

# FUTURE SOLID WASTE MANAGEMENT ISSUES: RESULTS OF A DELPHI POLL

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Municipal solid waste management has changed dramatically over the past two decades, bringing a host of technological, managerial and financial innovations. Many solid waste operations that were once primarily a municipal function are now being assumed by private enterprise. The practice of open dumping has been replaced by greater use of lined sanitary landfills with leachate treatment systems, and the simple incinerator has been abandoned in favor of technologies that convert waste to energy. And throughout the country, communities are contemplating materials recycling with a seriousness unknown since World War II.

Undoubtedly, the future will bring continued change, but what form will it take? Furthermore, some of the recent developments have created many perplexing new issues for which we have yet to find answers. In seeking answers to these questions, Malcolm Pirnie, Inc., consulting environmental engineers, recently conducted a survey of solid waste experts which has been called the Solid Waste Delphi Poll. This is the second in a series of polls for examining current environmental issues. The hope was to stimulate discussion within the industry, and among a larger audience as well, on the solid waste problems confronting our nation in the years ahead.

What were the results? Several key issues came to light among the experts: dioxin, recycling, the private sector's role, toxic waste in landfills, and resource recovery. Ironically, many of these topics were to receive

increased national attention when the odyssey of the wayward Islip, New York garbage scow began in the Spring of 1987. Indeed, requests for copies of the survey increased dramatically as additional media attention was focused on the state of solid waste management.

It should be noted that the Delphi survey results first appeared in the February, 1987 issue of *American City and County* magazine. Stephen C. Schwarz and Merlin J. Shelstad, both of Malcolm Pirnie, authored that original report.

## DELPHI POLL

What then is a Delphi poll? The polling technique is named for the ancient Oracle of Delphi, a soothsayer of mythical times, and was originally developed by the Rand Corporation as a structured method of soliciting expert opinion. Participants for the Delphi survey were initially chosen based on recommendations by our managers and technical directors. Candidates were then asked to identify leaders in the solid waste management field, in addition to themselves, that they felt should be included in the survey group. These new candidates were also invited to respond to the survey. Additionally, trade, news, and professional publications were reviewed to identify individuals with extensive experience or comment relating to solid waste management issues. These individuals also were invited

to participate in the survey. Using this approach, responses from 39 recognized authorities were received (see appendix) in the solid waste field, from 18 states and the District of Columbia, representing all segments of the solid waste field — municipal, state and federal agencies, legislators, vendors, consultants, industry associations and academics.

In a three step process, panel members were initially asked to respond to open-ended essay-type questions, thereby reducing any bias in the initial questionnaire. Based on their responses, a second round of questions was constructed, the answers to which were then used to develop a final questionnaire. This technique serves to identify the issues of greatest concern to the panelists, rather than predisposing them to comment on specific subjects. Panelists were also given an opportunity to pose questions to their colleagues so as to provide an awareness on many issues. To further maintain the integrity of the survey, none of the panelists were employees of our consulting engineering firm.

The results were organized into the following categories.

## DIOXIN

The most surprising result, and the most clearly defined area of agreement, was in response to the question of health risks from dioxins. With the advent of waste-to-energy technologies, debate over dioxin emissions has been a critical factor in the implementation of resource recovery programs. And although half the panelists felt additional research was needed, they unanimously agreed that the public faces much less risk from dioxin emissions from waste-to-energy plants than from other, more common sources of carcinogens such as cigarettes or charcoal-broiled meat. In fact landfills, a more common method of waste disposal, are seen as a greater health hazard by over 70% of the Delphi respondents because of potential ground-water contamination.

This issue of human health risk from dioxin was recently summarized by Thomas Gasiewicz during a symposium on the subject.<sup>1</sup>

“It seems likely that for the near and distant future, humans as well as the rest of our environment will continue to be exposed to TCDD and a variety of related compounds.

<sup>1</sup> Gasiewicz, Thomas A. “Dioxin and Human Health.” In *Dioxin and Resource Recovery: Proceedings of a Symposium* sponsored by the American Society of Civil Engineers, Schwarz, S. C., and Wolfe, P. L. (eds.), 1987.

While the above issues do not rule out the possibility that present environmental levels to which humans are exposed may have no significant effect on human health, they do stress the need for continued investigations.”

