Perspectives on Private Investment in Innovative Remediation Technology Companies

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PERSPECTIVES ON PRIVATE INVESTMENT IN INNOVATIVE REMEDIATION TECHNOLOGY COMPANIES

I. Introduction

The purpose of this report is to develop a framework for the Environmental Capital Network (ECN) and for policy makers to significantly accelerate the successful commercialization of innovative clean-up, treatment and site characterization remediation technologies. More specifically, ECN has attempted to identify and understand the steps that can be taken to increase the quantity and speed of private equity investments in early stage companies developing and commercializing innovative remediation technologies.

The basic premise of this report is that the ability of small companies to successfully develop and commercialize innovative remediation technologies, is thwarted, to a large degree, by a severe lack of private equity capital. A small company's capital needs almost always substantially increase as the company moves a technology from research through demonstration, to first commercial success, and finally to full commercialization and profitability. There is, however, a dearth of needed seed and startup private capital available to remediation technology companies to carry them through these early stages of development, presenting the small company with a break-down in the supply of capital required to survive and prosper.

This early stage period in a company's development cycle has been termed the "Valley of Death". The valley of death is the gap that exists between the time when a company no longer has any personal resources to draw from to support their business and the point where professional sources of capital become a realistic option. The lack of capital within this gap presents a real challenge for companies in virtually every industry.

Most innovative technology companies attempt to raise startup capital from individual, professional and corporate investors. Interestingly, most have an extremely difficult time accessing these early stage funds. The startup stage is characterized as a high risk period in a company's development cycle. Most professional investors prefer to invest in a company's later (and hence lower risk) stage of development.

The problem of the "valley" is particularly daunting for remediation technology companies (RTCs), because of the near total *absence* of individual, professional and corporate investors willing to invest in companies commercializing technologies in the remediation marketplace.

The absence of willing investors greatly diminishes the opportunities for remediation companies to raise the capital they need to commercialize their innovative remediation technologies.

The trends within the capital marketplace are not encouraging. In 1993, five percent of US venture capital firms actively invested in the "environmental" field, at that time a sector consisting largely of remediation related companies[1]. Today, ECN estimates that fewer than 2% of venture capital firms actively consider RTCs[2]. ECN's review of the PricewaterhouseCoopers' MoneyTree Reports, which documents many of the venture capital investments made in 1998, yielded slightly more than $500,000 in venture capital investment in RTCs. While this statistic undoubtedly understates the actual level of investment activity, because it does not include individual investments, corporate investments, and many small venture capital firms, it is certainly indicative of an extremely low level of private investment today in RTCs.

A key premise of this research, therefore, is the critical need to understand more clearly what can be done by ECN and others to enhance the *willingness of private investors to place capital* in early stage remediation technology companies. We believe that the expansiveness of the valley of death can most effectively be made smaller by increasing the number of investors active in the remediation marketplace.

[1] "Bridging The Valley of Death: Financing Technology for a Sustainable." U.S. Small Business Administration. December 1994.

[2] ECN knows of approximately 10 venture capital firms that would consider seriously investing in RTCs. More than 800 venture capital firms are listed in the Pratt's Guide to Venture Capital.

II. Research Methodology

This report uses four market classifications. ECN considers the "remediation market" to be a market within the much broader "environmental industry." The remediation market itself is divided into several market "sectors," including the clean-up, treatment, and characterization sectors. These market sectors are divided into multiple market "segments", each defined by a different cluster of customer types. For purposes of this report, a "remediation technology company" is defined as a firm that is developing and/or commercializing a technology that will be used by customers in one or more remediation market segments.

The industry, market, market sectors and market segments considered in this report are listed below.

Table 1. Classifications of the Environmental Industry and Remediation Market

Industry	Market	Sectors	Segments
Environmental			
	Remediation		
		Clean-up	
			Military
			National Labs
			Superfund
			Non Superfund State/Local
			Corporate Property
			Brownfield Projects
			Spills, Emergency Response
		Treatment Market	
			On site Treatment by Industry
			Off site Treatment, Storage, & Disposal
			Waste Handling, Hauling
		Characterization Market	
			Site Assessment/Investigation
			Site Monitoring
			Analytical/Lab Services
			On site Industrial Monitoring

For our research ECN sought input directly from individual, professional and corporate investors who have invested or have seriously considered investing in RTCs. ECN utilized information from two complementary sources: (1) A survey of qualified investment professionals who are familiar with the remediation market, who have made investments in RTCs, and who serve as "gatekeepers" for other investors, and (2) Internal ECN historical information about how investors evaluated specific RTCs within the ECN network.

ECN prepared and distributed a survey entitled "Investor Interest in Hazardous Waste Remediation Companies" to individual, professional and corporate investors. The survey was designed to enable ECN to better understand why investors do invest in RTCs, why they hesitate, and how third parties might help them be more willing to invest in such companies.

A summary of the results of the survey are presented in tables provided in Attachment A. Where appropriate, the report's text includes references to tables in Attachment A which support the observations made in the report. A copy of the survey itself is included as Attachment B.

ECN collected completed surveys from a group of 15 investment professionals. More than 85% of those responding directly invest capital into early and expansion stage environmental technology companies. Nearly 45% have tracked the remediation market for 10+ years, while a total of 80% have tracked the market for at least 3 years (Tables A.1 and A.2).

It should be noted that these results should not be considered statistically significant, due to the non-random nature of the surveys' distribution, its small sample size, and the limited number of responses. Nonetheless, ECN feels that the results are indicative of the opinions of key people within the investment community who are familiar with this sector and whose actions and attitudes shape the opinion of others.

