Voluntary Approaches to Solid Waste Management in Small Towns: A Case Study of Community Involvement in Household Hazardous Waste Recycling

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Abstract

An enormous amount of household hazardous waste (HHW) is generated as part of municipal solid waste. This scenario presents problems during disposal, including endangering human health and the environment if improperly disposed. This article examines current HHW recycling efforts in Hammond, Louisiana, with the following objectives: (a) analyze factors and attitudes that motivate residents to participate in the program; (b) quantify various types of HHW; and (c) analyze the e-waste stream in the HHW.

Residents and city officials who were surveyed and interviewed cited that commitment shown by local authorities and passion to protect the environment and human health were part of their active participation in the program. An awareness program has played a key role in the success of the program. A legislation specific to e-waste is encouraged. While knowledge and information on laws and permit application processes and the promotion of greener products are encouraged, provision of storage or collection facilities and communal transportation will further motivate more residents to participate in the recycling program.

Introduction

Household waste management is a growing problem in the U.S. and many other parts of the world. The U.S. generates at least 4.5 pounds of household solid wastes per day per person (Government Accountability Office [GAO], 2007; U.S. Environmental Protection Agency [U.S. EPA], 2008a). In a small town with a population of slightly higher than 20,000, household wastes can easily translate into about 100,000 lb. per day. About 1% of municipal solid waste (MSW) generated in the U.S. is household hazardous waste (HHW), a fraction that corresponds closely with what is being produced in other developed countries (Pendle & Poll, 1993; Stasiskiene, Gaiziuniene, & Zidoniene, 2011; U.S. EPA, 2011).

In 2006, U.S. residents, businesses, and commercial institutions generated more than 251 million tons of MSW per year and about 8 billion tons of industrial solid wastes (U.S. EPA, 2009a, 2009b). This enormous amount of waste is both hazardous and nonhazardous. While hazardous waste is regulated by subpart C of the Resource Conservation and Recovery Act (RCRA) or 42 U.S.C. § 6901, nonhazardous waste falls under the management guidelines of RCRA, subpart D (U.S. EPA, 2009a).

HHW is distinguished by four characteristics: ignitability, corrosivity, reactivity, and toxicity (Hall, Davis, Schwartz, Bryson, & McCrum, 1996). Since these features contribute to the extent to which HHW can damage property and cause physical illness and fatalities, concerns for the growing fraction of MSW being HHW will continue to present real waste management challenges to municipalities of all sizes for the foreseeable future. The main objectives of our study were to assess factors that motivate residents to participate in the city of Hammond, Louisiana's, HHW recycling program; to quantify various fractions of HHW generated in a semiurban environment; and to address the issue of e-waste in the city of Hammond and its surrounding communities.

Background

Household waste management practices present major environmental and public health concerns. High disposal costs and lack of disposal facilities along with the increasing stringency of laws and regulations and declining or limited natural resources have been cited as some of the problems associated with the management of HHW (Forfás, 2006; Reinhart, 1993; U.S. EPA, 1993). An ever-increasing cost of waste disposal is clearly an incentive to promote good HHW management practices such as pollution prevention strategies that embrace on-site recycling and reduction, reuse, or remanufacture, commonly known as the 3 Rs of the pollution prevention hierarchy of HHW management practices (Figure 1). Pollution prevention approaches can sustain MSW management practices, particularly in small cities and towns where resources are limited.

FIGURE **1**

Pollution Prevention Hierarchy and the 3 Rs for Reducing, Recycling, and Reusing

Prevention and Reduction

Recycling and Reuse

Treatment

Disposal

FIGURE **2**

Study Location

Lack of landfill sites for waste disposal is an obvious challenge in the management of HHW. Key infrastructures to support safe and sustainable waste disposal management operations are also lacking in many semiurban areas (Forfás, 2006). Since most cities and towns continue to face population growth, this continually puts pressure on local government, including communities' resistance to locate landfill facilities in their neighborhoods. Population growth and awareness on the impacts of HHW include what is now commonly known as the "not in my backyard" syndrome among people. This condition makes it extremely difficult for cities and towns to implement safe and sustainable management of HHW (Forfás, 2006; U.S. EPA, 1993).