In a correlative view, the Delphi panelists did not dismiss the dioxin issue entirely. As one state official noted, “It is unwise and incorrect to characterize dioxin as a nonissue.”

Of course the issue of dioxin has been discussed by the academic, industrial, and environmental communities from a variety of perspectives. In Round 1 of our poll, the panelists were asked: given what is known about dioxin toxicity and the performance records of operating plants here in the U.S., is concern over dioxin justified? For one-fourth of the panelists, uncertainty did not permit a direct answer. Of those that provided a direct answer, the overwhelming response, by a ratio of 5:1, did not believe there was cause for concern. It was decided, nevertheless, to pursue the subject in our Round 2 questioning.

### What is known

Referring to more than 20 years of waste-to-energy experience in Europe, 63% of the panelists (one-fourth expressed no opinion) felt there was no evidence that dioxins are causing health problems. When asked whether the dioxin issue was being used as an excuse for obstructing waste-to-energy facilities in the U.S., the panel was evenly divided. As one vendor commented, “no doubt that antiincineration forces will be active for awhile, but unless they find an alternative to resource recovery other than landfill, they will eventually lose their clout.”

### Public Perception

Much of the furor over dioxin emissions seem to be a result of citizen opposition to resource recovery projects. A recent *Wall Street Journal* report on the “Nimby” (“not in my backyard”) phenomenon showed city officials nationwide are plagued by citizen rejection of disposal technologies close to home.<sup>2</sup>

Querying the panelists on this subject, we found that the average citizen judges environmental issues on an emotional level and according to three-quarters of our respondents, is not capable of comprehending the technical arguments of the dioxin issue. If further research were to indicate that dioxin emissions are not a health

<sup>2</sup> Paul, Bill - “Garbage Strains Planner’s Ability to Handle It All,” *Wall Street Journal*, June 9, 1987.

hazard, 77% of the Delphi panel believed it would take many years for the public to be persuaded. They were equally divided, however, on the proposition that the public expects "zero" risk from environmental facilities regardless of cost. As one panelist noted, "Dioxin is a negative buzzword. People don't understand that it is everywhere in the environment. . ."

### **What to do**

The Delphi panelists were in agreement that more research is needed on dioxin emissions. They cited health effects from dioxin exposure, quantification of dioxin emissions from operating resource recovery plants, and the total dioxin balance in the environment from all sources as the priorities for further research. Who should do this study? The panelists first identified the National Institutes of Health or similar federal agency, followed in order by the U.S. EPA, and university researchers.

### **RECYCLING**

Materials recycling is not a new concept. During World War II when raw materials were in short supply, it was practiced extensively. However, the degree of success for recycling to date has varied considerably throughout the nation.

The extent to which recycling may be incorporated into the routine of the typical U.S. citizen was deemed relatively low by the panelists. Nearly two-thirds of the respondents feel Americans do not participate in source separation programs primarily because they prefer convenience and will not go out of their way to separate their wastes.

To change this attitude, 63% of the Delphi panelists believed public education programs would substantially increase recycling participation by the general public. Source separation programs that implement curbside pickup rather than recycling centers were also seen as bettering recycling participation, according to more than half the poll's respondents.

Fifty-seven percent of the panelists identified college-educated, middle to upper-class citizens as most likely to participate in recycling programs. On the other hand, the panelists did not write off the possibility of source separation in larger metropolitan areas. Only 26% agreed with the statement that source separation will never work in urban centers such as New York, Chicago and Philadelphia. Finally, about half of the respondents believed that public works directors and consulting engineers underestimate the extent to which

citizens would cooperate with a source separation program (17% had no opinion).

We also asked the panelists their opinions on various methods of implementing source separation. About 60% agreed that citizen participation would be achieved if there were curbside pickup, but not if they have to transport their cans, bottles and newsprint to a recycling center.

### **Economics**

Not every participant in the Delphi poll believed that materials recycling makes economic sense. Noting the abundance of many virgin materials and fluctuating market prices, the panel split evenly on the statement that a given material should be recycled only if the recovered materials can be sold at a profit. As one panelist stated, ". . . economics is the key to recycling. What Americans won't do for the environment, they will do for money."

Finally, the panel did not believe that government intervention in materials recovery markets is desirable. Nearly 80% disagreed with the proposition that governments should guarantee the purchase of recycled materials when no "free enterprise" markets exist.

