Examination of the Factors and Issues for an Environmental Technology Utilization Partnership between the Private Sector and the Department of Energy

DOE/ER/12951--T1

Final Report

Prepared for

Department of Energy

Cooperative Agreement No. DE-FC02-90ER12951

May 1997

prepared by

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Review of Joe Palladino Files

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Task 1 - Review of Files from Joe Palladino

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Background Book: Barriers to Technology Integration and Strategy for Industrial Collaboration - April 1991

Barriers discussed during meeting included:

- Inconsistent operational philosophy
- Need for streamlining operations
- Need to determine markets
- Methods for handling of proprietary information and data
- Support for Recoupment

Overview of Technology Transfer Workshop - December 1992

Lessons learned:

- Program offices need to overcome 'creeping bureaucracy'
- Workshop provided opportunities to reevaluate CRADA processes and procedures
- Emphasis should be on quality, not quantity, of CRADAs
- Other forms of collaboration may also be fruitful (e.g., SMPC, HTSC pilot centers)

Major issues plaguing successful technology transfer

- Product liability
- U.S. competitiveness concerns

Industry feedback from November meeting at Dulles Airport:

Perceived problems with DoE planning & budget processes

- Lack of a clear, uniform of technology transfer
- Need better mechanisms for input into DoE R&D planning process
- Industry members recommend major program initiatives (Manhattan project)
- Industry concerns over risks associated with multi-year projects
- Protracted industry-DoE CRADA negotiations

Perceived problems with multi-party agreements

- Agreements stuck in limbo between DoE Program elements
- Industry perceives labs competing among themselves, as well as with industry
- DoE & other agencies need to provide 'one-stop' shopping for industry

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- DoE/lab capabilities not well understood
- DoE inability to make contact with more than a small group of potential partners
- short- and long-term benefits to U.S. Economy; taxpayers needs to be clearly identified and communications achieved
- DoE needs to establish a more formalized method of communication internally

Perceived problems concerning education & training opportunities

- Industry perceives lack of uniform commitment, process among DoE program elements
- Field offices and labs define and respond to editorial & substantive definition of language differently
- education & training opportunities must be expanded and guidance to industry to take advantage of opportunities should be regularly and consistently issued
- DoE's cultural changes need to be accelerated

Industrial Executive Roundtable

Folder containing meeting notes from several meetings. The following is a review of the meetings:

1. January 14, 1993

Contains transcript of meeting.

"Current situation is federally funded research and applied technology development occurs without marketplace customers. We have basic research and technology looking for problems. Need to bring R&D and industry together early in the cycle".

"The Enterprise is associated at the present time as a concept to drive both the push and pull of technologies into rapid commercialization [....] I do see an organization, external to the DoE, moving to implement the concept of the Enterprise reality very rapidly".

2. March 12, 1993

Contains transcript of meeting.

"12 to 18 Months ago had grand opportunity - previous Secretary met with the lab directors - started study on how to design system in which we can create rapid delivery of new technologies and implementation and commercialization of those technologies within the ER/WM arena"

"Present situation is such that for a principal investigator in a lab there is no driving force to commercialize."

"DoE's goal is to go out of business in the year 2005".

"Asking the national labs to solve environmental problems is like asking IBM to go into pharmaceutical production according to an editorial I recently read".

"What we are attempting to do is to create a situation where the inventor of a technology and the private sector form a partnership to move technology through the system".

"If a national lab invented cornflakes, it would come packaged in a satellite, it wouldn't be in a simple paper box".

"You have an opportunity to create a new role form DoE since we're now safe from Communism. Are regulations going to change, or am I wasting my time"?

"Industry is willing to take technology and capital risks. But technology risks, capital risk, and a risk in a process that doesn't give us any benchmarks on how to succeed is a problem".

"I'm not going to spend money getting performance data unless I know I have a customer lined up. I can't convince him to buy it if I don't have performance data. That's the real value to having labs perform the test. The labs materially assist private sector to commercialize. I don't call that a soft service".

3. April 14, 1993

Contains transcript of meeting.

"The 'enterprise' concept embraced the need to have strong collaboration between labs, DoE, states, industry, etc. Get the U.S. in a world leadership role".

"Changed name to the Alliance which is a 501(c)(3) organization". **Is this the same as the 'enterprise'?...yes**

"Need to show return on investment".

"The Alliance purpose is to develop a system like Japan and Germany".

[Sheila Conway] "I'm the chief operating officer on an interim basis for the Alliance".

"If I invent a computer and develop it so that I can sell the computer to you, then I can sell the same unit to all of you. If I develop an aspirin tablet and I get approval from FDA, everyone can buy it and use it. Let's come to environmental technologies---when I develop an environmental technology, I don't get approval as a technology, I can only get approval to use the technology at that particular location...If you have a permitted technology, people will come. If all you have is a technology people will not come".

"I've done millions of dollars of business by a hand shake with the paperwork to follow. Why can't we do business with the government that way?"

"The issue is, when you test and demo on a federal facility, if it works you are then forbidden to bid on it on that site. It gives you unfair advantage".

4. April 14, 1993

Contains transcript of meeting.

"The Alliance makes good sense, but unless changes occur within the regulatory environment, as well as governmental thinking, operations like the Alliance concept will not have a chance to work".

"One barrier to new technology utilization is: when you go to work on a project with a ROD, the ROD is based on performance".

"Barriers to developing small business: (1) Procurement. Many small businesses have gone out of business waiting for procurements that they have won to come out of the procurement shop. (2) Need special 'ease to government procurement' for people who are taking technologies out of the federal laboratories".

"Problem with CRADA's is that DoE is the invisible partner. DoE does not have a signature spot but they have to buy in, because they have the programmatic funds. The labs don't have their own money. This destroys the part of the 'market-pull' concept that DoE currently expounds".

5. August 12, 1993

[Important paper...a copy is in appendix A]

1. Individuals from the DoE, Los Alamos Lab, and Sandia Lab hosted tables during a working lunch at the "Environmental Bottom Line" briefing for small business. Questions asked:
2. How can we do a better job of communicating environmental opportunities to you?
3. Would you like to be on a DoE/HQ, LANL, &/or SNL database of environmental firms who would receive bidding and contracting information?
4. How can we facilitate technology transfer to and technology commercialization by small business?

5. Do you prefer our program [a regionally-oriented focus] or a DoE-wide focus for business opportunities?
6. Has this workshop been a valuable experience for you?
7. What other types of information would you like to see provided at future workshops?
8. How often should these types of workshops be held?
9. What are the barriers for you in doing business with the DoE. LANL, and/or SNL?
10. Does anyone have a success story in working with the DoE, LANL, and/or SNL?

Statement of Hazel R. O'Leary, May 26, 1993

Policy on contract management. **[All even-numbered pages missing, may be we can get a copy from Joe Palladino]**

Improving Industry Access - September 1993

Questions asked of LANL:

What are the current mechanisms for businesses to gain information on current subcontractors and potential business opportunities?

What technologies are licensable?

What is the best way to track, forecast and disseminate information on business opportunities?

What are the current prime and subprime contracts and their scopes. schedules, and costs?

What subcontracting is required in these contracts?

National Security Industrial Association, White Paper, Barriers & Disincentives to Environmental Contracting - no date

Barriers & disincentives discourage many from pursuing environmental work

Inconsistent federal policies

Appendix A - Department of Energy Industry Partners Feedback Meeting Summary Report - November 1992

Introduction

The Department of Energy (DOE) held a meeting on November 12, 1992 to evaluate the DOE relations with industry and university partners. The goal of this meeting was to receive feedback from the DOE industry and university partners for the identification of opportunities to improve the DOE cooperative work processes with the private sector. The meeting was designed to collect information and to turn that information into action to improve private sector partnerships with DOE.

Participatory Group Activities and Processes

The general approach taken by DOE for the Industry Partners Feedback Meeting was to arrange a day long series of meetings with representatives from industry, not-for-profit organizations, and universities who participate in the DOE technology transfer program to identify areas of strength as well as problem areas, and to identify possible solutions for improving the problem areas. Participants in the meeting were invited by DOE to be a sample representation from the DOE industry partners. Observers from DOE (headquarters, field offices, and labs) were present but were asked to listen, not to participate in the meeting discussions. The meeting process included the following:

1. A morning plenary session that included introductory addresses by senior DOE officials, including Admiral Watkins, Secretary of the Department of Energy, and a charge to the breakout groups.

2. Morning breakout sessions to elicit feedback from participants in three areas: how the National Technology Initiatives (NTI) program has worked; what has worked well in The DOE technology transfer program; and what aspects of The DOE technology transfer program need work.

3. A lunch plenary session that included a brief presentation from each breakout group summarizing their morning discussion, followed by a charge to the breakout groups for the afternoon session.

4. Afternoon breakout sessions to elicit feedback from participants on possible solutions to improve the problem areas identified in the morning breakout sessions.

5. Closing plenary session that included a brief presentation from each breakout group summarizing their afternoon discussion, followed by closing remarks by Secretary Watkins.

The breakout sessions were organized into six separate groups. Four groups focused on technology transfer through cooperative agreements. One group focused on small business and technology transfer, while the final group focused

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organizations responsible for implementing the recommended solutions and solutions that required legislative changes were to be identified.

Summary of Results

The summary of results that follows is organized by focus of the breakout groups -- cooperative agreements, small business, and not-for-profit organizations. Comments captured from each breakout group are presented in the appendices to this report. Actual operation of the individual sessions followed a modified approach as proposed and accepted by each group. The summary includes a statement of the modified processes used by each group.

Cooperative Agreements Breakout Groups

Four of the six breakout groups focused on technology transfer through cooperative agreements. The type of cooperative agreements to be discussed was not limited; nevertheless, most participants in these groups focused their discussion on the cooperative research and development agreement (CRADA). The cooperative agreement groups generally followed the DOE plan as described above. Most groups chose not to rank identified problem areas. In addition, a strict brainstorming process to generate ideas was not followed, rather a general discussion format was preferred by most of these groups. This summary presents major findings across these four breakout groups.

National Technical Initiatives Regional Meetings. Some of the industrial participants had attended one or more of the NTI Regional Meetings. According to the industrial participants, the meetings were good public relations and provided an excellent overview of the capabilities of the labs. In addition the meetings helped establish contact with key personnel. The program, however, may have been oversold at the NTI Regional Meetings, and the meetings may have raised false expectations. Specifically, industrial participants suggested including more information about the contracting process to establish partnerships. From the industrial participants, the general consensus was that the NTI Regional Meetings were useful and essential for NTI.

What Is Good about DOE Efforts in Technology Transfer. The industrial participants agreed that interaction between DOE and industry was a major component in what is good about DOE efforts in technology transfer. Industrial participants praised DOE recognition that technology transfer is needed and DOE support of technology transfer. The involvement of DOE personnel and the ability of industry to interact directly with DOE personnel was cited as an important aspect of technology transfer. This interaction occurred across all levels of DOE and across functions (e.g., legal, management, and technical). In addition, the ability of DOE to work with and aid in forming industry consortia was mentioned by two of the breakout groups.

Critical characteristics for technology transfer that presently are occurring at DOE (or at least, some parts of DOE) include:

- High level support of technology transfer at DOE.

- Knowledgeable and involved science and engineering personnel who assist in problem understanding and provide enabling technologies and processes to industry.
- Intersection of DOE and industrial partner interests in accomplishing the cooperative agreement. One group reported that "what DOE wants done, they will help get it done."

In one of the cooperative agreement breakout groups, Mr. Lenmark, an industrial participant, presented a summary of the excellent support provided by the Lawrence Berkeley Lab (LBL), especially the acting president of the University of California, Berkeley. Mr. Lenmark represents a small company interested in assistance from LBL. He heard of the opportunity from a friend who suggested that he contact LBL for help. His initial concern was that small companies need a low initial cost. This could be bundled by DOE sharing in the subsequent profits to accommodate the high cost ($150K). This cost could have proven to be a deterrent for obtaining the technology. A meeting at LBL was held and within hours a new policy that enabled Mr. Lenmark to pursue a cooperative agreement was arranged. The key, Mr. Lenmark believes, was to develop a very specific definition of each problem.

Other industrial participants cited positive experiences with Los Alamos Pilot Centers and Oak Ridge National Laboratory.

What Needs Work in DOE Efforts in Technology Transfer. According to industrial participants, aspects of DOE technology transfer efforts that need work included time and funding problems, technology ownership issues, legislative and regulatory problems, information and cultural problems, difficulties in dealing with multiple national laboratories, and problems of concern to multi-national corporations.

Time and funding problems were cited as major inhibitors in each of the four cooperative agreement breakout groups. Time problems included time required to get an agreement in place as well as problems with the timing of funding. One industrial participant recounted his experience that the time required to get a task order under an umbrella CRADA was as long as the time required to get the umbrella CRADA in place. Several groups mentioned the lack of funding for participation in CRADAs by the national labs was a major problem. Participants across the breakout groups cited lack of DOE funding as a barrier for participation in cooperative agreements by small businesses and that the initial investment was too high for many small businesses.