Another significant problem of HHW management is myriad regulations regarding waste collection, storage, transportation, disposal, and long-term monitoring requirements for landfills and human health impacts of HHW. Although regulations have evolved over the years at different levels of the government to solve solid waste management issues, recycling efforts that are being encouraged by nonregulatory voluntary programs are receiving positive responses from communities across the country. As an example (Figure 1), the Pollution Prevention Act of 1990 encourages nonregulatory voluntary waste management initiatives through the 3 Rs of recycling, reducing, and remanufacturing or reusing resources embedded in the HHW that would otherwise be discarded (National Pollution Prevention Center for Higher Education, 1995; World Class Communications Technologies, 2011).

Since the early 1980s, the U.S. Environmental Protection Agency (U.S. EPA) has encouraged voluntary community approaches to managing HHW (Illinois Environmental Protection Agency [EPA], 2003; U.S. EPA, 2008a). Municipalities across the country have successfully used these approaches as tools to minimize impacts of HHW, mainly by voluntary recycling efforts and encouraging proper disposal of wastes through training and awareness raising (Illinois EPA, 2003). As a result of these initiatives, which include sharing of successful case studies, voluntary community programs have increased by a factor of 400 within a period of 10 years, from two programs in 1980 to more than 800 programs countrywide (Illinois EPA, 2003; U.S. EPA, 1993). The city of Hammond, in Tangipahoa Parish, Louisiana (Figure 2), is one of the cities in the country that have embraced pollution prevention and voluntary participatory approaches to address HHW management practices at the local level.

Materials and Methods

A semistructured study questionnaire was designed during March and April 2011 with an objective of assessing perceptions of residents and finding out key factors for their voluntary participation. Recycling of HHW in Hammond is a half-day, twice-per-year event. It brings together citizens from the city and the neighboring towns to recycle and dispose HHW.

The questionnaire was circulated for review among members of three separate entities. These included faculty members from Southeastern Louisiana University's kinesiology and health studies department, Hammond city officials, and committee members representing the household solid waste advisory committee. The latter oversees Hammond's recycling activities and has played a key role in the city since the recycling program began almost a decade ago (City of Hammond Storm Water Advisory Committee [SWAC], 2012; Subsurface Drainage, 2012). A review by that committee was sought out in order to ensure the validity of the questionnaire and to clarify and identify relevant issues related to HHW management at the local level.

Three undergraduate students were asked to answer the questions as if they were responding to the questionnaire. This process helped to determine the approximate amount of time required to fill out the questionnaire and also provided an opportunity for editorial feedback and accuracy. In addition, exemption for review was submitted to Southeastern Louisiana University's institutional review board (IRB) together with the questionnaire. An exempt research includes activities where human subjects are not subjected to any form of discomfort such as laboratory tests or clinical trial and experiments to determine drug efficacies. Following the approval of the exemption form, an IRB consent form was prepared to communicate important information to participants of their rights and privacy in the study. This consent form accompanied the questionnaire.

On the day of the HHW recycling event, questionnaire and consent forms were administered to each resident who drove through the park where the recycling event took place. Respondents received a briefing on the objective of the survey and were informed that the survey was voluntary and it would take at most 15 minutes to complete. In addition, participants were informed that the number of questions to be answered was completely under their own discretion and that they could remain anonymous if they so desired. Identifying information such as participant's social security numbers or dates of birth was not needed for this survey.

Participants who were willing to fill out the questionnaire could choose to complete the survey at the site or to take it home and mail it back once completed. Each participant was given the questionnaire at the entrance to the park. The questionnaires were collected at the park's exit.

Participants willing to participate in a short interview were asked four questions: (a) What motivates you to participate in the recycling events? (b) Describe difficult types of HHW not accepted at the recycling event. (c) What do you consider to be the most significant strengths and weaknesses of the HHW recycling events? and (d) What would you like to be done five years from now?

TABLE **1**

Exposures to Heavy Metals and Potential Human Health Impacts

Heavy Metals	Potential Sources of Emission or Exposures	Minimum Risk Levels	Chronic Toxicity Effects
Lead (Levy & Bro, 1994)	Paints (in U.S. before 1978), burning of plastics and papers, plumbing, electronic products, circuit boards	Blood lead levels <10 µg/L	Neurological impacts and lowering of IQ
Mercury (European Council, 1991)	Electronic products, plastic wastes, pesticides, pharmaceuticals, fluorescent tubes, dental wastes	Blood levels <10 µg/L	Gastrointestinal (GI) disorders, respiratory tract irritation, renal failure, neurotoxicity
Cadmium (Friberg, Elinder, Kjelistrom, & Nordberg, 1986)	Electronic products, plastic wastes	Blood lead levels <1 µg/L	Irritation of the lungs and GI infections, damage to kidneys

Other sources: Schübeler et al., 1996; United Nations Environment Program, 2006.