### **LANDFILLING**

Landfilling, the predominant solid waste disposal method today, will continue to provide over 40% of municipal disposal for the next 15 years, according to two-thirds of the Delphi respondents. When asked to look further into the future, 54% of the panelists disagreed with the statement that landfills will eventually disappear as a solid waste disposal option for "raw" unprocessed wastes.

The regulation of landfilling areas was another subject considered by the Delphi panel. Nearly 86% agreed with the statement that landfill regulations should be flexible to reflect site-specific conditions. Asked whether landfill regulations should be less strict for small communities because they cannot afford the costs of compliance, the entire panel said "no!"

### **Toxic Wastes**

The disposal of hazardous wastes in landfills, even in small quantities, was another concern of our panel.

Although some respondents believed the quantities involved were too small to be a problem and too costly to control, 86% agreed that greater monitoring of landfills to reduce the amounts of these toxics was necessary.

Their recommendations included:

(a) Specially scheduled collection once or twice each year.

(b) Drop-off collection centers.

(c) Manufacturer buy back of empty containers through a deposit program.

(d) Better labeling by manufacturers.

### **Private vs Public Sector**

The private sector's role in solid waste management will continue to grow, according to a 6:1 opinion of the participants. Citing the ability to control labor costs through competent management, the panelists agreed that the private sector is better equipped to deal with solid waste programs, such as waste-to-energy, which have complex financial and technical considerations.

Although 60% of the panelists agreed that the cost efficiency of the private sector is overstated, 74% saw competition by the private sector as making municipalities more competitive and business-like. Nearly half of the Delphi participants saw municipalities handling their own solid waste problems in a profitable manner, if willing to take risks and manage well.

In political terms, many respondents saw the private sector as relatively free from influence. Graft and corruption potential do not increase with private sector management, according to 57% of the respondents.

### **Responsibility**

Although some critics have argued that the long-term maintenance and monitoring of solid waste disposal systems warrant public sector control, the Delphi experts called for partnerships in all aspects of solid waste management. Over 89% agreed that the private sector should not be left to do the job alone. In recommending functions to be retained by the public sector, the panelists suggested:

(a) Environmental regulation, monitoring and enforcement.

(b) Administration of licensing and contracting arrangements.

(c) Public education.

(d) Monitoring of performance.

(e) Planning and siting functions.

(f) Overall solid waste management.

### **RESOURCE RECOVERY**

Interest in the development of waste-to-energy technologies has increased steadily, due in large measure

to diminishing landfill availability and 20-year demonstrated success in Europe of these technologies. Of the many technologies available, only two have found general acceptance, said the experts. Of those, mass-burn has been far more successful in the marketplace than RDF (refuse-derived fuel).

In mass-burn technology, like conventional incineration, waste is burned as received in furnaces lined with water-filled tubes which capture combustion heat for conversion to steam or electricity. In RDF technologies, waste is sorted to recover marketable materials or eliminate noncombustibles such as metals and glass from the waste stream and then processed, usually by shredding and compaction, to form fuel for combustion in specially dedicated boilers.

Asked to judge the prospects of these two technologies, half of the panelists agreed that mass-burn will continue to dominate the resource recovery market (14% had no opinion). Citing RDF failures and market undesirability, one panelist observed that "in a political climate, failure cannot be accepted." Although the panelists noted the air quality benefits of RDF, anticipated improvements in both technologies would still find mass-burn systems the more marketable.

On the other hand, the panelists proposed that improvements will continue to be made in mass-burn technology. Nearly 74% of the respondents disagreed with the statement that mass-burn technology has essentially been developed to its highest level. Instead, half of the respondents (a rather large 37% had no opinion) agreed that continued research and improvements in mass-burn technology will keep it in the lead compared to RDF.

### **THE FUTURE**

What is the future of solid waste management?

In many instances the Delphi participants did not foresee significant changes in municipal solid waste disposal practices. Modifications in collection systems that incorporate automatic source separation, smaller work crews, or greater waste compaction can be anticipated to reduce labor costs, according to the majority of the panelists.

Packaging materials, a major source of solid waste, may be reduced because of economic factors (e.g., rises in oil prices may lessen the use of plastics), but most of the respondents cite the consumer's desire for convenient and sanitary packaging as increasing the use of these materials.

