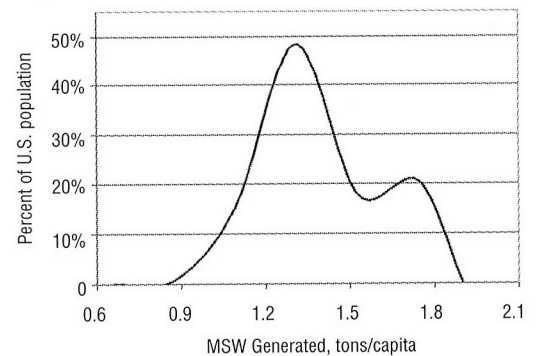
One interpretation of this dramatic jump is that a higher generation rate yields a higher diversion rate. More significant to a survey like State of Garbage In America, however, is how a reported 48 percent diversion rate in a state with the highest population in the country (35 million according to the 2002 Census) affects the national recycling rate. As an ex-

ample, let's assign California the per capita generation rate of 1.8 tons (roughly the highest per capita rate reported in the 14th State Of Garbage survey). Using the 2002 population, the corresponding solid waste generation would be 63.2 million tons and the recycling rate would be 30.7 million tons, i.e., 48 percent of the generated solid waste. The tonnage of MSW generated in all 50 states would increase from 376 million to 385 million tons and the national recycling rate would increase from 26.7 to 28.4 percent.

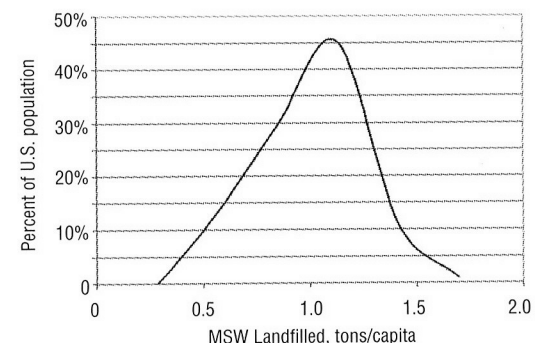
In assigning Nevada's 1.55 generation rate to California, we attempted to compensate for the non-MSW tonnages that are clearly present in California's reported generation of 2.0 tons per capita. Using 2.0 tons would have skewed the national picture. Changing California's per capita generation rate from 1.55 to 1.8 tons (as above) demonstrates how great an effect this populous state has on national percentages. Estimates of *percentage* recycling can compromise the reliability of national data. This reality further reinforced the methodology developed for the 14th SOG survey to use actual tonnages wherever possible.

The effect of estimations/percentages versus tonnages can be viewed graphically in Figure 3, which plots the per capita rate of MSW generation across the nation, using the data from the 14th SOG survey. The second peak represents the influence of California at the assumed MSW generation rate of 1.55 tons per capita.

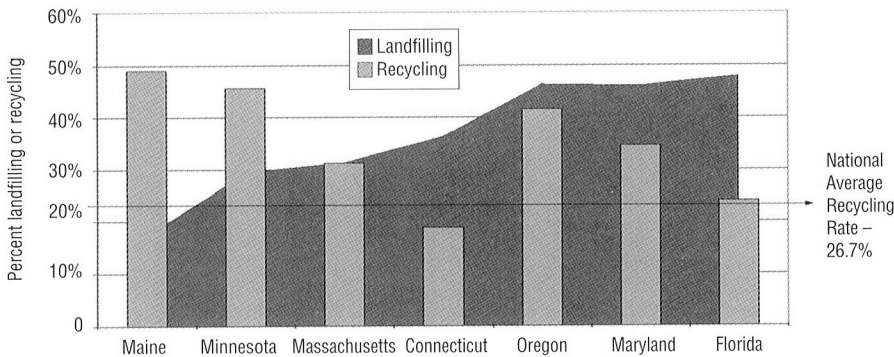
**Figure 3. Per capita MSW generation by percent of reporting U.S. population**