The investors indicated that they were, on average, "somewhat familiar" with all of the market segments considered, with 40% indicating that they were "familiar" or "very familiar" with the following market segments: Superfund; Non Superfund State/local Cleanup; Corporate Properties; Brownfield Projects; On site Industrial Waste Treatment; Off site Treatment, Disposal & Storage; Waste Handling & Hauling; Site Assessment & Investigation; and On site Industrial Waste Monitoring (Table A.3).

More than 80% of the investors that had seen 11 or more investment proposals from RTCs since 1995, had considered 3-5 of those proposals, and had invested in 1-2 RTCs. Over half of the investors had placed $2-5 million of capital in RTCs (Tables A.4 and A.5).

ECN also examined and summarized extensive detailed comments on RTCs that investors have provided ECN since 1997. These comments were drawn from investor reviews of business plans submitted to ECN by remediation technology companies that applied to ECN's Environmental Capital Forums and that have submitted their business plans for our Business Plan Review Service.

III. Research Findings

This section presents the key findings of this research effort, along with some analysis associated with the findings.

Finding #1: Investors' assessment of overall investment opportunities in the remediation industry is not optimistic.

Although a number of investors feel bullish or somewhat optimistic in their assessment of investment opportunities in the remediation market over the next 3-5 years, eighty percent of investors indicated that they were neutral, not optimistic or pessimistic regarding the market's clean-up and characterization sectors, and more than 60% felt the same way about the waste treatment sector (Table A-7). Not surprisingly, investors tend to invest in growing markets and industries that they feel positively about. This finding suggests that the challenge to bridge the valley of death, inherent within the remediation market, will be significant.

Finding #2: Investors see poor prospects for growth in the remediation market.

It is of primary importance to investors that the companies in which they invest grow in sales and profits. Investors are successful only when their interest in a company is sold to another party for a significantly higher price than it was purchased for. Future stock prices are, to a large part, driven by a company's growth in sales and profits. Without such growth, the investor stands to lose all or a major portion of his investment.

As a result, investors, particularly venture capitalists, are attracted primarily not only to companies that are growing, but to industries that are growing. As stated by Bob Zider in his article "How Venture Capital Works" in the Harvard Business Review,

> Venture capitalists must earn a consistently superior return on investment in inherently risky businesses. The myth is that they do so by investing in good ideas

and good plans. *In reality, they invest in good industries -- that is, industries that are more competitively forgiving than the market as a whole.* (Italics added)[3]

Given this perspective, it is instructive to note that approximately three quarters of the investors surveyed felt that the market growth prospects for ten of the market segments[4] were declining, stagnating or slowing. Roughly two thirds of the investors felt that the Non Superfund state/local, the corporate properties and the brownfield market segments were also declining, stagnating or slowing.

Investor perceptions appear to be well supported by historical evidence. The overall environmenta

l industry grew rapidly in the late 1970s and 1980s, driven in large measure by new environmental regulations. This expansion spanned numerous rapidly growing businesses, many of which received considerable investment capital. In the 1990's, however, the market began to steadily contract. The reasons for this are well known. They include a fundamental shift in U.S. environmental policy, a growing emphasis on economic instead of regulatory drivers to improve environmental practices, increasing emphasis on pollution prevention instead of pollution control, and a focus by manufacturers on cutting costs.[5]

As an example, revenues in the hazardous waste management and the remediation/industrial services industries actually declined from a total of $17.4 billion in 1990, to $17.1 billion in 1998. According to one measure, market share within the broader environmental industry declined from 11.6 percent to 8.9 percent over this same period.[6] Indeed, the market sizes of the hazardous waste treatment and characterization shrunk in absolute terms throughout most of the 1990's.[7]

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[3] Zider, Bob. "How Venture Capital Works." Harvard Business Review. November/December 1998. (www.hbsp.harvard.edu/products/hbr/novdec98/98611.html)

[4] The military, national lab, Superfund, spills & emergency response, off-site industrial waste treatment, waste hauling, site assessment, site monitoring, lab, and on-site industrial monitoring market segments.

[5] "Seismic Shift Shakes the Environmental Industry." Steve Maxwell. Massachusetts Environmental Ventures. Fall 1997.

[6] Unpublished analysis conducted by TetraTech EM Inc., 1999.

[7] The U.S. Environmental Industry Executive Summary. Office of Technology Policy, Department of Energy. October 1998.

Finding #3: **Investors are reluctant to invest in RTCs primarily because of concerns about the remediation market and the market's potential negative impact on the profitability of their RTC investments.**

The decline of market demand for remediation technologies combined with growing, and now excess, remediation capacity in the market has created a situation in which firms can grow significantly only through consolidation. As a result, the primary business strategy for growth in the remediation market has been and still is through consolidation, not technological innovation. The pace, scope and opportunity of consolidation in the industry is considerable.

The remediation market is dominated by highly fragmented end-users serviced by large, mature companies which have staked out market share in a stagnant market and are growing themselves primarily through consolidation. This reality can be seen in the market's clean-up sector for example. The world's four largest firms (Bechtel, ICF Kaiser, Fluour Daniel-GTI and OHM/IT) have combined worldwide sales of nearly $2 billion, according to Mary Anderson, a consultant with the McIlvaine Company. The worldwide market consists of more than 1,000 companies with annual remediation revenues of more than $1 million, and 14,000 companies worldwide have remediation clean-up revenues of more than $100,000.[8] Consolidation is likely to continue given the market's limited growth and highly fragmented nature.

Given this situation, RTC's (and their investors) have two options for growth: (1) Merge or license technologies to other RTCs or to larger companies in the industry which already have significant market share; or (2) Focus on relatively small niche markets where they can profitably sell their products and services.[9]

Not surprisingly, when asked to identify the primary reasons they hesitate to invest, nearly half of the reasons given were related to the ability of RTCs to *gain entry and grow in* the market place. Investors were most concerned about the potential of the RTC to penetrate the market, the high barriers of entry for a startup into the market, and concern for the overall lack of market growth (Table A-9).