## Education

According to the Delphi panelists, by a ratio of 4:1 the level of training in solid waste management is currently inadequate in contrast to other public works areas, such as water and wastewater management. Among the reasons, they noted that the field is somewhat newer in terms of technical sophistication, that licensing agreements have restricted the distribution of technical information, that the universities have not yet responded with suitable programs, and that the field, unlike water and wastewater, has not received the support of Federal policies. Many believed, however, that it is just a matter of time before education will improve. Also, citing the need for operator training, many panelists advocated state certification, as is done in the water and wastewater fields.

## Consultants and Potential Conflicts of Interest

Some of the respondents questioned conflicts of interest among those consultants who advise municipalities on solid waste management, so the issue was put to the Delphi panel. First, the panelists were asked whether the potential for higher consulting fees biases engineers toward expensive, high-technology disposal systems. Those panelists who believed this is not the case outnumbered those who do by approximately 2:1. Some panelists remarked that although most engineers are not influenced, there might be a small number who are. Other panelists believed that engineers are not comfortable with low technologies such as recycling and composting, or with nontechnical approaches involving educational and marketing issues. As one panelist put it, engineers are not trained to think in terms of behavioral solutions, so approaches such as source separation are outside their training and experience.

The Delphi panelists were also asked whether consultants who advise municipalities on the selection of resource recovery equipment vendors should also refrain from taking on vendors as clients. The panel was divided roughly 3:2, with the majority believing that consultants should avoid such conflicts of interest. On the other hand, a sizable number felt this isn't really a problem, if the consultant decides each case on the basis of conflict of interest, or if the relationship is fully disclosed. A few even thought it was a good idea for the consultant to work for vendors so as to become more familiar with the technology, while others thought it was best to avoid the appearance of conflict of interest, simply in the interest of public relations.

## RESEARCH

Finally, the Delphi participants ranked the areas that should be given priority for further research and development. Among the top were emission control technology, toxic substances, leachate control and treatment, and materials separation. Additional priorities include recycling programs, operating costs and collection methods.

Regardless of opinion diversity, the Delphi panel stressed that research and innovation must continue on the part of industry leaders. In this way, municipal decision-makers will have the option to choose the most cost-effective and environmentally sound system for their growing solid waste needs.

## APPENDIX

### The Delphi Panelists (Partial Listing as of February 1987)

#### Eileen Brettler-Berenyi, Ph.D.

An internationally recognized consultant in solid waste and municipal management and a principal of Governmental Advisory Associates, Inc., Dr. Berenyi has served diverse public sector clients (New York City, San Juan, Newark, and the U.S. Departments of Energy and Housing and Urban Development), and managed two NSF projects on solid waste service delivery systems. She is author of *Resource Recovery Yearbook: A Directory and Guide*.

#### Gordon M. Boyd

Now Executive Director on the New York State Legislative Commission on Solid Waste Management, Mr. Boyd directs varied research on solid waste problems. He also coordinates Planning and Program Development for the New York State Assembly, including important legislation on resource recovery and waste management policy.

#### Paul Casowitz, P.E.

As Deputy Commissioner for Resource Recovery and Waste Disposal Planning for the New York City Sanitation Department, he is responsible for a waste disposal system handling over 6 million tons yearly. A strong believer in public education as a critical element of disposal programs, he has provided testimony on resource recovery, and received the City's Public Service Award.

#### Llewellyn E. Clark, Ph.D.

In 1975, as Chairman of Pittsfield's Solid Waste Commission, he established the concept of waste-to-

steam resource recovery as an alternative to landfill. Later, as Project Manager for Vicon Recovery Associates' Pittsfield, Massachusetts, resource recovery plant, he oversaw the plant from design through start-up, and now, as the firm's Vice President of Engineering & Operations, he still manages the plant and other projects.

**Sandra Johnson Cointreau**

Now President of Solid Waste Management Consulting Services, Ltd., Ms Cointreau's expertise in waste system analysis and planning has been applied worldwide, primarily in developing countries, for such clients as the U.S. Agency for International Development, the World Bank, the U.N. Development Program, U.S. EPA COE, and other cities. She chairs ASCE's Committee on Legislative Review of Solid Waste Management.