Technology ownership was cited as a major issue by participants in three of four cooperative agreement breakout groups. One group suggested improvement was needed in the intellectual property rights (IPR) process. Another group cited the lack of protection for inventions and trade secrets, apart from the patent process, as a major problem. Terms and conditions issues also were cited as a problem area. Another aspect of technology ownership that was a major issue for two groups was the role of DOE in selecting "who gets what." The implications of technology transfer decisions by DOE can affect the survivability of organizations in the private sector. Both groups that raised this issue mentioned it was a very important problem.

Legislative and regulatory problems were also frequently cited as areas that need work. Participants suggested studying the NASA CRADA model as a approach to address some of the policy and regulatory problems. Lack of a legislative basis for technology transfer was cited by one group as a major problem.

Information and cultural problems were raised as other major areas that need to be improved. Cultural problems cited included the need for better communication, the enormous cultural change needed for management and operating contractors (M&O), reluctance on the part of some lab operators to share their rights to technology, and lack of uniform commitment and involvement to technology transfer across all components of DOE.

Difficulties in dealing with multi-national corporations and multiple national laboratories were also cited as problem areas. The inability to establish partnerships across several national labs using a CRADA was cited as a problem by two groups. The variation in processes across national labs was detailed in another group as a problem.

Recommended Solutions. Each breakout group recommended solutions for the problem areas it identified Several solutions were echoed by many of the cooperative agreement breakout groups. For instance, developing a combined DOE/industry advisory council to address issues in technology transfer was a solution recommended by three of the four cooperative agreement breakout groups. Improving communication between DOE and industry by conducting workshops, preparing and distributing a manual of guidelines for technology transfer, and documenting the CRADA approval process were also suggested. Budget allocation for technology transfer was suggested by several groups as a key component in solving a variety of problems. Evaluating the CRADA process so that it can be streamlined and improved was a solution recommended by the majority of industrial participants.

Small Business Breakout Group

The Small Business Breakout Group had the rare opportunity to interact during the morning session with Admiral Watkins, Secretary of the Department of Energy. Because of this, the group did not want to stay with the DOE planned meeting format. The group unanimously agreed that they would prefer to conduct the morning session as a town meeting, with participants asking Admiral Watkins questions and soliciting his feedback.

During the morning session, 164 ideas were captured during the interaction between the Small Business participants and Admiral Watkins. These ideas centered on several main themes including:

- Need for clearer definitions of NTI
- Better communication between the laboratories and small business
- Research and Development issues
- Planning
- Small Business/Industry Advisory Mechanisms
- Predictability
- Tools

Because of the nature of the morning discussion, possible actions to mitigate some of the areas of concern discussed were suggested by both the participants and Admiral Watkins. These included:

- More Small Business workshops
- Small Business oriented communication
- Solve transitioning problems between laboratories and small business
- Better Inter-agency coordination
- Better training
- Better technology transfer

The priority of the problem areas and representative solutions include:

- Research and Development
  - Implement a market assessment of products that are being researched and developed
  - Standardize an abstract of all of the research and development that is occurring
- Small Business/Industry Advisory Mechanisms
  - Review abstracts standardized in the laboratory research and development
  - Provide a Small Business advisory panel to give DOE a substantial list of what they want implemented
- Predictability, Continuity and Funding
  - Need to have phased procurement
  - Need to better disseminate Small Business Transfer Pilot Program
- Tools/Mechanisms to make things happen - contracts
  - There should be a special model CRADA designed for Small Business
  - Need to export EM process to other PSOs
- Intellectual Property Rights
  - Offer licensing opportunities to Small Business
  - Create a summary of DOE Intellectual Property explanations

- Lab Competition
  - Need a clear definition of the problem
  - Laboratories should not be competing with industry for program dollars
- Communication
  - Publicize information through the national press
  - Establish a regional focal point for relaying information; also a functional area focal point that would cut across regions
- Definitions
  - Establish the definition of the relationship between NTI, CRADAs and international competitiveness
  - Create a directory of DOE acronyms

Not-for-Profit Organizations Breakout Group

The Not-for-Profit organization breakout group closely followed the DOE planned process.

National Technical Initiatives Regional Meetings. The Not-for-Profit Organizations group participants voiced the value of the underlying concept of the meetings: sharing technology information.

What Is Good about DOE Efforts in Technology Transfer. The participants made several comments concerning the benefit of attempting such programs, i.e. sharing of ideas is always helpful. National funding of research projects is appreciated, even on a cost-share basis. "Opening the Labs" was considered a positive step.

What Needs Work in DOE Efforts in Technology Transfer. The four principal categories organized by the participants were:

1. Process - concerning what the participants perceived to be a fairly inflexible and time consuming administrative process. The volume of information required in the program was mentioned several times.

2. Communication - between both DOE and its partners, as well as internal communication within DOE. Again, the volume of information that was required from the DOE partner was considered a substantial problem.

3. Mission - or, the major intent behind the technology transfer programs. Participants identified the necessity of clarifying the program mission. Primarily, the participants were concerned with the polarity between basic and applied research and the lack of clarity as to which would be emphasized in the DOE programs.

4. Requirement for Matching Funds on the part of the DOE partner - rather than full funding by DOE. Participants emphasized the problems associated with availability of financial resources in a Not-for-Profit organization.

Recommended Solutions. Solutions offered by Not-for-Profit Organization group participants fell into four categories:

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21. National Technology Initiative responsible for signing CRADA.
22. DOE needs to reach out to the industry.
23. Inform industries of National Technology Initiative
24. Identify the businesses needing the technology that is in the laboratories.
25. National Technology Initiative very effective within small businesses.
26. National Technology Initiative has caused heightened interest.
27. Conflict of interest not seen by some the business people
28. Scientists in lab have option to go into the business world.
29. Scientists leaving lab has been tried but not generally used
30. National Technology Initiative has been effective in bringing tech to university - clinical testing.
31. EM30 & EM40 need to be more involved in the technology transfer process.
32. Workshops are effective.
33. What is the view of CRADA toward small business?
34. Communication needs to be defined within small business.
35. What is the mechanism for communication?
36. Push hard for Small Business
37. Information on meetings come very late. Some attendees were faxed notice of this meeting only a couple of days ago.
38. Two-way communication needs to be established between small business and DOE
39. Environmental program is prevalent.
40. Communication is fine think some participants.
41. Others felt there is a need to reinforce communication channel.
42. CRADA meant to be 2-way street.
43. Mixed success with CRADA.
44. The job of DOE is not to solve national problems.
45. What is dual use of technology?
46. National Technology Initiative is not meant to solve national problems in labs.
47. Who is forcing technology problems?
48. Dual use technology.
49. Establish end-user relationship.

50. Don't generate standards for national needs.
51. May develop into something bigger than needs to be.
52. Only one way vision of communication process.
53. Major objective -- 2-way street.
54. Word of mouth is big communication factor.
55. No one place to ask questions/no focus.
56. Public information office not a source for information about National Technology Initiative.
57. Not everybody is a participant with National Technology Initiative.
58. No clean communication process for small business.
59. Needs to be identifiable person(or shop) at labs.
60. Need list of labs technology process.
61. Need standard information going out to industries about important information.
62. Congress is aware of National Technology Initiative.
63. Large majority of Congress supports National Technology Initiative.
64. We need to fight those opposed.
65. How do you get the word out?
66. Small business has good outreach.
67. List of names relating to important topics at hand.
68. Help overcome bureaucracy.
69. Office dedicated to tech transfer with information on how to get around labs as well as names and places.
70. List labs, general specialty and phone # to call.
71. Press is a way to get information on National Technology Initiative out in the open.
72. Nobody prints articles - because they believe it is a political gimmick.
73. Get word out, but first need to know about National Technology Initiative.
74. Print National Technology Initiative information in a catalog.
75. Access to equip was not known of.
76. Mechanism to bring information to small business.
77. Workshop is successful.
78. Feedback mechanism to avoid failures.

79. Communication National Technology Initiative to the press plus saying that it does produce success.
80. Meetings are just the means to the success.
81. Media needs to know the success stories of National Technology Initiative then they will print the information.
82. Need for small business groups to stimulate technology transfer, not the other way around.
83. We need a forum for getting word out.
84. Double percentage of CRADAs for small business.
85. Small business initiative is initial recognition of problem.
86. Recognition is not there between lab and end user.
87. Advertise National Technology Initiative? DOE is prohibited from advertising, however small business may use their own budget to advertise.
88. Local publicity not issue.
89. National publicity is the issue.
90. Current law should not be an obstacle.
91. Govt. has to be aggressive in reaching out to small business.
92. Model CRADA needs a better definition.
93. Trust factor needs to be established.
94. Variety of mechanisms .
95. Need to explain intellectual property rights
96. Advisory committee should be established for property rights.
97. End of contract shouldn't be the end of the road.
98. Good working relationship with small business.
99. Committees have been dominated by universities.
100. We need an infrastructure that remains stable.
101. CRADA is well defined in intellectual property rights.
102. Facilitate information about intellectual property rights.
103. Success for small business measured by contract.
104. Clear definition of where contract comes from should be established.
105. Transfer of technology in private structure is very important.
106. Companies that have been successful with CRADA would provide great model.

107. Companies with failure with CRADA should be represented as well.
108. Small business conference in the spring.
109. Success is personality driven - it traces back to 1 - 2 people.
110. Combo of small business and other entities has been a progressive program - it's the people who are the key.
111. Scientist needs to understand the issues.
112. DOE employees should understand the key issue.
113. Small team of inter-disciplinary people.
114. Manufacturing process an important part of National Technology Initiative.
115. Where is the capital stream coming from?
116. No reward system for the business side - it's not on a first come first serve basis.
117. Anybody welcome to share technology.
118. Don't distort competitive market place.
119. Need self-interest.
120. One failure brings everybody down.
121. Control check point so labs don't duplicate technology.
122. Labs should not compete with private sector or create competition.
123. Work on program formulation.
124. DOE should convey the programs that offer opportunities.
125. Operate on already existing programs.
126. Small business has been a part of technology transfer.
127. Research is being duplicated within small business and local universities - labs shouldn't compete with small business.
128. DOE needs to know of the duplications.
129. Move from lab to demonstration is a difficult process.
130. Review of R&D phase.
131. What kind of tech is available through DOE.
132. Peer-group should be established to review R&D.
133. Challenges should be made toward success.
134. Review rapport will expand to other agencies e.g. EPA.
135. Forcing other agencies to become involved with DOE, very valuable.
136. Don't distort research.

137. How to tap into other agencies?
138. Establish a transfer technology shop plus linkage between labs.
139. DOE not regulator.
140. Structure relationships with other agencies.
141. Small business responsibility to find out about these relationships - 2-way street.
142. Workshop's output has had very positive effects.
143. Who generates set programs within DOE?
144. Done on a cycle basis.
145. National Technology Initiative works well as a program.
146. For a successful program there needs to be money to jump from phase 2 to commercialization.
147. Small business Pilot Tech Transfer Program has just been approved by both sides of the house.
148. More effective hand-off with money.
149. Work with other agencies for successful SBIR program.
150. SBIR tax doubles.
151. DOE sponsors commercialization workshops to help small business.
152. DOE is the only department that supplies continuous funding from phase 1 to phase 2.
153. How to institutionalize process to be successful?
154. Procurement coming that addresses results from phase 1 to phase 2.
155. This procurement will support EM50 with involvement of members from EM30 and EM40
156. Come up with a Phase 3.
157. Mixed success with tech transfer.
158. Potential conflict of interest relating to CRADAs
159. Don't get CRADA don't get research money and vise versa.
160. DOE needs to fund the industry pulled technologies not the industry driven plans.
161. DOE has to answer the why's.
162. Labs need to be more affordable.
163. Researchers and labs need more funding
164. More means of regulating labs R&D.

