Encouraging Environmental Technologies: Three States' Initiatives
to Foster the Use of Innovative Solutions to Environmental Problems

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ABSTRACT

States around the country are initiating programs to help businesses commercialize environmental technologies, and to encourage their use. The emergence of state efforts to spur commercialization and use of environmental products, goods and services is rooted in several areas: 1) innovative technologies can help solve environmental problems while reducing costs, 2) in helping with the commercialization and export of technologies, states can spur a growing industry; and 3) states want to stay ahead of and possibly shape federal environmental regulations. Many programs attempt to address problems that exist with our regulatory system such as redundancy in permitting, regulatory confusion and which work against the introduction of new technologies. This thesis presents a comparative analysis of three states’ programs to encourage the introduction of innovative technologies. The thesis focuses specifically on efforts to introducing flexibility into the regulatory systems in those states.

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Introduction

Complex and overlapping state regulations governing the use of environmental technologies are often cited as being significant impediments to the introduction of innovative environmental technologies. Many states around the country are attempting to address regulatory problems and have created a diverse array of programs to encourage innovative technologies.¹ This thesis compares and analyzes the ways that regulatory design and implementation are being changed in California, Massachusetts, and Texas to address these problems. This comparative analysis of the strengths and weaknesses of three states’ efforts form the basis of the policy recommendations outlined in Chapter Six.

The array of mechanisms being examined in this thesis to encourage the introduction of innovative technologies accomplish the following objectives: 1) simplify the introduction of new technologies by creating a mechanism such as verification; 2) create regulatory flexibility. These programs accomplish this by establishing permit pathway clarification, educating regulators about new technologies, and increasing communication between regulators; 3) shift the decision as to which technology to use in pollution prevention and control to the private sector. This is called adopting performance based standards. These varied approaches mentioned above will be discussed in Chapters Two through Five, and are outlined below.

Chapter Two describes what is meant by the term “environmental technology,” and what the problems associated with technology commercialization are. The chapter also outlines why state governments are interested in encouraging innovative technologies.

Chapter Three is a case study of California’s technology certification program and of one of its regulatory streamlining efforts. California’s certification program provides

¹ Gary Broetzman, “An Analysis of State Activities for Approving and Encouraging Innovative Environmental Technologies,” Colorado Center for Environmental Management. The study estimated that at least 25 states have environmental technology programs.
technology developers with verification of product claims. The program is making it easier for regulators to permit new technologies and for the private sector to use those technologies. While the program has been extremely successful in increasing revenues for certified companies, the program has the potential to “lock in” technologies. Chapter Three will discuss the strengths and shortcomings of this program. The other California program being examined in this chapter is a regulatory reform effort called “tiered permitting.” Tiered permitting establishes five levels of permits for hazardous waste technologies, greatly simplifying the permitting process for new technologies. Tiered permitting is working in pilot projects with the certification program to speed implementation of certified technologies.

Chapter Four examines two Massachusetts programs: technology verification and regulatory reform. The verification program is helping companies establish performance histories and improve product sales. The regulatory programs called the Environmental Results Program and the new 21E\(^2\) law are using performance based standards to increase the number of innovative technologies that are introduced for use in the state. The program has increased the implementation of new technologies in over 75 cases. While introducing performance based standards has been shown to encourage the use of innovative technologies, there are difficulties associated with such programs.

The success of performance based standards depends largely on the type of industry and process being considered, the political will to shift to performance based standards, and the ability to design standards in a way that requires improvements in efficiency. All of these issues must be considered in each case of performance based standard implementation. It is beyond the scope of this thesis to provide a complete accounting of when such standards can be used legally and effectively. This would involve a thorough review of the legal framework which exists dictating the use of such standards. Rather, it is the goal of this thesis to look at two very specific applications of performance based standards as an illustration of how this process can work for the introduction of new technologies. One of the main criticisms of performance based standards is that the flexibility they offer is often not taken advantage of by regulators. In

\(^2\) Massachusetts General Law c. 21E.
this thesis I examine efforts to introduce flexibility into the regulatory system which will help improve introduction of new technologies under both performance-based and technology-based systems.

Chapter Five details the Texas Natural Resources Commission Innovative Technology Program. This program is designating technologies as "innovative" and is providing companies with expedited permitting and permit clarification. The TNRCC is also helping technology companies establish performance histories by conducting demonstrations through the state's superfund program. The program is successfully integrating the technology verification and regulatory re-design programs within the same agency and can provide a model for other states.

All of the chapters examine the three states' participation in a multi-state effort called the Interstate Technology Regulatory Working Group (ITRC). The ITRC is working to encourage the transfer of technologies among the 29 member states. The ITRC is developing a technology transfer mechanism whereby the states come to agreement on how to share information and test technologies.

From the comparison of the three states' programs mentioned above, the thesis concludes that:

1) Implementing performance based standards can encourage the use of innovative technologies and should be expanded with careful review of each case.

2) Each state environmental agency needs to establish a group or person that acts as an ombudsman for innovative technologies.

3) Each state environmental agency needs to determine a mechanism to "accept" environmental technologies, whether it be verification by a certain body or another means.

4) Interstate cooperation and communication on the transfer of technologies should be expanded to include all states.

Methodology

California, Massachusetts, and Texas were chosen for examination in this thesis because they represent different regions of the country and because they are considered to have some the most developed programs underway for encouraging innovative
There are approximately 130 companies that have been helped through the various state verification programs examined in this thesis. I conducted interviews with 19 of them. Additionally, I interviewed 10 companies that had participated in regulatory streamlining efforts (a few companies had participated in both aspects of a state’s program). The conclusions in this thesis are based largely on these interviews with companies that have participated in the California, Massachusetts, and Texas technology programs. The businesses interviewed were not chosen by random sample, but rather by availability. Though this approach is not scientific, the anecdotes collected are still valuable and can provide the basis for comparison of the impact of the three state programs on sales for the participating companies. The criteria for analysis is increases in sales, increases in the market area for companies, and a general satisfaction with the program as expressed by company personnel.

In addition to interviews with participating businesses, interviews were conducted with 20 regulators in the three states and a few representatives from private industry. The interviews with private businesses focused on whether or not the state programs have made it easier for private companies to be permitted to use innovative technologies, choose technologies, and/or reduce paperwork associated with introducing the technologies. The interviews with state environmental agency personnel focused on how state programs have helped regulators permit new technologies and accept information from other states' environmental agencies. Interviews were conducted with regulators who ran state programs and/or who were coordinators for interstate cooperative efforts.

Detailed bodies of literature are available on the three states’ initiatives through web sites, publications, and agency memos that were made available to me. A large body of information is available on the inter-state cooperative effort called the Interstate Technology Regulatory Cooperation Work Group (ITRC). These publications reveal the types of impediments that exist in the transfer of information between state environmental agencies. ITRC publications also detail the group’s efforts and approach to creating protocols for technology testing and transfer to member states.

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Regulation has traditionally driven the environmental industry. As such, environmental technologies have been defined in the past as those technologies that industry uses to comply with legal requirements. The technologies that fall into this category include treatment devices, proper disposal techniques, site characterization and remediation methods, and monitoring technologies. The Environmental Business Journal defines the industry as being composed of hazardous waste management, remediation services, consulting, water equipment, information systems, air pollution equipment, waste management, water utilities, resource recovery, environmental energy, analytical services, and water treatment (Figure 1 provides a breakdown of the revenues from U.S. environmental companies for the year 1994). Until recently these products were “single medium” and comprised technologies dealing with end-of-pipe pollution such as air pollution control devices. Examples are scrubbers and catalytic converters.

In recent years laws have been passed which emphasize pollution prevention measures. This shift in emphasis away from pollution already generated and toward reduction in the generation of pollution has spurred the development and growth of the pollution prevention industry. This new part of the industry focuses on redesigning industrial processes and on multi-media applications. Pollution prevention technologies are strategies, systems, and techniques designed to increase the material or energy efficiency of the production process, and to prevent the generation of waste. Substitution of chemicals, low input processes and cleaner and more efficient energy supplies and fuels can all be deemed pollution prevention technologies.

Innovative environmental technologies are new technologies that have not yet been used in any application for any of the above purposes but which have the potential to improve environmental quality. Innovative technologies can also be new applications of a technology that has been used in another area previously but which does not have an established performance history for the new application. Lastly, an innovative technology
Figure 1

Billions of Dollars

Total $170.5 Billion Spent in 1994
Source: Environmental Business International Inc. (San Diego)
can be the use of a new combination of established technologies that have not previously been combined.

The businesses that comprise the environmental industry vary in size and provide a diverse array of products and services. In California, a total of 12,824 companies which produce or provide environmental products and services exist. They range from huge multi-national corporations such as Hewlett Packard (total revenues of $25 billion) and which produces environmental instrumentation products to small start up companies with one product and revenues of $5.5 million (See Attachment 1 for a summary of California’s environmental industry overview). Similarly, in Massachusetts and Texas the environmental industries comprise small and large companies, some dedicating all resources to environmental products and some dedicating only a small portion of resources into environmental products and services (see Attachment 2 for a list of all states environmental industries).

The total revenues in the United States were estimated to be $170 billion for the above listed categories of services (see Figure 1). In the thesis, the term environmental technologies is defined by some states to include technologies for all media and is defined more narrowly by other states. In Massachusetts the innovative technology program considers all technologies including hazardous waste remediation, waste water treatment, pollution control equipment, pollution prevention equipment and processes, environmental instrumentation, and recycling technologies. In California, innovative technologies currently being considered are for hazardous wastes, air pollution control equipment, and pesticide reduction. Texas, like Massachusetts, considers technologies for all media in their innovative program. The states being considered in this thesis have taken a special interest in environmental technologies. They have been singled out as having some of the more developed programs in the country. The following sections discuss why the states are interested in fostering their environmental industries.

I. State Interest in Fostering Innovative Technologies

The desire on the part of state governments to encourage the use of innovative technologies can be attributed to three factors: 1) A desire to improve environmental
quality, 2) a desire to stay ahead of, and in some cases shape, federal regulations; and 3) a desire to foster an industry that provides strong revenues and good jobs, i.e. jobs that are a mix of professional, skilled, and semi-skilled labor.  

A. Improving Environmental Quality

All three states looked at in this thesis have histories of placing an emphasis on environmental quality. They have gone beyond what is mandated by the federal government and have passed strict environmental laws and/or have encouraged the use of innovative technologies. California’s environmental stewardship began in 1947 with the passage of the first air pollution legislation in the nation, the Stewart Act. This pioneering law established California as a leader in environmental regulation and led the way for federal air pollution control efforts. California also acted early to encourage innovative solutions to environmental problems. One example of this is the state program to encourage independent “green” producers of electricity through tax credits which began in 1979. Massachusetts has also acted aggressively to protect and improve environmental quality. For instance, in 1989 the State passed the Toxics Use Reduction Act which mandates reductions in hazardous waste each year from Massachusetts industry. This was the first law of its kind in the country. Texas also has been fighting pollution and encouraging green technologies. For example, in 1992 the Texas legislature passed Assembly bills which mandate the conversion of all public fleets of over 50 vehicles to 90% natural gas by the year 1999.

B. New Technologies Can Make Compliance With Increasingly Stringent Regulations Easier

Despite these efforts, serious pollution problems persist in these states and throughout the country. Thus, we can expect that, in the future, complying with existing regulations and staying ahead of new regulations will place increasing demands upon businesses and governments in the states examined in this thesis. It is clear that

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regulations will continue to become stricter. Two examples illustrate this. The first is the EPA’s recent proposal to regulate pollution from non-road sources such as boats and lawnmowers for the first time, and the second is EPA’s proposal to tighten the ozone and particulate (PM) standards. These new regulations will demand more of companies in terms of pollution control and pollution reduction.

Even maintaining current standards will require more from industry in the coming years. The trend of increasing automobile use illustrates this point. Vehicle miles traveled in Southern California are projected to grow from 290 million to almost 400 million per year in 2010, an increase of 33%. Because of this, emissions from existing vehicles will have to become cleaner to maintain air quality. Using innovative applications of energy sources (such as electric and natural gas) in cars and trucks may be necessary to prevent air quality from deteriorating from its current level.

C. Fostering A Growing Industry

In California, the environmental industry employs 160,071 people, and in Texas it employs 98,711 people. In Massachusetts 60,000 people are employed in environmental companies. Revenues in the three states are also significant from the environmental industry. In Texas, environmental revenues were $13 billion dollars in 1994, the second highest in the nation. California’s industry generated the most income in the nation with $21 billion in revenues. Massachusetts’ companies earned $6 billion, equivalent to the environmental industry in Germany. State tax revenues from these companies are substantial.

The industry is growing faster than other sectors of the economy and in the process is producing relatively more jobs. Growth over the last year averaged 6%, much higher than other industries. In the area of pollution prevention and process technology.

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6 The figures in this section are taken from the Environmental Business Journal.
job growth in the last few years has been more than two times the average for the U.S. over the past few decades (11%).

The states are eager to foster their environmental industries to continue the trend in strong job growth and to help position local companies to capitalize on the estimated $180 billion U.S. market for environmental technologies. While the above figures show the expansion of the domestic environmental industry, the overseas market is also growing rapidly. As areas such as Southeast Asia develop economically, a new market for environmental technologies is emerging. As an illustration the Asia Pacific market for pollution prevention technologies is growing at a rate of 7% annually. The following graph illustrates projected growth in foreign investment in environmental products.

Growth in U.S. vs. Global Environmental Markets

![Growth in U.S. vs. Global Environmental Markets](image)

Figure 2 Source: Environmental Business Journal

The reason state governments want to foster environmental technologies is clear: to improve the environment, to take advantage of a huge market, and to help make compliance with regulations easier. As mentioned in the previous chapter, regulatory confusion and overlap are often cited as the main causes for difficulty in commercializing innovative technologies. The following sections discuss these problems that the states looked at in this thesis are attempting to remedy.

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9 Environmental Business Journal, May, 1996
II. Regulatory Design

Even in comparison with other highly regulated products, environmental technologies face formidable and restrictive regulatory barriers. To illustrate the magnitude of the problem, we can compare an environmental technology with a prescription drug. Both pose risks, both are highly regulated. However, a prescription drug, once it has been approved by the FDA, can be sold nationwide. An environmental technology, in order to be sold nationwide, must receive permits in at least 50 different states, and possibly in many more permitting districts. This is only one example of how the use of environmental technologies is restricted by fragmented permitting areas.

Aside from the many permitting areas that exist, overlap and fragmentation in the administration of permits exist in government. Sometimes several different departments within an agency may have the power to permit the same technology. This structure creates a situation where “inspectors to the same plant do not talk to one another, make conflicting demands and waste time and resources.” Additionally, the structure of permits is extremely restrictive and is designed to be that way to protect environmental quality. However, this often works against the introduction of new technologies. Other forms of regulatory barriers exist in the mandating of technologies by federal and state environmental agencies. Mandating the use of particular technologies by state DEPs creates barriers to entry for new technologies. Another formidable barrier exists in the fact that established permit pathways exist for technologies or types of facilities. Innovative technologies demand new pathways, and these often involve negotiating the different laws which regulate environmentally harmful substances. The inability or unwillingness to create new permit pathways is often the cause of delays or failure to introduce many new technologies.

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11 MACT (Maximum Achievable Control Technology), BACT (Best Available Control Technology), RACT (Reasonably Available Control Technology), BAT (Best Available Technology), LAER (Lowest Achievable Emission Rate Technology)
III. Regulatory Implementation

The unwillingness to create new permit pathways create formidable barriers to the introduction of new technologies. While permit writers can choose which technologies will be used (depending on the statutory requirements) to keep permitted facilities in compliance with environmental laws, in practice few innovative technologies are introduced. There are several reasons for this. For one, it is in the permit writer’s interest to use a technology that is tried and true, because this minimizes the possibility of failure. Overcoming this resistance to writing permits which use new technologies is of key importance to the introduction of innovative environmental products.