Closely connected with concerns about the remediation market itself were concerns about the actual investment opportunity. Nearly 30% of the concerns cited revolved around RTC profitability and the ability to "cash out" of the investment either through an initial public offering (IPO) or acquisition. The concern investors have about the profitability of RTCs is well founded. According to recently conducted analysis, gross profit margins in the industry have

[8] Anderson, Mary. "Capturing the Remediation Market." Prepared for Brownfield News.
[9] Tetra Tech EM Inc., 1999.

declined steadily from 28.1% in 1988, to 18.3% in 1997. Net profit margins have declined from 10% in 1988, to 2% in 1997. This compares very poorly with many other industries where gross profit margins typically range from 40 to 60% and net profit margins range from 20 to 30 percent.[10]

This concern is also based, in part, upon particularly visible and unfortunate investor experiences with RTCs. In 1993, five RTCs (Catalytica, Energy BioSystems, Ensys, Purus, and Molten Metals Technology) went public only to see their stock prices plummet from their original IPO prices because their lengthy technology development processes caused their earnings to fall far below initial projections and analyst expectations. The experience of these companies remains with investors as roughly ten percent of the concerns cited were related to remediation technology itself, particularly the difficulty and costs associated with verifying technology performance, costs that directly reduce a firm's profitability.

Investors also indicated that their reluctance was heightened because of the market's reliance on government regulation, the lack of permit reciprocity and the lack of enforcement of existing standards. Furthermore, others have noted that the movement toward government policies that increase "flexibility" primarily through greater "cooperation" with regulated parties will often favor the use of containment and natural attenuation strategies instead of innovative technologies.[11]

In addition, concerns about market penetration and RTC profitability are reflected in the comments investors have made about RTCs which have applied to present at ECN's Environmental Capital Forums. The most frequently cited concerns revolved around a limited and/or very competitive market, followed by concerns about a weak management team. The order of this is interesting, as concerns about management are typically the most frequent concern, followed by concerns about the market place for technology companies in most other industries.

Finding #4: Investors see some promising drivers in the remediation market that could positively affect their consideration of investing in RTCs.

Investors felt that the three most promising drivers in the remediation market are: (1) The emergence of new niche market opportunities that have new potential for sales and profit; (2) The growing flexibility and acceptance of new technologies by the regulatory community; and

[10] Tetra Tech EM Inc. 1999.
[11] Tetra Tech EM Inc. 1999.

(3) The availability of new remediation technologies which are better, faster and cheaper. (Table A-10).

A significant number of the investors also felt that the growing brownfield market, increasing remediation expenditures by Fortune 1000 companies, as well as the growing international market for remediation services and increasing expenditures by government are helping to shape a more promising future for RTCs and are creating new market growth opportunities (Table A-6 and A-10). Investors also noted that the use of remediation related technology in non-remediation applications thereby creating new markets and lowering production economies of scale for the RTCs.

It is important to note that investors are encouraged by growing willingness of regulatory permit writers to accept the use of new technologies. Increasingly, this growing willingness to find innovative alternatives to slower and more costly traditional remediation technologies is creating access to market opportunities for innovative technologies that were previously not available. It is also noteworthy that when investors considered RTCs' strengths during our Forum application process and in our Business Plan Reviews, the most cited strength noted was the apparent market need for the technology, followed by notes of a good management team and of superior, proven technology.

Interestingly, several investors identified the growing availability of insurance policies to cover project and technology risk as a positive factor. While liability concerns are often a reason used to avoid innovative technologies,[12] these new insurance policies are also making it easier for larger firms to both use and transfer the use of innovative technologies.

The drivers mentioned above are perceived as affecting the remediation market over the next 3-5 years. In the long term, another driver may emerge as a crucial foundation to the eventual recovery of this market. The long term premium for clean water and clean land will increase as global population climbs past 6 billion and unspoiled water and land become scarcer. The impact of this driver is already being seen in Europe and Asia, where demand for remediation services and technologies is growing more rapidly than in the U.S.[13]

These promising drivers have some interesting implications for innovative technologies. The use of bioremediation and phytoremediation cleanup technologies, for example, is rapidly growing. According to the Site Remediation World Markets Report 1998-2000, published by the McIlvaine Company, worldwide demand for bioremediation and phytoremediation will grow

[12] Tetra Tech EM Inc.
[13] Anderson, op.cit.

from $870 million in 1997, to $1.1 billion in 2002. Much of this demand is overseas, where European demand for these technologies is stronger than US demand, and Asian expenditures are expected to grow from $200 million in 1997, to $300 million in 2002.

Finding #5: **Investors are more likely to invest in RTCs that focus on certain remediation market sectors, and to avoid others.**

While investors tend not to be optimistic about the market as a whole, many are looking closely at specific segments. Nearly 60% of the investors surveyed indicated a "high" or "very high" likeliness to invest in RTCs that target the on-site industrial waste treatment segment. Roughly 30% indicated a high or very high likeliness to target RTCs that target the site assessment and investigation, military cleanup, corporate property cleanup and brownfield property cleanup segments (A-6).

Brownfield property cleanup is one of the relatively "hot" sectors at the moment. Nearly 20% of investors felt that the brownfield market segment is experiencing "rapid" growth. Many brownfields are now being rehabilitated with creative equity and debt financing mechanisms. Brownfield redevelopment is increasingly approached as a real estate transaction where remediation technologies that are better, faster and cheaper can literally add to the bottom line. While still in its infancy, the potential scope of this market is considerable, as there are between 400,000 and 700,000 brownfield properties nationwide.[14]

In contrast, very few investors indicated a likeliness to invest in RTCs that target the analytical/laboratory, the national lab cleanup, the Superfund cleanup, or the on-site industrial waste monitoring segments.