**Figure 4. MSW landfilled per capita by percent of U.S. population**

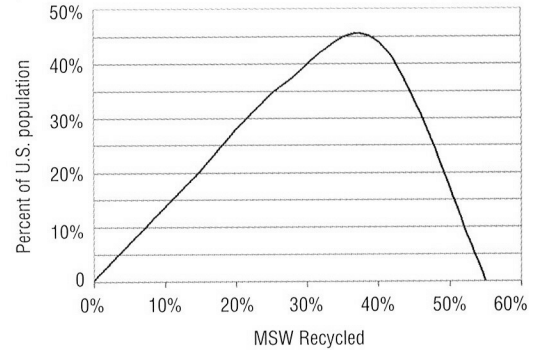


**Figure 5. Landfilling rate vs. recycling rate (seven states with lowest landfilling rates)**



Conversely, the distribution of the landfilling rate with the U.S. population (Figure 4) follows a more normal distribution curve than Figure 3. On average, U.S. citizens generate 1.31 tons of MSW and landfill 0.86 tons per capita, i.e., 65.6 percent of the generated MSW. Because landfills are strictly required to record all incoming tonnages — while recycling facilities, for the most part, are not — analysis of landfilling provides a much more accurate picture of waste management practices, especially if all states were to report MSW landfilled separately from industrial and C&D wastes landfilled.

**Figure 6. MSW recycling rate by percent of U.S. population**

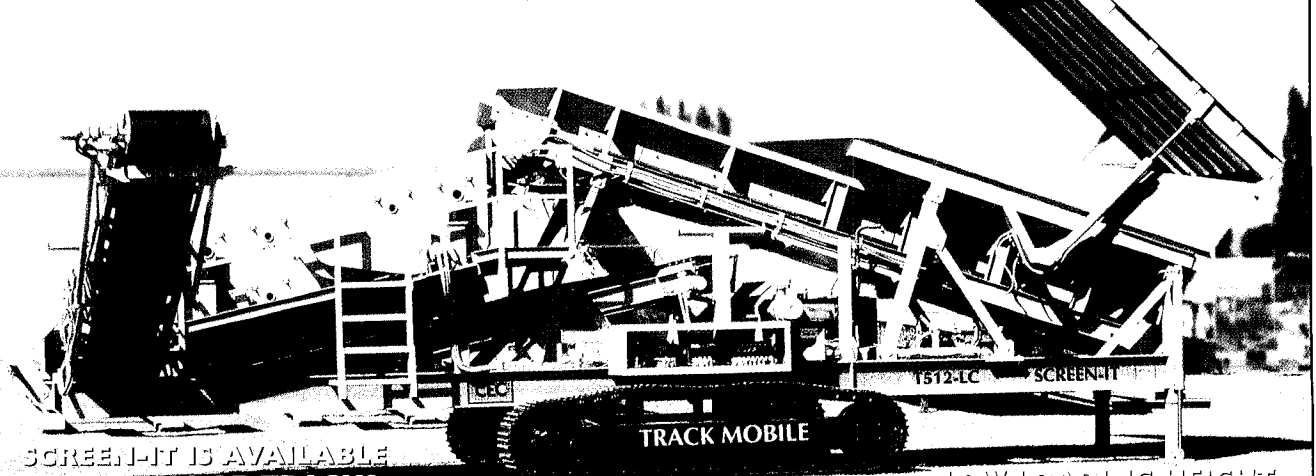


**RECYCLING AND COMPOSTING**

Figure 5 shows that there is a correlation between *low* landfilling rates and *high* recycling rates. The states with the seven lowest landfilling rates are plotted with their associated recycling rates. Five of these states have significantly higher recycling rates than the national average. Conversely, 19 states, accounting for about 20 percent of the U.S. population, reported landfilling rates higher than 80 percent.