Recommended Solutions - Small Business Group

1. R&D - where tech transfer is going
   - 1.1. they couldn't assess nature of R&D - where they were, where they were headed
   - 1.2. SB people didn't see the incentives of where R&D was headed
   - 1.3. Technical issue
   - 1.4. No common way of evaluating common research
   - 1.5. Not clearly defined
   - 1.6. Gap b/w commercialization and R&D
   - 1.7. Lab workers don't know how to assess the tech transfer
   - 1.8. What can be done to develop tech?
   - 1.9. CRADA tries to address this problem
   - 1.10. Specific cos. looking for what they want
   - 1.11. Entrepreneurs doing the same as above
   - 1.12. This should be implemented into the tech transfer program
   - 1.13. implementation of on-going support
   - 1.14. Is tech ready for adaptation?
   - 1.15. What is whole comprehensive assessment of the tech?
   - 1.16. Definition of what everyone is going to do
   - 1.17. Implement a market assessment
   - 1.18. Standardize an abstract
   - 1.19. Orderly MKT analysis
   - 1.20. DOE-wide standard abstract/unknown
2. SB/Industry Advisory Mechanisms
   - 2.1. Peer-group review
   - 2.2. look at peer-group and analyze
   - 2.3. review abstracts from above
   - 2.4. advisors should be represented from a broad sense
   - 2.5. Assign mentors to start u companies
   - 2.6. List those in charge

2.7. SB advisory panel - to give DOE substantial list of what they what implemented

3. Predictability Continuity and Funding

3.1. Internal solution must be implemented

3.2. Go through stages to solve - may be a lengthy process, but successful

3.3. Phased procurement implemented

3.4. EM Procurement Strategy

3.5. Mechanism for solutions to present to DOE - after identifying the problems and coming up with a solution

3.6. Re-prioritization

3.7. TTP - DOE's funding mechanism

3.8. Disseminate - SB Tech Transfer Pilot Program

4. Tools - Mechanisms to make things happen - contracts

4.1. Phase Funding

4.2. Special model CRADA designed for SB

4.3. Export EM Process to other PSOs

4.4. List of interested people

4.5. TTP

4.6. Education of how DOE works

4.7. After the contract is over, remember the SBs

4.8. Outreach efforts need to be expanded

5. IPR - Intellectual Property Rights

5.1. Exclusive and non-exclusive rights - to what extent?

5.2. Need specific programs - spell out CRADA

5.3. Negotiate rights/licensing

5.4. Exclusivity entails risk

5.5. Offer licensing opportunities to SB

5.6. Offer CRADA opportunities to SB then the public - therefore SB has an edge

5.7. Summary of DOE Intellectual Property Explanations

6 Lab Competition

6.1. If handled incorrectly, issue that could kill NTI

6.2. Knowledge of what happens inside of the lab

6.3. Definition of the problem

6.4. Another aspect -- Competing for program $

6.5. Competing for industries and trying to transfer into commercial sector

6.6. Tell DOE about any competition between labs and industry

6.7. Distinctions

6.7.1. Lab hanging onto tech

6.7.2. Lab inadvertently competing

7. Planning

8. Communication

8.1. Outreach

8.2. How to get information out to SB

8.3. Lab should contact local businesses

8.4. Media

8.5. Send newsletter to R&D trade groups and follow-up information/ complete information flow

8.6. On-going SB workshop (regional)/More perspectives

8.7. Regional focal point for relaying information

8.8. Functional focal point, as well

8.9 SB umbrella organization to get information out

8.10. Publicize through the press

9. Definitions

9.1. NTI

9.2. CRADAs

9.3. International competitiveness

9.4. Relationship of the above

9.5. Acronyms/Dept. Responsibility Areas (in functional areas)

9.6. Dual-use Areas

9.7. Program Planning - Directions/Priorities

Appendix B - Zerox of "Environmental Bottom Line" questions and answers between DoE, LANL, SNL, and small business

Review of Existing Federal Authority and Review of Representative State Authorities

AN EXAMINATION OF THE FACTORS AND ISSUES FOR AN ENVIRONMENTAL TECHNOLOGY UTILIZATION PARTNERSHIP BETWEEN THE PRIVATE SECTOR AND THE DEPARTMENT OF ENERGY

Conducted for the Department of Energy
Office of Environmental Restoration and Waste Management
Technology Development

Interim Report on the Conduct of
Task 2 - Review of Existing Federal Authority
and
Task 3 - Review of Representative State Authorities

George Mason University
School of Information Technology & Engineering
and
The John Francis Co, Inc.
February 24, 1995

AN EXAMINATION OF THE FACTORS AND ISSUES FOR AN ENVIRONMENTAL TECHNOLOGY UTILIZATION PARTNERSHIP BETWEEN THE PRIVATE SECTOR AND THE DEPARTMENT OF ENERGY

Interim Report on the Tasks 2 and 3
Federal and State Legislative Authority

I. SUMMARY OF CONTRACT ACTIVITY

This interim report describes the work performed in partial fulfillment of Tasks 2 and 3 of the Statement of Work. These tasks were designed to document how both the Federal and representative State Governments conduct their technology transfer and outreach programs. Each of these tasks essentially has two parts. The first part is an examination of the legislative authority exercised by both the Federal Government and representative State Governments to conduct their activities, including a discussion of the permissible scope of activities that the legislation permits and a description of how this legislative authority has been implemented. The second part of both of these tasks, is to describe the policy context in which these statutes are operative. The subsequent examination in Task 4 of how this authority is utilized and implemented in particular case histories and its relevance to the DoE-EM program will be conducted in close concert with DoE Staff.

We have chosen to examine the small business technology outreach programs conducted by the State of Pennsylvania in the form of its Ben Franklin Partnership system and the State of Virginia in the form of its Innovation Technology Authority and Innovation

Technology Center. We have examined these particular state programs in detail. This has included interviews with the Executive Director of the Ben Franklin Partnership for the Northeast Tier of Pennsylvania, and likewise with the former Vice President of the Virginia Center for Innovated Technology, and also with its former Director of Communications and Outreach.

II. SUMMARY OF FINDINGS

The stated legislative intent of the statutory enactments in both states, are directed primarily to the encouragement and development of small business enterprises within their states by making available to such small businesses relevant advanced technologies and by bringing to bear the educational and scientific resources resident in the state to the aid of small businesses. This, of course, is exactly the intent which has motivated the current George Mason University study.

We have chosen to examine the activities of these two states principally for two reasons: (1) our close familiarity with the working operations of these two organizations and (2) the fact that they embody two significantly different approaches toward assisting small business.

The Virginia statute is directed primarily at the creation of relevant infrastructure that would support small business and the coordination of state resources and incoming federal resources. This approach has been primarily a "brick and mortar" development effort which has targeted specific industries related to the states well being and has attempted to help businesses within those industries through the State University System.

The Pennsylvania statute, on the other hand, is almost completely devoid of infrastructure building and rather is concentrated on the actual one-on-one delivery of state services from existing state institutions to small companies. It is a very decentralized one-on-one interaction.

Our examination of the Federal statutes, has been a straightforward review of the Stephenson-Wydler Act and its numerous amendments particularly the 1989 Technology Competitiveness Act. This review has **not** been an attempt to find unexplored new or creative ways of applying the statute, but rather a straightforward review of the authorities granted. Such a review quickly evidences an enormous discretionary authority granted to the Federal Agencies providing them with wide latitude in how the Federal Government interacts with small business. It is clear, that the limitations on activities in technology transfer are not contained by lack of statutory authority but rather by the political and policy commitment to utilize the authority contained within these statutes.

An examination of the way the Federal Government and various states do business with small business must first be preceded by an examination of the distinct roles of the Federal and State Governments in dealing with small business and in dealing with technology utilization.

The Federal Government is a developer of advanced technologies and likewise a customer and user of such technologies for the environmental problems contained in its own facilities and generated by its own operations. This technology development and remediation effort is inherently a high cost, centralized activity where the Federal Government is literally in control of all aspects of the problem. This includes the technology identification, the problem characterization, the funding of technologies and the utilization and demonstration of those technologies for the remediation of the Department's sites. This is an inherently centralized activity and the role of small business in assisting the Federal Government function is inherently premised on social or political reasons to involve small business and not on any inherent need to have small business participate as an essential element of solutions to federal problems. Consequently, if the Federal Government is to deal with small business, the interaction becomes a labor intensive, multiple point interaction, which is simply unsuited to the Federal Government's focused approach to problem solving.

As a result, to satisfy the political and sociological imperative to involve small business, the Federal Government has searched for models which will enable the Federal interaction to be achieved in as cost effective a manner as possible.

The core content of these interaction models between the Federal Government and small business, has involved in various degrees, the incorporation of some intermediary entity which has the distributed infrastructure necessary to deal with small business and has the necessary ability to focus and synthesize in order to deal with the Federal Government. These models have variously succeeded or failed depending on the measure of success adopted and based on the willingness of the Federal Government to relinquish control of the process to the intermediary and the intermediary's ability to administer the resources provided by the Federal Government in a way that meets the general objectives of the Federal program.

The Federal statutes either directly or through their creative implementation by the agencies have generated a set of models for interaction. For example, the Department of Energy's Weapons Laboratories have utilized their ORTAs (Office of Research and Technology Applications) to deal directly in their communities with small businesses. This typically has been achieved through cooperative research and development agreements (CRADAs) typically in the range of $20,000 to $30,000. It soon becomes apparent that the ORTA simply does not have the necessary staff to negotiate cooperative agreements and to tailor the interaction on any scale that might achieve some national impact. This recognition has lead to administrative streamlinings where such things as a standardized CRADA document and pre-approved conditions are pre-adopted to speed the administration of the interaction with small business.

A further refinement designed to increase the scope of this outreach, was to have the Laboratories deal with non-profit community action organizations and with state governments and to support them with generic funding that would enable these organizations to deal with small business and in some way provide the technologies resident at the laboratories to these small businesses. There is a high degree of leverage and decentralization in this process but the technology transfer process utilized under this model has primarily been **FROM** the Federal Government **TO** small business. While the infrastructure in some cases exist for the transfer of technology into the Federal Government, the National Laboratory decentralized model has not yet been exercised to flow technology backwards into the Federal Government for Federal Government needs.

Another approach or model has been adopted by the Commerce Department in the implementation of its technology centers. This is an attempt by the Federal Government to directly interact with small business and in many ways has similarities to the agricultural extension services that deliver federal technology and services to the farming community. Unfortunately, the costs of such an enterprise are significant. Also delivering agricultural services requires a large but not particularly sophisticated work force for its implementation. Delivering technology services requires a highly educated, fairly flexible and innovative work force and hence an expensive one.

III. Policy Boundary Conditions on Environmental Technology Transfer

The Stephenson-Wydler Act and its numerous subsequent amendments provides to the mission agencies, particularly the Department of Energy, a broad spectrum of vehicles which can be used to deal with the private sector. In addition, recent authorizing legislation has codified technology transfer as a part of DoE's basic mission. Consequently, the Energy Department has the ability to use its full contracting authority enabling it to draw funds not only from line item appropriations but to use its general overhead and construction funds to further its basic mission of technology transfer.

Furthermore, under traditional constitutional concepts of legislative interpretation, an agency has the authority to interpret the meaning of its enabling statute based on any reasonable interpretation of the statutory language and its legislative history. Consequently, DoE can construe terms of the Technology Transfer Act and it other enabling legislation in a way most favorable to itself in conducting its mission of technology transfer as long as the facts justifiably warrant such an interpretation. Such an interpretation of Congressional intent behind the statute does not have to be the preferred or best rationale for the use of the legislation but, rather only a reasonable interpretation based on the language on its face and its legislative history.

Consequently, the existing authority which the Department of Energy already has in the Technology Transfer Act is quite broad, limited primarily by the political will within the Department to creatively utilize the provisions already granted to it.

The relevant questions, therefore, should not be what do the technology transfer statutes permit, but rather what policies will the agency pursue to achieve technology transfer recognizing that it has a statute granting it enormously broad discretion. In reviewing the potential scope of activities under this statute and what DoE has been willing to implement to date, the Department is a long way from filling the available space allocated by the statute.

Of much more relevance is an examination of the Administration's policy with regard to environmental technology transfer and the actions flowing from those policies and to compare those actions with the policy boundaries emerging from the new 104th Republican controlled Congress.

The Office of Environmental Management, in its technology transfer program, has recognized that there is a social benefit to the American economy in transferring technologies generated with Federal funds into the private sector. Under the traditional technology transfer rationale these technologies would enable American companies to be more cost effective and hence more competitive in an international world market. Under the scrutiny of the emerging philosophy from the 104th Congress, such activity could simply be labelled as industrial subsidy and hence subject to criticism and curtailment in the appropriations process.

However, unlike technology transfer conducted in many of the other agencies and other parts of the Department of Energy, the concept for environmental technology has also been a two-way street that promotes the sharing of government developed technologies as an outreach to attract partners with their own technologies that might be relevant to the actual clean up of the Department of Energy's facilities. Consequently, the outreach to small business includes an emphasis on attracting technologies that are resident in these small companies into the Department of Energy complex for utilization. In so utilizing those technologies the DoE provides the cash flow which makes those companies more competitive, more viable and hence indirectly contributes to American international industrial competitiveness. In this concept of technology transfer, government technologies are combined with industrial technologies to better remediate DoE sites and the social aspect of "subsidizing companies" happens only indirectly as a result of their actual assistance to the Energy Department and hence their ability to "be made economically viable" through a department contract for remediation work.

This approach therefore shifts the whole question from how to share Department of Energy developed technologies to the more relevant question of how can the Department enter into partnerships with private companies for the benefit of DoE facility remediation and with the incidental benefit of providing the companies with cash flow and hence with economic viability.