The structure of environmental agencies also contributes to a lack of flexibility in regulatory implementation. Our environmental laws have in some cases exacerbate this problem. Typically, for instance, the RCRA, CERCLA, and LUST\textsuperscript{12} programs are administered by separate divisions within a state environmental agency. Each of these programs has separate authority related to acceptance and use of technologies. Generally, the program coordinators do not communicate with one another and act somewhat autonomously even though they are organized within the same department. Acceptance of a technology by one of the programs does not mean that the other will accept it – which in some cases is necessary for use in a particular location or facility.

Changing the way that regulators think about environmental technologies, and how they might be used under existing laws are essential aspects in fostering the environmental industry. Increasing communication between regulators, environmental product developers, and state and federal agencies are important ways that the state programs examined in this paper attempt to deal with the above problems. Lastly, writing permits which use new technologies entail learning about those technologies. Until recently there were no established mechanisms for regulators to learn about new technologies, with the exception of one or two clearinghouses which list new technologies\textsuperscript{13}. The drawback of using these clearinghouses is that few states contribute

\textsuperscript{12} Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation, and Liability Act, or “Superfund”

\textsuperscript{13} “BACT/LAER Clearinghouse”
information to the services, and secondly regulators cannot always base decisions on the limited information made available through these information sources.

IV. Communication Between State Environmental Agencies

The above described communication problems within state environmental agency programs limit the use environmental technologies within states. A larger problem, the balkanization of states one from another, causes difficulties in exporting technologies across state lines and across permitting areas. This segmentation and lack of communication between regulators aggravates a problem that innovative technology vendors have: establishing performance histories for their technologies. A vendor can do one of two things to create a data set in support of a permit application: 1) establish a data set for the technology through trial use in the field; or 2) write an article for publication in a hazardous waste management journal (for example) that would be peer reviewed. These two processes, although effective, are both time consuming and do not always get to the right audience. Often regulators and clients have piles of journal articles and data sets in their offices, and no time to read them. One environmental technology salesman, Dwight Denham, stated in an interview that “as it is now, environmental companies can’t count on state DEPs to convey success stories or data or information.” Because there is little communication between state environmental agencies product performance information is not passed between states. This means that environmental technology companies must demonstrate their products in each state in order to convince regulators of their product claims.

Two aspects of the communication problem between state agencies need to be addressed. First, state agencies need to agree upon what constitutes an acceptable field demonstration of a technology so that several states can use data from one demonstration. As described above, field demonstrations in every state are required to support permit applications for new technologies. Second, the state environmental agencies need to

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14 Kleinfelder chemist Stacey Wissler, subcontractor for Bechtel and many regulators stated this
15 Dwight Denham is currently a regional salesman for Strategic Diagnostics, and has started 3 environmental technology companies, and 16 regional offices in his career.
establish better lines of communication about innovative technologies. Reaching agreements between states on what information site demonstrations should produce (in terms of specific types of data) is being worked on by the ITRC. This group is working to gain consensus on the procedures for testing technologies and on new approaches to regulation to introduce those technologies. Their efforts will be described throughout the thesis.
Chapter Three

Verification of Technologies and Regulatory Reform in California

In 1992, California EPA\textsuperscript{16} began a program to encourage environmental technologies called the California Environmental Technology Partnership (CETP). To date the CETP plan has initiated 145 projects to help recognize, assist, and promote companies that research, develop, and market environmental technologies, goods, and services domestically and abroad. The CETP program addresses all aspects of commercialization of new technologies including financing, export to foreign countries, research and development, verification of product claims, and increasing market areas for new technologies through inter-state cooperative efforts. This chapter examines how three components of the CETP program work to encourage the use of innovative hazardous waste assessment, cleanup, and pollution reduction technologies. First, it will discuss the California certification program. The certification program oversees the verification of environmental product claims through laboratory\textsuperscript{17} analysis or by corroborating information available from previous users of the technology. While certification is intended to increase use of innovative technologies in industry and for hazardous waste ("superfund") site cleanups, some contend that in the long run this state effort will itself become a barrier to entry for new technologies. Critics of the program

\textsuperscript{16} California EPA or Cal/EPA is the state environmental agency charged with permitting and enforcement of the state's environmental laws. The agency comprises seven divisions that regulate air, drinking water, solid waste, hazardous waste, pesticides.

\textsuperscript{17} Occasionally claims are verified in Cal/EPA laboratories but more often in industry labs or at research facilities such as the one operated by South West Research Institute.
say that certification may effectively become a new type of technology designation such as “BAT”\(^{18}\) and may also encourage end-of-pipe solutions over pollution prevention technologies. While potential problems do exist in the administration of the certification program, the benefits achieved to date strongly suggest that the program should be expanded. The first section of this chapter will examine the benefits accrued to certified companies in the form of increased sales and expanded markets.

The second part of the chapter discusses the interstate cooperation effort that California is participating in called the Interstate Technology and Regulatory Cooperation WorkGroup (ITRC). As described in Chapter Two, the work of the ITRC is to come to agreement between state environmental agencies on how testing of innovative technologies will be conducted and on what types of information will be traded between states on innovative technologies. This group expands the market for California certified products and reduces the amount of testing that must be conducted in order for technologies to be used in the 29 member states. This section of the chapter shows how the California certification is being used by the ITRC as a template for technology sharing between states and how California is fostering its environmental businesses by participating in the group.

The third part of the chapter will discuss one aspect of regulatory reform called the tiered permitting system and specifically how it works with the certification program. The tiered permitting system establishes five different types of permits for hazardous wastes which vary in cost and in complexity depending on the hazardous waste in question. Technologies which are certified will be eligible for the lower cost and least administratively complex permits. This program is the only California regulatory reform effort that works directly with innovative technologies to foster their use. While the technology aspect of the tiered permitting system has not been approved for widespread implementation, a temporary program involving health care facilities is being conducted and this program forms the basis of this part of the chapter.

\(^{18}\) Some environmental laws require technology designations for whole industrial sectors. While these do have sunset provisions, they do not allow for frequent review and introduction of new technologies.
The last section of the chapter will address the problems that critics contend will undermine the certification program, and will suggest ways to solve some of the drawbacks of the current certification process. The chapter will conclude by making recommendations as how to expand the certification and tiered program models for use in other states.

As described in Chapter One, the states are attempting many different strategies to increase the applications for and the use of innovative technologies. The California efforts accomplish this by proving to regulators and private companies that certified technologies work. This increases the number of technologies that the state agency will consider for use in permitted facilities. It also increases the number of innovative technologies that are used by private businesses. The program does not change the way that site cleanups are administered by the agency (by shifting to a private system for example). Nor does it establish a performance based system for site cleanups, but rather allows for more types of technologies to be introduced through coordination with a modified permitting system.

I. The Certification Program

The certification program creates a new class of environmental technologies – those that have been proven by the state to reduce hazardous waste or process those wastes in an innovative manner. Like the Massachusetts verification initiative being conducted by the University of Massachusetts and Texas’ innovative technology designation, the California program provides a mechanism to prove to regulators of the value of a given technology and helps them permit or introduce that technology. Like Massachusetts’ verification, the California certification focuses on proving product claims. This approach does not train permit writers to take advantage of the flexibility inherent in the permitting system as a way of increasing the use of new technologies. In this sense, the California program increases the use of new technologies, but only for those which are certified. It does not increase the flexibility in the way the agency handles innovative technologies.
The specific goal of certification, to prove product claims, was articulated by James Strock, Secretary of Cal/EPA. In an interview James Strock described that the idea came about during a financing working group for innovative technologies run by the agency. Financiers felt that addressing the problem of unverified product claims would be the most important issue in any program to encourage new technologies. Certification, they felt, would solve the credibility problem environmental technologies face by providing a stamp of approval for new products. In doing this the department hoped to make the use of environmental technologies easier for the private sector and to make them more acceptable to regulators and inspectors, both in California and in other states.

The certification process involves several steps (see Figure 3). The basic steps are first, an applicant’s eligibility is determined. Second, data is submitted in support of the technology. This data could be lab analyses or performance information obtained during product use or in lab tests as part of a company marketing effort. Other acceptable data might be a list of companies that have used the technology and that are willing to vouch for the product. Third, confirmation of data is conducted either by interviewing companies that have used the product or by reproducing laboratory results in various public and/or private facilities. Lastly, the company receives a certification statement.

The program is run almost exclusively by Cal/EPA engineers. There are ten people, nine engineers and one chemist within the TSCD who handle the certification program. Initial screening, contract negotiations, and the actual certification are carried out by those ten people. Occasionally, a person from the permit program, a permit writer for instance, will be asked to review a certification application to determine whether the technology is eligible for regulatory certification (meaning the technology will work with the tiered permitting program to be discussed later in the chapter). Other than this infrequent discussion of new technologies, permit writers are not exposed to innovative technologies, except after they have been certified. After certification, surveillance personnel such as inspectors are informed of certifications so that they will be familiar with them as they do their job. The structure of the program thus limits exposure of TSCD permit writers and regulators to the process of certification and innovative technology assessment since they are removed from the certification process.
Figure 1: The California Toxic Substances Control Division Certification Process
The Office of Pollution Prevention and Technology coordinates the certification efforts of the seven Boards which comprise the Cal/EPA. Each one of the Boards controls permitting and enforcement of different types of wastes and resources. Under the CETP program each Board will initiate a certification program for technologies to be used in its area of its authority. This chapter will focus on the Toxic Substances Control Division program which is furthest along in conducting certifications. The Toxic Substances Control Division (TSCD) certification program was established to certify: hazardous waste management, site mitigation, waste minimization, and pollution prevention technologies. These technologies consist of less-polluting raw materials, processes and products; recycling; analysis, monitoring and process control; treatment; and site characterization and remediation technologies. The only technology that the Toxic Substances Control Division will not consider is incineration technology. To date 48 hazardous waste related technologies have been certified (see Attachment 3 for a complete list of companies certified).

While the focus of the certification program has not been to train permit writers to think of ways to permit new technologies under existing laws, it has been extremely effective in encouraging the use of a few new technologies that have been certified. The certification is highly effective for the following reasons: 1) certified technologies have experienced an increase in sales in California and in other states which is attributed to the certification; 2) through reciprocity agreements being worked out between California and foreign nations certified technologies may be more easily exported for use in other countries; 3) certified technologies will be eligible for the lowest cost and least administratively complex permits in California which is increasing their market potential.

Of the 48 companies that have been certified by TSCD, interviews were conducted with eight company sales representatives and executives. Detailed descriptions of the companies and their products are given in Attachment 3. Those companies were:

20 Assembly Bill 2060 (Stats. 1993, c. 412, Weggeland)
21 Public concern about the health effects of incinerator ash resulted in this policy.
1) Strategic Diagnostics, manufacturer of a 4 immunassay products for testing for contaminants in soils.
2) TriOx, manufacturer of an ozone treatment system to reduce contaminants in tower water.
3) EnSys, Inc. manufacturer of five technologies which test soils for contaminants.
4) T.F. Purifiner, Inc. - Manufacturer of an oil filtration system
5) BioNebraska - produces a test kit using immunoassay for soil testing.
6) Asahi America, Inc., manufacturer of piping components.
7) Ohmicron, manufacturer of five technologies to test for soil and water contaminants.
8) Trend Scientific, manufacturer of a batch treatment process to reduce formaldehyde waste.

Of those eight, seven reported increased sales due to the Cal/EPA certification. Only one company, BioNebraska, said that sales for their product had not increased after certification. BioNebraska representatives said that the market was poor for their product generally. Aside from anecdotal information gathered in interviews, information on public company sales is available on the Internet. Several companies experienced growth much higher than the average of 5.6% nationwide for the environmental industry. For example, Asahi’s sales went from $28 million in 1995 to $37 million in 1996, an increase of 25%. Employment at Asahi in the same period went from 95 to 111, up 15%.

Responses in interviews ranged from those who attributed a small percentage in growth in sales to certification to others who attributed all recent growth in sales to the certification. T.F. Purifiner President Richard Ford has credited the certification with increasing sales at his company by 600% (Purifiner only sells one product). Generally, a correlation between increased revenues after certification and the certification itself was confirmed in interviews with sales, financial, and management personnel at the companies that have been certified.

One of the most important ways that certification helps companies increase their sales is by proving product claims, as it was created to do. One of the reasons it is effective is that Cal/EPA is respected by the environmental community, regulators, and clients for technologies. First, the agency has great resources: There are 7,000 Cal/EPA employees, extensive labs and connections to the university system in California.

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22 Tax forms and general company information available from the Securities and Exchange Commission web site “Edgar.”
Second, California environmental laws are among the strictest in the country and thus a technology certified by the state agency benefits from the positive perception people have of the state’s rigorous standards. Following is anecdotal evidence on how certification has helped companies sell their products.

T.F. Purifiner sells an oil filtration system which reduces the need to change oil in heavy duty engines. The potential market for the Purifiner filter includes all engines in trucks and buses and all equipment that uses hydraulic oil. Before certification Purifiner had difficulty selling its product. This was true for both public and private sector clients. The Department of Defense was reluctant to use the system, as were other potential clients, because they assumed it was similar to another oil purifying system that did not work. After certification, Purifiner was able to obtain government contracts, and has established its product as original equipment in Ford engines. Additionally, Navistar is now displaying for sale the Purifiner system in all of its heavy duty truck showrooms. In interviews with other companies that had received certifications, 6 of 7 said that proving product claims was key to increasing sales on their products. They all contended that the certification accomplished this for them.

While Purifiner provided an example of how certification proves product claims to purchasers of technologies such as private engine manufacturers and the U.S. government, proving claims to regulators and inspectors is equally important. For example, a Product Specialist at Asahi America, Inc. stated that the California certification has allowed his company to make sales because inspectors trust that certified products will perform well. Inspectors often make key decisions as to how projects will be carried out and as to which products are used. Certification is an important sales and marketing tool for this reason. Asahi manufactures a double-containment pipe which effectively prevents leaks of hazardous wastes and protects public health. Asahi’s market for the pipe comprise businesses handling or producing hazardous wastes, such as chemical companies. Ollis said that when Intel was recently installing piping in one of their facilities, the local county inspector did not protest to using the Asahi pipe because of the Cal/EPA certification. Certification is especially helpful in the area of plumbing supplies because California has one of the strictest plumbing codes in the nation.
Therefore inspectors in many states will accept the Cal/EPA certification because they know that California has strict codes.

Four other companies expressed the same sentiment: Trend Scientific, Strategic Diagnostics, EnSys, and Ohmicron. Dwight Denham salesman for Strategic Diagnostics, EnSys, and Ohmicron described that the U.S. EPA certification that preceded the Cal/EPA certification (and that are now reciprocal) originally caused EnSys to be ahead of its competitors. Ohmicron and Strategic acknowledged that they were losing jobs to EnSys because the certification was helping EnSys make sales. The others then went ahead and had their products certified. The line of products is used to test superfund sites for gasoline and diesel fuel. EnSys’ clients are environmental consulting companies conducting site cleanups such as Bechtel and Flour Daniel. This opinion expressed by the three companies’ sales representative was confirmed in an interview with one of Bechtel’s subcontractors, Kleinfelder.

