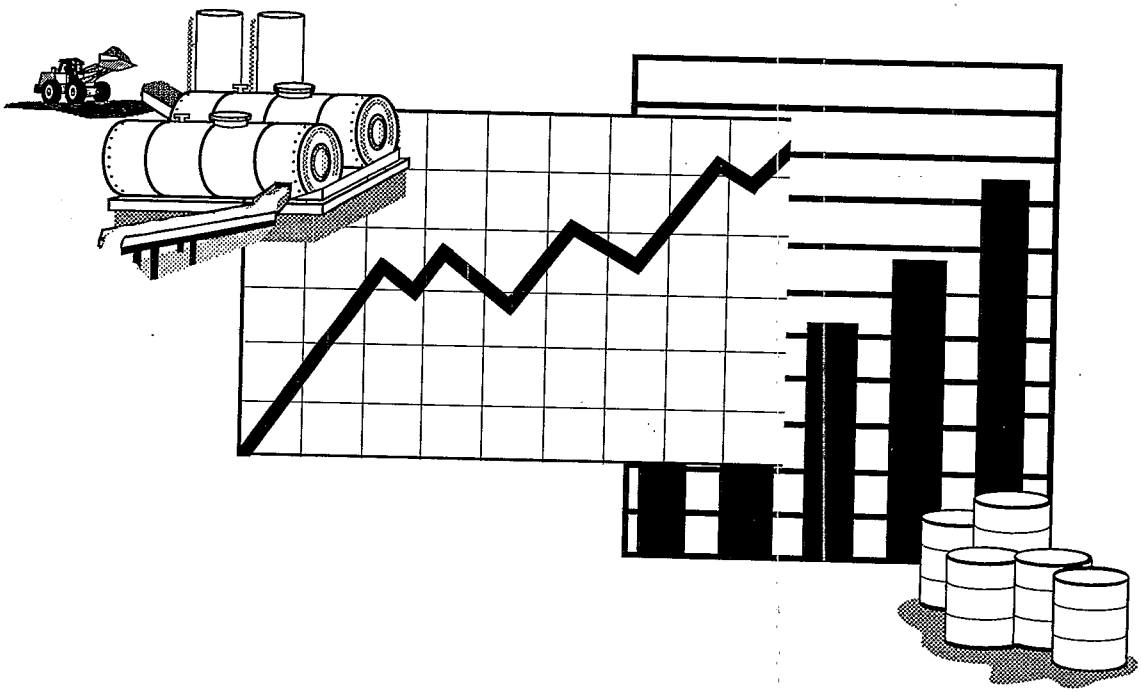
United States
Environmental Protection
Agency

Solid Waste and
Emergency Response
(5102W)

EPA 542-R-94-002
December 1993

EPA

Profile of Innovative Technologies and Vendors for Waste Site Remediation



Purpose

Over the next 20-30 years, federal, state, and local governments and private industry will commit billions of dollars annually to clean up sites contaminated with hazardous waste and petroleum products. This commitment will result in an increase in the use of all types of site remediation services. While existing technologies to remediate contaminated sites have been successful, the investment in site cleanup offers new opportunities for the development of less expensive and more effective solutions.

EPA is promoting the development and commercialization of more effective and less costly technologies to solve the nation's remediation problems. In addition to improving the quality and efficiency of the nation's environmental clean-up programs, these technologies are contributing to the leadership position of U.S. firms in the international marketplace for waste treatment and site remediation.

This monograph documents the findings of a review of the vendors who supply innovative technologies. The study was undertaken to better understand the characteristics of the companies in this field. A separate study was concurrently conducted by EPA to analyze the potential demand for remediation services[1].

Background

Prior to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Resource Conservation and Recovery Act of 1976 (RCRA), most hazardous waste was disposed in landfills. These laws, as amended, require remedies that treat, rather than dispose of, waste to the "maximum extent practicable." Consequently, EPA defines alternative treatment technologies as "alternatives" to land disposal. The most frequently used alternative technologies are incineration and solidification/ stabilization. Available cost and performance information on these two technologies is sufficient to support their routine use.

EPA defines "innovative treatment technologies" as those that lack the cost and performance data necessary to support their routine use. In general, a treatment technology is considered innovative if it has experienced only limited full-scale application. Often, the first-time application of an existing technology or process to new waste types is what makes it innovative.