For this emphasis to be successful, the organization of the Department of Energy's Environmental Technology Transfer effort must change from the current laboratory-centered distribution network to a more impartial intermediary distribution system. Under the current distribution and outreach system, the Department of Energy utilizes its National Laboratories through their ORTA Offices to interact with various state, local, and regional authorities and directly with companies. This is an ideal mechanism for technology transfer from the government to private industry. However, the emphasis in future environmental technology utilization efforts must be a two-way street and must conform to the policy boundary conditions that inevitably will be put down by the 104th Congress and which also match the Administration's goal of making this technology transfer process really a technology interchange or dialogue process as discussed above.

The technology transfer process within the Department has evolved along a path through the National Laboratories where the National Laboratories are able to transfer their technologies into the private sector. This process has work amazing well as the National Laboratories have seen the process as in their best interest for survival and as a mode of redefining their role in a post cold war America. Under this mode of operation however, the Laboratories have a vested interest and a preconceived prejudice to transfer from the Laboratories into the private sector. The system as constituted does not do well in taking technologies from the private sector into the government for utilization.

In order, therefore, to have this technology dialogue or two-way interchange of technology, an intermediary must be chosen which has no technology content and hence no vested interest in the direction of flow so that the system works equally as well in both directions. This very well may mean a Laboratory teaming with such a organization or the organization dealing directly with the Federal Government.

There are however some significant political dangers in going outside of the Laboratory system. As long as DoE deals through its Laboratories the inevitably mishap or a deal gone wrong as must be expected in any business relationship, can be taken in stride. The Laboratories provide a certain amount of insulation from mistakes made. The blame does not fall to DoE entirely but rather is shared between DoE and its Laboratories who have their own political constituency to protect them and hence cushion any criticism. On the other hand if the Department were to deal with some business intermediary the Department inevitably is open to criticisms of favoritism, partiality in "sweetheart" deals, lack of management oversight, etc. Anything that goes wrong becomes the direct responsibility of the Federal Government.

Consequently, in the search for "safe" intermediaries either to act alone or in concert with the National Laboratories, the DoE must engage entities who have their own political constituency and political insulation so that when problems occur in the technology dialogue process, any blame or criticism is diffused and shared.

This pragmatic policy constraint leads inevitably into only one direction. The most logical partner for the Department of Energy in this technology dialogue is to utilize state organizations as the intermediary that are entities or instrumentalities of the different states. This sharing of responsibility puts the administrative burden of any outreach effort which is extremely labor intensive on the states.

Many states have functioning and well developed service organizations within their state agencies who interact with small business as a matter of daily course. For example, most states have local Economic Development Authorities in each county. These are staffed by people who are not particularly technology trained, but they are people trained to identify economic and business problems and/or promote the business activities within their region. Regardless of the specific mechanisms, most states have such outreach infrastructure already in place and many states have a specifically created technology distribution and technology utilization systems within their state government that could be readily utilized by the Department as the vehicle for the technology dialogue envisioned in the Environmental Technology Program.

Following this train of thought, we have examined two rather aggressive state programs designed to both deliver advanced technologies to private companies and to utilize the specialized technologies within companies for the benefit of other industries within the state. We have examined two such programs, the Pennsylvania Ben Franklin Partnership which espouses a very decentralized one-on-one technical interaction between companies and government agencies and the Virginia Innovative Technology Authority whose primarily emphasis has been to strengthen technology infrastructure and university participation as a mode for interaction with private companies.

IV. The Virginia Innovative Technology Authority

In 1984, the Virginia Legislature established the Innovative Technology Authority in an attempt to coordinate the state's academic and technology resources to support the foundation and growth of high technology companies within Virginia. The Authority was established as a political subdivision of the Commonwealth and was given broad authority and independence from normal state agency oversight in order to conduct its activities in a flexible, responsive fashion appropriate for commercial dealings.

In founding the Authority, the legislation noted that

"there exists in the Commonwealth of Virginia a need to:

(i) promote the economic development of the Commonwealth by attracting and retaining high technology jobs in businesses in Virginia.

(ii) increase industry competitiveness by supporting the application of innovative technologies that improve productivity and efficiency,

(iii) mobilize support for high technology industries to commercialize new products and processes including organizing assistance for small business and supporting select industry sectors,

(iv) enhance and expand the scientific and technical research and development capabilities of the institutions of higher education....and coordinate such capabilities with....the private sector,

(v) expand knowledge pertaining to science and technology,

(vi) attract research and development facilities and contracts from the Federal Government and from the private sector and,

(vii) develop a statewide strategy to compete for large R&D contracts,

(viii) facilitate and coordinate the marketing, organization and utilization of scientific and technological research and development in the Commonwealth."

The Act goes on to establish a governing Board of Directors responsible for the management and policy of the Authority with designated members on the Board drawn from the various universities, government agencies, and private industry within Virginia. The Authority is permitted to hire its own technical and management personnel and the compensation for these people is outside of the State's Civil Service System and outside the control of State Auditing Agencies.

In addition, the Authority was permitted to establish Technology Centers at the various universities or at key industrial regions of the Commonwealth and was given by statute the unique authority to issue its own revenue bonds to finance joint ventures with private companies relating to high technology facilities within the Commonwealth. The specific authorities enumerated within the statute include the authority to:

- sue and be sued,
- acquire and purchase all types of real, personal and intellectual property,
- plan, develop and construct facilities,
- establish and maintain satellite offices and centers throughout the Commonwealth,
- charge and collect rents and royalties on both facilities, property, and intellectual property,
- collect funds, make principal payments, and pay interest on its obligations,
- borrow money and issue bonds,
- make and enter into contracts and agreements ,
- hire and fire its own employees and retain consultants
- partner with other organizations,
- receive and accept grants and bequests from both federal and private sources.

In addition, to these operational powers, the Authority is charged with various duties. The Authority is obligated to: render advice and assistance and provide services to institutions of higher learning and to develop and to promote programs for scientific and technological research. In addition, the Authority is urged as a goal to obtain patents, copyrights, and trademarks and to generally acquire intellectual property and "to coordinate the scientific and technological research efforts of the public institutions and private industry..."

In addition, the Authority had a direct role to fund emerging companies and new industries and to participate with them in promoting new technological products. In this regard, the Authority since its founding in 1984 has had on average a funding level of between eight and ten million dollars per year. The approach, taken by the Board of Directors and the Authority has been to provide most of their funding to the Universities in the form of infrastructure building, both equipment and brick and mortar facilities, and to fund research work at the Universities. This process fostered the founding of technical institutes at the major Universities. Under the provisions of the Authority funding, these institutes are to conduct the outreach to local small businesses in their region.

These policy choices have effectively removed the Authority from aggressively pursuing direct interaction with Virginia corporations and rather has transferred that initiative to the various implementing Universities who sponsored the technology centers. This represented a distinct positive subsidy for research and development at Universities within Virginia but has not lead to the vibrant interaction between government and small business that was envisioned in the original statute. Consequently, the Authority has come under considerable criticism in recent years for not fully developing its industrial mission. Even so, the establishment of decentralized technology centers across the Commonwealth, while taking longer to implement, now represent an infrastructure which the State can use to more effectively reach small business and to provide the one-on-one services needed.

V. The Pennsylvania Ben Franklin Partnerships

In 1982 the Pennsylvania legislature created the Ben Franklin Partnership fund and its governing Board of Directors within State Department of Commerce. The "Ben Franklin" has virtually the same authority, purposes, and operational freedom as discussed earlier regarding the Virginia Authority. The Ben Franklin Partnerships were established:

> "....to promote, stimulate, and encourage (i) basic and applied scientific research and development in Pennsylvania and (ii) scientific and technical education in Pennsylvania which may reasonably be expected to advanced the Commonwealth's economic growth and welfare...and to provide advice to the Governor and to the Executive Agencies concerning science and engineering matters which relate to the economic growth and health and safety of the Commonwealth...."

In addition, the Partnership was given the authority to:

> "....to establish Advanced Technology Centers which shall serve as University based consortia between businesses, universities, and government to provide advanced technology, research and development, training, education, and related activities which have significant potential in diversification of Pennsylvania's economy."

While both the Pennsylvania and Virginia enabling statutes speak to the same goals of the utilization of technology to revitalize their states, the Pennsylvania motivation throughout the statute continues to point to economic growth, to relationship with private industry and with business. As a result, the implementation of the Ben Franklin Partnership Program has tended to be far more business oriented than the Virginia Innovative Technology Authority which is far more academically oriented.

Some of this motivation in the Pennsylvania case comes from the fact that the Ben Franklin Partnership was founded in a period in Pennsylvania's economic history when small businesses and suppliers were under considerable pressure from foreign part suppliers. The reality of foreign competition was causing considerable economic hardship in Pennsylvania and the creation of the Ben Franklin Partnership was designed in part to be one of the mechanisms that might be used by the Pennsylvania to help alleviate and combat this foreign competition.

Since its founding, the Ben Franklin Partnership has received on average approximately 20 million dollars per year in state funding. These funds have been used to conduct the programs of the Partnership. The Ben Franklin system is organized into four regional centers disbursed geographically around the State so as to represent an approximate coverage of the whole State. One in Pittsburgh, Philadelphia, Central Pennsylvania, and Northeastern Pennsylvania. These technology centers however are not associated or run as part of a university system, rather they are physically and organizationally independent facilities but located near universities and large metropolitan areas.

The governing Board of the Ben Franklin Partnership sets general policy for the activities to be conducted by the Partnership. However, each technology center has its own Board of Governors which actually sets further policy guidelines and specific goals for the operation of each technical center. Each technology center is run by a Director who has broad discretionary authority subject to local Board guidance. Those four regional boards are composed of the representatives from the various local universities but predominately are composed of business and community leaders. As a consequence, the general activities of each of the technology centers, while focusing on different technologies relevant to the indigenous industries, has almost predominately been a coordination effort between the resources at the universities or at particular companies that might be applied to the specific needs of other companies, usually small businesses. In addition, each regional center has two or three satellite offices which are staffed by one to three people on a full or part time basis in an attempt to maintain close community contact.

This close community association has given the Ben Franklin Partnership considerable local profile as a promoter of technology businesses. Consequently many small local companies come to the Ben Franklin seeking help. The Ben Franklin has chosen to use its resources to fund specific developments at companies, to fund partnership arrangements between university professors and company programs, to make loans to corporations, to give grants, and in many cases to take a stock and equity interest in a particular company.

In addition, each budget cycle the Ben Franklin conducts a survey of the different companies in which it has been involved to determine the number of jobs created or the number of jobs retained because of the technological assistance given or coordinated by the Partnership. This straightforward management tool has shown that the Ben Franklin has provided more tax revenue than the cost of its operation. This has provided the political justification for the maintenance of funding to the Ben Franklin Partnership from the State through some very rough budget circles.

The advantages of the Ben Franklin Partnership concept is that it is organized in such a way that it readily permits the two-way technology dialogue required by DoE-EM. Furthermore this technology dialogue is conducted at the most decentralized level with considerable authority granted to the regional directors to make grants and to utilize his funds in an independent fashion governed by his local board. Decisions are made by the people who know the companies and who live in the same community where those companies conduct their business.

VI. Completion of Tasks 2 and 3

Considerable investment has been made in this study in understanding the operations of both the Pennsylvania and Virginia models for technology dialogue. At this stage of the study however, the completion of these tasks will require a significant involvement of DoE staff time to cooperate with the George Mason Staff in actually reviewing and analyzing the components of these State Programs and how they might relate to candidate federal approaches to doing business in a technology dialogue situation.

Case Studies - Examination of Current Status

Department of Energy

Office of Environmental Restoration and Waste Management

Technology Development

Examination of the Factors and Issues for an Environmental Technology Utilization Partnership between the Private Sector and the Department of Energy

Phase I: Examination of Current Status

Task 4 - Case Studies

Submitted by

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Introduction

This report encompasses Task 4 of the contract George Mason University has with the Department Energy, Office of Environmental Restoration and Waste Management Technology Development entitled "Examination of the Factors and Issues for an Environmental Technology Utilization Partnership between the Private Sector and the Department of Energy", contract number DE-FC02-90ER12951. The subcontractor for this effort is John Francis Company. The purpose of the contract is to conduct a major two-phase study of the factors and issues associated with technology partnerships between U.S. small business and the Department of Energy. The objective of the study is to develop recommendations for enhancing the role of small business in development, adoption, and waste management at DoE facilities. A significant amount of innovative technology in various stages of development presently resides in the business community. A dual benefit is achievable, in terms of enhanced business growth in the private sector and cost-savings in the DoE clean-up programs, by helping small firms develop and deploy their technologies, as well as by promoting partnerships between small firms and the national laboratories. The study forms the basis for development of policy relative to enhancing the utilization of small business capabilities by DoE in advanced technologies and services.

The purpose of Task 4 of the contract was to review existing Small Business mode of business. To accomplish this, we interviewed a sampling of small businesses in the environmental facility remediation business area to generate a set of Case Histories. As part of this process we examined the mode of operations, interaction with the Government/DoE and the States, and problems/barriers encountered by these representative small businesses.

The following paragraphs document the interviews that were conducted.