The benefits of certification for technology purchasers is that the Cal/EPA certification reduces duplicative and costly studies and redundant reviews required by different regulatory jurisdictions. A Kleinfelder project chemist explained how this has worked for Kleinfelder. Kleinfelder worked recently on a U.S. Navy site cleanup project called “The Clean Team.” Project Chemist, Stacey Wissler was responsible for choosing the technology that would be used for the project. The site to be remediated contained oil and gasoline among other pollutants. It was Wissler’s job to choose which technology to use in cleaning up the site, and in assessing the extent and location of contaminants. Using new technologies, and evaluating them carefully before they are used is a large component of her job since the technologies can offer cost effective solutions to environmental cleanups, and because clients often specifically ask that innovative technologies be used. Typically, in order to choose which technology to use on a site cleanup a chemist must read all the journal articles and available data on new technologies (to see if the technology can be used in the specific application). Reading all of the literature on technologies and contacting colleagues about potential products can be a great amount of work. Cal/EPA essentially does this work for clients of environmental technologies by consolidating all of the bits of information available and
providing one respected recommendation on a product. Wissler said that the California certification helped distinguish the EnSys technology from the many others that she reads about.

While the certified environmental companies that were interviewed said that certification improves sales in California, they also said it did so in other states as well. This distinguishes the California certification from the Massachusetts and Texas verification programs examined in this thesis. California’s is the only program that has significant impact beyond the certifying state - it is recognized in many states. For example, Asahi America is located in Massachusetts and decided to become California EPA certified because the certification is known of and accepted in Massachusetts. Only four of twenty two technologies certified in the first two years of the program were produced from companies located in California. The other 18 technologies that became California certified are produced by companies located in Massachusetts, Pennsylvania, Delaware, and other states, and those companies conduct most of their business in states other than California. No companies interviewed in Texas and Massachusetts said that the verification programs in those states had helped them sell products out of state (without the assistance of the Memorandum of Understanding and ITRC cooperative efforts).

While technologies certified by the California program are experiencing sales outside of the state, California is also participating in interstate cooperation groups to increase the market area for innovative technologies further. The next section describes these efforts.

II. Transfer of Technologies Between States: the Six State MOU and the ITRC

Chapter Two discussed some of the problems associated with using technologies across large regional areas. The largest problem is the requirement that technology companies provide technical data to each state environmental agency in support of a permit application. While data collected in other states is of interest, it has historically not been accepted as evidence that the technology will work by state environmental
agencies. This is because of two things. For one, environmental conditions vary state to state. For example, any technology which impacts ground water must be tested in all permitting areas because soil conditions differ regionally (and thus affects how a technology will perform). Microbes in soils and in water differ regionally also, and so the impacts of a technology cannot be predicted unless regulators actually see how the product performs in conditions similar to that which exists in their state. Another reason that exchange of data is not reciprocal among states is a general lack of communication between state environmental agencies. Each state often works entirely independently of adjacent state environmental agencies in such matters as permitting. The process of transferring information between states is complicated and has never worked in the past. A lack of cooperation in the areas of exchange of methods, procedures, and recommendations has been the norm.

California is participating in two groups which are working on increasing the flexibility in permitting requirements and communication between states to address the above problems. The two groups are: 1) the Memorandum of Understanding between six states, and 2) the 29 state group called the Interstate Technology and Regulatory Cooperation Working Group (ITRC). The state’s participation in the two groups provides an outlet for California certified technologies. Certified technologies are given direct exposure to regulators who are in charge of permitting in over 30 states.

A. Six State Memorandum of Understanding

The Memorandum of Understanding outlines a reciprocity agreement between six states California, New Jersey, Massachusetts, Illinois, New York, and Pennsylvania to foster cooperative testing, technical transfer, and approval of environmental technologies. The agreement is called the “Six State MOU”. It has as its goal the creation of permit reciprocity for technologies evaluated in the signatory states. The principal of the memorandum is that regulators will meet, discuss, and come to agreement on what data will be considered acceptable and what reciprocity of data means, i.e. what the parameters of reciprocity are. In participating in efforts such as these, the states are beginning to establish protocols as how to trade information.
As part of the MOU, California is submitting the names of two technology companies that will be considered by the group as having potential for use in all of the six states. Detailed data on the company products will be examined as part of the MOU agreement, and if accepted by the other states will broaden the market areas for those products considerably. While the technologies will still have to be permitted in all of the states it sells in, the technology company will not have to perform tests for the individual environmental agencies to prove that the product can work in the state. The MOU allows data taken from one state to be used in another state in support of a technology.

B. The Interstate Technology and Regulatory Cooperation Working Group (ITRC)

Like the Six State MOU, the ITRC is working to reduce the number of approvals and reviews that technology developers must obtain in order to sell their products across state lines. The Western Governors Association, California, and Texas were instrumental in forming the Interstate Technology and Regulatory Cooperation Working Group to develop standardization for environmental technology regulation. Twenty nine states participate in the ITRC whose mission is to facilitate cooperation among the states when dealing with the implementation of innovative technologies. The DOE supports the ITRC by providing funding, specialized laboratories, technical expertise, and other resources. The total cost of cleanup of waste sites nationally has been projected to be hundreds of billions of dollars. Regulators believe that new technologies can significantly lower these costs while at the same time achieving excellent environmental results. The goal of the ITRC is to speed cleanup and lower the costs of cleanup by encouraging the use of new technologies. They intend to accomplish this by educating states as how to overcome their regulatory barriers. The ITRC work which is geared toward hazardous waste site cleanup has dovetailed well with California’s Toxic Substances Control Division certification program, which deals exclusively with hazardous wastes. The certification program has provided a potential model for the

23 The ITRC grew out of project that was begun when the U.S. Department of Energy, six western states, and California participated in the “Demonstration On-Site Innovative Technology” initiative. The project sought better technologies to cleanup federal facilities, especially military installations.

24 Interstate Technology and Regulatory Cooperation Work Group “Case Studies of Regulatory Acceptance In Situ Bioremediation Technologies” p.1
testing of innovative hazardous waste related technologies. In turn, the testing procedures have been reviewed by ITRC member states and some agreement has been reached as to what form testing should take. The next section discusses how this communication on testing protocols has worked in the ITRC.

The first ITRC project was to form four Technology Specific Task Groups. These projects provide examples of the types of technologies the group is working to get interstate agreement on. The groups focused on in situ bioremediation, low temperature thermal desorption, plasma technologies, and a new screening characterization technology. The groups developed regulatory protocols for evaluating these technologies, and in the process were charged with determining what they found to be the best mechanism for interstate cooperation on technology transfer.

An example of how the California certification can be used in conjunction with the ITRC can be seen in the demonstration of a U.S. Navy developed technology to assess the amount and location of oil and gas on contaminated sites. The technology is called “site characterization” or SCAPS-LIF. Without this technology, soil samples must be taken at various locations on a site, brought back to a lab, tested, and then the process is begun again several times until an understanding of where contamination exists is gained. It is a long, iterative, and costly process. With the new technology a laser beam measures contaminants and an analysis is produced almost instantly. Soil samples still need to be taken, but many fewer.

Significant barriers exist to the widespread use of SCAPS. The first is that soil conditions vary state to state. The second is the reluctance of environmental agency workers to accept a technology without actually having seen it being demonstrated. The third is that multiple laws govern the regulation for site characterization procedures. For example, CERCLA, RCRA, and LUST are administered by separate departments which often do not communicate, yet each department has statutory control over site characterization procedures.

In September of 1995, the ITRC arranged for 2 site demonstrations of the technology. Representatives from Utah, Idaho, California, Nebraska, Texas, New Mexico, Louisiana, and New Jersey attended the demonstrations. All members were
given information that the Navy had provided to California as part of its certification application. After review, the state representatives were allowed to comment and make suggestions as to how the testing should be done as part of the California Certification. In addition members received a detailed description from the technology developer in face to face meetings. In this way scientists and engineers could answer questions and address concerns of the state regulators.

After the tests had been conducted, the members were asked to evaluate the technology demonstration and the usefulness of the California certification in allowing their state to accept a technology, among other factors. As a result of the process all seven states have accepted the technology fully or partially. Without the ITRC and the Cal/EPA certification program, the technology company (in cooperation with the developer, the U.S. Navy) would have had to demonstrate the technology in each of the seven states. The vendor may even have had to demonstrate in several locations in some states. The cost of doing such demonstrations is prohibitive.

The ITRC work is helping states agree on how testing of technologies should be conducted so that all the necessary information is gathered in site tests. Another goal of the ITRC is disseminating information on proven technologies. Expanding that effort to provide information to the private sector could be one of the groups most important functions. Stacey Wissler, the Project Chemist at Kleinfelder gave an example of how a central source for information could help Kleinfelder, and also technology vendors. In a recent site cleanup she wanted to use an immunoassay process, but could not get agreement from the state, nor could she find enough information on the technology. However, the Army Corps of Engineers had conducted extensive tests and demonstrations on the technology and had amassed a significant body of data on its success. She only found out about this data long after the time that she needed it. Had this data been available through a central system, Kleinfelder could have used the technology. Dwight Denham of Strategic Diagnostics echoed this sentiment. He contends that unless environmental companies disseminate information about products directly to state agencies they often do not hear about those products. He contends that state agencies do not convey success stories, data, or information to each other. A central
source of information could solve this problem. The ITRC has the potential to be the provider of such a central source of information.

Anecdotal evidence shows that the California certification is helping certified companies (both those located in California and those located out of state) to sell their products to private companies and to the state and federal government. This is so due to the high profile that the program has around the country. Additionally, California is helping certified companies gain access to markets by the state’s participation in the two interstate cooperative efforts. The state is going one step further in an effort to help environmental technology companies sell their products overseas. This effort sets the state apart from other states in terms of aiding technology companies. These international efforts provide large potential markets for certified technologies that other states do not. And again, this advantage is provided to companies largely because Cal/EPA is in the forefront of creating environmental regulations and programs. Because California is out in front of the rest of the nation it has an international reputation.

The first effort is the initiative on the part of the U.S. EPA to find a model for its national verification program which may be based upon the California system. If the two programs become reciprocal (as is likely to happen if the federal program is modeled on the state program) then certified technologies will have a national stamp of approval. Secondly, Germany, Canada, Russia, and Mexico are working with Cal/EPA to coordinate with and structure their certification programs upon the Cal/EPA certification. Additionally, the International Standards Organization and the program to develop environmental certification standards called ISO 14023 is considering using California as a model for the ISO program. If the ISO adopts California’s program structure it is likely that California certified technologies could be used more easily in all of the countries that adopt the ISO program. These international efforts set the California certification apart from other verification programs being conducted in other states. It is an extremely respected program and gives participants exposure on an international level.

The last sections have described how the California certification program verifies the product claims of new technologies and in so doing increases sales for participating companies in California, in other states in the nation, and in foreign markets. In the next
section I will show how certification is working with a regulatory streamlining effort called “tiered permitting” to simplify the administrative process of using certified technologies for companies in California.

III. Toxic Substances Control Division Tiered Permitting Program

The most extensive effort to reform California’s regulatory process has taken place in CalEPA’s Toxic Substances Control Division. Although the efforts of this group date back to 1991 and 1992, and were not established to help promote environmental technologies, the shift in the permitting process has been tailored in some programs to dovetail with the department’s technology encouraging program. The TSCD was authorized in 1993 to implement the tiered system to reduce the costs and paperwork associated with hazardous waste permits.\(^{25}\) While tiered permitting has been implemented for 12 waste streams the technology component has not yet been approved by the legislature and is being implemented under a temporary special authorization.\(^{26}\) The temporary authorization has been granted to California health care providers to use formaldehyde reducing technologies that have been certified. In looking at this program we can see how the coordination of the two programs will ease the regulatory complexity of using these technologies.

Prior to the creation of the tiered permitting system, only one permit could be acquired from the Toxic Substances Control Division. This was a “full permit.” The cost of a full permit was $60,000 to $100,000\(^{27}\) and involved large amounts of paper work. Processing a full permit is time consuming, taking two to five years from the time of application to final approval. In addition, no distinction was made in volumes of discharge. A company that released 10 gallons of waste per month and one that released 10,000 gallons of waste per month would have to pay the same amount for a permit regardless of the different volumes. Until now, the only way to avoid the costs of a full


\(^{26}\) Health and Safety Code section 25201.5c (11)

\(^{27}\) Although the full permits are expensive, many companies in California have operated without a permit for many years and have thus not experienced the permitting process. Under the tiered system, all industries that discharge hazardous wastes must obtain a permit.
permit was to apply for a variance. If the variance was issued the permitted company would have to pay $10,000.

TSCD's “tiered program” establishes five different levels of hazardous waste and thus creates categories of permits. Tiered permitting sets the administrative process commensurate with the risk posed by the technology and the wastes in question. Under the new tiered system, lower tiers are eligible to obtain a “permit by rule” which is much less time consuming than a full permit, and only costs $1,270. So far, twelve waste streams and treatment processes have been included in the tiered permitting procedure established by the state. More waste streams will be admitted soon and this will greatly expand the program.

A. Tiered Permitting and Innovative Technologies

Technologies that are granted “regulatory certification” under the Toxic Substances Control Division certification program will be eligible for lower tier permitting status in the tiered permitting system. The only such technology to date which is authorized to receive the lower tier permit has been a waste reduction technology for use in hospitals. Under a special authorization, health care facilities have been approved for a Conditional Exemption Specified Wastewater (CESW) category permit if they use the certified technology to reduce formaldehyde (used as a tissue preservative). The classification reduces the administrative process for permit application and in so doing shortens the application time by six months and paper work by hundreds of pages. In addition, users do not need liability insurance nor must they conduct full site assessments in order to use the technology. Reducing aldehydes is an important environmental goal as can be seen from the following description.

Hospitals nationwide produce 675,000 gallons of aldehydes annually\(^2\). Typically the waste is shipped out of state for disposal at a cost of $7 to $10 per gallon. One of the two certified technologies to neutralize formalin (a sterilizing agent) and glutaraldehyde (a tissue preservative) that are Cal/EPA certified is produced by Trend Scientific and is

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called the VYTAC 10F system. The technology allows aldehydes to be neutralized in the hospital and disposed of as waste water for a cost of $3 per gallon. The new treatment system also reduces worker exposure to the toxic substances.

Trend salesmen said that such streamlining initiatives have improved the sales of the product and that many customers insist on the Cal/EPA certification, both because of the relative ease in gaining approval for the product, and because certification gives customers a level of comfort with a product. The certification program and the tiered permitting program have simplified the process by which all health care providers in the state use a technology that reduces costs, reduces toxic waste exposure to workers, and reduces potential release of toxins into the environment. Because of these benefits Kaiser Permanente announced that it would use only Cal/EPA certified technologies to reduce aldehydes from waste streams in all of its Northern California facilities.29

The reason only one technology has been used in the new tiered permitting system is that the guidelines for the program have not yet been passed by the California Legislature. When the guidelines that define the technology aspect of the tiered program are completed it is expected that the California legislature will pass a law allowing all certified technologies to be used under the expedited application rules. Thus, all certified technologies will be able to be introduced in a much more simplified manner than before the tiered program. The example of Kaiser Permanente shows how certification can help overcome institutional barriers caused by the reluctance of regulators to accept new technologies, and at the same time make it easier for companies to introduce those technologies.

IV. Conclusions

The three initiatives examined in this paper: certification, the technology aspect of tiered permitting, and the interstate cooperation groups, while relatively new, are increasing the sales of environmental technology products and have great potential to increase market areas further. Two of the programs focus on increasing the flexibility of the current regulatory system: the interstate effort and the permitting reform effort. The

29 "A Green Industrial Policy Takes Root" Business Week, July 25, 1994, p. 84
certification process does not focus on increasing flexibility but rather on creating an outside mechanism to guarantee the performance of products. These products can then be considered by regulators and permit writers.