Finding #6: **The most significant steps the government can take to enhance investor willingness to invest in RTCs are to: (1) Implement stronger policy and regulatory commitments to use innovative remediation technologies, and, (2) Aggressively consider new technologies in government clean-up contracts.**

The most commonly investor cited steps for the federal government to take are were to develop a stronger policy and regulatory *commitment* to use new technologies and to *aggressively* consider

[14] Anderson, op.cit.

new technologies in government cleanup contracts (see Table A-11). The investors surveyed clearly indicted that they want government to become a much more proactive "player" in the market place by backing its good intentions with stronger actions.

In support of this overall desire, investors felt additional steps should include facilitating the transfer of accepted new technologies among regulators; accelerating the use of performance based permits and contracts; facilitating and certifying technology verification; and more aggressively enforcing existing regulations.

The investment community generally perceives the government as part of the problem primarily because it sends mixed signals to the marketplace. For example, government regulatory "flexibility" in some cases allows responsible parties to "remediate" property through natural attenuation and avoid the need for innovative technologies, while in other cases "flexibility" enables regulators to accept the use of an innovative technology that they would otherwise not allow. Such contrary actions create confusion in the marketplace, confusion that enhances investor risk thus, keeping investors away. Investors will become more comfortable with RTCs as they more clearly understand where and how specific government policies and practices affect specific market segments.

When federal and state government send clear and consistent signals to the marketplace on *a segment-by-segment basis*, private capital has demonstrated its willingness to invest. An example is Brownfield Redevelopment where federal and state governments have developed new flexible and consistent policies and regulatory approaches to innovation solutions and provided public funds as a catalyst to facilitate cleanups and redevelopment.

Finding #7: **Investors indicated that the most useful information that ECN could provide them, to enhance their willingness to invest in RTCs, would be information focused on industry investment and merger/acquisition activity. For example success stories, and identification of promising investment opportunities.**

Investors generally value information that reduces their investment risk, i.e. information that increases the probabilities they are going to make the "right" decision. Accordingly, investors indicated that the most important information for them to be more active in this market is to know more about who is doing what and who is being successful. They also want to know of new promising RTC investment opportunities, case studies about past investments, and more

accessible and objective information about the performance and costs of technologies being developed and verified (see Table A-12).

Investment intelligence on RTCs and the remediation industry was once provided by Wall Street investment analysts. It chronicled a rapid rise of fortunes in the 1980s and an even more rapid decline of fortunes in the 1990's. RTCs and the remediation industry are not followed by investment analysts today to any significant degree, leaving potential investors with little guidance or sense of what broader investment activity is happening in the remediation market. In a situation where investors have many opportunities to fund innovative non-remediation technology companies, the lack of such information makes it more difficult for investors to feel comfortable with analyzing and placing capital in RTCs.

Investors also indicated an interest in marketing information related to future government activity and contracts, specific niche markets, and international market opportunities. Clearly there are growth opportunities for RTCs in the remediation market. Investors sense them. However, ECN suspects that investors will not be inclined to act until these opportunities are much more clearly presented in their terms.

IV. Summary and Conclusions

The "valley of death" faced by remediation technology companies is a manifestation of the absence of private investors willing to invest in small remediation technology companies. Private investors are absent because they see little opportunity to profit from their investment. This situation effectively stifles the ability of technology developers to successfully commercialize innovative remediation technologies.

Private investors have a less than positive view of investment opportunities in the remediation market. This view is primarily fed by concern about the ability for RTCs to successfully grow and become profitable in a market that has stagnated growth, shrinking profit margins, dominated by consolidation and which is very competitive.

While the overall remediation market exhibits little growth, niche market opportunities are developing which offer potential for sales and profit. These opportunities combined with better technologies, a more flexible regulatory environment and new market opportunities creates a basis for optimism that the valley of death, though still wide and deep, may be bridgeable.

Both the federal government and third parties like ECN can take steps that might increase their willingness to invest in remediation technology companies. Investors feel the federal government's actions should revolve around a stronger policy and regulatory commitment to use new remediation technologies. ECN feels it is very important that the federal government also focus on sending clear and consistent signals to the marketplace on *a segment-by-segment basis*. Investors will become more comfortable with RTCs as they more clearly understand where and how specific government policies and practices affect specific market segments.

Investors also felt that the most important information ECN or other third parties could provide is information about investment transactions and success stories in the remediation market. Investing in the remediation market is clearly a high risk proposition. Yet, ECN believes investors will be more comfortable with the risks when they have access to high quality information about:

- The "Hot" Remediation Market Segments - i.e. the market segments that are growing and where innovative RTCs have a solid opportunity to rapidly grow their revenues and profits. Investors invest in market niches that are growing. They need better information about the nature and dynamics fueling these niches, who to contact for more information, what reports and magazines to read, and other critical information.

- Key Trends, Drivers and Successful Business Models - to better understand the underlying reasons *why* an RTC may be successful, and *how* the RTC can achieve success. In addition, investors need more information to clearly understand where and how specific government policies and practices affect specific market segments. Investors need to understand the "fundamentals" why a company may grow, and the "business models" for how a company can grow.

- Profiles of Major Industry "Players" - to better understand who has market power in the industry, and who *controls* and *manages* the market and technology-adoption decisions that will directly impact an RTC's ability to grow. Investors need to know who the market, technology, and financial players are, what are their interests, what they look for in RTCs, and how they operate.

- Recent Private Investment Activity - who else is placing capital in RTCs, what kinds of capital they are placing, company valuations, who is buying RTCs, and which Wall Street firms are brokering private placement or merger/acquisition RTC deals. While some investors prefer to be on a the leading edge of an industry, most prefer to follow the lead of other investors.