Results and Discussion

Participants

At least 360 residents participated in the HHW recycling program in spring 2011. Out of the total participants at the event, 187 (51.9%) residents agreed to fill out the survey. One respondent submitted responses via regular mail. On-the-spot survey methods are usually rare, but often the response rates are very similar to what is expected (Health Communication Unit, 2006).

About 32% of the participants attended this event for the first time. A similar number of participants (31%) attended past events more than three times, and 16% attended either once or twice. About 1% of the residents attended more than five program events, and 3% do not remember the exact number of events they have attended. Based on the zip code, 48% of residents were from the city of Hammond, and 16% lived in the nearby city of Ponchatoula. At least 6% and 4% of the residents were from the cities of Tickfaw and Springfield, respectively. Only 1% of the respondents came from as far as 100 miles away from Hammond.

Analysis based on ethnicity, age, sex, and marital and income status indicated that more males (58%) than females (42%) attended the recycling event. Previous studies, however, have reported women to be more willing to participate in recycling activities than men (Saphores, Nixon, Ogunseitan, & Shapiro, 2006). About 5% of residents were in the age group of 60–70 and 7% were in the 20–39 age group. Married couples represented 75.9% as compared to those who were single (21.7%) or divorced (2.3%). Middle age has been reported, however, as a significant factor in residents who are willing to participate in community and curb recycling efforts (Gamba & Oskamp, 1994).

More whites (85%) than African-Americans (3%), Asians (1%), Native Americans (11%), and Hispanics (0%) attended the HHW recycling event. This can be attributed to many factors including lack of transportation to and from the recycling event or the lack of passion and perhaps knowledge about protecting the environment among some residents.

While residents with a $25,000–$40,000 annual income accounted for 62% of the participants, a small fraction (4%) reported an income in excess of $150,000 per year. While 42% of residents were employed full time, 6.8% and 41% showed part time and retirement status, respectively. Previous studies demonstrate that income and employment status, both of which are dependent on education level, are good predictors of the willingness to participate in community recycling efforts (Saphores et al., 2006).

How Residents Receive Information on HHW Events

About 59% of residents participating at the HHW event received information from local

TABLE **2**

Household Hazardous Waste in Municipal Solid Waste in the U.S.

Category of Household Hazardous Waste	Percentage by Weight (% w/w)
Household maintenance items (paint, thinners, glues)	36.6
Household batteries (plus electronics)	18.6
Personal care products (nail polish and remover, hair spray)	12.1
Janitorial cleaning products	11.5
Automotive maintenance products (grease, oil, windshield washer fluids, tires)	10.5
Pesticides, pet supplies, and fertilizers	4.1
Hobbies/other (pool chemicals, lighter fluid)	3.4
Pharmaceuticals	3.2

Sources: Pendle & Poll, 1993; U.S. Environmental Protection Agency, 2011.

newspapers. *The Daily Star* is a local newspaper circulated throughout Tangipahoa Parish. This media outlet in a rural community with fewer Internet services can be an effective way of communicating information. Other ways by which residents became aware of the program were through word of mouth (14%), fliers (7%), radio (4%), Internet (3%), and local television (4%).

Characteristics of Recycled HHW

Residents recycling HHW contributed by only one person accounted for 17%; but 55% and 28% of residents recycled HHW that was contributed by two and three other people in the household, respectively. At least 64% of the HHW originated from one household; and slightly over 19%, 9%, and 6% of HHW originated from two, three, and four other households, respectively. This is not surprising in a community with close-knit families.

Most HHW products contain toxic chemicals such as heavy metals, e.g., lead, mercury, and cadmium (Schübeler, Wehrle, & Christen, 1996). Table 1 shows the relationship between exposure to heavy metals and potential human health impacts. HHW also contains solvents such as propylene glycol ether, which can be found in ordinary inks, resins, adhesives, paints, and household cleaning products (Bolognesi et al., 2001; European Council, 1991; Friberg, Elinder, Kjelistrom, & Nordberg, 1986; Levy & Bro, 1994; Nestmann, Otson, Williams, & Kowbel, 1981; Staples & Davis, 2002; United Nations Environment Program, 2012). Exposure to solvents can also cause significant environmental, public health, and safety concerns. Some HHW contains acids and alkalis, which are corrosive. Examples of corrosive HHW include automotive battery acid, which can have a pH of 2 or less, and domestic detergents with a pH of 12.5 or greater because of their high sodium hydroxide content (Levy & Bro, 1994).