Critics of the certification program state that this process may allow the current rigid permitting system to exist without changes, and that what is most needed is to increase the flexibility of the existing system, rather than creating mechanisms to make the rigid system continue to exist without improvement. Since certification allows regulators to avoid the risks associated with permitting new technologies they do not learn how to handle those risks. Nor do they learn how to establish alternative permit pathways. However, the combination of the certification program with the tiered permitting program does provide much needed flexibility into the California permitting system. Additionally, while certification does not directly encourage regulators to find innovative ways to permit technologies, it does expose members of the Cal/EPA Boards to new technologies. Making a few changes to the certification program would allow permit writers more exposure to new ways of thinking about permitting technologies. This could be accomplished easily and will be discussed in the chapter describing Texas’ program (Chapter Five).

Another criticism of certification is that it may encourage end-of-pipe solutions over pollution prevention technologies. However, of the 22 technologies approved in the first two years of the program only one could be considered an end-of-pipe technology (a containment system for hazardous waste). Sixteen technologies fell into the category of environmental instrumentation (assessment of contaminants in soils), and five were pollution prevention technologies such as innovative methods for reducing solvent use, oil use, and aldehyde waste. The criticism that certification will lock in end-of-pipe solutions is unfounded if we look at the technologies that have already been certified. The above criticism could also mean that in avoiding the introduction of needed flexibility into the system, new technologies that are not certified will continue to be rejected for permits because they are unfamiliar. In this way some pollution prevention technologies that demand innovative permits will not be introduced. However, this problem could also be remedied in a manner which will be discussed in Chapter Five.
A more serious criticism is that the California certification could “lock in” technologies if it becomes slow and expensive, thus establishing a long approval process and a kind of monopoly for those technologies that are certified. Several approaches could solve this problem. One approach would be to establish the federal system of certifications that is currently being considered by the U.S. EPA. This would replicate and expand the California process and relieve some of the demand for the state system. Aside from expanding the system, making changes to the California certification would help remedy the problems of high costs and long approval processes. Altering the system for evaluating applications and negotiating contracts would benefit those companies participating in the program as well as Cal/EPA.

As described earlier in this chapter the process for conducting certifications involves negotiating a contract which states what exactly Cal/EPA will certify. Cal/EPA engineers said that improving communication between clients and TSCD certification team could help keep costs down. Companies occasionally approach certification with unrealistic goals. For example, Trend wanted their technology certification to say that the technology reduced Formalin to several parts per million. Accomplishing this is far more difficult, expensive, and time consuming that certifying that the equipment “reduces” Formalin. Increasing communication between Cal/EPA engineers and clients can help achieve an agreement on certification that keeps some cost down. The trade-offs of costs and performance claims need to be examined by everyone involved in the certification process before the goals of certification are decided upon.

During the pilot phase, the cost of certification ranged from $8,000 to $15,000, due to a TSCD policy that stated costs should be kept to a minimum for the pilot companies. Now, Cal/EPA has moved out of the pilot stage and is charging not less than $40,000 and as much as $110,000. These costs reflect the actual costs for hours spent by Cal/EPA employees on the certifications. Many companies interviewed said that at such a high price certifying their products would not be possible. Trend Scientific personnel stated that potential sales of their technology which has a limited market would not merit the cost of certification. Clearly establishing the goals of certification and how much the process will cost before contracts are signed are essential to reducing costs and
maintaining the efficiency of the system. Making changes such as those suggested above could address some of the concerns critics of certification have expressed about the program.

We have seen in this chapter how the CETP’s certification and tiered permitting system work together to reduce barriers to the introduction of innovative technologies. The programs do so by creating a mechanism that proves to regulators and the private sector that environmental technologies can accomplish what manufacturers say they can. The tiered permitting system allows for the technologies to be used in new applications. Interstate agreements further expand the market areas for those technologies. It is in the linking of the programs that the greatest benefit to participating companies occurs.

The question of whether or not in the long run the program may become another layer of permitting that effectively slows down introduction of new technologies can be answered in the following way. Certification has been proven to be an excellent tool for encouraging the introduction of innovative technologies. If certifications can be provided to all eligible companies within a short period (three months) and at a moderate cost (many people stated $40,000 is reasonable) then it can continue to be extremely successful.

In the next chapter we will look at the Massachusetts’ initiatives to encourage regulatory and private industry acceptance of environmental technologies. Massachusetts has started a comprehensive technology partnership to accomplish these goals. One aspect of the program, like California’s, is a verification system to help companies prove product claims. The second is a regulatory reform effort and is the first privatization initiative for hazardous waste site cleanups in the nation. This approach differs from California’s in that the state is moving toward less control over which technologies are used in site cleanup. Massachusetts is shifting their oversight of superfund cleanups to a private group who decide which technologies to use for site cleanups. Although the mechanism is different, like certification, this system is introducing more technologies for use in hazardous waste site cleanup.
Chapter Four

The Massachusetts Strategic Environmental Technology Partnership (STEP)

The Massachusetts effort to encourage environmental technologies began in 1993 when the Legislature established a forum to investigate ways for the state to encourage new technologies, especially ones that were beneficial to the environment. It was called the Innovative and Alternative Technologies forum. The group members explored the possibility of instituting a tax break for innovative environmental technologies to encourage their use. Over the six months that the group met, they discussed the mechanisms which would most help environmental technologies. They came to the conclusion that tax incentives would not be a great enough incentive to spur commercialization and use of new technologies and instead recommended four other strategies to do so: 1) streamline regulations, 2) conduct state demonstrations, 3) provide business and marketing assistance, and 4) establish “envirotechnology” centers. The committee also recommended the establishment of a public private partnership called the Strategic Environmental Technology Partnership (STEP).

STEP, like the California program, assists environmental technology companies with many aspects of environmental technology commercialization. STEP helps companies with: technology verification; research and technology enhancement; technology demonstration at state-owned facilities; regulatory clarification and expedited permitting; targeting of University research to environmental priorities; access to state markets; financing assistance; and business plan development. Together, these programs are attempting to address the full spectrum of problems that environmental companies face in commercializing their technologies. This chapter examines three aspects of the STEP program: two regulatory reform efforts; a product verification program; and
Massachusetts' participation in multi-state efforts to increase the regional acceptance of new technologies. The first part of this chapter will examine the verification program being carried out by six University of Massachusetts campuses. The second part of the chapter will examine the interstate efforts that Massachusetts is participating in, and the third section of the chapter will look at two state regulatory reform efforts. Lastly, this chapter will discuss the strengths and weaknesses of the different programs.

The STEP program helps companies which produce all types of environmental products: those which reduce solid and hazardous waste, use innovative energy sources, cleanup hazardous waste sites, and recycle wastes. Only one component of the program is geared towards a particular technology and this is the loan program. The bulk of loans provided by the state go to recycling companies. The other aspects of the project: verification, regulatory assistance, and business development are not geared or limited to any one technology.

Verification of product claims are performed by four University of Massachusetts campuses. Each campus works in certain areas of expertise but perform verifications outside of those specific areas. The Boston campus is working on testing, assessing and evaluating of innovative environmental technologies and on business plan development. The Lowell campus has established the Chelsea Center for Materials Reuse (CEAM) which focuses on reuse of solid waste materials. The Dartmouth campus through its Advanced Technology Center has worked on reducing runoff from the cranberry industry, urban aquaculture, and the recycling of fish processing wastes. The Amherst campus is working on process design to minimize and prevent pollution in their program called the National Environmental Technology for Waste Prevention Institute. While several of the campuses are working on research and development of innovative technologies, this chapter will focus on the verification work being conducted by the four campuses.

Like California, the Massachusetts verification program helps environmental technology companies compile enough data to prove that their products can help improve environmental quality. The regulatory streamlining efforts that Massachusetts is initiating differ from California’s in that Massachusetts is moving towards implementing performance based standards in two of their programs (as stated in program literature).
Like California, companies benefit from the coordination of regulatory and verification activities. As was seen in California, participation in or assistance from any one aspect of the program helps businesses, but it is the linking of the different efforts which makes the program very successful. STEP documents emphasize that linking the state programs is also one of their goals. STEP literature states that the success of one office’s efforts is reliant on the success of other participating state agencies.

The STEP program, like California’s CETP, and the Texas Innovative Technology program makes use of existing state resources to assist technology companies. In order to use the resources available in the state and to foster a network among existing bodies rather than create a separate new agency, STEP is composed of three state agencies: The Executive Office of Environmental Affairs, The Executive Office of Economic Affairs, and the University of Massachusetts.

To date 110 companies have requested STEP assistance. Of those companies 35 received business assistance and regulatory review and/or guidance. Sixteen companies received or are receiving Technical Assessments, ten demonstrations have been completed, and four companies were assisted through the regulatory process. Technology companies wanting to participate in STEP approach the Massachusetts Office of Business Development where there is an Environmental Technologies Industry Specialist. After the technology is assessed as to what it needs to be commercialized, it is referred to either DEP, or one of the six University of Massachusetts (UMass) campuses participating in STEP. Companies that do not have enough data on their technologies are referred to the UMass campuses for verification of product claims.

I. Technology Verification at the Four UMass Campuses

Ten innovative technology companies have participated in technology demonstrations at UMass. Of the companies that have had their demonstration completed, and that have been found to reduce pollutants, six were interviewed. The companies were:

1. Second Wind, manufacturer of wind power instrumentation equipment

   One technology manufactured by Bluestar and which claimed to prevent molybdenum from entering boiler and cooling tower water failed to show pollution reductions.
2. AIRxpert Systems, manufacturer of indoor air quality monitoring equipment
3. Environmental Management Technologies, Inc., manufacturer of pollution mitigation equipment for underground tank facilities
4. Solometrex, manufacturer of equipment to remove metal from industrial wastewater
5. Twin Rivers Technologies, manufacturer of a fuel called biodiesel, which is a mixture of diesel fuel and soy bean extract
6. Cellini, manufacturer of a wastewater treatment system.

Five of the six companies were positive about their experience with STEP. STEP’s verification of their technologies helped most often in obtaining of State contracts. AIRxpert contended that implementing the air quality monitoring equipment in state buildings without help from STEP would have been next to impossible. AIRxpert has also benefited from STEP in that the state is helping the company through the various interstate programs it is participating in. Although verification took 18 months, AIRxpert did not feel that it was too long a process.

Similarly, EMT, Solmetrex, Ion Signature and Second Wind reported increased sales due to the verification program. The only company that was dissatisfied with the verification process was Twin Rivers Technologies. Gene Gebolys, its Director of Marketing, has seen few results from the program to date. The scope of the program did not help companies obtain major contracts such as had some of the California certified companies. Examples such as Purifiner’s installation as original equipment in Ford engines, and Kaiser Permanente sole use of certified aldehyde reducing technologies was not seen in the Massachusetts verified companies. Additionally, use in other states of the verified products was not reported (without assistance from interstate groups) nor were sales in foreign countries. The STEP verifications helped most often in obtaining government contracts. While these represented significant revenues to companies, the influence of the program is mostly within Massachusetts and most often for government work.

Interestingly, one of the more successful California certified companies, T.F. Purifiner, applied to STEP for assistance. This shows the importance of participating in STEP in order to become established in the state. Most of those interviewed were pleased with the STEP process and had few complaints. They did not feel the verification took too long, and felt that the time committed by staff members was well worth the benefit
received. In contrast to the California certification program, the STEP verifications were performed almost entirely for Massachusetts companies. Only one out of state company (mentioned above) participated in the program.

Like California, Massachusetts is participating in interstate regulatory cooperation groups. And also like California some of the greatest benefits to STEP verified companies is being seen in this participation in multi state regulatory cooperation groups. It is in the linking of the verification program with these interstate efforts that market areas for Massachusetts technologies can be increased. Two companies, Cellini and BioClere have been helped through the interstate efforts to date and are seeing increased sales. The following section details efforts to promote Massachusetts technologies in other states.

II. Export of Technologies: the MOU and the ITRC

A. Six State Memorandum of Understanding

In 1995 Massachusetts EOEA and three other states New Jersey, California, and Illinois signed a commitment to mutually support their environmental technology industries and the sharing of information, expertise, and performance data on environmental technologies. In 1996 two more states, New York and Pennsylvania joined the MOU. The work of the MOU to date has been to coordinate a technology review pilot project. Two technologies from Massachusetts have been chosen, an industrial wastewater technology manufactured by Cellini, and an on-site wastewater disposal technology manufactured by Bio-Clere, and that is sold to individual home owners, strip malls, and nursing homes. As part of the technology review, Massachusetts is providing a standard data package to the other five states. The pilot program will help the states develop a standard format for information exchange between states, a specific description of the state’s review and permitting process and a streamlined, coordinated process to review information.

To date, Bio-Clere has sold three units in New York State. The units ranged in cost from $4,000 to $12,000 each. Bio-Clere personnel said that interest generated in the
six MOU states for his product is substantial and he expects his sales to go up considerably once he begins market his product in New Jersey, Pennsylvania, and the other MOU states. Without the MOU, Bio-Clere would have had to conduct a test in New York of his product. This would have cost him anywhere from $2,000 to $10,000. The agreement between the six MOU states has saved Bio-Clere an amount somewhere between $12,000 to $60,000 in testing costs. The five other states are also preparing packages of data on two technologies from their states. It is still too early to tell how companies will benefit from the program but early anecdotal evidence such as that given by Bio-Clere suggests that the MOU will help companies overcome some of the overlap in permitting requirements between states and increase sales. Massachusetts is also participating in the ITRC which was described in the last chapter. The state’s participation in this group could give Massachusetts companies such as Bio-Clere exposure to regulators in many states around the country.

B. Interstate Technology Regulatory Cooperation Working Group (ITRC)

Several Massachusetts initiatives have been studied by the ITRC as part of the ITRC’s effort to foster the introduction of innovative technologies in member states. The DEP has been a participant in designing several protocols including in-situ bioremediation (ISB) and low temperature thermal desorption technologies. The protocols outline a method for introducing innovative technologies which allows for environmental quality to be improved and regulatory reform to be achieved. Bioremediation use which will be described later in the chapter through the Environmental Results Program is being looked at by the ITRC as a potential model for how other states can implement this technology. The technology was selected to be the subject of a case study because members of the ITRC believed that ISB could provide cost effective, safe, and successful cleanup, yet the technology is not widely used.

The Task Group found the major impediments to ISB use are institutional and regulatory, not technical. The audience for the report was the state policy makers and managers of regulatory processes. After the final reports were issued, a survey of 22 state DEPs found that 17 of the 22 said that the protocols would lead to faster regulatory
acceptance of the technologies studied in their states. In addition the Department is now a lead in two new project involving another technology (permeable barrier walls) and the Department has also formed a policy team to assess integration of products into future policy initiatives. Because the program is relatively new there is little information on the number of applications of the new technologies that have been introduced in member states.

The DEP, in being involved with the ITRC and in creating models for how other states can use technologies is creating outlets for the state’s technologies. It is also acting as a leader in shaping how regulations evolve in other states. Through its involvement in the ITRC, DEP noted the following lessons:\(^\text{31}\): 1) The use of a tightly controlled pilot project to collect data can be used as a guide for broader regulatory changes. 2) Advance agreement by all interested parties on pilot protocols is necessary to achieve a document that everyone supports. 3) It is important to focus on performance standards. Several managerial lessons were noted: 1) It is necessary to have “front-line” staff available to provide expertise on regulatory issues, 2) Senior management must be committed to innovative technologies, and 3) It is extremely valuable to have a coordinated assistance plan to guide technologies through a lengthy regulatory process.