- Case Studies of Successful RTCs - Investors want to know who has been successful and why. Investor sentiments about this industry are informed mostly by a number of notable RTC failures. Investors need to learn more about RTC successes.

Such information, which currently does not exist in a coherent fashion aimed specifically at investors, can provide investors with clues about what is happening in the market and how they might be more successful as investors.

After working with hundreds of investors for more than five years, ECN has observed that investor sentiments are a dynamic interplay between perception and reality. Based upon historical experiences, most investors do not believe they can make sound investments in RTCs, and the valley of death will persist as long as this is the case.

ECN has also observed, however, that investor perceptions can change as new information is presented. One critical pathway to changing perceptions is to fill some crucial investment-related information gaps: investors need current intelligence about investment activity in the remediation market, RTC success stories, high potential RTCs raising capital, and new emerging markets for RTCs.

The lack of capital available to remediation technology companies will be mitigated only as more private investors feel they can be successful in betting on innovative technology companies in the remediation market. While this research has underscored the challenge involved, it has hopefully also illuminated some real opportunities for ECN and others to take some very positive and effective steps to accelerate the bridging of the valley of death for RTCs.

ATTACHMENT A: SUMMARY OF FINDINGS OF SURVEY

The survey consisted of 13 questions divided into three sections. A summary of the results for each question is provided below. ECN's approach to this effort was to seek input directly from individual, professional and corporate investors who have invested or have seriously considered investing in RTCs. Accordingly, this survey was sent to investment professionals ECN felt are familiar with the remediation market, who have made investments in RTCs, and who serve as "gatekeepers" for other investors.

Surveys were sent to 31 investors and responses were received from 15 investors. It should be noted that these results should not be considered statistically significant, due to the non-random nature of the survey's distribution, its small sample size, and the limited number of responses. Nonetheless, ECN feels that the results are indicative of the opinions of key people within the investment community who are familiar with this sector and whose actions and attitudes shape the opinions of others.

I. INVESTOR BACKGROUNDS

Capitalization Role. The investors who responded to the survey were all professional investors who characterized their capitalization functions as:

Table A.1. Functions of Responding Investors

Capitalization Role	% of Responses
Capital Fund Managers	25%
Investment Bankers	21%
Financial Consultants	18%
Corporate Investors	11%
Individual Investors	11%
Project Financier	7%
Other	7%

Investor Experience. Nearly 90% of the investors had three or more years of experience tracking this industry; nearly 45% had tracked the industry for ten or more years.

Table A.2. Number of Years Responding Investor s Have Tracked the Remediation Market

Years Tracking Market	% of Investors
10+ Years	44%
6-10 Years	13%
3-5 Years	25%
1-2 Years	6%
0 Years	13%

Investor Familiarity with Remediation Market Sectors and Segments. The responding investors were, on average, "somewhat familiar" with all market segments. Investors indicated if their degree of familiarity on a 1-5 scale, ranging from "Not at all Familiar" (1) to "Somewhat Familiar" (3) to "Very Familiar" (5). Average ratings were is shown below, with market segments where at least 40% of responding investors were "Familiar" or "Very Familiar" highlighted.

Table A-3. Investor Level of Familiarity with Selected End Markets

Market Sector Market Segment	Average Rating	Segments Investors where 40%+ of investors indicated 4-5 rating
Cleanup Market		
Military	2.93	
National Labs	2.80	
Superfund	3.47	*
Non-Superfund State/Local	3.00	*
Corporate Property	3.23	*
Brownfield Projects	3.25	*
Spills, Emergency Response	2.89	
Treatment Market		
On-site Treatment by Industry	3.27	*
Off-site Treatment, Storage, Disposal	3.47	*
Waste Handling, Hauling	3.33	*
Characterization Market		
Site Assessment/Investigation	3.40	*
Site Monitoring	3.27	
Analytical/Lab Services	3.13	
On-site Industrial Monitoring	3.07	*

Investment Activity in Remediation Technology Companies. As shown below, more than 80% of the investors had seen 11 or more investment proposals from remediation technology companies since 1995, had seriously considered 3-5 investment proposals, and had invested in 1-2 of the companies they considered. Most investors who had invested had placed $2-5 million in capital.

Table A-4. Investors' Investment Activity in Remediation Technology Segment Since 1995 (Percent of Investors and Level of Activity)

	Number Since 1995					
	31+	11-30	6-10	3-5	1-2	Zero
Proposals Seen (% of Investors)	31%	38%	13%	6%	7%	6%
Proposals Considered (% of Investors)				60%	33%	7%
Investments Made (% of Investors					75%	25%

Table A-5 Amount of Capital Placed in RTCs by Investors Since 1995

	Capital Placed (millions)				
	$2-5	$1-2	$0.5-1	$0.25-0.5	<$0.25
Percent of Investors	55%	9%	18%	0%	18%

II. INVESTMENT OPPORTUNITY PERSPECTIVES

This section presents an overview of investor perspectives on the prospects for market growth, investment opportunities in the remediation market in three remediation market segments, the reasons they hesitate to invest, and the promising market trends that may positively affect their willingness to invest.

Market Growth Prospects. Generally speaking, investors were not optimistic about growth prospects in the remediation market.

Table A-6. Investor Characterization of Market Growth Prospects

	Percent of Investors Indicating Declining, Stagnant or Slow Growth	Percent of Investors Indicating Moderate Growth	Percent of Investors Indicating Rapid Growth
Cleanup Market			
Military	73%	18%	9%
National Labs	73%	27%	
Superfund	78%	9%	9%
Non-Superfund State/Local	64%	27%	9%
Corporate Property	60%	30%	10%
Brownfield Projects	64%	18%	18%
Spills, Emergency Response	100%		
Treatment Market			
On-site Treatment by Industry	46%	46%	8%
Off-site Treatment, Storage, Di	77%	23%	
Waste Handling, Hauling	75%	25%	
Characterization Market			
Site Assessment/Investigation	100%		
Site Monitoring	83%	17%	
Analytical/Lab Services	92%	8%	
On-site Industrial Monitoring	75%	17%	8%

Assessment of Investment Opportunities in Cleanup, Treatment and Characterization Remediation Market Segments in Next 3-5 Years. Investors characterized their assessment of investment opportunities in the three remediation sectors as follows.