Meeting with John LaFond, Quadrell

Participants: Peggy Brouse, John LaFond, Dom Ripeche

Date: 28 April 95

Affiliation: Quadrell

1. Review of Quadrell and what they do. They are an Environmental Testing Company with proprietary testing equipment and method to track trace gases emitted from the earth. He gave us company brochures.

2. Technically successful, becoming commercially successful.

3. DoE relation. There is a cultural mindset that is not conducive to good relation with small business. Quadrell has dealt with headquarters.

Headquarters:

1990/1991: Clyde Frank's office. Dennis Miller was contact. He suggested they talk with Carolyn Purdy. Tried to reach her for 3 months. Finally, met with staffers, who said Quadrell didn't need their help and told him to talk to prime contractors. John couldn't get list of prime contractors.

Argonne National Laboratories:

Spring 1992: DoE Technical Search Program. They wanted Quadrell in their database. Dr. Dale Pflug recommended that Quadrell was one of the top 6 technologies. No one has ever called.

Sherri Zussman called about another database. She works 3 doors down from Pflug, but was redoing the same work as Pflug.

Aberdeen Proving Ground

1992. Aberdeen Proving Ground. Lou Martino, Argonne contracted with Quadrell to do work through Argonne for the Army.

Savannah River

1991. Demonstration Facilities Program that benchmarks new technologies against old technologies. Quadrell couldn't get anyone to meet with them.

1993. Met with old friend, Tom Hendrickson/VASCO, who introduced John and tried to get Quadrell in. But they have (VASCO & Quadrell) given up because of Savannah River inaction.

Los Alamos

1991. Quadrell found contractor IT Corp., Torrance, CA who told them to meet with ERM/Goldar, Bob Gilkeson who pushed for 2 1/2 years to get Quadrell a job with Los Alamos using their technology. It unfortunately has ended because most Environmental cleanup at Los Alamos has practically stopped.

Hanford

Spring 1992. Gave field demo Aug. 1992 and received task order with Westinghouse. In August 1993, spent $10K or $50K then ERMAC contract came about which required Westinghouse to give up contract because they caused original problem.

December 1994. Bechtel/IT won new contract. However, Hanford has to cut by 50% which means they are allowing no new subcontractors. So, nothing is happening with Environmental Clean-up.

Rocky Flats

EG&G contractors there. 1990. Quadrell briefed EG&G. 1991. 2nd briefing, go on small business bid list. 1992. EG&G reorganized twice. No field work was done. Now Kaiser/Hill won ERMAC contract.

Sandia Labs

Quadrell has done 2 projects there and have been treated fairly. Sandia functions more like DoT.

Department of Defense (Navy and Army)

Regional commands to do environmental clean-up. There is a clear chain of command.

Army Corp of Engineers, Omaha office> issue scope of work that is very specific to prime contractor, prime negotiates for $$$, Corp. and prime have project management team, a detailed plan is written including subcontractor info, Corp signs off and work begins. Quadrell has good relation with DoD who gives them lists of prime contractors who Quadrell contacts. Sometimes Corp. calls specifically for EMFLUX (Quadrell product).

Navy also has set of rules that are straightforward.

Air Force works differently. AFC for Environmental Excellence (AFCEE). They have created manual that is counter to EMFLUX. Manual will not be revised until 1997.

Comments

DoE is just not effective in doing business, nothing happens. Quadrell currently has no DoE business.

Contacts:

Dr. Dale Pflug (708) 252-6682.

Teleconference with Dale Pflug, Argonne Laboratories

Participants: Peggy Brouse, Dale Pflug, Dom Ripeche

Date: 8 May 95

Affiliation: Argonne Laboratories

1. Dale Pflug has been with Argonne Laboratories since late 1992. He heads the Technology Connection Program funded by EM43. Charter: How do we use technologies that are available but not being used by DoE? He is reviewing barriers to keeping technologies from being used. There was a conference 2 weeks ago. The came up with 52 barriers, using Virginia Tech's "option finder" wherein each participant has keypad to vote on issues.

2. There are barriers between EM40 and EM50. EM50 doesn't really know who the customer is. EM50 has began focus groups across all EM to bring together stakeholders. Matrixed group but is having a lot of problems. EM40 response is that EM50 is not listening, so why bother? EM40, however, has "feet of clay". There is a lack of knowledge in defining solution to problems.

Specific barriers:

DoE infrastructure

Site specific

Technology providers

Because EM40 doesn't understand technology, they have difficulty in telling EM50 what they want.

3. EM50 needs peer review by field people.

4. EM40: multiple discipline group. There are organizational conflict. Individual sites have field operations and contractors. Contractors want to maximize profit/revenue. But contractors don't have experience in new technology and there is no incentive to do so.

5. DoE field management typically do not know new technology. Therefore they are reticent to use new. There aren't skilled operators.

6. Small companies are not always realistic about how much they can do.

7. DoE headquarters. Remedy decisions are made at headquarters without clear defined need:

Field identifies generic problem, but doesn't inventory solutions (technologies that could be used). "Defined need" is lacking.

Because of this:

a. unusable technology at great expense

b. risk-adverse people make bad decisions

8. Political. Very large sites with very large contracts. The contractor tries to maximize revenue. There is no incentive to be efficient.

> Example: Turn-around time in sample analysis. Takes months currently. However, it has been proven that it can be done on-site and save 75%.

There is no accountability. There is a disconnect between Environmental Restoration and new technologies.

> Example: Soil Washing Technology at Fernaught site. Rather than bringing in small companies the large companies determined it would cost $300 Million to create landfill. Small companies say they can do it (guaranteed) for $200 Million. Because DoE personnel aren't technically able to make decisions, they allow large contractors to make decisions.

9. There is a push, however, from small business to change this practice. DoE is very difficult to penetrate. The RFPs are not geared for small business. Also, small business have little access to inside DoE.

10. Getting into DoE is a long-term process. DoE needs to change. Technology development determination shouldn't be made at headquarters [EM50]. Remediators [EM40] should be stakeholders.

11. Is there a need for EM50 at all? No.

12. Hostile environment at DoE. Contractors are forced to give demonstrations at great expense.

13. Pflug's greatest concerns:

   a) We don't have experience with new technologies.

   b) We need to derisk them.

   c) We need to empower people not to just demonstrate but to clean-up.

   d) Large companies use politics to protect their cash cow.

   e) Small companies need to organize and develop political clout.

14. Solutions:

   a) Educate people at sites; train operators.

   b) Use new usable technology in small increments (pilots) to gather experience. Use unbiased evaluators.

   c) National labs become process improvement centers that partner with small business.

15. Other contacts:

Alternative Remedial
Dr. Mike Mann
(813) 264-3571

Advanced Analytic Products
Jim Wrigley
(408) 926-4057

Viking Instruments
Tom Kuehne
Chantilly

Meeting with John Hoover, Siteworks

Participants: Peggy Brouse, John Hoover, Dom Ripeche

Date: 8 May 95

Affiliation: CEO, Site Works 476-4835

1. Our work is for EM50, Clyde Frank's group, for Joe Palladino We are preparing a briefing for upper management at Joe's request.

2. John Hoover spent 15 years within DoE. 1968-1980 he was at Argonne Labs. 1980-1990 Energy Impact Associates and Advanced Technology. 1990-1993 Argonne. 1993 - present Siteworks. He got involved with EM40 Tech Con program when he was at Argonne the second time.

3. He spent time with Clyde briefly in 1992.

4. Siteworks. Field analytics and site investigation and clean-up. Has rights to technology developed at Tufts University that allows for very high sample throughput (up to 30 per day versus standard 10).

5. He though Siteworks would do more work with DoE. When he works with Navy or Corp. of Engineers they are very supportive. They know their own problems. They will point to the correct contractors. They are very proactive They are very aware.

6. DoE is much more amorphous, "like jelly". They don't have support network. The large M&O contractors and other large contractors have a real interest in keeping things they way they are. Example given was Westinghouse/Savannah River. The large companies buy technology not the services of small companies. The government then has to pay CPFF.

7. Another example Martin Marietta/Bechtel who purchased ReTech. A monopoly is created. It is hard to have open competition.

8. Some myths need to be dispelled:

   a) Regulators resist change (not true).

   b) Procurement is a hurdle (not true).

Gave example of his company getting contract very quickly with Navy/Jacobs/EPA.

9. TERC contracts (Corp. of Engineers). Hoover went to RFP meeting on TERC contract, which required 40% of contract to go to small business They had an innovative approach to allow small business to mingle with large companies.

10. Value Engineering. Provision of the FAR. Allows that if a small (or any) company can come in and recommend a cost savings then they will get share of dollars. Hoover is looking into this provision as a means to get small business

in. Example: he reviewed Argonne with 15 others and recommended cost savings.

11. Unfortunately, DoE counts small businesses that do administrative work only in their accounting. They should be required to count small technology companies.

12. Need mentor program like DoD has. This program helps form teaming agreements. May be a good model. Big business gets something, too. Some of the G&A is covered. Dynacorp participates in this.

13. Need for technology advocate. New technology needs to be supported. Currently each DoE site is independently evaluating new technology. There needs to be a central site to deal with regulators and certify the technology.

14. There is poor communication between EM40 and EM50. EM40 should be asked what projects need to be developed to meet their needs. EM50 may be doing R&D on technologies not blessed by EM40. As a result, EM50 is being closely scrutinized by Congress.

15. R&D in large labs are not subjected to external peer review, by and large. Clyde tried to mitigate this with TTPs, but hasn't been successful.

16. Hoover believes labs should have private sector partner, that is willing to partner. Also, technologies being developed in labs should have an end user. The first test should be if technology is developed then it should be implemented.

17. Incentive fees. Lockheed example. Nice idea, but are incentive $$$ flowing down to small business subcontractors?

18. DoE turnoffs:

Hoover went to Oakridge to Conference on 5 categories of waste. 300 people showed up. DoE wanted innovative suggestions but then someone in audience asked "Do you have $$ for this?". The answer was "No". Perception is labs are going on fishing expedition to steal other's ideas.

19. Contacts:

Argonne
Mitch Erickson
(708) 252-2000
regarding $3M R&D to 15 companies [about half was small business]

Viking Instruments
Tom Kuehne
Chantilly

Questionnaire Developed for DoE by George Mason University

DoE/EM Questionnaire

A. Paragraph Questions.

1. Please describe the nature of your product or technology.

2. Please describe how your Company interacts with DoE/EM.

3. Please describe how your Company interacts with the DoE Labs.

4. Have you received funding from DoE, partnered with them or conducted any business or joint venture with DoE or its
Please describe.

5. What are your general comments on how DoE-EM does business?

6. Give examples or discuss incidents of DoE understanding the workings of Small Business.

7. Describe some postive aspects of your relationship with DoE.

8. Describe some negative aspects of your relationship with DoE.

9. List improvements that may be made to the DoE contracting/procurement process.

10. Any suggestions, comments, or editorials?

B. Instructions: For all of the listed questions, please place an X in the position that most closely matches your feeling regarding the question: [There should be only one X per question].

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. DoE/EM has a good understanding of the needs of Small Business.	☐	☐	☐	☐	☐
2. DoE understands your capital formation needs and the venture capital process.	☐	☐	☐	☐	☐
3. DoE understands how its contract on partnership support can assist your cash flow.	☐	☐	☐	☐	☐
4. DoE support could have been helpful to your company's survival.	☐	☐	☐	☐	☐
5. DoE support arrived at the right time to assist your Company's needs.	☐	☐	☐	☐	☐
6. The DoE Office with which you dealt or your DoE point of contact was able to:					
a. understand your motivation for dealing with DoE.	☐	☐	☐	☐	☐
b. technically appreciate/understand the capabilities of the product.	☐	☐	☐	☐	☐
c. provide proper feedback and response to your questions or to your particular situation.	☐	☐	☐	☐	☐
d. generally be responsive to **your** needs.	☐	☐	☐	☐	☐

DoE Questionnaire

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
7.	The Federal Government has a Role to Play in Promoting the Development of Environmental Technology.	☐	☐	☐	☐	☐
8.	If the Government DoE has a Role in Promoting new Environmental Technologies, do you believe that role should be:					
	a. standards and certifications.	☐	☐	☐	☐	☐
	b. direct contract/partnership support.	☐	☐	☐	☐	☐
	c. loans.	☐	☐	☐	☐	☐
	d. equity participation.	☐	☐	☐	☐	☐
	e. ad hoc technical/scientific advice.	☐	☐	☐	☐	☐
9.	I am satisfied with the DoE Contracting/Procurement process.	☐	☐	☐	☐	☐
10.	I am satisfied with the technical understanding of the DoE program people.	☐	☐	☐	☐	☐

C. **The Department of Energy has identified various factors which it believes may be releva development activities conducted by DoE's Environmental Management Office. Although there may be some redundance or similarity to earlier questions, please please place an X in the position that reflects your response to the following questions without regard to any earlier responses.**

1. In your company's dealings with the Department of Energy indicate which of the following intermediaries you have used to gain access to DoE Headquarter's Decision Makers.

a. DoE Laboratories ☐

b. DoE Program Managers ☐

c. M&O Contractors of DoE Facilities ☐

d. Outside Technical Brokers ☐

	Helped	Hurt
2. Have these intermediaries helped or hindered your access?	☐	☐

D. **Please indicate whether any of the following items were issues in your decision to do business with or partner with the DoE and if it were an issue please indicate whether it had a positive or negative impact on your decision.**

		Was an Issue		Impacted Negatively		Impacted Positively
1.	Access which my company had to DoE/EM Decision Makers	☐	if checked, then did it ->	☐	or	☐
2.	The types of procurement which DoE offered as a mechanism for interaction.	☐	if checked, then did it ->	☐	or	☐
3.	DoE/EM willingness to listen to and incorporate our ideas into their programmatic decisions.	☐	if checked, then did it ->	☐	or	☐
4.	Level of resources which our company must spend to monitor and keep current with DoE/EM activities.	☐	if checked, then did it ->	☐	or	☐
5.	Our corporation's need to use the DoE technology transfer data base.	☐	if checked, then did it ->	☐	or	☐

E. Please indicate whether you agree, disagree, or there is no relevance to your company for the following statements. Please an X in the block that matches your response.