The degree to which information\(^\text{32}\) is being exchanged between the ITRC and the states can be seen in the way that ITRC documents are finding their way into state environmental agency memos and documents. A recent Massachusetts guidance document on how to remediate contaminated soils with an innovative technology\(^\text{33}\) refers to an ITRC document\(^\text{34}\) and was distributed to environmental agency personnel saying “the ‘ITRC …Document’ is attached and provides the basis of these recommended guidelines. All of the “requirements” in the ITRC Document have been adopted by the Bureau of Waste Site Cleanup as recommended guidance.” There were a few caveats. The fact that Massachusetts environmental agency did not participate in the preparation of

\(^{31}\) This is especially true with bioremediation since different soils are more or less conducive to the technology and the regulations must be written so that misapplications do not occur.

\(^{32}\) Both about technologies, and about how to get technologies through the regulatory process.

\(^{33}\) “Recommended Guidelines for the Use of On-Site Low Temperature Thermal Treatment of Petroleum/Coal Tar/Gas Plant Wastes Soils” Massachusetts Department of Environmental Protection.

the ITRC report, and yet accepted the results without having to see demonstrations of the technology shows the extent to which the inter-state organization is beginning to facilitate exchange of information between states. The above two interstate regulatory cooperation groups are helping Massachusetts and other states learn from each other as how to introduce new technologies. Massachusetts is also participating in a New England regional effort to affect the same learning process.

C. New England Interstate Regulatory Cooperation Project (IRC)

Massachusetts is the only state examined in this thesis that is participating in the IRC (the IRC comprises New England states only). The IRC is a partnership to promote the acceptance of innovative environmental technologies in New England and improve the competitiveness of regionally-based environmental technology companies. The six New England state environmental agencies are the partners along with other state regulatory agencies and the U.S. EPA. To date the group has established a panel that will review technologies for all of the six states, so that technology vendors do not need to test and demonstrate their products in all six states. They will still need to be permitted in all states. The first technology to go before the panel was a wastewater (septic) system. Bioclere was one of the companies whose products have been approved across state lines, and Cellini’s technology is being evaluated by the group. The group has compiled an available technology list and a technical expertise list which are both shared among member state DEPs.

The above descriptions showed how STEP is helping technology companies verify product claims and improve sales. This aspect of the technology program is similar to California’s in its approach. The next section will detail the efforts of the Massachusetts Department of Environmental Protection to encourage innovative technologies. The Department’s efforts focus on two areas: regulatory reform and an Innovative Technology Program aimed at educating regulators about new technologies and helping companies in permit pathway clarification.

The regulatory reform initiatives (this chapter details two of them) differ from all other reform efforts going on in the country in that they affect a shift away from DEP
control of technologies used in hazardous waste site cleanups and in permitted facilities and towards private sector choice in what technologies will be used for compliance with regulations. The two programs are called Environmental Results Program and the new 21E. The programs use performance based standards rather than the traditional command and control mechanisms. This Massachusetts effort has allowed the state environmental agency to redirect some of its resources that had previously been occupied in overseeing site cleanups and in writing permits which specify particular technologies.

The other regulatory effort to help environmental technology companies is a permit clarification and educational system for permit writers called the Innovative Technology Program. This program encourages the permitting of innovative technologies and helps regulators accept innovative technologies. The next sections will detail how Massachusetts regulatory reform efforts are helping businesses in Massachusetts.

III. DEP’s Innovative Technology Program and Regulatory Reform

As described above, DEP’s efforts are divided into two “prongs” 1) regulatory reform to address the problems of barriers to new technologies, and 2) the creation of an office within DEP that acts as an ombudsman to shepherd new technologies through the permitting process, which is called the Innovative Technology Program. The following section describes the Innovative Technology Program.

A. The Innovative Technology Program (IT)

The IT program began in 1993 as part of the STEP plan. Then DEP Commissioner Daniel Greenbaum proposed the Innovative Technology plan. DEP staff were charged with detailing the 30 examples of ITs permitted by the agency, and with creating protocols for responding to and reviewing future IT proposals. DEP then held a hearing with public and private organizations to solicit feedback on the steps taken and proposed by the Department. Specific barriers to innovation were discussed, including insufficient DEP in-house expertise, lack of clear review process, risk of technology failure, and financial risk for developers. The ideas that came out of this working group
have guided DEP in its development of the IT program. The IT program is within the Bureau of Strategic Policy and Technology.

The Innovative Technology Program is in part funded by the U.S. Environmental Protection Agency through an Environmental Technology Initiative (ETI) grant. The grant funds the Coordinator position ($100,000 per year), and was awarded to the state as part of the federal effort to encourage innovative technologies. The technology program has as its main document the Innovative Technology Review Process Guidance Document. The Guidance Document is a description of how innovative technologies should be handled by the DEP. The IT Review Process is DEP’s guide as to how it should handle innovative technologies as they come into the Department. Key in carrying out the stated goals of the Guidance Document is the Technology Coordinator. It is the Technology Coordinator’s role in the DEP office to advocate for a review process for given technologies that is clear and simple for its “customers.” Like California, Massachusetts refers to the companies that go through the technology office as clients or customers – representing a new way of thinking of the role of the regulatory agency as providing a service to businesses. An important concept in the STEP organizational structure is that rather than having a centralized staff devoted solely to innovative technologies, the IT Initiative relies on the expertise of many DEP staff as needed for individual projects and limited assistance from Coordinators. The structure is intended to build awareness of and commitment to innovative technologies by all staff.

Before the IT Program was begun, when a new technology was brought to DEP by the developer, it ran the risk of running into two problems. The first would be that since there was no established pathway for that particular type of technology, and thus no precedent as how to permit it, the vendor might be denied a permit. The process would end here for this vendor. Another possibility would be that a permit pathway might be found, but it could be an extremely time consuming process and costly for the vendor. The IT program was created to address these two problems.

The process for innovative technologies is as follows: a technology developer or a facility wishing to use a new technology comes to the DEP either directly or through the STEP program. Sometimes vendors have an idea as to what permit they might need,
sometimes they do not even know they need a permit and are just trying to bring their product to the attention of the DEP. They can come through the STEP program, or through any one of the regional or Boston office. A single reviewer, or a review team, takes an initial look at the technology to determine what permitting and/or regulatory issues it is likely to raise. This screening process is carried out by the Technology Coordinator. While the Coordinator is not a technical expert he or she is familiar with the issues that are likely to come up in the permitting process. While considering the technology DEP considers to what extent the technology is proven or unproved, what risks will be posed to the environment if it fails and how will those risks be managed, and whether or not the environmental results are likely to meet or exceed those that would be achieved through a more conventional approach.

If during the review one of the IT coordinators determines that there is insufficient data to prove the claims of the manufacturer then the technology developer will be referred to one of the six STEP programs to develop data on the product. If the technology poses unknown or unmanageable risks to public health or the environment, then they will also be referred to STEP to further develop the product. The same is true if the technology company needs business planning. The next step in the process is a scoping session. In this session technical experts are present while vendors cover information on the technology. Information presented includes: a comparison with existing technology; effectiveness; what type of technology it is; potential project impact; proposed site; desired scale of a project; and information about the proponent’s needs. All technology performance data is reviewed. DEP’s part in the scoping session is to determine the degree of innovation of the technology, and to indicate what additional data might be needed and or what type of permit could be applied. Permit timeframe and what subsequent actions need to be taken are identified.

The next part of the process involves data assessment and negotiation. Goals for the project are determined as is the scope of the project. Environmental standards to be met are decided upon and a risk rating and monitoring conditions are negotiated. When questions on both sides have been addressed then an authorization to proceed is issued.
The Innovative Technology Office was charged with three main objectives: Ensure that good science drives decision making at DEP, ensure regulatory streamlining, and identify and pursue environmental priorities and improve methods for evaluating progress. As of the end of 1996 58 companies had been assisted by DEP. It is one of DEP’s main goals that environmental quality not be sacrificed to get projects permitted. Thus in the review one of DEP’s objectives is to find ways to obtain more data if that is necessary while not adding burdensome costs to the developer. 28 companies have gone through the IT process to date. In the following sections, results of the programs as seen by businesses that have participated are detailed.

The Innovative Technology Program is like a program which Texas has initiated and which will be discussed in the next chapter. It is aimed at educating regulators about innovative technologies and trying to increase the flexibility of the system by helping regulators understand how to permit new technologies. In the next section, regulatory reform efforts being conducted by the Department will be discussed. These efforts are also aimed at increasing the flexibility of the system by taking advantage of performance based standards which allow some leeway in the choice of technologies for site cleanups especially.

B. The Department of Environmental Protection Regulatory Reform Efforts

While the DEP’s Innovative Technology program aims to make the existing permit system work better for new technologies by expediting their acceptance by regulators, the Department of Environmental Protection’s regulatory reform efforts take an altogether different approach. This approach removes the DEP from the decision making process as to which technologies should be used for (example) site cleanups. Massachusetts’ efforts to reduce regulatory confusion and barriers focuses on “outcomes, not technologies,” i.e. performance based standards. In so doing the state is hoping that more innovative technologies will be introduced by the private sector.

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35 Michael Porter “Toward a New Conception of the Environment-Competitiveness Relationship,” p.110-111
1. Environmental Results Program

The Environmental Results Program is an effort by the state to remove itself from the decision of what technology should be used in permitted facilities. This program is the first of its kind in the nation. It aims to eliminate the permit system and instead implement a self-certification system, for about 16,000 small to medium size businesses. ERP substitutes a facility-wide performance based compliance certification for the existing permit process. For now the program includes only photo processors and dry cleaners, but later will be expanded to include other industrial sectors. These are only for State permits (not federal). The idea behind this initiative is that in issuing permits, the State government begins to “engineer the permit” or to specify exact installation methods, and technologies. Requirements such as these can be costly, and can thwart innovation. There are a total of 16,000 permits issued to industries state-wide. By allowing those permit holders to “certify annually” their own performance, DEP will be free to do more enforcement and compliance work. This shift will place 70% of all companies in Massachusetts that now require DEP permits on to performance-based facility-wide self-certification.

The new program requires companies to comply with the Code of Massachusetts regulation 310 CMR 70.00 which governs the Environmental Results Program. This code defines ERP participants as dry cleaners and photoprocessors. Under this system, ERP participants self certify that they are in compliance with 310 CMR 70.00. The new regulations allow for participants to install any equipment they want to as long as they are in compliance with the emissions and effluent standards dictated in previous regulations. Before ERP was established, dry cleaners and photoprocessors would have had to maintain the same standards (with a few exceptions), but the types of equipment they were using would be specified in their permits. DEP is no longer writing permits for these facilities and is thus no longer specifying which equipment should be used.

DEP is considering asking the U.S. EPA to address federally required permits in the same way. While the ERP program gives permitted facilities more flexibility in choosing which technologies are installed (because the CMR does not dictate which
technologies will be used) it has also been used to establish new permit pathways for innovative technologies.

The rules that ERP has established allow for the introduction of new technologies in circumstances other than dry cleaning and photoprocessing businesses. The flexibility that exists in this program has resulted in the introduction of a STEP assisted innovative water purification system manufactured by Cellini. Cellini's water purification system is used to treat industrial process wastewater. It is useful for metal finishers, electronics producers, and photochemical machining shops that want to recycle wastewater and/or recover metals from waste streams. These types of businesses already by law must pre-treat their wastewater before it enters the sewer system, the Cellini system would provide them with an alternative that not only removes pollutants but recaptures wastes and produces valuable end products.

The Cellini system, being what is called zero discharge, would under current regulations have been virtually impossible to permit. This is due to conflicting requirements under RCRA and the Zero Discharge rules. The DEP used the ERP program because zero discharge technologies are applicable to many ERP regulated facilities. The Cellini system can now be used in zero discharge systems, as guided by the set of definitions and performance standards that clarify the existing exemption from RCRA licensing. This example shows how some flexibility inherent in performance based standards has been used in the ERP program to introduce a new technology. In this case, conflicting rules would have prevented the introduction of the Cellini system.

Regulating the water system under the ERP program allowed for use of the system if water quality standards in and around its installation were maintained. While the ERP program is geared towards permitted facilities in the state the new 21E superfund law outlines new procedures for hazardous waste site cleanup. The new law has allowed private groups to introduce new technologies without state approval. The next section describes how this system has worked.

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36 The technology uses vacuum assisted binary flash distillation.
2. The New 21E Superfund Site Cleanup Law

21E represents a major effort on the part of the state to remove itself from making specific decisions on technology use is in the area of hazardous waste ("superfund") site cleanup. The state’s involvement in remediation of superfund sites until recently was extensive. Under the 1983 “Massachusetts Superfund Law” the state was required to oversee all cleanup of superfund sites. In 1990 less than one fourth of all the 4,200 hazardous waste sites in the state were being assessed or cleaned up, and the backlog of sites was growing. A lack of clear standards and guidelines defining when and how sites should be cleaned up was hampering remediation efforts.

To address this problem a “new 21E law” was passed. This law allows the state to privatize the cleanup of superfund sites. The new approach reduces the DEP’s work load and enable it to focus on enforcement. The licensing of “site professionals” will allow for cleanups to be conducted by the private sector. Review of procedures will continue by the state, but complete involvement by DEP employees will no longer be the case. Under this program 75% of existing hazardous waste sites have been cleaned up in the first two years.

In its efforts to implement the 21E program, administrators are holding forums on environmental technologies that could provide innovative solutions to the remediation of hazardous waste sites. The 21E program encourages innovative technology use in that performance standards can be met in a variety of ways, and specific technologies are not mandated by the DEP. In addition, 21E through its pilot projects and forums, helps new technologies become accepted by Licensed Site Professionals who are cleaning up hazardous waste sites. 21E also addresses a key problem in the cleanup of waste sites and the use of new technologies: liability. Companies that are using a new technology previously were subject to strict penalties. Under 21E a “Covenant Not to Sue” began in 1995 which relieves a new owner of liability if he or she voluntarily cleans up a site.

An example of a 21E project that used an innovative technology referred by the STEP program is In Situ Bioremediation to reduce contamination on site. Bioremediation stimulates microbial activity through the use of nutrients to increase

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37 Massachusetts General Law c. 21E.
degradation of petroleum products such as gasoline and diesel fuel. In some cases microbes are added to the soil. The technology can offer a cost effective way to get good environmental results. However, because the technology requires injecting microbes, air, water, or other substances into the ground, the process requires a groundwater discharge permit which takes six month for review, and the conditions of the permit often make the use of bioremediation not possible.

The use of bioremediation under 21E was spurred by Licensed Site Professionals who wanted to try the technology. A workgroup was set up to compare the risks of delayed or unsuccessful site remediation vs. pollution to groundwater from the petroleum. The group decided to conduct a pilot project whereby 9 sites would be remediated using bioremediation technology. These sites were located underneath houses with leaking fuel tanks. The sites were overseen by LSPs. Instead of requiring groundwater discharge permits, the Department settled on the use of performance measures on downstream water from the polluted area. In eight of the sites, no violation of groundwater standards was found. The project allowed passage of 310 CMR 40.0040 specifying performance requirements for bioremediation projects, when a groundwater discharge permit is not being issued. Due to the regulations the Department has facilitated the use of this technology on 50 sites since the pilot project.

This case was one of the first in the nation, and is an example of the kind of regulatory changes that are helping environmental technologies. This case was studied by the ITRC Working Group as an example of how regulations can be modified to both increase environmental quality and lower costs of cleanup. Very few states in the county had been able to resolve the problems that bioremediation caused regulators. Through the ITRC, Massachusetts legislation and procedure may be duplicated in other states.