**The Hon. Paul J. Contillo**

Senator Contillo, Vice Chairman of the New Jersey Senate's Energy and Environmental Committee, has made waste management a key concern. He authored recent legislation to mandate solid waste recycling in the state, and sponsored a bill passed in 1986 allocating \$100 million in bond revenues for hazardous waste cleanup.

**Alfred B. DelBello**

Mr. DelBello combines public and private sector perspectives on solid waste issues. Now Senior Vice President of Wheelabrator Technologies, Inc., he became President of Signal Environmental Systems after serving as lieutenant governor of New York State. Before that, as Westchester County Executive, he was instrumental in developing an innovative regional refuse-to-energy system there.

**Epaminondas K. Demos, Ph.D.**

As Denver's Director of Environmental Services, Dr. Demos has been involved in waste-to-energy studies and management of the Lowry Landfill Superfund project. He also serves on the Urban Consortium Energy Task Force, and has authored many publications on waste-to-energy and hazardous waste management.

**Franklin B. Flower**

Mr. Flower, an Extension Specialist in Environmental Sciences at Rutgers University, has worked with many agencies to promote proper management of New Jersey's solid wastes. A member of many professional groups, he is trustee of the New Jersey Recycling Forum and Vice Chair of the New Jersey Council on Solid Waste Management.

**Floyd Hasselriis, P.E.**

A leading engineer in refuse-to-steam technology, Mr. Hasselriis has devoted his career to development of commercial and municipal resource recovery facilities. With Combustion Equipment Associates, he spearheaded some early commercial successes in waste-to-energy, and helped develop waste incineration systems for Waterbury and Bridgeport, Connecticut. A noted author, he chairs the Research Needs Committee of ASME's Solid Waste Processing Division.

**Thomas M. Henderson**

As Director of the Broward County, Florida, Office of Resource Recovery, Mr. Henderson has coordinated County efforts to develop two waste-to-energy facilities, which at 4,000 TPD combined will be the world's largest project. He also managed a Santa Clara County, California agency responsible for planning and developing solid waste facilities for the Silicon Valley area.

**Ronald D. Heveran**

With Waste Management, Inc., a vendor of resource recovery systems, Mr. Heveran has had key roles in two successful Florida waste-to-energy projects, in Tampa and North Broward County (100 TPD and 2200 TPD, respectively). He has also worked on many other resource recovery, recycling and solid waste management projects.

**H. Lanier Hickman, Jr., P.E.**

Mr. Hickman is Executive Director of the Governmental Refuse Collection and Disposal Association (GRCD), an organization of solid waste professionals providing technical assistance, information and training worldwide. He also directed the federal solid waste program in U.S. EPA, where he helped develop and implement several key programs including the Resource Conservation and Recovery Act (RCRA).

**Charles A. Johnson, Ph.D., P.E.**

As Technical Director of the National Solid Wastes Management Assn., which provides technical assistance to federal and state agencies in formulating policy and standards, he is responsible for evaluating and promoting new disposal techniques. He was Operations Manager at the Onondaga County, New York, resource recovery project.

**Walter L. Johnson, Ph.D., P.E.**

Now Director of Planning with the St. Paul, Minnesota Metropolitan Waste Control Commission and previously its Director of Quality Control, Dr. Johnson has worked as a consultant and was a staff member and researcher in the University of Minnesota Engineering Dept. An author and past president of ASCE's



Northwestern Section, he was on the Governor's Committee on Certification of Treatment Plant Operators.

#### **Harry L. Kelman**

As Sanitation Administrator for the City of Phoenix, Mr. Kelman is responsible for the city's \$30,000,000 solid waste program. Previously a solid waste market consultant and specialist in refuse collection, he has authored many articles on that topic.

#### **Frank McManus**

Mr. McManus publishes *Resource Recovery Report*, a newsletter focusing on energy and material recovery from municipal waste, and is Executive Director of the Pulp & Paper Machinery Manufacturers' Association. A consultant as well as sponsor of many seminars on resource recovery, he is a member of 15 state recycling associations as well as the NRRA.

#### **Frank H. Miller, Jr., P.E.**

Currently Public Works Director of the City of Hampton, Virginia, he is responsible for operation of the NASA/USAF refuse-fired steam plant. On the state's Solid Waste Commission and Waste Mgt. Board, he is also a member of the APWA Institute of Solid Waste's Executive Council.