	Agree	Disagree	No Relevance
1. DoE has made available to your corporation the type of information that is necessary to make correct business decisions as to whether to invest in technology development.	☐	☐	☐
2. DoE has provided appropriate information to your company to enable you to reasonably estimate the return on any investment that you may make in technologies that would be used to support the DoE.	☐	☐	☐

F. Please indicate whether any of the following items were issues in your decision to do business with or to partner with DoE and whether the item had a positive or negative impact on your decision.

	(Check one box)			(Check one box)	
	Not Important	Some what Important	Very Important	Positive	Negative
1. The predictability of funding.	☐	☐	☐	☐	☐
2. The timing of funding.	☐	☐	☐	☐	☐
3. The level of DoE funding.	☐	☐	☐	☐	☐

DoE Questionnaire

	(Check one box)			(Check one box)	
	Not Important	Some what Important	Very Important	Positive	Negative
4. DoE's funding is relevant to investor or venture capital assessments of the company's activities.	☐	☐	☐	☐	☐
5. The company's potential exposure to strict liability fortechnology development.	☐	☐	☐	☐	☐
6. The company's potential exposure for proper cleanup of facilities.	☐	☐	☐	☐	☐
7. Availability of private insurance to cover environmental cleanup risks.	☐	☐	☐	☐	☐
8. Financial costs of technology demonstrations.	☐	☐	☐	☐	☐
9. Intellectual property and/or licensing concerns.	☐	☐	☐	☐	☐

Profile Information

Title: ______________________________

Type of Product: ____________________

Name (not mandatory): ____________________

Company (not mandatory): ____________________

Phone (not mandatory): ____________________

Interview with John Servo

Examination of the Factors and Issues for an Environmental Technology Utilization Partnership between the Private Sector and the Department of Energy

Interview with John Servo

Conducted for

Department of Energy

Cooperative Agreement No. DE-FC02-90ER12951

April 1997

prepared by

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The John Francis Co., Inc.

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Director, Center for Systems Engineering Technologies

GMU Paper - John Servo Case Study

- Servo runs a professional services company that assists other technology companies who have new technologies, attempt to bring them to the notice of investors or purchasers . Servo conducts investment events.

- Servo presents a company and their technologies, assist those companies with access to DoE. Also sizes of companies--start ups and venture capital companies -- a few companies of a few million dollars in sales

- Many cases the initial funding for these companies have come from the DoE itself. Generally he deals with companies where DoE has provided the initial funding to examine a technology capability.

- He also represents companies some funding for the actual development of the technology or they have the technology and DoE likes it or the laboratories share with the company through a CRADA

- Most companies are started on the basis of DoE or DoE laboratory funding. Companies often have a basic core capability funded by "various government sources". These companies are responsive government defined needs -- not necessarily to the marketplace.

- These companies often assume that DoE wants to use the technology when actually the DoE may only be interested in looking at the capabilities of the technology.

- As an example DoE may fund dozens of technologies but none or only a few will ever get into the marketplace.

- The laboratories also fund much of these research but the labs/M&O contractors have a "cultural bias" against outsiders that tends to maintain the status quo.

- EM-50 may be the source of technology funding but EM-30 and EM-40 actually buy the technology and use it.

- EM-50 is now attempting to fund the first year of actual technology development of these advance technologies.

- It is the people at the specific remediation site that determine the technologies to be used -- that is the M&O

- There is an attempt by DoE to shift the cultural of the laboratories and to prime the pump for these small companies

- The result of the change in EM-50 strategy is essentially to cutback on new technology funding and emphasize caring through on existing technologies to the initial year of deployment

- The technology companies need to form alternatives to provide other funding participants for example major environmental companies. There are negatives to the way in which EM-50 operates. For example there is a need to be a "subcontractor to an M&O which simply adds to the administrative burden and there is no incentive for the M&O to reduce the size of its own statement of work in response to new technology.

- There is general dissatisfaction with DoE because of this M&O system. Upset is not directed at DoE employees at has not affected their relationship with the technology companies but rather directed at the laboratories and M&O contractors.

- The reality is not build a better mouse trap and they will beat a path to your door rather build a better mouse trap and the M&O and other major majors want to see it dead.

- The technology companies generally assume that the hardest part is developing their technology or as truly the most difficult work is deploying the technology.

- EM-50 now recognizes that implementation of these technologies is the key. The DoE as always asked the question is the prospect worthwhile in a technical or scientific sense since these government programs have generally run by scientists who put dollars into good science.

- There is the assumption that if there exists a better mouse trap then the market will simply take it up. There exists a need for training of the scientist or at least cultural awareness for DoE scientists who fund R&D. The more conscious of getting the technology into a product and then into the field not just interesting.

- This cultural reorientation or "training" is not done in a formal sense but only indirectly through use of successful mechanisms for the transition of technology.

- DoE is notoriously poor as a customer.

- Companies are frustrated with the M&O contractors. For example a successful demonstration by a small company of a technology gets them nowhere since it may be contrary to the M&O own interest.

- DoE should attempt to help build user service company links for needs identification in the future. For example noting the need for cleanup of radioactive contaminated concrete walls.

- Much depends on the timeline for utilization of the technology. Other there is just not enough time to put the new technology into the decision process.

- The companies often have inexperience in cooperation with EPA and with the states. We must attempt to make it easier for advance technology options that are not part of the winning remediation proposal to be used. For example a provision of the remediation contract might require that the contractor show that the best technology is being used. There must be the possibility to use other "best technologies". For example the technology company may give the M&O part of the "action" of the new technology development. The real question is how do you change the incentives for the existing contractors who are operating under current contracts. Such incentives must be structured by "outsiders" from the M&O.

- The DoE should continue "forms" for company-government exchange of ideas in business planning.

- Global technology enterprise-follow through with companies. DoE needs outside intermediaries to crossover all the multiple points of contact. DoE also needs a more coordinated effort across all the EM functions.

- DoE should bring together the separated incentives into one place.

- Technology deployment and regulatory approval are conducted on a state by state basis. The DoE could help by establishing mutual reciprocity of regulatory approval amongst different states. EM-50 originally had a poor record with EM-30 and EM-40 developing technologies that the remediation people could not use and hence there existed no amino incentives to incorporate technologies or to make useable products out of those technologies.

- Only in the last two or three years has EM-50 begun to move toward a produce focus versus just good R&D exploration. The DoE objective should be to get technology out of the labs. There should not be simply another level of bureaucracy to achieve this transition but put a EM-50 person at each of the laboratories to promote such coordination with technology companies.

- Operating technology is the field is the goal but first EM-50 needs to be better organized internally.

There is no need for new legislation but rather use the flexibility that DoE already possess. The problem is a management problem not an authority problem or a policy issue. Simply does not need a new goal or a management reorganization what it needs first is to show a new direction that the EM-50 program is taking. Definition of the new direction and an associated plan come first then DoE can show the results of its spending and then problem solutions are more possible since you can see the success of management decisions.

DoE Multiple Choice Question

- DoE-EM has a good understanding of the needs of small business -- **DISAGREES**

- DoE understands the companies capital formation needs and the venture capital process -- **DISAGREES**

- DoE understands how its contract on partnership support can assist companies' cash flow -- **STRONGLY DISAGREES**

- DoE support could have been helpful to a company s survival -- **STRONGLY AGREES**

- DoE understands the company's motivation for dealing with DoE -- **STRONGLY DISAGREES**

- The government has a role to play in promoting the developing of environmental technology -- **STRONGLY AGREES**

- The government/DoE has a role in promoting new environmental technologies -- **STRONGLY AGREES**

- To direct partnership support -- **STRONGLY AGREES**

- To loans -- **STRONGLY DISAGREES**

- To equity participation -- **STRONGLY DISAGREES**

- To technological and scientific advice -- **STRONGLY AGREES**

- Most companies are satisfied with DoE contracting and procurement process -- **STRONGLY DISAGREES**

Most companies are satisfied with the technological understanding of the DoE program people -- **AGREE**

AN OVERVIEW CASE STUDY

DRAFT

The fundamental focus of the George Mason study is to directly elicit from small businesses their attitudes, opinions and comments on their relationship to DoE in general, and particularly to DoE's office of Environmental Management (EM-50). DoE is concerned that its relationship with the technology companies that it funds be structured in a way that maximizes the financial survivability and business prospects for those companies. The goal for DoE is to create viable companies who could promote their innovative environmental technologies for ultimate use in the DoE remediation process.

An additional motivation for the GMU study was also to explore the basis for some of the criticisms which DoE has received from the technology companies which it supports who have voiced dissatisfaction with their relationship with DoE. What appears to emerge is: (1) a basic disconnect between what the DoE EM-50 role is and what the companies' expectations are in their dealings with DoE; (2) a management structure which effectively offers disincentives for the introductions and exploitations of new technologies, and (3) a laudable DoE cultural orientation toward exploring good science which often inhibits good product development

To explore the relationship between new technology companies and DoE's Office of Environmental Management (EM-50), it is helpful to go back to the motivating reason for the formation of an environmental technology development office. EM-50 is founded on the premise that the environmental restoration of the DoE's own facilities is simply not achievable within any realistic financial commitment. Consequently, the general thrust of the DoE remediation strategy put into place almost 20 years ago was to develop new, more efficient, more cost effective technologies that would enable the Department to remediate its environmental problems within reasonable cost parameters. This is exactly the type of role, creating new scientific and technology options, for which DoE and its predecessor the Atomic Energy Commission have been world famous. This indeed has been the cultural orientation of this agency since it founding 50 years ago.

The trouble is that good scientists focus on and develop good science and the associated technologies. What is needed, however, are good products that can effectively remediate, on a full scale basis, the DoE's environmental legacy.

The development of new scientific and associated technology options does not necessarily mean that those options are suitable for implementation for a variety of technical, financial, scheduling and budget reasons. Consequently, far more options are created than can ever be ultimately utilized as products for actual remediation. The consequence, due to the very structure of the process, is that the majority of the DoE funded development companies will not be carried forward to actual DoE funded remediation.

These general observations emerging from the basic GUM study, were borne out in a final short case study based on an interview with a management consulting company which has dealt with dozens of DoE funded technology companies. This consulting company attempts to provide access for them to DoE and to other corporate environmental remediation companies through a variety of mechanisms. This company who also advises small companies on their internal management structure and their marketing techniques The interview was conducted to elicit from this company its integrated, on balance, identification and assessment of the issues raised in their direct interviews with technology companies. Consequently, we are reporting here on the observations of a third party who itself has dealt with numerous DoE funded companies. Such companies range in size from initial start up operations to companies of the order of one or two million dollars in sales, essentially all small start up venture companies.

Our study respondent noted to us that many of the companies with which he deals have had their initial funding from the DoE itself In fact , the Department of Energy was responsible in large part for the start up of these companies. Often it has been his experience that most of the companies with which he had dealt have had substantial DoE funding provided in the initial development of their technological capability. In other cases the companies may have had an initial technology capability and then DoE or DoE laboratory funding has developed that technology into a specific use for Departmental purposes, often through the use of a Cooperative Research and Development Agreement (CRADA) or through a direct DoE contract Many of these companies often have a basic core capability funded by various government sources not all DoE Also, such companies are extremely responsive to government defined needs since that is the source of the bulk of their funding and these government defined needs are not necessarily those required by the marketplace

It has been the respondent's experience that many companies often assume that DoE wants to use the technology which it has funded whereas actually DoE may only be interested in looking at the capability of that technology or in assessing its potential future interests or simply because it is good science that might just lead some place.