Aside from establishing performance based standards programs the Department of Environmental Protection has worked to create flexibility in the existing permitting system by conducting permit pathway clarification, and re-designing certain regulations. The effort described below shows how one regulatory streamlining effort in Massachusetts is encouraging the introduction of innovative technologies.
3. On-Site Wastewater Disposal Systems

Title 5 of the state’s environmental code\textsuperscript{38} established standards for on-site wastewater disposal. In the early 1990’s it became clear that many of the systems were failing, which caused sewerage to flow into streams, rivers, ponds, wells, and coastal waters. To address the problem in 1995 the legislature passed a law mandating the inspection of all household septic and cesspool systems in Massachusetts when houses are bought and sold. While a variety of innovative technologies for on-site systems were available, Title 5 standards and a rigid approval process created a barrier to the use of those technologies. The regulations required that any system that varied from standard systems be approved on a case-by-case basis. From 1978 to 1995 only five technology approvals were issued for general use. No innovative technology was approved for general use, although 50 technologies were approved on a case by case basis.

The new law set performance standards for septic systems and acknowledged the importance of innovative systems. Such systems can be important in areas where a greater level of treatment is necessary, or where soil conditions do not allow the use of a standard technology. The new review process for septic systems aims to provide a clear process for technology review and approval, and ensure protection of public health and the environment. DEP will approve an innovative technology if one of the following is provided to the department: available data on the system, approval letters from other states, testing results, third party independent reviews, or performance data. The level of approval depends on the type of data that is available.

DEP has trained local Boards of Health, inspectors, and installers about the new technologies. In addition, the department is making information available to property owners through the establishment of a dedicated hotline, compute bulletin boards, and regional technology fairs.

The results of the program are that in the first year 26 systems had been approved under the innovative program. In many cases the innovative technologies allowed homeowners to comply with the law more cheaply than if they had used a standard

\textsuperscript{38} enacted in 1978
system. In other cases, innovative technologies provided superior treatment to conventional systems. DEP's role in this situation was to remove the regulatory barriers and confusion to implementation of the technology. The program allowed DEP regulators to shift from standard permit review to a broader role of technology evaluation.

IV. Conclusions

Massachusetts' program to encourage environmental technologies has taken an approach similar to California's in several ways. For one, the state is verifying technology performance claims. Secondly, the state is working to reform regulations in order to encourage the introduction of those new technologies. Third, participation in multi-state programs greatly expand the number of states in which the technologies can be used. The aspects of the Massachusetts programs are meant to work together and reinforce each other like the California programs do.

While there are similarities in the two states' approaches, there are also large differences. The regulatory reform efforts in Massachusetts differ in their methods from California's. California is removing the risk posed to permit writers posed by innovative technologies through the establishment of the certification program. Through ERP and 21E Massachusetts is removing the risk to permit writers that new technologies pose to by allowing the private sector to choose which technologies will be used. By removing regulators from the decision as to which technologies will be used (in site cleanups especially) the state is transferring the risk of introducing new technologies to the private sector. The approach helps overcome the risk averse nature of regulators in regard to innovative environmental technologies. This is a novel approach to the problem of institutional resistance to permitting innovative technologies.

While this approach has been shown to work in Massachusetts as was seen in the example of the use of bioremediation at 50 sites, there have been some problems with the administration of the program. There is a fear that performance based programs have the potential to affect a relaxation of environmental standards if the DEP is not especially careful in its implementation of the programs. For instance, 60% of the 23 companies...
that were allowed to participate in the pilot test of ERP were found to have violations on their permits. Careful implementation is necessary to ensure that established violators are not given the opportunity to pollute more rather than less in performance based programs. Further exploration of the cases where performance based standards can be initiated should be looked into. Chapter Six will discuss some of the conditions which affect how successful these programs can be. While the above efforts have focused on moving the decision making process as to which technologies are used to the private sector, Massachusetts is also taking another, different approach to increasing the use of innovative technologies.

The state is working hard to introduce regulators to new technologies and methods to establish alternative permit pathways through the Innovative Technology Program. The IT program is working to educate regulators about new technologies through data review, question and answer sessions with technology developers, and alternative permit pathway establishment. These efforts are geared toward making the existing permit system work better. While the Massachusetts IT program does involve regulators in the evaluation of innovative technologies, some of the risk of approving those technologies is removed by the work of the University of Massachusetts verification efforts. Verification takes some of the pressure off of permit writers and makes it easier and more acceptable to introduce the technologies for permit writers.

The state’s approach is multi-faceted. On the one hand it works to increase flexibility within the existing system. On the other hand the agency removes itself from decisions on technologies. This method also solves the problem of inflexibility in the regulatory agency. In the following chapter another approach will be examined. The Texas Natural Resources Conservation Commission is working to increase regulatory flexibility through the establishment of the Innovative Technology Program. This program allocates all risk in introducing new technologies to permit writers within the regulatory agency but distributes the risk among the 3,000 member group to reduce the risk to any one group.

Chapter Five

The Texas Innovative Technology Program

In 1993 the Texas Natural Resources Commission (TNRCC)\textsuperscript{40} adopted the ambitious goal of reducing state wide waste generation and emissions by 50\%, by the year 2000\textsuperscript{41}. This initiative is called “Clean Texas 2000” and was begun by then Chairman of the TNRCC, John Hall. Hall wanted to encourage pollution prevention measures within industry and he felt that innovative technologies showed promise to reduce wastes. The Clean Texas 2000 initiative is attempting to shift reliance from conventional pollution control technologies to innovative technologies. The agency realized in 1993, however, that the objective of improving environmental quality by implementing innovative solutions could be thwarted by the state’s permitting system, which was deemed by Hall to be obstructive to new technologies. The TNRCC thus adopted the Innovative Technology Policy to encourage new technologies. The policy would be carried out by the three member group called the Innovative Technology Program. The function of this group is to spearhead the agency’s multi media effort to spur environmental technologies in all regulatory programs at the agency: air, water, solid waste, hazardous waste, and remediation. The Innovative Technology Program is

\begin{flushleft}\textsuperscript{40} The Texas Natural Resources Conservation Commission (TNRCC) is in charge of permitting and enforcing the state’s environmental laws, except in regard to coastal oil spills and the exploration and drilling of oil. Those two functions are handled by the Texas General Land Office and the Texas Railroad Commission, respectively.\\
\textsuperscript{41} “Innovative Technology Program” TNRCC 1994\end{flushleft}
overseen by the Innovative Technology committee, a 15 member group that is composed of representatives from all media: air, water, solid and hazardous waste.\textsuperscript{42}

The permitting of innovative technologies generally takes longer than does approval of conventional technologies. Sometimes technologies are rejected because of resistance and suspicion of new technologies in the TNRCC. For this reason, the Texas program emphasizes overcoming those institutional barriers. To do this the Innovative Technology office has five items on its agenda: create of a list of new technologies that will be available on the Internet, provide staff education, provide public education, conduct permit project review, and identify barriers and change regulations.

Technology coordinators have found that institutional barriers are the greatest hindrance to the utilization of innovative technologies. The following quote characterizes an interview conducted with Nancy Worst, Director of the Innovative Technology Program and is from the ITRC final Report, June, 1996 on the ITRC’s activities.

"The primary disincentive for regulators is the fear of making the wrong decision. Therefore they often choose conventional remedies, even if they cost more, because of cost and performance uncertainty associated with innovative technologies ... States indicate that, second only to site specific field demonstration data, they rely on information from each other to help guide cleanup decisions."\textsuperscript{43}

Texas’ efforts to remove institutional barriers have largely been in the area of educating Natural Resources staff as to the benefits of new technologies, and in the expediting of permit review. Members of the department are so skeptical of new technologies that they routinely reject ideas. This is due to the large number of technologies they have seen that could not accomplish what their designers claimed. This is where presentations by technology companies and the other steps in the review process (described in the next section) bring out information so that the regulators can properly evaluate the technology, and learn about its potential. Texas Dept. of Natural Resources personnel expressed the goal of changing the attitude of the department in favor of innovative technologies. The TNRCC does not want to create a new bureaucracy to

\textsuperscript{42} The Technology Committee is composed of TNRCC members at the staff technical level, and some Section Managers. The Committee members rotate among the different TNRCC personnel.
\textsuperscript{43} ITRC Final Report, p.5
handle new technologies, but rather wants to make the department that exists become accustomed to handling the innovative ideas.

This mechanism is somewhat different from California’s and Massachusetts’ where a new program entirely, verification, is created to reduce institutional resistance to unfamiliar technologies. Unlike the Cal/EPA certification or STEP, the Texas program designates processes or technologies as “innovative,” but does not assist companies in creating a data set to prove the claims of a technology. Thus, Texas’ innovative technology program takes a more pared down approach to the problem than either California or Massachusetts, but is highly effective\(^\text{44}\). Although the program specifically states that designation does not imply a technology will be permitted, and indeed the program is not geared towards products but rather technologies\(^\text{45}\), the process does facilitate the use of innovative technologies in permitted projects.

The process by which technologies are designated as innovative is as follows. To become designated as an innovative technology, a vendor must submit a written description of the product. When the paper work is received, the appropriate staff are given copies to review. For example if the technology is drip irrigation of wastewater then the regulators who handle permits for a wastewater treatment would review the material. Once the review is complete, a presentation by the vendor to those with expertise in the department takes place. The Technology Committee then prepares comments and reviews all of the information to see if the technology should be designated as innovative. Staff bring in all of the people at the TNRCC who should be aware of the technology. The entire process takes two to three months.

Once a technology is designated as innovative, all projects and permit applications involving the technology get a priority status in permit review. The Program coordinators also keep track of the status of projects using innovative technologies to see that their review is expedited. The Coordinators act as point people for questions, and help resolve issues related to permitting which are worked out between the permit writers.

\(^{44}\) Gary Broetzman “An Analysis of State Activities for Approving and Encouraging Innovative Environmental Technologies,” p. 11

\(^{45}\) Only technologies are designated as innovative, in other words on the TNRCC web site, company names are not listed, only the technology descriptions are. The TNRCC does not want to assist individual companies, but rather types of innovative technologies.
Coordinators, and the Technology Committee members. The objective of these exchanges is to keep the permit review process moving ahead. A total of 60 air, water, waste and pollution prevention technologies have been reviewed and designated as innovative. They are listed on the TNRCC’s web site. In interview with three companies that have had their processes designated as innovative, all said the TNRCC program had benefited them in sales and in obtaining a permit.

I. Plasma Technology and TNRCC Innovative Technology Designation

Two examples of the TNRCC facilitating the use of a particular technology in the state can be seen in the case of plasma technology. Plasma technology replaces incineration as a disposal process for certain hazardous wastes such as asbestos, weapons components, radioactive wastes, incinerator fly ash, and contaminated soils. The technology is called an “alternate thermal technology” in that like incineration, the process uses extreme heat to break down wastes, but unlike incineration the process does not use an open flame, and therefore do not require high volumes of air. Importantly, the technology does not release toxic substances into the environment because the temperature at which the breakdown of waste occurs is much higher than with incineration. These high temperatures destroy toxic compounds, or create stable residues. Texas found that although the technology was new to the environmental control area, the waste, air management systems, and residue handling systems could be similar to other projects which regulatory agencies have dealt with in the past.

The problem with regulating a new technology such as plasma is that regulators are confronted with new combinations waste streams and technologies. For example, if radioactive wastes are to be put into the plasma container, determining how they are piped in needs to be done very carefully, so that no material escapes. Similarly, an automatic cut off mechanism for waste feed may need to be designed to stop the process if there are fugitive emissions. All unexpected operating conditions must be anticipated by the regulators (as in the case of the addition of a material that the unit is not designed to handle). Specific regulatory confusion exists with plasma technologies as to where to regulate plasma units under 40 CFR 264 (and equivalent state laws). In addition
regulators argue over whether the EPA term “flame” applies to plasma technologies, even though the heat source is indirect. As of 1996, many state agencies had spent considerable amounts of time trying to determine how plasma facilities should be regulated under RCRA.

Texas in July, 1995 was one of five states to have heard of plasma technologies, and only Idaho, California, and Texas had permitted such facilities. The Texas model for permitting these facilities is being examined as a potential template for other states. In 1996 a total of seven states had received permit applications for plasma technologies. Texas in permitting this new type of facility examined the technology and found an alternative permit pathway which would allow them to let the project go forward. The Texas IT team, in acting as the point group for both Quantum and Molten Metals, was able to coordinate between the personnel within the large 3,000 member TNRCC, which expedited the permit process. The following sections describe these cases.

A. Quantum Chemicals Company

Quantum Chemicals Company has recently begun using a plasma technology developed by Texaco to reuse hazardous heavy hydrocarbons in the production of hydrogen. Quantum uses hydrogen to manufacture its chemicals. The production of hydrogen entails oxidizing a feedstock such as natural gas or asphalt. The innovative process allows up to 10% input into the hydrogen manufacturing unit of “alternative” feedstocks which can be comprised of any heavy hydrocarbon (used oil, etc...) In 1996 Quantum used 10.5 million gallons of “alternative” feedstock collected from various companies and from waste brokering firms. Most of this waste would have been designated as “hazardous“ under RCRA. However, RCRA states that if a waste is to be used commercially, i.e. not burned for fuel or disposed of then it is no longer hazardous. Using 10.5 million gallons of waste saved Quantum the cost of purchasing 10.5 million gallons of natural gas or other fuel. In addition, it saved the companies who gave them the materials the cost of disposal (companies pay for transportation only).

In order to get a permit to use the hazardous wastes for hydrogen production, Quantum applied to the Texas Natural Resources Commission for a “recycling
determination." After examination of Quantum's methods, the TNRCC decided that if Quantum followed precise procedures detailed by the TNRCC, it would be allowed to remove and use the hazardous waste from companies. Since the materials were to meet certain specifications, they would be exempt from the definition of hazardous waste and thus would not be subject to the permitting requirements of 40 Code of Federal Regulations (CFR) 264, 266, and 270, and 30 Texas Administrative Code (TAC) 305 and 335.

B. Molten Metals

Molten Metals, like Quantum, requested a recycling determination for a facility it wanted to build adjacent to a Hoechst Celanese Corporation (HCC) facility in Bay City, Texas. Molten Metals proposed to process RCRA waste into a syngas using plasma technology to meet Hoechst syngas specifications. In addition, Molten Metals is recycling HCC waste streams using a molten metal bath to break down the wastes into elemental components and produce hydrochloric acid, metals, and ceramic. Wastes being recycled include chlorinated hydrocarbons, refining and petrochemical wastes, and waste solids such as sludge. Molten Metals will sell back to HCC the syngas it produces from Hoechst’s wastes. Molten Metals is exempt from RCRA regulations for the facility, and must have a storage permit for hazardous waste, keep records and provide proof of product quality and sales, and must document the amount of off-specification products disposed. Molten Metals provides this data every month. As part of the agreement, if Molten Metals does not perform as described in its proposal to the TNRCC, the TNRCC will revoke its recycling determination.

Aside from plasma technologies, many other innovative technologies have been helped through the Texas program. Safe-Seal offers a valve repair service to oil refineries and to chemical companies. The TNRCC designated Safe-Seal as an innovative technology in 1996.