About 49% and 20% of residents surveyed produce 10–50 lb. or 50–100 lb. of HHW per year, respectively. Data in the city of Hammond and interviews indicate that a considerable and consistent increase of HHW generation has occurred since the inception of the program (City of Hammond SWAC, 2012). Although current levels of about 100 tons per year of HHW recycled at the events are high, it is far less than the national average of about 4–5 pounds per person per day. At the national level, composition of HHW in most MSW is broken down as shown in Table 2.

The effort taken by local governments to promote good HHW practices is beneficial for the environmental and public health because poor management of MSW can be a leading cause of ground water contamination and environmental degradation (Kumar, 2012). There are constraints, however, such as budgetary constraints which make it difficult for small cities and towns across America to produce reference manuals that can help small-quantity generators of hazardous wastes to comply with existing regulations pertaining to proper HHW management (Missouri Department of Natural Resources, 2008). Literature show that most local government authorities in developing countries spend between 20% and 50% of their total budgets for solid waste management (Schübeler et al., 1996). Local authorities in developed countries are recognizing that environmental laws and regulations, including HHW management guidelines, are more stringent now than in the past and will continue to be so in the future. Therefore, given the nature of contemporary financial constraints, these authorities are becoming more innovative in designing safer and sustainable HHW management practices, including recycling program.

Of the 68% of residents who left one type of HHW or another at home, some raised concerns that either that HHW was not being accepted at the recycling event or they lacked the ability to transport that fraction of HHW to the recycling event. While 32% of residents left no unacceptable HHW in their households, 68% could not recycle some HHW, such as pesticides. The recycling event did not accept pesticides because a permit that is needed from the Louisiana Department of Environmental Quality (LDEQ) for this fraction of HHW was not secured.

An issue of unaccepted HHW can be addressed by implementing a fee-to-recycle system. A nominal fee paid upfront during purchase of household products can support end-of-life product management, such as incineration or other proper methods of recycling of pesticides and other HHW not accepted at the recycling event. For example, the state of California has successfully reduced in a significant way the waste generated by electronic products by implementing such systems (California State Board of Equalization, 2010).

Interviews and Comments From Residents and City Officials

Residents and city officials who were interviewed showed that turnout at the HHW events continues to increase each year, resulting in over 100 tons of waste being recycled to date (City of Hammond SWAC, 2012). Residents cited the passion to protect the environment and human health, top management commitment, and the ability of the city officials to connect with residents. These factors correlate well with the concerns of other communities who have practiced recycling (Domina & Koch, 2002; Meneses & Palacio, 2005).

Another motivating factor cited was commitment of city officials to recycling efforts through the resources they provided. The city pays fees to truck owners for recycling HHW and provides fliers, safety briefings to residents, student volunteers, and emergency trucks and personnel. The fliers outline the types of waste that are and are not accepted at the recycling events.

Residents and city officials cited the short duration (about four hours on Saturday for this recycling event), the number of events (only twice per year), lack of storage, and lack of collection and communal transportation facilities for HHW as being the main weaknesses of the recycling program. Design of permanent and temporary collection facilities have proved to provide convenience in other communities to residents who wish to recycle HHW but are unable to do so because of lack of transport, time, or other resources (California State Board of Equalization, 2010; Domina & Koch, 2002; Hornik, Cherian, Madansky, & Narayana, 1995; Saphores et al., 2006).

E-Waste

At the event, cell phones, stereos, computers, television sets, and other e-waste were recycled. In comparison to other types of HHW, the amount of e-waste was significantly higher (45%) than paint, tires, and "other" HHW that constituted 15.6%, 5.2%, and 1.6% of the total HHW, respectively. In comparison to the nation, e-waste is a growing concern in the city of Hammond. Generation of e-waste occurs in homes, government agencies, and at commercial facilities in the form of television sets, laptops, desktops, cell phones, and stereos. E-waste accounts for about 2% of all the waste transported to landfills and is nearly 70% of all hazardous waste generated in the U.S. (Ahmed & Tanveer, 2008; Integrated Waste Management Board, 2012).