EPA provides two sources of information on innovative treatment technologies. The Vendor Information System for Innovative Treatment Technologies (VISITT) database and the Superfund Innovative Technology Evaluation (SITE) Technology Profiles[2] provided the inventory of vendors and much of the information for this study.

The VISITT database was developed to improve communication between technology developers and technology users. It provides companies the opportunity to describe their capabilities and enables federal, state, and private sector environmental professionals to screen technologies for application to specific sites. The database is available at no cost and has been distributed on request to 9000 users. VISITT contains information on technology capabilities, past performance, and availability as provided to EPA by the vendors. The system includes technologies at the bench-, pilot-, and full-scale that are capable of treating contaminated soils and ground water. The system was developed by OSWER's Technology Innovation Office.

The SITE program was initiated six years ago by EPA's Office of Research and Development to evaluate new and promising treatment technologies for cleanup of hazardous waste sites. The SITE program provides an opportunity for developers to demonstrate their technologies' capability at hazardous waste sites. The two components of the SITE program from which vendors were selected for this report are: 1) The Demonstration Program for field-scale and 2) The Emerging Technologies Program for laboratory or bench-scale units.

This study utilizes these information sources to assess the characteristics and trends of companies that develop and supply innovative technologies.

Methodology

Data on vendors and technology characteristics were developed from the VISITT database and SITE program. Observations were made in 1992 (the first version of VISITT) and 1993, allowing very preliminary suggestions of trends. Although VISITT and SITE do not include all innovative technology applications, they are believed to be representative. To develop an inventory of technology applications for the study, the scope of "innovative" technologies consisted of the more restrictive definition used in VISITT. This definition eliminates incineration, solidification/ stabilization and above-ground aqueous treatment technologies from consideration. (Using these two criteria, two VISITT technologies and 39 SITE technologies were eliminated from further review.) This is a definition of convenience, as there are important technical advancements for these technologies as well. In addition, the criteria were broadened in 1993 to include off-gas treatment technologies, delivery excavation systems, and materials handling technologies. A total of 177 technologies were selected for analysis from VISITT and SITE in 1992 and 289 were selected for 1993. Although participation in these programs is not limited to U.S. companies, the firms are primarily domestic.

Table 1 shows the number of technologies selected for observation in the SITE program, in the VISITT database, and in both SITE and VISITT.

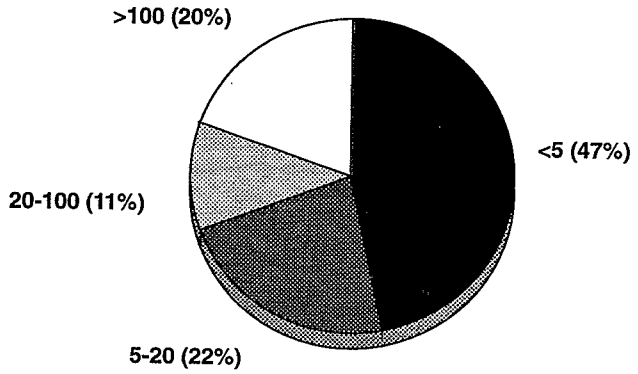
Table 1 Number of Technologies from VISITT and SITE Program

EPA Involvement	# of Technologies in 1992 (177 Total)	# of Technologies in 1993 (289 Total)
SITE Program	34 (19%)	60 (21%)
VISITT Database	107 (61%)	189 (65%)
SITE and VISITT	36 (20%)	40 (14%)

The following information was compiled from VISITT and SITE profile information for technologies:

- Company or organization name of the developer
- Number of technologies developed by the same developer
- Media treated (soil or ground water)
- Contaminants treated (organics, inorganics, or both)
- Developmental status (bench-, pilot-, or full-scale)