Table A-7. Investor Overall Assessment of Investment Opportunities in the Clean-up, Treatment, and Characterization Segments in the next 3-5 Years

Assessment	Clean-up	Treatment	Characterization
Bullish/Somewhat Optimistic	19%	38%	20%
Neutral	44%	31%	47%
Not Optimistic/Pessimistic	37%	31%	33%
	100%	100%	100%

Interestingly, the greatest overall level of optimism is for the treatment sector, a sector that is and has been in a major consolidation phase. This consolidation has benefited many investors in remediation technology companies that target this sector.

Market Segments Where Investors are More and Less Likely to Invest in RTCs in Next 3 Years. Investors indicated that they were more likely and less likely to invest in the RTCs that targeted the following market segments:

Table A-8. Likeliness in Next 3 Years of Investing in RTCs that Target Different Segments

Market Segments	% of Investors Indicating High or Very High
More Likely Market Segments	
On-site Industrial Hazardous Waste Treatment	57%
Site Assessment/Investigation	33%
Military Clean-up	31%
Corporate Property Clean-up	30%
Brownfield Property Redevelopment	30%
Less Likely Market Segments	
Analytical/Laboratory Services	0%
National Lab Clean-up	16%
Superfund Clean-up	16%
On-site Industrial Monitoring	17%

Primary Reasons Investors Hesitate to Invest in Remediation Technology Companies. Investors expressed a range of *primary* reasons they were hesitant to invest in remediation technology companies.

Table A-9. Reasons Why Investors Hesitate to Invest in Remediation Technology Companies

Reason/Concern	Frequency Cited
Potential for Market Penetration	12%
Lack of Overall Market Growth	9%
Potential for Investor Profits and ROI	9%
Poor Industry Track Record on Wall Street	9%
Difficulty & Cost to Verify Technology	8%
Market Reliance on Government Regulation	7%
High Barriers of Entry for Startup into the Marketplace	7%
Lack of Enforcement of Existing Regulations	5%
Lack of Investment "Exits" for Investors	5%
Lack of Permit Reciprocity Among Regulators	4%
Markets are Driven More by Regulations Than Economics	3%
Higher Investor ROI Potential in Other Industries	3%
Potential Liability Exposure for Investors	3%
Lack of New, Proprietary, Cost Effective Technology	2%

Promising Remediation Market Drivers Identified by Investors. The investors surveyed identified several drivers in today's remediation market that could positively affect their consideration of remediation technology investment opportunities.

Table A-10. Promising Remediation Market Drivers Cited by Investors

Description of Drivers	Frequency Cited
Niche Market Opportunities with Potential for Sales, Profits & ROI	19%
Growing Regulatory Flexibility Towards and Acceptance of New Technologies	18%
Better, Faster, Cheaper Technologies	15%
Growing Brownfield Re-development Market Opportunities	11%
Growing Expenditures by Fortune 1000 Companies	7%
Availability of Insurance Policies to Protect Investors	7%
Technology Applications in Non-Remediation Markets	6%
Growing International Market	6%
Growing Expenditures by Government	4%

III. ACCELERATING NEW INVESTMENTS IN THE INDUSTRY

In the survey, ECN asked investors to suggest actions that the federal government and third parties such as ECN might take that could enhance their willingness to commit capital to remediation technology companies.

Most Significant Steps by the Federal Government. The actions most frequently cited by investors that the Federal Government could take revolved primarily around developing and implementing a stronger policy and regulatory commitment to use new remediation technologies.

Table A-11. Most Significant Steps by Federal Government To Increase Investor Willingness to Commit Capital

Step	Frequency Cited
Develop a Stronger Policy and Regulatory Commitment to Use New Technologies	21%
Aggressively Consider New Technologies in Government Cleanup Contracts	17%
Provide Additional Funding to Support Technology Commercialization	10%
Facilitate Transfer of Accepted New Technologies Among Regulators	10%
Accelerate Use of Performance-Based Regulatory Permits and Contracts	10%
Enforce Existing Regulations More Aggressively	8%
Facilitate and Certify Verification of Remediation Technologies	8%
Establish Better Regulatory Consistency and Cooperation Across Jurisdictions	6%
Provide Additional Funding for Technology R&D	4%
Strengthen Company Business and Marketing Skills	2%
Provide Investors with Market & Technology Information	2%

Most Important Types of Information that ECN or Another Third Party Can Provide. Investors responding to the survey also identified information that ECN or another third party could provide that might enhance their willingness to commit more capital to remediation technology companies. The respondents indicated that most of the important information they would find most important focuses on industry investment and merger/acquisition activity, success stories and other case studies, and promising investment opportunities.

Table A-12. Importance of Different Types of Information To Increase Investor Willingness to Commit Capital

Information Type	Frequency Cited
Data About Industry Investment and M&A Activity	15%
Technology Company "Success Stories"	13%
Identification of High-Potential Investment Opportunities	11%
Case Studies (Good and Bad) About Private Investments Made	11%
More Accessible Information about Technologies Being Developed and Verified	11%
Objective Technology Performance & Cost Data	11%
Future Government Cleanup Activity & Contracts	9%
Information on Specific Niche Markets	9%
Information on International Market Opportunities	7%

ATTACHMENT B: SURVEY

Environmental Capital Network

A program of the Center for Environmental Policy, Economics, and Science

Return Fax Directions. Please Return by September 15, 1999.