In 2003, at least three million tons of e-waste were generated, but in 2008, more than 36 million units of television sets, 24 million personal computers, and 140 million pieces of portable cell phones, pagers, or phones were being sold, leading to the generation of more than 13 million tons of e-waste (Consumer Electronic Association, 2008; U.S. EPA, 2008a). In 2007, data showed a significant increase in e-waste (Table 3). This apparent increase in e-waste is attributed to the fast expiration of the useful life of electronic products and their recycling rate that has remained relatively low.

TABLE **3**

Amount of E-Waste Discarded or Recycled in 2007

Product Type	Total Disposed or Trashed (Million Units)	Recycled (Million Units)	Recycling Rate (% w/w)
Television sets	47.5	6.3	9%
Computer products	362.8	48.2	9%
Cell phones	266.6	14	5%

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

Appropriate e-waste handling practices serve two major purposes: first, to prevent or minimize significant health, safety, and ecological impacts from the toxic materials embedded in the products; and second, to support recovery of valuable materials for reuse.

Legislative Frameworks to Manage E-Waste at the Local Level

Currently, 50% of states have enacted legislation to address sustainable management of e-waste (Figure 3). Some initiatives are in the form of take-back plans, and others focus on the producer responsibility laws (Electronic Take Back Coalition, 2011). E-waste constitutes a significant amount of recycled HHW. The use of electronic devices will continue to increase and this situation may present challenges to e-waste end-of-life management to state and local authorities.

Resources to Support E-Waste Recycling Management

Many useful resources are available for community use to design and implement successful management strategies for e-wastes. The Basel Action Network (BAN) in Seattle and the Silicon Valley Coalition in California and numerous nonprofit organizations have accumulated a lot of information about e-waste problems (BAN, 2002; Canadian Broadcasting Corporation, 2008). Large amounts of useful resources are discarded with e-waste across the globe. A personal computer may contain 26% silica or glass; 20% ferrous and nonferrous metals; 23% plastic materials; 14% aluminum; and 17% precious heavy metals such as lead, copper, zinc, mercury, and cadmium (E-Waste Collections, 2011). Discarding one million cell phones is equivalent to disposing of 35,000 lb. of copper, 800 lb. of silver, 75 lb. of gold, and 33 lb. of palladium.

Appropriate legislation includes regulatory and nonregulatory frameworks at local, state, and federal levels. Existing federal regulatory requirements such as the Pollution Prevention Act of 1990 can provide a sustainable framework since most state governments can use these legislative and regulatory resources as their benchmarks (Kubasek & Silverman, 2008). For example, LDEQ has guidelines covering hazardous materials handlers, including conditionally exempt small-quantity generators (Louisiana Department of Environmental Quality, 2012).