#### **Raymond A. Moreau**

Mr. Moreau is now Resource Recovery Project Coordinator for Jacksonville, Florida, responsible for all aspects of its planned refuse-to-energy projects. He was Environmental Supervisor for the Florida DER's Resource Recovery Program, and directed the state's Resource Recovery Council.

#### **Ronald W. Musslewhite**

Mr. Musslewhite is Deputy Director of the U.S. Conference of Mayor's Office of Development Programs and Executive Secretary of its affiliate, the National Resource Recovery Assn. He is also editor of *City Currents*, a municipal newsletter on energy, and was with the National Center for Resource Recovery.

#### **Emil F. Nigro, Ph.D., P.E.**

A Coordinating Engineer for Chicago's Dept. of Streets and Sanitation, Dr. Nigro manages solid waste disposal for the nation's third largest urban center. He has served on various energy and solid waste "task forces," and is a noted author on urban waste policy, bioenergy and energy systems.

#### **Philip E. Richmond**

As Escambia County, Florida, Director of Sanitation, Mr. Richmond oversees collection operations and contract management for private refuse franchises as well as the County landfill and transfer station op-

erations. Formerly Director of Solid Waste Management in Tulsa, he developed a 1125 TPD waste-to-energy project, and has headed national and two state chapters of GRCD. A.

#### **Robert E. Sarver**

In Richmond, Virginia, where he is Public Works Director, Mr. Sarver oversees design and construction of refuse collection and disposal facilities and public information programs. Previously, as Chief of Engineering, he supervised landfill gas migration studies and demonstration projects on innovative technology in methane gas recovery.

#### **George M. Savage**

Mr. Savage, as Vice President of Cal Recovery Systems, Inc., is an expert on materials and energy recovery approaches, including procurement management for waste conversion systems, field and market studies, and environmental impact assessments. He has authored many books, articles and two design guides.

#### **Theodore R. Siegler**

As Project Manager of the New Hampshire/Vermont Solid Waste Project, Mr. Siegler is responsible for implementing a 200 TPD waste-to-energy facility and ashfill to serve 24 New England municipalities. He also helped develop Nevada's solid waste management plan, and did further planning in the Baltimore metro area.

#### **Garret A. Smith**

Mr. Smith directs the Essex County, New Jersey Division of Solid Waste Management, whose program includes a proposed 2200 TPD waste-to-energy facility and a recyclables processing center. Earlier, with U.S. EPA, he helped plan new programs for dioxin destruction and oversaw its RCRA Compliance Section. He was also Middlesex County, New Jersey, recycling coordinator.

#### **Henry D. Stubing, P.E.**

Mr. Stubing is Commissioner of Public Works for the Town of North Hempstead, New York, and Chief Engineer for its Solid Waste Management Authority. Under his aegis the Town has used innovative methods to treat and dispose of sanitary landfill leachate and gases.

#### **L. Don Thurman, P.E.**

As Chief of the Texas Bureau of Environmental Health, Mr. Thurman plays a major role in critical environmental decisions facing the southwestern U.S. He has worked in the public health engineering field for over 27 years.

**P. Aarne Vesilind, Ph.D., P.E.**

Chairman of Duke University's Dept. of Civil and Environmental Engineering, Dr. Vesilind has taught, done research, design and consulting in solid waste and wastewater sludge management both in the U.S. and abroad. Now specializing in refuse-derived fuel and resource recovery technologies, he has directed more than half a million dollars in research in these areas. A noted author, he received ASTM's Special Service Award for Resource Recovery.

**Donald K. Walter, P.E.**

Mr. Walter directs the U.S. Department of Energy's Biofuels and Municipal Waste Technology Division,

including research and development programs for converting wastes to fuel. Previously director of municipal waste programs for DOE and City Engineer of Annapolis, Maryland, he is a recognized expert on municipal waste recovery/reuse.

**Louis Ott Ward**

A resource recovery pioneer, Mr. Ward helped introduce European waste-to-energy technology into the U.S. He has overseen numerous projects nationwide, including the 1600 TPD Chicago Northwest facility, and has served on the boards of GRCDA and the NSWMA Institute of Resource Recovery.