C. The Safe-Seal Company
Safe-Seal produces a product which prevents valves in chemical plants and refineries from leaking. Most chemical plants have between 40,000 and 70,000 valves which are monitored on a quarterly basis. Some refineries have up to 200,000 valves. At any given time 2% - 6% of those valves leak beyond the 500 parts per million allowed by the Clean Air Act Amendments in nonattainment areas such as Houston. In 1996 Safe-Seal obtained an innovative technology designation from the TNRCC. The designation took two months and cost the company nothing. The designation by the TNRCC was instrumental (as well as data on effectiveness) in Safe-Seal’s obtaining a sole source contract with Dow Chemical for their Freeport plant. This contract is worth approximately $1 million annually, with the valve portion of the job comprising 15% of that amount. John Butler, Environmental Manager of Safe-Seal, said that the designation helps the company get contracts for its valve service. However, he said it is not as effective as other designations such as “Best Available Technology (BAT)”. Use of BAT technologies allows plants to take write-offs on taxes that use of non-designated technologies do not.

The TNRCC is sponsoring two “fugitive air emissions” conferences along with the U.S. EPA in the Spring of 1997 which will allow innovative technology vendors such as Safe-Seal to display their products and data. Butler said that these forums always generate business for Safe-Seal because plant managers come to the conferences to see what new technologies are available. Butler described that some difficulties he is having in reaching plant managers is causing him business. If his technology were to be BAT designated, then it would come to the attention of plant managers in their review of the overall economics of the plant. Instead most of his business comes from mechanical supervisors who are responsible for parts economics at plants. Because they are concerned with the costs of individual parts, and not the overall costs of running the plant he feels that his technology does not get the sales it should. Bringing the innovative technology designation to the attention of plant managers and others in the industry who have decision making power could greatly strengthen the effectiveness of the innovative

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46 Leaks can cause significant amounts of emissions. Safe-Seal’s use in 4 plants in 3,000 valves in the Houston area reduced hydrocarbon emissions by 637 tons in one year.
II. Interstate Technology Regulatory Cooperation Working Group

Texas is participating in the ITRC along with California, Massachusetts, and the other member states. Texas was one of the founders of the group and along with California and Massachusetts is participating in site demonstrations. The ITRC has looked at Texas’ permitting of plasma facilities as a model for other states in the nation. The recycling designation that was granted to Molten Metals and Quantum has been studied as a means to permit alternative technologies to incineration.

III. Conclusions

The Texas program in comparison to California’s and Massachusetts’ is small both in personnel (it involves 18 people, 15 of them part time) and in scope (there is no business plan assistance, funding assistance, or regulatory reform efforts). However, the size of the program belies its effectiveness. The TNRCC places the responsibility of verification of technologies with those most likely to affect the use of innovative environmental products: permit program personnel. Placing the duty of evaluating the technologies with the regulators who can most affect their introduction increases the awareness of new technologies within the 3,000 member TNRCC. At the same time the innovative technology designation works as a mechanism to prove to users of innovative technologies in the private and public sectors that those products work.

If one of the major goals in increasing the use of innovative technologies is to increase regulatory flexibility, then changing the attitude of regulators towards new technologies must be a key component of this goal. Those regulators working on permit writing are the ones who perform permit clarification, designate conditional exemptions, approve variances, and create alternative permit pathways. They are the ones who must examine the waste streams in a facility and anticipate all possible unexpected outcomes associated with the introduction of a new technology and decide how to deal with the risks the technology may pose if the unexpected does happen. Therefore, having these
people evaluate the data and literature on new technologies, and providing them with the opportunity to ask questions of the technology developers is extremely important to improving their understanding of how and why they should allow the technologies to be used in their states. The TNRCC program provides this education to its permit writers.

While the Massachusetts program approaches this level of involvement of permit writers, the responsibility of verification is placed with a state agency outside of the Department of Environmental Protection. This insulates permit writers from the risks of introducing the innovative products. The California program retains the role of designating technologies within the environmental agency, but removes permit writers entirely from the certification process.

It has been shown through the work of the ITRC that new technologies are most effectively introduced across regions by including permit writers in the design of technology testing, witnessing of technology demonstrations, and question and answer sessions with developers. Without this extensive involvement, regulators do not have the information they need to include new technologies in their states’ facilities. The work of the Innovative Technology Program in Texas is similar to this process in that Texas permit writers are involved in the review of all aspects of data in the innovative designation procedure.

The cases reviewed in this chapter have shown how this process leads to innovative applications of technologies. For example, state designation was a major factor in Molten Metals, Inc. obtaining its contract with Hoechst-Celanese, and with Safe-Seal obtaining its contract with Dow Chemical. Examples of its effectiveness were seen in this chapter with Safe-Seal and Molten Metals. The IT Group in educating the members of the TNRCC about technologies teaches them to think about new pathways for getting innovative technologies approved. In so doing they are establishing flexibility into the system by targeting problem areas in the permitting system. They are also educating regulators to think differently about innovative technologies.
Chapter Six

Recommendations

Chapters Two, Three, and Four detailed the diverse array of programs that are being tried by the three different states to encourage technologies. Most of the programs address problems associated with barriers created by our regulatory system, either directly or indirectly. They do this by proving to regulators that technologies work, so that new technologies will be deemed acceptable. California’s certification program provides a method by which the state can formally “accept” a technology. Texas has created a system which attempts to address the same problem – lack of acceptance by regulators – by establishing a group to educate regulators about new technologies. The Massachusetts STEP program “verifies” technologies so that regulators will allow them to be used in site cleanups and in industrial facilities.

These strategies are designed to make it easier for technologies to move through the existing technology-based system. Although the programs are speeding up the implementation and use of new technologies some of these efforts can create another layer of bureaucracy to help overcome an existing problems in the regulatory system. Some people interviewed for this thesis felt that verification mechanisms have the potential to become new barriers to technologies. For example, some expressed the opinion that the California certification is becoming a kind of permitting requirement for technologies, and could evolve into another hurdle for technologies. By this they mean that although technologies are not required to be certified in order to be permitted, the certification is becoming a practical necessity. Vendors especially felt that they were losing business in many cases because inspectors, regulators, and clients want to see the certification label. As long as certification can be completed in a reliable, quick, affordable manner, and is available to all who are eligible, it is a good idea. However,
problems arise when certification becomes too slow or too expensive to be of use to new technology vendors wishing to become certified. Thus, any certification or verification program must be able to handle the demand for the service in a timely, affordable way, and not exclude companies if it is not to become another barrier for technology implementation.

Only one state examined in this thesis, and in the nation, is discarding (in some cases) the existing technology-based regulatory standards in favor of performance based standards. This is the Massachusetts STEP program and specifically the new 21E or superfund law and the Environmental Results Program. By allowing Licensed Site Professionals to choose which technologies will be used in site cleanup under the new 21E law, and in removing permits from the 16,000 permitted Massachusetts businesses in favor of self-regulation, the state is removing itself from the decision of what technologies should be used for site cleanup and for industrial processes and discharges. While the application of new technologies under these two programs has shown that performance based standards can encourage the introduction of innovative technologies, the strategy poses risks which certification or verification do not.

Recommendations:

I. Expand States Mechanisms to “Accept” Technologies

Several mechanisms by which states “accept” new technologies have been described in the last three chapters. The certification program is one. STEP’s verification program is another. Texas’ Innovative Technology program is that state’s mechanism. A recent report showed that 25 states have no such mechanism through which innovative technologies can be examined by state DEPs. If states do not have a means to examine, evaluate, and permit new technologies, then new technologies will not be implemented in those states. This has been shown many times. The lack of bioremediation implementation was one example. The inability to permit plasma technologies, and immunoassay are two more.

This acceptance mechanism has two components. The first is the institutional one. To take care of this need, designation of a person or several persons within a state DEP to act as a contact point for innovative technology vendors. In short, state DEPs should implement a system similar to Texas' and Massachusetts' to make sure technologies are reviewed and permitted quickly, instead of being rejected or permitted at a very slow rate because they are novel and unfamiliar. Secondly, a verification mechanism needs to be established so that DEP personnel have information and data with which to evaluate innovative technologies and products.

Since many states do not have the resources to conduct their own verification, and the California certification is beginning to be accepted widely, California’s certification should be used as the mechanism for “proving” technologies to the extent that it can certify all the technologies that want to be certified. The role of Cal/EPA in this capacity would be to review the plethora of literature available on innovative technologies, conduct field tests, and boil down information for state DEPs who do not have the time or resources to do this. However, since the California system is already in danger of being overwhelmed by the volume of requests for certification (450 in the first six months of the program), and by the complexity of conducting the certifications, a federal system might be better. Such a system is currently being developed with the U.S. EPA. Another possibility would be to begin a private program. In this case, Cal/EPA could be in charge of licensing a private group, or could license groups jointly with the U.S. EPA. Establishing a program that all states acknowledge and that can handle the volume of work that is required to verify technologies is essential to the acceptance of technologies by state DEPs.

II. Expand Multi-State Cooperation on Exchange of IT data

The only way that data and technologies can be transferred from state to state without interstate negotiations, coordination, and extensive communication between agencies is by conducting site demonstrations of new technologies in each state. This process is too costly and time consuming to allow the transfer of technologies between regions. Multi-State organizations can solve the problem of multiple demonstrations for
technology vendors. It can also solve the problem of gaining access to the appropriate people in state DEPs. The problems of circumscribed market areas, and a lack of information about reliable technologies are the greatest problems which these companies face. The multi-state groups offer the best solution to these problems.

One of the reasons the Interstate Group has been successful in addressing the concerns of various state DEPs is that the group has achieved consensus on what types of information need to be gathered during testing of technologies. Prior to demonstration of a technology, a draft test plan is circulated to those who will be attending. Regulators can then add comments or request that additional data be gathered during the test. In so doing, individual concerns are addressed, and the technology is much more likely to gain acceptance by the various state agencies. Since state agencies vary in how they permit technologies, and in what they will accept as a rigorous testing procedure, bringing these stakeholders in early in the process is essential for acceptance of the technology.

III. Create An Information Network Based on Findings of the Multi-State Group

The establishment of a single source or outlet for information on environmental technologies that the multi-state group demonstrates and approves would make using innovative technologies much easier for the private sector. At this time, many data bases exist. The National Technology Transfer Center maintains a database of government technologies. Many of the states have individual web sites which list the technologies that have gained approval in the state. For example California’s web sites have the lists of companies that have been certified by the different Boards, and Texas’ site has listed technologies designated as innovative. Massachusetts also has a list of technologies that have been assisted by STEP. However, all of the claims that these technologies make have not been proven to a consistent and accepted standard. The work of the ITRC in demonstrating technologies to an accepted and rigorous standard for all states or in gaining agreement that technologies have been demonstrated to an acceptable degree should be disseminated widely. If this was done, the private sector would benefit greatly.

48 ITRC “Multi State Evaluation of an Expedited Site Characterization Technology” May, 1996
The above recommendations describe a system that helps increase the flexibility of the existing regulatory structure. These measures should be adopted in all states. Another approach -- giving responsibility and decision making over to the private sector has been shown in Massachusetts to encourage the introduction of innovative technologies. Below I have outlined some of the issues involved with implementing such programs. I recommend that these efforts be expanded to a limited degree.

IV. Expand Performance Based Standards

While performance based standards can foster the use of innovative technologies as shown in Chapter Four, the introduction of performance based standards is not a panacea to the overly complex regulations that exist. For one, performance based standards have the potential to be as restrictive as technology based standards and can thwart introduction of new technologies (in part because of the rigidity of the system) 49. Secondly, some industrial processes and sectors can be regulated under performance based standards while others are not suited for such regulation. Third, it is politically difficult to re-write laws governing what the standards should be. Regulators and the public are reluctant to re-open the discussion on how strict the standards are, and are resistant to facing powerful interests in court who want to see regulations rolled back. Fourth, laws governing how and when performance based standards are used are in place and often dictate the use of those standards. Fifth, policy makers are often reluctant to implement performance based standard due to fears that abuses could occur in the implementation of the programs.

All of these considerations must be taken into account when implementing performance based standards. Additionally, designing programs so that they work as intended and monitoring effectively is key to the success of these programs. Massachusetts’ efforts in this area provide an example of how this approach can work, and another where introduction of such a program was less successful. We can draw a

49 John Atcheson “Can We Trust Verification” Environmental Law Journal July/August 1996 A variety of impediments mentioned in the thesis “poorly trained staff...in the regulating institutions has made it nearly impossible to use [the] flexibility [that performance based standards afford]
lesson from the Massachusetts experience. In the case of the use of bioremediation to clean up heating oil underneath private homes, using performance based standards allowed an innovative solution to be used which improved environmental quality and lowered clean up costs. In this instance, the state carefully monitored the bioremediation technology in a pilot study and later drew up guidelines as to how and when it should be introduced. This careful management of the use of a new technology under the 21E law allowed for successful implementation of the technology using the performance based standards. The example seen in ERP where facilities that were not in compliance with their permits were allowed to participate in the pilot phase of the project decreases the public’s confidence in such programs.

Careful monitoring is key to success of the programs also. Currently DEP is monitoring 20% of all state superfund site cleanups under the guidance of Licensed Site Professionals. Since the program and the approach is so new, 100% of all sites should be monitored initially. The percent of monitored sites should be reduced annually until it reaches the 20% goal that the state wants to achieve. The state will still be devoting less resources and money to site cleanup (an important state goal) while at the same time it will be ensuring that Licensed Site Professionals are conducting cleanups as they are required to. Carefully monitoring sites in this way will allow DEP to assess how well the cleanups are being conducted, and will give the public confidence in the process.
V. Conclusion

Although many argue that a large scale move to performance based standards is the most effective method to encourage innovative technologies, the existence of federal regulations regarding the kinds of technologies used and federal permitting regulations mean that a large scale move to performance based standards is not likely in the near future. Additionally, increasing the flexibility of the regulatory system will be necessary in many cases before performance based standards can work. Therefore the recommendations outlined in this chapter will help improve the permitting system as it exists now and also any future use of performance based standards.

The mechanisms outlined in sections I to III of this chapter are necessary measures that the states must take to increase the introduction of environmental technologies. The system for this transfer is already being put in place, and is an ideal mechanism to help companies become commercialized. There is no corollary in the private sector for the Interstate Technology Regulatory Cooperation Working Group which can assist technology companies to the degree that the ITRC does. Coming to agreement on what types of data will be accepted by state environmental agencies and on how it should be collected is the work of the states and not any other organization. Creating this technology transfer system will benefit technology developers, state governments, private users of technologies, and the environment. These are goals that the states are invested in, and in which they are achieving significant successes. They should continue and expand their efforts.
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I. Environmental Industry Overview

Revenues and Employment by Environmental Industry Sector (1994)

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<th>Sector</th>
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<th>Est. Export Revs ($Mil)</th>
<th>Employment (No. of Jobs)</th>
<th>No. of Companies</th>
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Source: Environmental Business International

Environmental Industry Revenue Breakdowns in 1994

- Environmental Services: 21%
- Environmental Resources: 28%
- Environmental Equipment: 51%

Source: Environmental Business International
## 1994 State Environmental Industries by Size

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<th>State</th>
<th>Total Env'l Industry Revenues</th>
<th>Environmental Exports Revenues</th>
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<td>1,684</td>
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<td>North Dakota</td>
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**Total:** 207,054 14,660 2,929,255 18,002

Source: Environmental Business International Inc. (San Diego, Calif.)