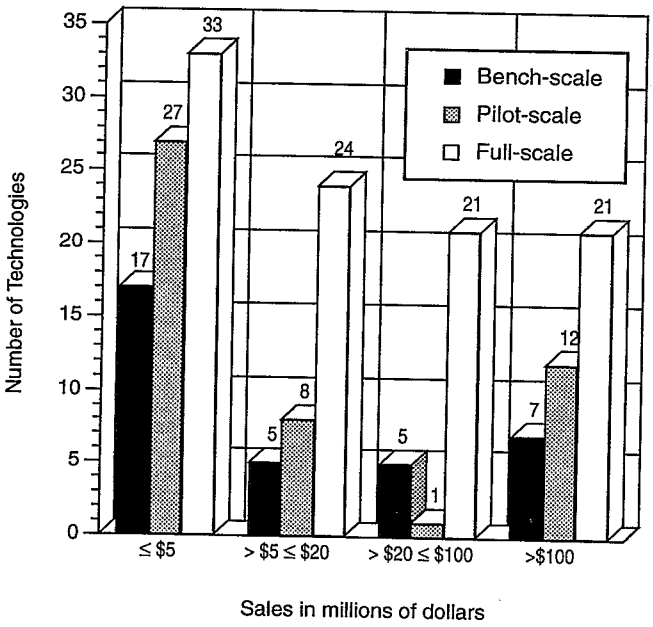
Figure 5
Vendor Sales Data for Innovative Technology Vendors (1993)*



***Based on available data for 107 companies. Sales are in millions of dollars.**

Figure 6 shows the development status of each technology application and the annual sales for the associated developer.

Figure 6
Vendor Sales



The data show that a high proportion of innovative remediation technologies are being developed by small businesses.

- half of the technologies are developed by companies with fewer than 50 employees
- three-quarters of the technologies are developed by companies with fewer than 500 employees
- half of the technologies are developed by companies with sales revenue of less than $5 million
- many of these full-scale technologies are from small companies

Summary and Conclusions

The inventory of technologies and vendors for this analysis comes from EPA's SITE program and the VISITT database, both of which are designed to assist the development of new hazardous waste remediation technologies. While participation in the SITE program is through an annual solicitation and review process, VISITT is available to all innovative technology developers. The combined inventory is believed to be representative of the technology supply. This is a new business sector which is still small in comparison to the potential future market of hundreds of billions of dollars.

A wide variety of technologies is included in the analysis. Approximately one third of the technologies treat soil or ground water in situ, and the same proportion offer some form of bioremediation. Innovative treatment technologies for soil are far more common than in situ ground water processes. This illustrates a particularly large opportunity for new technology development due to the pervasiveness of ground water problems and limitations of conventional pump-and-treat remedies.

The 1993 inventory shows approximately half of the technologies at full-scale. This is encouraging for perspective users. However, vendor data for employment and sales indicate most of the firms are small and experience a relatively modest volume of business. Most of the current technology development is occurring in the smallest firms with annual sales less than $5 million. The review shows most of the bench- and pilot-scale technologies are being developed by these small firms.

Footnotes

[1]U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Cleaning Up the Nation's Waste Sites: Markets and Technology Trends*. EPA 542-R-92-012, April 1993.

[2]U.S. Environmental Protection Agency, Office of Research and Development and Office of Solid Waste and Emergency Response. *The Superfund Innovative Technology Evaluation Program: Technology Profiles, Fifth Edition*. EPA/ 540/ R-92/ 077, November 1992.

Table 3 shows the number of technologies in each of the three developmental stages. In 1992, there was a relatively even distribution of these technologies throughout the developmental process. In 1993, there are proportionately more at full-scale.

Table 3 Technology Development Status

Technology Development Status	# of Technologies in 1992 (177 Total)	# of Technologies in 1993 (289 Total)
Bench-Scale	47 (27%)	49 (17%)
Pilot-Scale	68 (38%)	91 (36%)
Full-Scale	62 (35%)	149 (47%)

Most of the increase in full-scale units reported can be attributed to the addition of new technology vendors to the VISITT system. Of the VISITT technologies present in both 1992 and 1993, over 25% demonstrate progress towards commercialization by experiencing an advance in status to pilot- and full-scale.

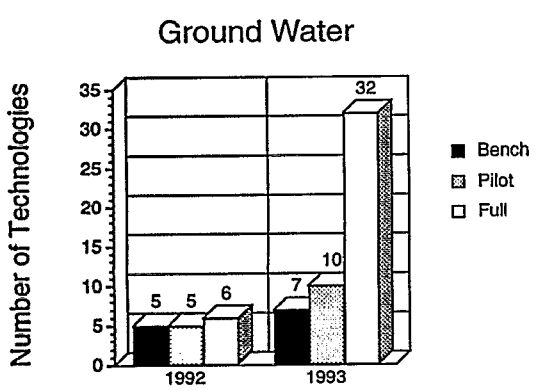
Table 4 provides a classification of technologies by media treated and Figure 3 shows the development status of technologies for ground water and soils.