To: **Loch McCabe, ECN @ 734-996-8732**

From: _____

INVESTOR INTEREST IN HAZARDOUS WASTE REMEDIATION TECHNOLOGY COMPANIES

Dear Investor:

ECN seeks to learn more about investor interest in hazardous waste remediation technology companies. To this end, ECN is conducting a limited query of selected investors who have placed or considered placing capital in companies commercializing innovative remediation technologies, specifically technologies that clean-up, treat and/or characterize hazardous wastes.

This query is important, as it will enhance ECN's ability to effectively provide guidance to remediation technology companies and to government programs that affect the investment potential of such firms.

Please take 10-15 minutes to complete the following query and fax or mail your response to ECN by September 15, 1999.

You may contact me at mccabe@recycle.com or 734-996-8387 with any questions. For completing this query, we will provide you with a copy of the findings.

We appreciate your input. Thank you for your time and attention.

Sincerely Yours,

Loch McCabe

I. Investor Background:

I.a What type of "investor" are you? (Please check all that apply)

__ Individual Investor
__ Venture Capital Fund
__ Corporate Investor
__ Lender
__ Project Financier
__ Investment Banker
__ Financial Consultant
__ Other _____

I.b For how many years have you tracked the remediation industry? (Please check one)

__ Zero __ 1-2 __ 3-5 __ 6-10 __ 10+ years

416 Longshore Drive • Ann Arbor, MI 48105 • Tel. 734.996.8387 • Fax. 734.996.8732
ecn@BizServe.com • http://BizServe.com/ecn

I.c How would you characterize your familiarity with the following hazardous waste clean-up, treatment, and characterization market segments within the remediation industry? (Please check one)

	Not at all Familiar		Somewhat Familiar		Very Familiar
Clean-up Market					
Military (US Dept. of Defense)	1	2	3	4	5
National Labs (US Dept. of Energy)	1	2	3	4	5
Superfund (EPA, PRP, States)	1	2	3	4	5
Non-Superfund State/Local Cleanup Projects	1	2	3	4	5
Corporate Property Clean-up Projects (incl. USTs*)	1	2	3	4	5
Brownfield Real Estate Development Projects	1	2	3	4	5
Accidental Spills, Emergency Response	1	2	3	4	5
Other _____	1	2	3	4	5
Treatment Market					
On-site Treatment by Industrial Manufacturers	1	2	3	4	5
Off-site Waste Treatment, Storage & Disposal	1	2	3	4	5
Waste Handling, Hauling and Related Services	1	2	3	4	5
Other _____	1	2	3	4	5
Characterization Market					
Site Assessment/Investigation Services	1	2	3	4	5
Site Monitoring Services	1	2	3	4	5
Analytical/Laboratories Services	1	2	3	4	5
On-site Industrial Process Waste Monitoring	1	2	3	4	5
Other _____	1	2	3	4	5

* Underground storage tanks

I.d How many investment proposals from remediation technology companies have you seen, seriously considered, and made since 1995? (Please check one per question)

Investment Proposals Seen?	Investment Proposals Seriously Considered?	Investments Made?
__ 31 + companies	__ 11 + companies	__ 11+ companies
__ 11- 30	__ 6-10	__ 6-10
__ 6-10	__ 3-5	__ 3-5
__ 1-5	__ 1-2	__ 1-2
__ Zero	__ Zero	__ Zero

I.e What is the approximate total amount of investment? (Please check one)

__ Less than $250,000
__ $250,000 up to $500,000
__ $500,000 up to $1 million
__ $1 up to $2 million
__ $2 up to $5 million
__ $5 up to $10 million
__ $10 up to $50 million
__ $50 million or more

I.f Please rate the importance of the types of informational sources you use to track the marketplace, industry changes, technology changes, and other influences that could affect your investment decisions? (Please circle your response, or leave blank)

	Not Important		Important		Critical
Personal Resources					
Personal and Professional Contacts	1	2	3	4	5
Personal Experience and Research	1	2	3	4	5
Industry Resources					
Industry Associations	1	2	3	4	5
Industry Publications	1	2	3	4	5
Industry Websites	1	2	3	4	5
Government Resources					
Government Publications	1	2	3	4	5
Government Meetings	1	2	3	4	5
Government Websites	1	2	3	4	5
Other _____	1	2	3	4	5
Other _____	1	2	3	4	5

II. Investor Perspectives

II.a What are the primary reasons you hesitate to invest in environmental remediation technology companies? (Please check up to 5 reasons. Additional reasons are welcomed.)

Technology & Regulatory Concerns
__ Difficulty and high cost associated with verifying technologies
__ Lack of enforcement of existing regulations
__ Lack of permit reciprocity across state and agency jurisdictions
__ Lack of performance-based regulatory standards
__ Other _____

Market Concerns
__ Lack of overall market growth
__ Manufacturers' focus on process control remedies to reduce hazardous waste
__ Questions about a company's potential for market penetration and ability to achieve significant size in a market that is mature and dominated by large firms
__ Discomfort with the degree of government involvement in marketplace
__ Discomfort with a reliance on government regulations that do not provide sufficient demand for ew remediation-related technologies and services
__ Other _____

Investment Concerns
__ Concerns about new firm's potential for profitability and return on investment
__ Liability concerns with owning a remediation technology company
__ Poor industry track record on Wall Street and few recent "winners" in the industry
__ Lack of an exit strategy for remediation technology companies into the IPO market
__ Higher likelihood of financial success in other industries such as IT and telecom
__ Other _____

II.b What are the most promising drivers in the remediation marketplace and industry that positively affect your consideration of future funding proposals? (Please check up to five. Additional trends are welcomed.)