Note: All Revenue Figures Are Listed in $Millions
## ATTACHMENT 3: A List of California EPA (Toxic Substances Control Division) Certified Technologies

<table>
<thead>
<tr>
<th>Certified Technology</th>
<th>Certificate Holder</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Certificate Number: 94-01-001</strong></td>
<td>T.F. Purifier, Inc.</td>
</tr>
<tr>
<td>Electric Mobile Oil Refiner</td>
<td>3020 High Ridge Road, Suite 100</td>
</tr>
<tr>
<td></td>
<td>Boynton Beach, FL 33426</td>
</tr>
<tr>
<td></td>
<td>(800) 488-0577</td>
</tr>
<tr>
<td><strong>Certificate Number: 94-01-002</strong></td>
<td>Asahi America Inc.</td>
</tr>
<tr>
<td>Double Containment Piping System and</td>
<td>P.O. Box 653</td>
</tr>
<tr>
<td>Associated Fittings</td>
<td>Malden, MA 02148</td>
</tr>
<tr>
<td></td>
<td>(800) 343-3618</td>
</tr>
<tr>
<td><strong>Certificate Number: 94-01-003</strong></td>
<td>American Bio-Safety, Inc.</td>
</tr>
<tr>
<td>Formalex® and FRC-3®</td>
<td>4322 Anthony Court, #4</td>
</tr>
<tr>
<td></td>
<td>Rocklin, CA 95677</td>
</tr>
<tr>
<td></td>
<td>(916) 652-8021</td>
</tr>
<tr>
<td><strong>Certificate Number: 94-01-004</strong></td>
<td>Ensys, Inc.</td>
</tr>
<tr>
<td>PCB Risc® Soil Test Kit, an enzyme</td>
<td>[merged with:</td>
</tr>
<tr>
<td>immunoassay for fast, semi-quantitative</td>
<td>•</td>
</tr>
<tr>
<td>field measurements of polychlorinated</td>
<td>•</td>
</tr>
<tr>
<td>biphenyls (PCBs) in soil</td>
<td>• Strategic Diagnostics Corp.</td>
</tr>
<tr>
<td></td>
<td>375 Pheasant Run</td>
</tr>
<tr>
<td></td>
<td>Newtown, PA 18940</td>
</tr>
<tr>
<td></td>
<td>(800) 544-8881</td>
</tr>
<tr>
<td><strong>Certificate Number: 95-01-005</strong></td>
<td>Millipore, Inc.</td>
</tr>
<tr>
<td>Enviro-Gard®</td>
<td>[merged with:</td>
</tr>
<tr>
<td></td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>• Strategic Diagnostics Corp.</td>
</tr>
<tr>
<td></td>
<td>375 Pheasant Run</td>
</tr>
<tr>
<td></td>
<td>Newtown, PA 18940</td>
</tr>
<tr>
<td></td>
<td>(800) 544-8881</td>
</tr>
<tr>
<td>Certificate Number: 94-01-006</td>
<td>Ohmicron PCB RaPID Assay®, an enzyme immunoassay for fast, semi-quantitative field measurements of polychlorinated biphenyls (PCBs) in soil and water</td>
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<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Ohmicron Environmental Diagnostics, Inc.</strong> [merged with:</td>
<td></td>
</tr>
</tbody>
</table>
|   • Strategic Diagnostics Corp.  
    375 Pheasant Run  
    Newtown, PA 18940  
    (800) 544-8881 |
| Certificate Number: 94-01-007 | TriOx ozone treatment for cooling tower water |
| Certificate Number: 95-01-008 | VYTAC 10F for treating 10% formalin |
| **Trend Scientific, Inc.**  
  1400 Unity Street, NW  
  Ramsey, MN 55303  
  (612) 323-7800  
  or [http://www.pro.med.umn.edu/bmec/company_folder/tsi.html] |
| Certificate Number: 95-01-009 | PCB D TECH® Assay, an enzyme immunoassay for fast, semi-quantitative field measurement of polychlorinated biphenyls (PCBs) in soils |
| **Strategic Diagnostics, Inc.**  
  375 Pheasant Run  
  Newtown, PA 18940  
  (800) 544-8881 |
| Certificate Number: 95-01-010 | Ohmicron RaPID Assay® System, an enzyme-linked immunosorbent assay for fast, semi-quantitative field measurements of pentachlorophenol (PCP) in water and soil |
| **Ohmicron Environmental Diagnostics** [merged with: |
|   • Strategic Diagnostics Corp.  
    375 Pheasant Run  
    Newtown, PA 18940  
    (800) 544-8881 |
| Certificate Number: 96-02-017 | Clayton Industries Steam Generator  
|------------------------------|---------------------------------|  
| Clayton Industries Steam Generator  
Model (S)EG504-LNB, natural gas-fired, water tube-type steam generator with fuel economizer (heat input 20.9 MM BTU/hr; heat output 500 horsepower BHP) emitting less than 30 ppm oxides of nitrogen (NOx) and less than 300 ppm carbon monoxide (CO), both pollutants corrected to 3% oxygen AND <http://arbis.arb.ca.gov/eqpr/eoclavl6.pdf> | Clayton Industries  
4213 North Temple City Boulevard  
P.O. Box 5530  
El Monte, CA 91734  
(800) 423-4585 |  
| Certificate Number: 96-02-018 | Clayton Industries Steam Generator  
Model (S)EG204-LNB, natural gas-fired, water tube-type steam generator with fuel economizer (heat input 8.37 MM BTU/hr; heat output 200 horsepower BHP) emitting less than 30 ppm oxides of nitrogen (NOx) and less than 300 ppm carbon monoxide (CO), both pollutants corrected to 3% oxygen AND <http://arbis.arb.ca.gov/eqpr/eoclavl2.pdf> | Clayton Industries  
4213 North Temple City Boulevard  
P.O. Box 5530  
El Monte, CA 91734  
(800) 423-4585 |  
| Certificate Number: 96-02-019 | Clayton Industries Steam Generator  
Model (S)EG254-LNB, natural gas-fired, water tube-type steam generator with fuel economizer (heat input 10.5 MM BTU/hr; heat output 250 horsepower BHP) emitting less than 30 ppm oxides of nitrogen (NOx) and less than 300 ppm carbon monoxide (CO), both pollutants corrected to 3% oxygen AND <http://arbis.arb.ca.gov/eqpr/eoclavl3.pdf> | Clayton Industries  
4213 North Temple City Boulevard  
P.O. Box 5530  
El Monte, CA 91734  
(800) 423-4585 |
<p>| Certificate Number: 96-02-013 | Miura Boiler West Boiler LX-100, natural gas-fired, water tube-type high pressure boiler (heat input 4.2 MM BTU/hr; heat output 100 horsepower BHP) emitting less than 30 ppm oxides of nitrogen (NO\textsubscript{x}) and less than 130 ppm carbon monoxide (CO), both pollutants corrected to 3% oxygen AND <a href="http://arbis.arb.ca.gov/eqpr/eomiur6.pdf">http://arbis.arb.ca.gov/eqpr/eomiur6.pdf</a> |
| Certificate Number: 96-02-014 | Miura Boiler West Boiler LXW-100, natural gas-fired, water tube-type high pressure boiler (heat input 4.2 MM BTU/hr; heat output 100 horsepower BHP) emitting less than 30 ppm oxides of nitrogen (NO\textsubscript{x}) and less than 130 ppm carbon monoxide (CO), both pollutants corrected to 3% oxygen AND <a href="http://arbis.arb.ca.gov/eqpr/eomiur7.pdf">http://arbis.arb.ca.gov/eqpr/eomiur7.pdf</a> |
| Certificate Number: 96-02-015 | Miura Boiler West Boiler LXL-100, natural gas-fired, water tube-type high pressure boiler (heat input 4.2 MM BTU/hr; heat output 100 horsepower BHP) emitting less than 30 ppm oxides of nitrogen (NO\textsubscript{x}) and less than 130 ppm carbon monoxide (CO), both pollutants corrected to 3% oxygen AND <a href="http://arbis.arb.ca.gov/eqpr/eomiur8.pdf">http://arbis.arb.ca.gov/eqpr/eomiur8.pdf</a> |
| Certificate Number: 96-02-016 | Parker Boiler Company Boiler 70L, Burner MFB-36, natural gas-fired, steam pressure boiler (heat input 2.94 MM BTU/hr; heat output 70 horsepower BHP) emitting less than 30 ppm oxides of nitrogen (NO\textsubscript{x}) and less than 130 ppm carbon monoxide (CO), both pollutants corrected to 3% oxygen AND <a href="http://arbis.arb.ca.gov/eqpr/eopark11.pdf">http://arbis.arb.ca.gov/eqpr/eopark11.pdf</a> |</p>
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<th>Certificate Number: 96-01-021</th>
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<tr>
<td>Site Characterization Analysis Penetrometer System with Laser-Induced Fluorometry (SCAPS-LIF)</td>
<td>Naval Command, Control and Ocean Surveillance Center</td>
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<tr>
<td></td>
<td>RDT&amp;E Division (NRaD), Code D361</td>
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<td></td>
<td>U.S. Navy</td>
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<tr>
<td></td>
<td>53475 Strothe Road</td>
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<td></td>
<td>San Diego, CA 92152-6325</td>
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<th>Certificate Number: 96-01-022</th>
<th>Ohmicron Environmental Diagnostics</th>
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<tr>
<td>PAH RaPID Assay®, a semi-quantitative immunoassay for detection for polynucleated aromatic hydrocarbons in soil and water</td>
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<tr>
<td></td>
<td>● Strategic Diagnostics Corp.</td>
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<tr>
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<td>375 Pheasant Run</td>
</tr>
<tr>
<td></td>
<td>Newtown, PA 18940</td>
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<tr>
<td></td>
<td>(800) 544-8881</td>
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<th>Certificate Number: 96-02-001</th>
<th>Hasstech, Inc.</th>
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<tbody>
<tr>
<td>Hasstech VCP-3A Vacuum Assist System, designed for control of gasoline vapor emissions during motor vehicle fueling operations: Executive Order G-70-164</td>
<td>6985 Flanders Drive</td>
</tr>
<tr>
<td></td>
<td>San Diego, CA 92121</td>
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<td>(619) 457-5880</td>
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<tr>
<th>Certificate Number: 96-02-002</th>
<th>Healy Systems, Inc.</th>
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<td>Healy Vacuum Assist Phase II System with Model 600 Nozzle, designed for the control of gasoline vapor emissions during motor vehicle fueling operations: Executive Order G-70-165</td>
<td>17 Hampshire Drive</td>
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<td>Hudson, NH 03051</td>
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<th>Certificate Number: 96-02-003</th>
<th>Wayne Division, Dresser Industries</th>
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<td>Dresser/Wayne Wayne Vac System, designed for the control of gasoline vapor emissions during motor vehicle fueling operations: Executive Order G-70-153</td>
<td>124 West College Avenue</td>
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<tr>
<td></td>
<td>Salisbury, MD 21802-1859</td>
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<tr>
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<td>(410) 548-6989</td>
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<th>Certificate Number: 96-02-004</th>
<th>Tokheim Corporation</th>
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<td>Tokheim MaxVac System, designed for the control of gasoline vapor emissions during motor vehicle fueling operations: Executive Order G-70-154</td>
<td>3323 Watt Avenue, Suite 290</td>
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<tr>
<td></td>
<td>Sacramento, CA 95821</td>
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<tr>
<td>Certificate Number: 96-01-016</td>
<td>Millipore Corporation</td>
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<tr>
<td>EnviroGard®; TNT in Soil Test Kit, a semi-quantitative immunoassay system for detection of trinitrotoluene in soil</td>
<td>[merged with:</td>
</tr>
<tr>
<td>Strategic Diagnostics Corp. 375 Pheasant Run Newtown, PA 18940 (800) 544-8881]</td>
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<tr>
<th>Certificate Number: 96-01-017</th>
<th>Ohmicron Environmental Diagnostics</th>
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<tr>
<td>TNT RaPID Assay®, a semi-quantitative immunoassay for the detection of trinitrotoluene in waste and soil</td>
<td>[merged with:</td>
</tr>
<tr>
<td>Strategic Diagnostics Corp. 375 Pheasant Run Newtown, PA 18940 (800) 544-8881]</td>
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<tr>
<th>Certificate Number: 96-01-018</th>
<th>Millipore Corporation</th>
</tr>
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<tbody>
<tr>
<td>EnviroGard®; Petroleum Fuel in Soil Test Kit (Total BTEX), a semi-quantitative immunoassay for detection of benzene, toluene, ethylbenzene, and xylenes (BTEX) in soil</td>
<td>[merged with:</td>
</tr>
<tr>
<td>Strategic Diagnostics Corp. 375 Pheasant Run Newtown, PA 18940 (800) 544-8881]</td>
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<tr>
<th>Certificate Number: 96-01-019</th>
<th>Strategic Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>D TECH®; TNT Immunoassay Test System, a semi-quantitative immunoassay for the detection of trinitrotoluene in water and soil</td>
<td>375 Pheasant Run Newtown, PA 18940 (800) 544-8881</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Certificate Number: 96-01-020</th>
<th>Strategic Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>D TECHNOLOGY; RDX Immunoassay Test System, a semi-quantitative immunoassay for the detection of cyclotrimethylenetrinitramine (RDX) in water and soil</td>
<td>375 Pheasant Run Newtown, PA 18940 (800) 544-8881</td>
</tr>
<tr>
<td>Certificate Number: 95-01-011</td>
<td>Ohmicron Environmental Diagnostics</td>
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<tr>
<td>-------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Ohmicron Total BTEX RaPID Assay®, an enzyme-linked immunosorbent assay for fast, semi-quantitative field measurements of petroleum hydrocarbons in water and soil</td>
<td>(merged with:</td>
</tr>
<tr>
<td></td>
<td>• Strategic Diagnostics Corp.</td>
</tr>
<tr>
<td></td>
<td>375 Pheasant Run</td>
</tr>
<tr>
<td></td>
<td>Newtown, PA 18940</td>
</tr>
<tr>
<td></td>
<td>(800) 544-8881</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Certificate Number: 95-01-012</th>
<th>Ensys, Inc.</th>
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</thead>
<tbody>
<tr>
<td>PETRO RiSc™ Soil Test System, an enzyme-linked immunosorbent assay for fast, semi-quantitative field measurements of total petroleum hydrocarbons in soil</td>
<td>(merged with:</td>
</tr>
<tr>
<td></td>
<td>• Strategic Diagnostics Corp.</td>
</tr>
<tr>
<td></td>
<td>375 Pheasant Run</td>
</tr>
<tr>
<td></td>
<td>Newtown, PA 18940</td>
</tr>
<tr>
<td></td>
<td>(800) 544-8881</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Certificate Number: 95-01-013</th>
<th>Strategic Diagnostics, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D TECH™ BTEX Immunoassay Test System, an enzyme-linked immunosorbent assay for fast, semi-quantitative field measurements of benzene, toluene, ethylbenzene, and xylenes (BTEX) in water and soil</td>
<td>375 Pheasant Run</td>
</tr>
<tr>
<td></td>
<td>Newtown, PA 18940</td>
</tr>
<tr>
<td></td>
<td>(800) 544-8881</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Certificate Number: 95-01-014</th>
<th>BioNebraska, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BiMelyze Field Screening Assay, a semi-quantitative immunoassay system for the detection of mercury in water</td>
<td>3820 NW 46th Street</td>
</tr>
<tr>
<td></td>
<td>Lincoln, NE 68524</td>
</tr>
<tr>
<td></td>
<td>(402) 470-2100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Certificate Number: 95-01-015</th>
<th>BOC Coatings Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airco Coating Technology (ACT) Surface Treatment System, cold gas plasma systems for surface cleaning of various plastic and metallic parts, and altering the surface chemistry of various plastic parts</td>
<td>4020 Pike Lane</td>
</tr>
<tr>
<td></td>
<td>Concord, CA 94520</td>
</tr>
<tr>
<td></td>
<td>(510) 680-0501</td>
</tr>
</tbody>
</table>