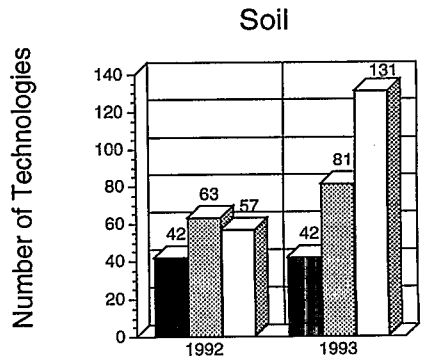
Table 4 Media Treated

Media	# of Technologies in 1992****	# of Technologies in 1993****
Ground Water—In Situ*	16 (9%)	49 (17%)
Air/ Off-Gas	NA***	29 (10%)
Soil**	162 (92%)	254 (88%)

*The Ground Water category in 1992 included in situ and ex situ. In 1993, the category is in situ only.
**Soil in this context also includes sediments, sludge, and solids.
***Off-gas technologies were not included in the 1992 survey.
****Totals are greater than the total number of technologies because some technologies treat more than one media.

Figure 3
Technology Development Status





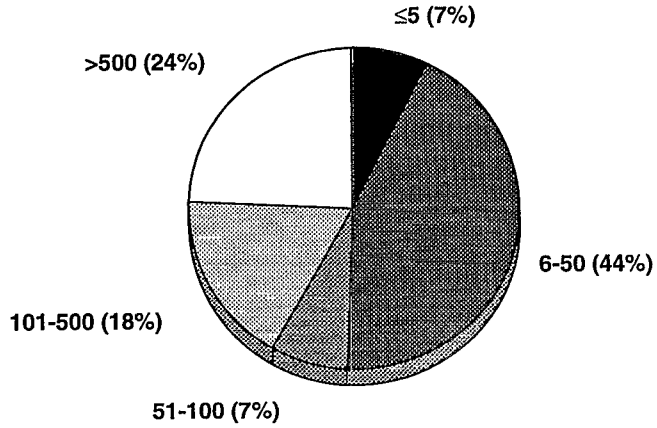
Developers of 31 technologies claim to treat ground water and soil. Soils in this context also include solids, debris, and sludge.

In addition to a relative increase in the inventory of in situ ground water technologies in the 1993 data, a substantially greater proportion of the ground water technologies in 1993 are available at full-scale than were available in 1992. Also, 31 of the technologies analyzed treat both ground water and soil according to their vendor claims.

Business Analysis

The 289 technologies in the 1993 inventory are being developed by 189 companies. Data are publicly available on employment and sales for approximately half of the companies. Figures 4 and 5 provide available employment and sales data for companies.

Figure 4
Vendor Size by Number of Employees for Innovative Technology Developers (1993)*



*Based on available data for 108 companies

In addition, the following business information was compiled for the companies or organizations that developed the technology:

- Sales
- Number of employees

The business data were gathered online from Dun and Bradstreet and the American Business Directory. When data from more than one source were found for the same company, the numbers were compared. In nearly all cases, the data were consistent. However, in the few cases where the numbers were not consistent, they were reconciled.

The data on company sales and number of employees are for the entire company, not for the portion of the company responsible for the innovative technology. Since many companies in the database have other lines of business in addition to innovative waste treatment technologies, company sales are often greater than innovative technology sales. Company sales are primarily an indication of company size, rather than a measure of activity in innovative technologies.

Business data were available for approximately half of the companies. The companies for which there were no business data are private companies and are believed to be primarily small companies.

Technology Analysis

Table 2 shows the distribution of technologies by type.

Table 2 Number of Technologies by Technology Type

Type of Technology	# of Technologies in 1992 (177 Total)	# of Technologies in 1993 (289 Total)
Soil Washing	27 (15%)	36 (12%)
Solvent Extraction	10 (6%)	14 (5%)
Thermal Desorption	21 (12%)	30 (10%)
Bioventing	NA	9 (3%)
Bioremediation—Ex Situ	32 (18%)	44 (15%)
Bioremediation—In Situ	23 (13%)	29 (10)
Vitrification—Ex Situ	14 (8%)	16 (6%)
Soil Vapor Extraction	13 (7%)	18 (6%)
Chemical Treatment	20 (11%)	25 (9%)
Ground Water—In Situ (Bio)	6** (4%)	16 (6%)
Ground Water—In Situ (Physical/Chemical)	6**	14 (5%)
Other—Ex Situ	2 (1%)	5 (2%)
Other—In Situ	9 (5%)	9 (3%)
Delivery/ Extraction Systems	NA	4 (1%)
Materials Handling	*	5 (2%)
Vapor Treatment/ Off-Gas Treatment	*	15 (5%)