One of the more significant impediments noted in his dealings with various companies is the cultural bias or, more correctly characterized as "not invented here" attitude exercised by the laboratories or the M&O contractors toward research from outside sources. There are various manifestations of this "bias". For example, if the M&O contractor is actually charged or responsible for site remediation, the use of a new cheaper or more efficient technology means that funds are effectively transferred from the M&O to the new technology company. Also, if the new technology is successful, then less funds may be required or more progress required from the M&O. Also the risk of failure becomes the responsibility of the M&O. Consequently, the M&O faces the prospect of both diversion of some of its basic funds and a reduction in the funds necessary to complete his statement of work in addition to which further exploitation of the technology rests with the technology company and not with the M&O. These are indeed potent disincentives for cooperation with a new start up technology company.

In addition to the obvious fact that only a limited number of exploratory technologies will eventually evolve into useable products there has also been a management disconnect between EM-50 which has been the source of technology funding and EM-30 and EM-40 who actually buy the technology and use it in the field. There has been criticism of EM-50 for not focusing the general direction of the technology development effort toward the specific per site uses defined by the actual operational remediators. In addition to the strait forward coordination problem between the technology developers and the technology users there is also a comfort "disconnect" namely that the users are simply not familiar with the technologies and tend to use tried and true mechanisms as opposed to the new technologies being developed. To overcome this gap EM-50 is now attempting to fund the first year of actual technology development of these advanced technologies, essentially trying to bridge the gap from technology creation to technology deployment and product creation.

While this change in emphasis by EM-50 hopefully will make transition into implementation and remediation more attractive and hence increase the number and efficiencies of the newly developed technologies, it does reduce the funds available for exploring and developing new science and technology remediation options. The result, of course, is the funding of fewer exploratory technologies.

Such a new EM-50 policy does mean however that the people at the specific remediation sites will have closer access to the newly developed technologies It is these site oriented people however who determine the technologies that will be used The twist however is that these people are essentially the M&O contractors whose inherent bias noted earlier has to be eliminated in some fashion DoE therefore is attempting to shift the cultural of both the laboratories and the M&O prime contractors toward "priming the pump" for these small companies by having the labs and the M&O share in the potential success process.

In conducting this survey of small business attitudes it would be easy to adopt the incorrect notion that somehow the DoE is responsible for keeping all these small companies happy or in some way for utilizing their technologies. This in fact runs exactly counter to the fundamental goal of the EM-50 program which is to provide numerous options some of which may eventually evolve into useable products for the DoE complex. Consequently, the small technology companies need to form alternatives to provide other funding participants, for example, major environmental companies.

Companies and the DoE also need to develop alternative ways of dealing with each other. Under the current system, for example, there is a need to be a "sub-contractor" to an M&O or to a laboratory in order to participant in the technology development process. This simply adds one extra layer of administrative burden and technical oversight. No organization has any real incentive to reduce the size of its own statement of work in response to these new technologies. We should note that the general dissatisfaction with the DoE because of its use of the M&O subcontracting system is not directed at DoE employees. Even so, the relationships between the DoE and the technology companies is generally good. The dissatisfaction is directed at the laboratories and M&O contractors DoE is still seen as the "good scientists" trying to develop technologies for the remediation process.

In addition, a considerable amount of the frustration expressed by small companies in their relationship with the M&O contractors relates to a fundamental misunderstanding of the operative process for technology development The basic assumption espoused by both the DoE funders and the technology companies which they support is that if we "build a better mouse trap the marketplace will beat a path to your door". The correct articulation of this concept should read, "build a better mouse trap and the competition will want to see you dead". Both the DoE funders and the technology companies, perhaps from their own cultural bias toward good science, view the development of the science and the technology as truly the most difficult part of the process; the "break through discovery" is the epitome of success. The reality is that the evolution and development of that technology into a useable, cost effective product acceptable to the marketplace is indeed the most difficult problem and has been where the real backlog has existed in transiting technologies into products.

EM-50 is now recognizing that implementation of these technologies is the key. The DoE, as a premise, usually asks the question, "are the prospects for the technology they are funding the development of a worthwhile technology.?" Unfortunately this is only the first part of developing a useable product. The perspective of the funders must somehow change. Consequently there exists a need for "awareness" by the scientists of their own cultural attitudes. It is the DoE scientists who fund the R&D that forms the basis for product development. Cultural awareness should raise their level of consciousness for getting the technology into a product and then into the field not just the focus on the development of an interesting and promising technology

While the concept of "awareness training" has a certain negative connection what is meant is a cultural reorientation toward product development. However, such a reorientation or "training" is not done in some formal classroom sense or by the setting of some external goals but only indirectly through the use of successful mechanisms for the transition of those technologies into the marketplace In fact, the scientists who fund the technologies through EM-50 need to "get their hands on" the levers of the mechanisms that will see these technologies into the marketplace

The awareness of this marketplace is much broader than the straightforward utilization by the Department for its own remediation needs. DoE is notoriously a poor customer. DoE should attempt to build user developer company links, where remediation needs are not only identified today but for future potential needs. Such links however go much beyond the mere. "in the future we will need a technology to decontaminate radiator active concrete walls", for example. Such identification must go further and recognize that there are time lines for utilization of technologies and often there is simply just not enough time to bring a new technology into the decision process and hence into utilization in the field.

Another area where DoE could be of considerable help in maintaining the viability of the technology companies which it funds but ultimately cannot use for its own remediation is in the regulatory process. These companies often have very little experience in dealing or cooperating with EPA and with the state regulatory agencies. The DoE, for example, could attempt to make it easier for advanced technology options that are not part of any winning remediation proposal or have not been chosen to be used in a particular Doe remediation action to obtain state certification

In addition, some provision in the winning remediation contract might require that the prime contractor show that the best technology is being used even if that technology is not the one that the prime contractor had bid in for the remediation. There should be some possibility for the use of other "best technologies'. For its part for example. the technology company might give the M&O contractor part of the "equity action" of the new technology development. The real fundamental question is how do you create the incentives for existing contractors to incorporate these new technologies.

Technology deployment requires regulatory approval by each state in which the remediation is to be taken essentially on a state by state basis. The DoE could help by establishing multiple mutually acceptable regulatory approvals among the different states essentially coming up with standardized certification procedures, to the extent possible, which the states could accept. EM-50 originally had a poor record with the remediators, EM-30 and EM-40, developing technologies that the remediation people simply could not use. Hence there existed no economic incentives to incorporate technologies or to make useable products out of those technologies. Product usability and the need to clear the regulatory roadblocks brings the technology funders and users closer together and hence facilitates utilization of the technology.

Only in the last two perhaps three years has EM-50 begun to move toward a product focus versus a good R&D exploration The DoE objective should be to get technologies out of the laboratories and into the field. This process should not simply be another level of bureaucracy to achieve the transition. EM-30 can work with the laboratories for example by placing people at the labs or on site to promote the movement of these technologies into the field.

With regard to new legislation or new policy initiatives the respondent felt that the general consensus among the companies with whom he deals is that there is really no need for new legislation or new goals In fact they only tend to upset and defocus the process. Rather, the DoE should use the flexibility which it already possess. The problem is really a management problem not an authority problem or a policy issue. DoE simply does not need another new goal or a new management reorganization. What it needs first is to show a new direction that the EM program is taking. Simply to define a new direction, develop the associated plan for that direction and then proceed with it. DoE can show some results that its spending is actually is producing solutions in the field. Then at that point it is much more able to redirect the cultural biases and to provide the incentives and motivation to its own people that it can move technologies from the laboratory into the field. You "retrain" by actually achieving success.

There are however some very distinct positives and negatives which the study respondent felt were consistently voiced by the companies with which he has dealt. For example, most of the companies would say that DoE-EM has a poor understanding of the needs of small companies. DoE does not understand the process of company capital formation and the needs of venture capital process. DoE does not understand how its contract or its partnership support of a particular company can assist that company's cash flow and hence its survival. Likewise, it was felt that DoE simply does not understand a venture capital company's motivation for dealing with DoE in the first place.

On the other hand, most companies would agree that DoE support could have been very helpful to them and to the company's survival. They all agree that the government and the DoE have a role in promoting new environmental technologies In addition, such companies would welcome direct partnership support with DoE. would support technology and scientific exchanges Probably most importantly, most companies are satisfied with the technological understanding of the DoE program people. They feel they can communicate at least on a technological level.

Other concepts, however, which companies generally would reject include DoE equity participation in their company or loans from the DoE to implement their programs. Finally, most companies, are in one way or another, uniformly dissatisfied with the DoE contracting and procurement systems

John Servo, Vice President, Dawnbreaker

John Servo joined Dawnbreaker in 1991 and has primary responsibility for the company's interface with the investment community. He is responsible for telephone outreach to Fortune 500 companies and venture capital firms, assessing their technology and investment interests, as well as assuring good participation at the Forums that we conduct for the U.S. Department of Energy and the National Institute of Standards.

John is also an active member of our commercialization team and works with small and large firms participating in the DOE, DoD, and ATP programs. Mr. Servo has a strong background in sales, acquired over a 20 year career as a master salesman, sales trainer, sales manager, and general manager. He is skilled in analyzing what needs to be done from a management, pricing, and product mix perspective in order to make companies more profitable.

Mr. Servo also works with our market research team, being responsible for primary research initiatives to assess potential customer interests. He also serves as a reviewer of draft agreements and as a mentor to companies involved with negotiations.

jservo@dawnbreaker.com

Resources

The TechCon Program

TechCon is a U.S. Department of Energy (DOE) Program developed to increase the use of commercially available technologies in cleaning up DOE sites. With an emphasis on technologies that have shown superior performance characteristics; i.e., those that can achieve remediation goals faster, safer, with greater environmental protection, or for less cost; TechCon's mission is to identify, screen, and support the implementation of currently available environmental technologies from both the private and public sector in the U.S. as well as from international sources.

The TechCon Program succeeds as a networking tool, working with sites to identify clean-up needs, finding commercially available technologies and services that have proven performance capabilities, matching available technologies to needs at DOE sites, and bringing information on these technologies to the attention of site personnel. By connecting representatives of technology companies with those at remediation sites, TechCon promotes the use of available technologies and resolves barriers to their field application.

A key to TechCon's success is improving communication among companies, site representatives, and regulators. Towards that end, TechCon has instituted an electronic mail discussion list that is hosted at ANL. With over 60 members, including DOE, EPA, site contractor, and technology company personnel, this e-mail list facilitates dissemination of information and can expedite the matching of technology needs with commercially available technologies.

To learn more about or subscribe to TechCon's E-Mail discussion list,

send e-mail to: Dale Pflug at mailto:dpflug@anl.gov for the dpflug@anl.gov.

Technical Assistance Centers

New York Centers

Environmental Business Association of New York State Inc.

The Environmental Business Association of New York State, Inc. (EBA/NYS) is the trade association dedicated to supporting the growth of the environmental industry in New York State. EBA/NYS's members support and promote the goals of business development, environmental quality and economic vitality. The environmental industry encompasses businesses that provide products and services to prevent, monitor, control or remediate pollution, conserve and / or recycle energy and resources.

The Environmental Business Association of New York State is located in Troy New York, at Rensselaer Polytechnic Institute's Business Incubator Center. Our address is:

1223 Peoples Avenue
Troy, New York 12180
Tel. 518 - 276 - 2164
Fax 518 - 276 - 6380

Or Send us a Message
mailto:info@eba-nys.org

Pennsylvania Centers

Ben Franklin Technology Center of Southeastern Pennsylvania

Promoting Innovation and Economic Growth in Southeastern Pennsylvania by linking Entrepreneurs and Technology

The following Ben Franklin Technology Center sites service other regional areas across Pennsylvania:

Ben Franklin Technology Center of Western Pennsylvania

4516 Henry Street, Suite 103

Pittsburgh, PA 15213

Ben Franklin Technology Center of Central/Northern Pennsylvania

115 Technology Center

University Park, PA 16802

(814)863-4558

North Tier Ben Franklin Technology Center

Lehigh University

125 Goodman Drive

Bethlehem, PA 18015

(610) 758-5200

Ben Franklin Technology Center of Southeastern Pennsylvania University City Science Center

3624 Market Street

Philadelphia, PA 19104-2615

Phone: (215) 382-0380

Fax: (215) 387-6050

Email: mailto:bftc@benfranklin.org or bftc@benfranklin.org

Virginia Centers

Center for Innovative Technology - Virginia's Center for Innovative Technology

525 Butler Farm Rd, Hampton, VA 23666

The Center for Innovative Technology (CIT) directs Virginia'sefforts to promote science and technology. A non-profitcorporation, CIT enhances the state's economy by transferringuniversity-based scientific research and technological resources tocommercial applications. CIT has a number of programs by which it accomplishes this.