Figure 6 shows that a large segment of the U.S. population recycles between 30 to 40 percent of their MSW. Also, on the basis of the 35 states that reported both recycling and composting tonnages, 28 percent of the

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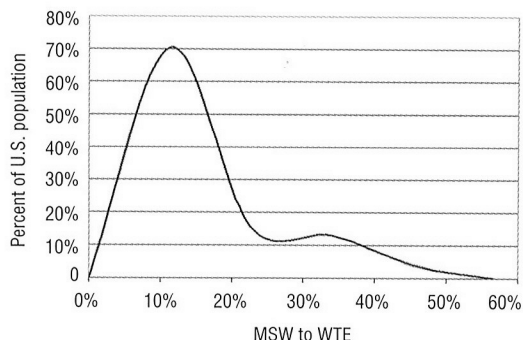


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**Figure 7. MSW waste-to-energy rate by percent of U.S. population**

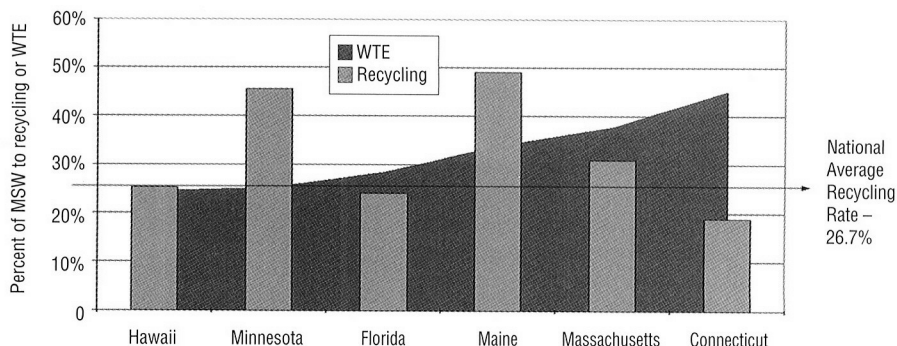


recycling was due to the composting of natural organics and wood. By assuming that the same ratio applies across all states, we estimated that the 26.7 percent “recycling” rate consists of 19.7 percent materials recycling and 7.0 percent composting.

**EFFECT OF WASTE-TO-ENERGY**

The 14<sup>th</sup> SOG showed that, on the average, 7.7 percent of MSW is combusted in waste-to-energy plants (Figure 7). An estimated 70 percent of the U.S. population sends between one and 20 percent of its MSW to WTE facilities. Coincidentally, the national WTE rate is fairly close to that of composting (7 percent).

**Figure 8. Recycling rates for states with highest waste-to-energy rates**



States with high WTE rates tend to have high recycling and low landfilling rates. All the states shown in Figure 8 have landfilling rates less than 50 percent. Maine and Minnesota have recycling rates approaching 50 percent and landfilling rates of only 17.2 percent and 29.3 percent, respectively. The landfilling rate in Connecticut is 36 percent.

**CONCLUSIONS**

Comparison of the results of the 14<sup>th</sup> State of Garbage In America Survey with earlier years shows that landfilling has remained the dominant mode of waste management in the U.S. As long as this remains true — and as long as recyclers are not required to report recovered tonnage — landfilled tonnages will remain the best indicator of progress made in the sustainable management of solid waste. The next important milestone will be for all states to track what portion of landfilled waste is actually “municipal solid waste,” i.e., excluding the C&D and industrial streams. (Tonnage data for waste-to-energy typically reflects the MSW stream, as industrial and C&D feedstocks rarely end up at WTE plants.)

More states are making impressive efforts to compile accurate waste management data. To truly reach a sustainable system of waste management, however, governments and businesses need to work together to encourage — or mandate — reporting of waste data *by tonnages rather than percentage rates* of materials recycled, composted, combusted, or landfilled. The overall goal is to increase materials and energy recovery, which means matching waste resources with societal needs. To do this most effectively, we need a clearer picture of the waste landscape. ■

*Nickolas J. Themelis and Scott M. Kaufman are with the Earth Engineering Center at Columbia University. The authors gratefully acknowledge Ms. Nora Goldstein of BioCycle and Dr. Karsten Millrath of EEC for their collaboration in the 14th SOG and to Mr. James Thompson of Chartwell Information Publishers for providing the results of the Beck/Chartwell survey. The support of Integrated Waste Services Association to the Integrated Waste Management group of EEC is gratefully acknowledged.*



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