*These technologies were not analyzed in 1992
**Ground Water—In Situ was a single category in 1992 with a total of 6

Figures 1 and 2 are meant to provide illustrative groupings of technologies. Figure 1 shows that nearly 1/3 of innovative technologies treat waste in situ, and Figure 2 shows that biological processes account for approximately 1/3 of technologies.

Figure 1
Overview of Innovative Technologies

Below-Ground (In Situ) Technologies (34%)
- Bioremediation—In Situ (10%)
- Soil Vapor Extraction (6%)
- Ground Water—In Situ, Biological (6%)
- Ground Water—In Situ, Physical/ Chemical (5%)
- Bioventing (3%)
- Other—In Situ (3%)
- Delivery/Extraction Systems (1%)

Above-Ground (Ex Situ) Technologies (66%)
- Bioremediation—*Ex Situ* (15%
- Soil Washing (12%)
- Thermal Desorption (10%)
- Chemical Treatment (9%)
- Vitrification—*Ex Situ* (6%)
- Solvent Extraction (5%)
- Vapor Treatment (5%)
- Materials Handling (2%)
- Other—Ex Situ (2%)

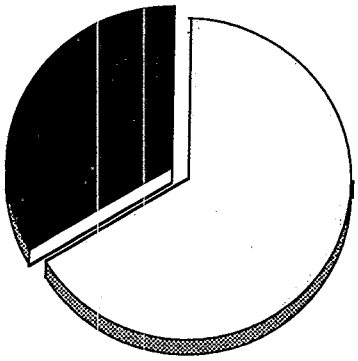
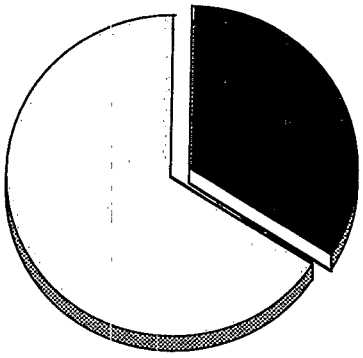


Figure 2
Overview of Bioremediation Technologies

Other Technologies (66%)
- Soil Washing (12%)
- Thermal Desorption (10%)
- Chemical Treatment (9%)
- Vitrification—Ex Situ (6%)
- Soil Vapor Extraction (6%)
- Ground Water—In Situ, Physical/Chemical (5%)
- Solvent Extraction (5%)
- Vapor Treatment (5%)
- Other—In Situ (3%)
- Materials Handling (2%)
- Other—Ex Situ (2%)
- Delivery/Extraction Systems (1%)

Biological Technologies (34%)
- Bioremediation—Ex Situ (15%)
- Bioremediation—In Situ (10%)
- Ground Water—In Situ, Biological (6%)
- Bioventing (3%)



Related Publications and Their Availability

Cleaning Up the Nation's Waste Sites: Markets and Trends. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 542-R-92-012, NTIS order number PB93-140762, April 1993.

Vendor Information System for Innovative Treatment Technologies. U.S. Environmental Protection Agency, Technology Innovation Office. VISITT Database Version 2.0, June 1993.

The Superfund Innovative Technology Evaluation Program: Technology Profiles, Sixth Edition. U.S. Environmental Protection Agency, Office of Research and Development. EPA/ 540/ R-93/ 526, November 1993.

Selected Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation (A Bibliography of EPA Information Resources), Fall Update. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA/ 542/ B-93/ 010, November 1993.

The above publications (other than the market study) can be ordered by fax or mail from:

National Center for Environmental Publications and Information (NCEPI)
11029 Kenwood Road
Cincinnati, OH 45242
513-891-6685 (fax)

When ordering, please cite the title and document or version number.

Notice

This material has been funded by the United States Environmental Protection Agency under contract number 68-WZ-0004. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

United States
Environmental Protection Agency
Office of Solid Waste and Emergency Response
Technology Innovation Office (5102W)
Washington, DC 20460

Official Business, Penalty for Private Use
$300

EPA 542-R-94-002