Technology Advancements
__ Many new technologies are better, faster, and cheaper
__ Many new technologies have applications in non-remediation markets
__ Government and other third party technology verification efforts
__ Other _____

Market Growth Potential
__ Niche market opportunities with potential for strong sales, profits and ROI
__ Growing expenditures by federal, state, and local government
__ Growing expenditures by Fortune 1000 for remediation services
__ Growing expenditures by small and mid-sized manufacturers
__ Growing demand overseas for remediation services
__ Growing brownfield redevelopment activity by private property developers
__ Introduction of insurance carriers to protect investors in brownfield projects
__ Other _____

Regulatory Changes
__ Regulatory framework is becoming more flexible regarding new technologies
__ Increased receptivity to new technologies by regulators
__ Increased willingness of regulators for permit reciprocity
__ Increased government spending and contracting flexibility
__ Other _____

II.c Please rate your general willingness to consider investing in remediation technology companies that are targeting the following end-markets over the next 3 years? (Please circle your response)

	Very Low				Very High
Clean-up Market					
Military (US Dept. of Defense)	1	2	3	4	5
National Labs (US Dept. of Energy)	1	2	3	4	5
Superfund (EPA, PRP, States)	1	2	3	4	5
Non-Superfund State/Local Cleanup Projects	1	2	3	4	5
Corporate Property Clean-up Projects (incl. USTs*)	1	2	3	4	5
Brownfield Real Estate Development Projects	1	2	3	4	5
Accidental Spills, Emergency Response	1	2	3	4	5
Other _____	1	2	3	4	5
Treatment Market					
On-site Treatment by Industrial Manufacturers	1	2	3	4	5
Off-site Waste Treatment, Storage & Disposal	1	2	3	4	5
Waste Handling, Hauling and Related Services	1	2	3	4	5
Other _____	1	2	3	4	5
Characterization Market					
Site Assessment/Investigation Services	1	2	3	4	5
Site Monitoring Services	1	2	3	4	5
Analytical/Laboratories Services	1	2	3	4	5
On-site Industrial Process Waste Monitoring	1	2	3	4	5
Other _____	1	2	3	4	5

* Underground storage tanks

II.d How would you characterize your overall assessment of investment opportunities in the environmental remediation, treatment and characterization industry segments in the next 3-5 years? (Please check one)

Clean-up	Treatment	Characterization
__ Bullish	__ Bullish	__ Bullish
__ Somewhat Optimistic	__ Somewhat Optimistic	__ Somewhat Optimistic
__ Neutral	__ Neutral	__ Neutral
__ Not Optimistic	__ Not Optimistic	__ Not Optimistic
__ Pessimistic	__ Pessimistic	__ Pessimistic

__ Not Sure __ Not Sure __ Not Sure

III. Accelerating New Investments in the Industry

III.a How would you characterize the growth prospects for the following market segments? (Please circle your response, or leave blank)

	Declining	No Growth	Slow Growth	Moderate Growth	Rapid Growth
Clean-up Market					
Military (US Dept. of Defense)	1	2	3	4	5
National Labs (US Dept. of Energy)	1	2	3	4	5
Superfund (EPA, PRP, States)	1	2	3	4	5
Non-Superfund State/Local Cleanup Projects	1	2	3	4	5
Corporate Property Clean-up Projects (incl. USTs)	1	2	3	4	5
Brownfield Real Estate Development Projects	1	2	3	4	5
Accidental Spills, Emergency Response	1	2	3	4	5
Other _____	1	2	3	4	5
Treatment Market					
On-site Treatment by Industrial Manufacturers	1	2	3	4	5
Off-site Waste Treatment, Storage & Disposal	1	2	3	4	5
Waste Handling, Hauling and Related Services	1	2	3	4	5
Other _____	1	2	3	4	5
Characterization Market					
Site Assessment/Investigation Services	1	2	3	4	5
Site Monitoring Services	1	2	3	4	5
Analytical/Laboratories Services	1	2	3	4	5
On-site Industrial Process Waste Monitoring	1	2	3	4	5
Other _____	1	2	3	4	5

III.b What are the three most significant steps that the Federal Government could take to improve the willingness of investors to commit capital to environmental remediation technology companies? (Please check your three most significant responses).

Resources and Programs
__ Aggressively consider new technologies in government clean-up contracts
__ Provide more funding to support more remediation technology R&D
__ Provide more funding to support technology commercialization
__ Facilitate verification of new remediation technologies
__ Work to strengthen the business and marketing skills of young technology firms
__ Provide more relevant information about remediation markets and technologies
__ Other _____

Regulatory Reform
__ Develop a serious policy and regulatory commitment to utilizing new technologies
__ Establish regulatory consistency and cooperation across jurisdiction
__ Conduct more aggressive enforcement of existing regulations
__ Accelerate the use of performance-based regulatory permits and contracting
__ Facilitate transfer of acceptances of new technologies by different regulators
__ Other _____

__ Other _____

__ Other _____

III.c What are the three most important types of information that ECN or another third party can provide you or the industry to enhance your willingness to commit more capital to environmental remediation and characterization technology companies? (Please check the four most important)

Technology Information
__ More accessible information about technologies being developed and verified
__ Objective technology performance and cost data
__ Guidelines to technology uses for specific types of applications
__ Other _____

Market Information
__ Better information about future government clean-up activity and contracts
__ Better information about specific remediation niche markets corporate remediation
__ Better information about international marketing opportunities
__ Other _____

Investment Information
__ Remediation and characterization technology company "Success Stories"
__ Data about investments, mergers and acquisitions of companies
__ Better information about private and public financial transactions in industry
__ Identifying investment opportunities with high-growth potential
__ Case studies (good and bad) about investments in these companies
__ Other _____

THANK YOU!