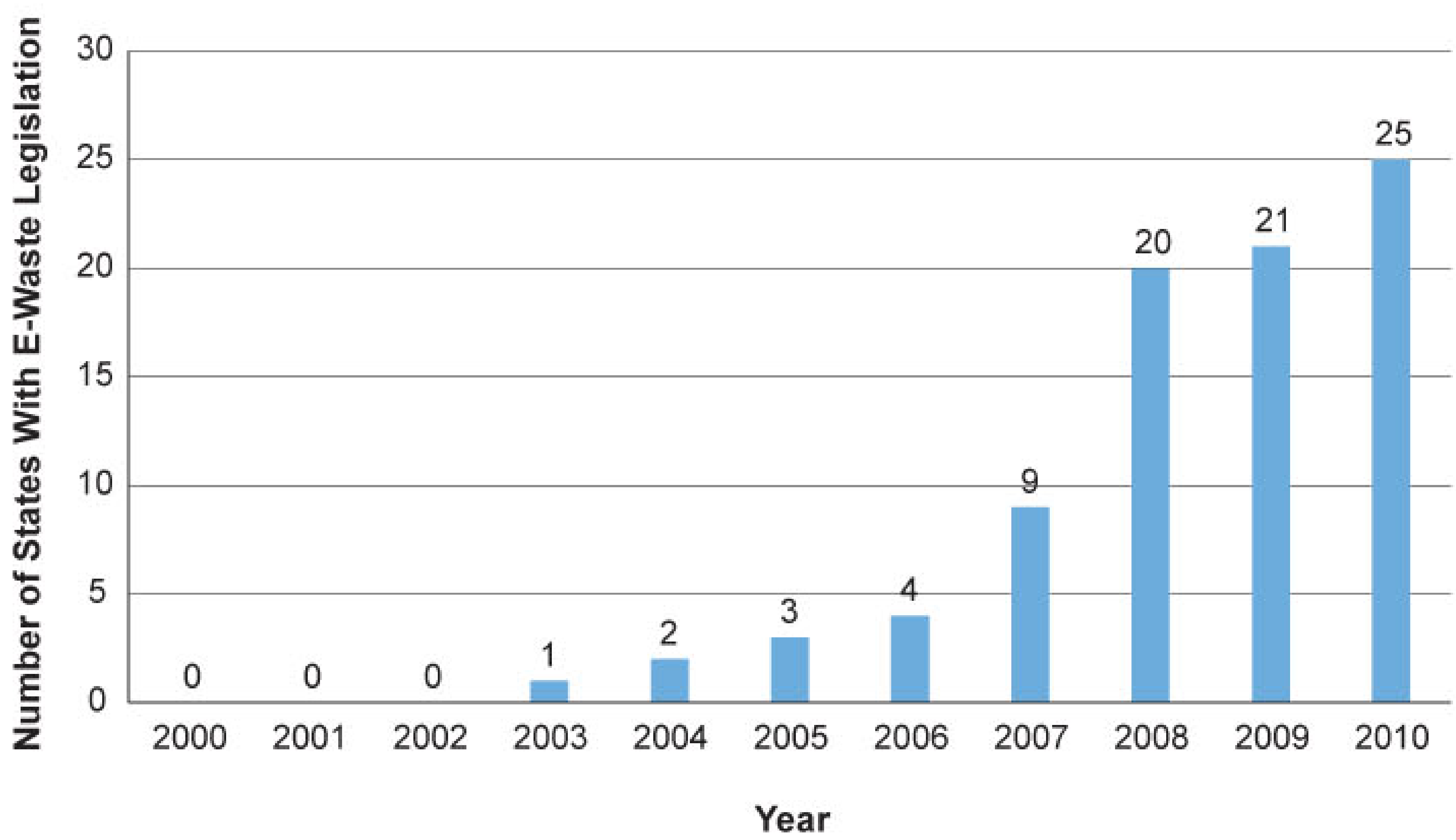
Nonprofit organizations and communities can also support these initiatives by providing resources for sustainable management of e-wastes. For example, the federal government passed the Resource Conservation and Recovery Act (RCRA) in 1976, which offers a good framework to manage both hazardous and nonhazardous wastes, including the e-waste fraction of HHW. Another federal government initiative is the Hazardous Waste Electronic Manifest Establishment Act of June 2011, which requires generators of hazardous wastes to use electronic version of e-waste manifests to track hazardous wastes through a "cradle-to-grave" approach (Government Printing Office, 2011). The waste electrical and electronic equipment directive number 2002/96/EC of the European Union can influence the e-waste recycling at the community level (European Parliament and Council, 2002).

Conclusion and Recommendations

There is every reason to believe that—like in other parts of the country—HHW is a growing problem in the city of Hammond and

FIGURE **3**

Number of States With E-Waste Legislation



Sources: Electronic Take Back Coalition, 2011; E-Waste Collection, 2011.

surrounding areas. Although the amount of HHW generated is not comparable to the national average data, the current recycling programs should be improved in frequency and time allocated in order to tackle any potential future growth of HHW as a result of potential population growth.

The city of Hammond's HHW program is successful as it incorporates a component of raising awareness and education through the use of fliers. This approach brings together residents, local institutions, government authorities, and community members through a participatory approach. This case study can be replicated elsewhere to support initiatives that are designed to reduce HHW.

E-waste is a growing problem in the city of Hammond and surrounding communities. An urgent need exists to establish e-waste management programs to address this waste. Continuous involvement and engagement of residents is also as important as raising awareness including that of the 3 Rs of pollution prevention in managing HHW. Media, especially local newspapers, can contribute to this awareness raising. A plan for community transportation for residents who cannot afford to transport wastes to the events is recommended.

Equally important is raising awareness on applicable regulations and ordinances about HHW through training and to provide residents with fundamental knowledge of procedures and permit application processes for HHW currently not permitted at the recycling events. These needs will promote proper management of HHW waste such as pesticides and polychlorinated biphenyl–containing products.

Some legislation to encourage take back of e-waste would minimize the generation of e-wastes in Tangipahoa Parish and in the state of Louisiana. Finally, green products are less toxic, and for common household products, promotion of these products can make a big difference in efforts to minimize the generation of HHW.

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continued on page 32

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