Mr. Stephen Cooper 804-825-2936, 804-825-2960 (fax)

Center for Innovative Technology - Herndon CIT Research Institutes CIT Research Institutes

2214 Rock Hill Road, CIT Tower, Suite 600, Herndon, VA 22070-4005

Four research institutes have been established at each ofVirginia's research universities to serve as focal points forjointly sponsored industry/CIT projects throughout the Commonwealthof Virginia. Each Institute director is a scientist and seniorfaculty member of the host university. Each Institute also has ascientific advisory group with both industry and universitymembers. Biotechnology; Computer-aided engineering; Information technology;Materials science and engineering

Mr. John M. Jerke, Associate 703-689-3015, 703-689-3041 (fax)

Center for Innovative Technology Commonwealth Technology Information Service

Commonwealth Tech. Information Service CIT Tower, Suite 600 2214 Rock Hill Rd. Herndon VA 22070

The Commonwealth Technology Information Service providesinformation on faculty expertise, government and industry researchpersonnel, and research facilities in VA. Also, the Center forInnovative Technology develops, markets, and licenses intellectualproperty for state agencies and institutions, and acts as aninformation clearinghouse and technology liaison for the state andfederal government, businesses and the general public.

Ms. Barbara Cooper, Director Public Information 703-689-3013, 703-689-3041 (fax)

Center for Innovative Technology Space Industry Development Program

Space Industry Dev. Program CIT Tower, Suite 600 2214 Rock Hill Rd Center for Innovative Tech. Herndon VA 22070

The Space Industry Development Program was initiated in 1988 byGovernor Baliles. Part of this program included a $500,000allocation to promote commercial space development in Virginia. The Governor also appointed a Space Business Advocate and allocated$5 million for the Virginia Air and Space Center in Hampton,Virginia. Aeronautical; Space

Mr. Mike Miller, Director 703-689-3024, 703-689-3041 (fax)

Center for Innovative Technology Technology Transfer Program

Technology Transfer Program Center for Innovative Technology 2214 Rockhill Rd Herndon VA 22070-4005

The Technology Transfer Program is a partnership between theCenter for Innovative Technology (CIT) and the Virginia CommunityCollege System. The program helps Virginia businesses become morecompetitive by using technology to solve business problems or totake advantage of business opportunities. Trained technologytransfer specialist at eleven community colleges work with localbusinesses at no charge. The directors help businesses: solveexisting problems and point out other technology solutions; provideaccess to the latest scientific and technical information throughVirginia Tech's worldwide computer searches; find supplies andcustomers; and arrange for education and training.

Mr. Michael W. Miller, Gen. Mgr. 703-689-3043, 703-689-3041 (fax), mike@pcmail.cit.org<B

Governor's Science Advisory Council

Governor's Science Advisory Council 1446 Duke Street Alexandria VA 22314-

3492

The Governor's Science Advisory Council was established byexecutive order in 1970. The Council acts as an advisor andconsultant to the governor on advanced technology issues,education, the environment, and opportunities for economicdevelopment. The Council is a volunteer organization of industrialand academic scientists and engineers. Expenses are paid by theGovernor's office.

Maryland Governor's Office Mrs. E. Lander Medlin, Executive Director 703-684-1446, 703-549-2772 (fax)

Thomas Nelson Community College

Center for Business and Community Services Center for Business & Community Services Thomas Nelson Community College P.O. Box 9407 Hampton VA 23670

The Center for Business and Community Services is one of the CITTechnology Transfer Centers. Virginia's Center for Innovative Technology

Mr. E. Ray Bud, Director 804-825-2936, 804-825-3552 (fax)

University of Virginia in Charlottesville

Institute of Computer-Aided Engineering Institute for Computer-Aided Engineering Mechanical Engineering Bldg., Rm 213 University of Virginia in Charlottesville Charlottesville VA 22903

The Virginia Center for Innovative Technology (CIT)'s Institute ofComputer-Aided Engineering at the University of Virginia inCharlottesville, awards grant money to faculty working in the areasof design automation, robotics, automated manufacturing, sensorsfor automation, and VLSI electronic circuits. Computer-Aided Engineering; Sensors; Robotics; Design automation;VSLI integrated circuits

Center for Innovative Technology Dr. Larry Richards, Director 804-924-3759, 804-924-7674 (fax), lgr@virginia.edu

Virginia Commonwealth University Institute of Biotechnology

Institute of Biotechnology Virginia Commonwealth Univ. P.O. Box 980126 Richmond VA 23298-0126

The Institute of Biotechnology, located at the VirginiaCommonwealth University in Richmond, performs research in moleculargenetics, macro-molecular engineering, novel and innovativediagnostics, and biocatalysis. Biotechnology Center for Innovative Technology

Dr. Terry Woodworth, Director 804-828-8565, 804-828-8566 (fax), woodworth@gems.vcu.edu

Virginia Department of Taxation R&D Sales Tax Exemption Program

R&D Sales Tax Exemption Program Virginia Dept. of Taxation Technical Services Section P.O. Box 1880 Richmond VA 23282-1880

The R&D Sales Tax Exemption Program allows tangible personalproperty purchased for use or consumption directly and exclusivelyfor R&D to be exempt from state sales and use taxes.

Mr. Gene Hawkins 804-367-8354, 804-367-0985 (fax)

Virginia Polytechnic Institute Virginia Productivity Center

Virginia Productivity Center 567 Whittemore Hall Virginia Polytechnic Institute Blacksburg VA 24061-0118

The Virginia Productivity Center (VPC) is a non-profitorganization whose objective is to bridge the gap between academictheory and organizational practice. VPC offers a variety ofservices designed to enable managers to plan, implement, measure,evaluate and control their organization's performance improvementefforts.

Dr. D. Scott Sink, Director 703-231-4568, 703-231-3575 (fax), dscott_sink@vqpc.vt.edu

Environmental Sites on the Internet

Conferences:

"http://www.nceet.snre.umich.edu/eeproj.html"

Electronic Journals:

"http://info.cern.ch/hypertext/DataSources/bySubject/Electronic_Journals.html"

Environmental Journals and Newsletters:

"http://ag.arizona.edu/OALS/ALN/ALNHome.html"
The Arid Lands Newsletter <i (Published by The Office of Arid Lands Studies at The University of Arizona / Tucson, Arizona USA) </i

"http://erg.ucd.ie/thermiewww/newsletters.html"
Building Technology Newsletters and Building Targeted Projects Newsletters <i (THERMIE Newsletters) </i

"http://www.rec.hu/REC/Bulletin/recbull.html"
The Bulletin <i (A quarterly of the Regional Environmental Center for Central and Eastern Europe, REC) </i

"http://www.risoe.dk/sys/c2e2.html"
c2e2 news <i (The Newsletter of the UNEP Collaborating Center on Energy and Environment) </i

"http://www.cicero.uio.no/cicerone.htm"
Cicerone Nyhetsbrev <i (Senter for internasjonal klima- og Miljöforskning, Universitetet i Oslo) </i

"http://www.ucar.edu/esig/newshp/newshp.html"
Climate-related Impacts Network Newsletter <i (Compiled and published by the Environmental and Societal Impacts Group (ESIG) of the National Center for Atmospheric Research) </i

"http://techno.isys.net/int-res/cr/cr.html"
Climate Research <i (Tables of contents with abstracts) </i

"http://techno.isys.net/int-res/cr/crspecial.html"

Climate Research Special Issue <i (Tables of contents with abstracts) </i

"http://techno.isys.net/int-res/dao/dao.html"
Diseases of Aquatic Organisms <i (Tables of contents with abstracts) </i

"http://www.envirolink.org/orgs/ef/"
Earth First! Journal

"http://www.mbnet.mb.ca:80/linkages/voltoc.html"
Earth Negotiations Bulletin

"http://www.igc.apc.org/climate/Eco.html"
Eco <i (The Climate Action Network Newsletter) </i

"http://ccme-mac4.bsd.uchicago.edu/DSAESR.html"
Eco-Socialist Review <i (The Journal of the Environmental Commission of the Democratic Socialsts of America) </i

"http://gopher.uidaho.edu/UI_gopher/library/egj"
The Electrical Green Journal

"http://www.gold.net/ecosystem/cont-old.htm"
The Environment Digest

"http://solstice.crest.org:80/environment/greenclips/"
GreenClips Environmental Journal

"http://gopher.uidaho.edu/1/UI_gopher/library/egj"
Journal of Political Ecology

"http://www.is.in-berlin.de/Service/Klimagipfel/"
Klimaforum Bulletin '95

"http://techno.isys.net/int-res/meps/meps.html"
Marine Ecology Progress <i (Tables of contents with abstracts) </i

"http://www.ornl.gov/ORNLReview/rev26-2/text/recent.html"
ORNL Review

"http://maui.net/~jstark/ournvmag.html"
Our Environment

"http://www.canuck.com:80/Planet/"
PLANETworks

"http://nn.apc.org/sei/redindex.html"
Renewable Energy for Development <i (Newsletter of the Energy, Environment & Development Programme. Stockholm Environment Institute) </i

"http://nn.apc.org/sei/sbindex.html"
SEI International Environmental Bulletin <i (Stockholm Environment Institute) </i

"http://www.cru.uea.ac.uk/cru/tiempo/index.htm"
Tiempo <i (Global Warming and the Third World) </i

"http://www.unep.ch/iucc/bulltn0.html"
The United Nations Climate Change Bulletin

Guides:

"http://www.rpi.edu/dept/environ/guide/index.html"
Environment & Society: An Internet Resource Guide

"http://www.envstudies.brown.edu/environ/documents/envguide.html"
A Guide to Environmental Resources on the Internet

"http://www.ncsa.uiuc.edu/SDG/IT94/Proceedings/Searching/crossley/paper.html
"
WAIS through the Web - Discovering Environmental Information

Listservs:

"http://www.tile.net/tile/listserv/index.html"
Tile.Net / Listserv

Some General Environmental Sites:

"http://www2.waikato.ac.nz/law/Enviro/Institutions.html"
Academic - Information - Research Institutions

"http://envirolink.org/envirowebs.html"
All Environmental Web Resources

"http://bcn.boulder.co.us/environment/center.html"
Boulder Community Network Environment Center

"http://netspace.students.brown.edu:80/environ" Brown is Green

"http://www.rain.org/~scottj/"
Directory of Environmental Resources on the Internet

"http://info.er.usgs.gov/network/science/earth/environment.html"
Earth and Environmental Science

"http://www.igc.apc.org/igc/www.eco.html"
EcoNet's Environmental Directory

"http://www.gold.net/ecosystem/index.htm"
The ECOSYSTEM home page

"http://ecosys.drdr.virginia.edu/EcoWeb.html"
EcoWeb

"http://galaxy.einet.net/GJ/environment.html"
Environment

"http://www.einet.net/galaxy/Community/The-Environment.html" The Environment

"http://akebono.stanford.edu:80/yahoo/Environment_and_Nature/"
Environment and Nature

"http://www.cfn.cs.dal.ca/Environment/EnvCFN.html"
The Environment at Chebucto Freenet

"http://boris.qub.ac.uk/cvui/info.html" Environmental Information

"gopher://ecosys.drdr.virginia.edu/11/library"
Environmental Library

"http://www.etla.fi/pkm/envi.html"
Environmental Resources for Economists and Others

"http://cyanolab.sb1.pdx.edu/environ/resources.html"
The Environmental Resources Homepage (Portland State University)

"http://envirolink.org:/start_web.html" EnviroWeb

"http://www.het.brown.edu:80/hungerweb" HungerWeb

"http://honor.uc.wlu.edu:1020/%23td/cl%20-su"
Netlink Server at Washington & Lee University: by Subject

"http://kaos.erin.gov.au/other_servers/other_servers.html"
Other Environmental Information Servers

"gopher://path.net:8001/11/.subject/Environment"
Pandora-Gopher Environment

"http://www.tiac.net/users/dploss/home.html"
Ploss Associates - Safety & Environmental Information on the Internet

"http://www.igc.apc.org" The Progressive Directory IGC

"http://www.ub2.lu.se/auto_new/auto_9.html"
WAIS Databases in Environmental Studies

"http://ecosys.drdr.virginia.edu/Environment.html" The WWW Virtual Library: Environment

Search Alphabetically by Subject:

This is an alphabetic subject list that will bring you to environmental information from different Home Pages and some Gopher Menus. Use the alphabetic index to browse this site more quickly. If you do not find what you are looking for try:

"http://lycos.cs.cmu.edu" Lycos and
"http://webcrawler.cs.washington.edu/WebCrawler/WebQuery.html" WebCrawler

two powerful tools for searching the Internet.

A full menu of search engines is available from IIASA at a site called "http://cuiwww.unige.ch/meta-index.html" W3 Search Engines Summary.

You can also try
"http://teal.nosc.mil/planet_earth/info_search.html"
Here you will find Planet Earth Home Page and Yahoo Server.

Pointers to lots of subject guides, search tools, and virtual libraries can be found at "http://information.com/" information.com.
"http://www.csn.net:80/way/"
The Way. World Access Internet Director & Navigator and
"http://honor.uc.wlu.edu:1020/"

Alphabetic Subject Listing of Internet Sites

Acid Rain:

"http://www.acidreign95.lth.se/"
Acid Reign '95? in Gothenburg, Sweden 26-30 June 1995

Acoustic Ecology:

"http://interact.uoregon.edu/MediaLit/WFAEHomePage"

Acronyms:

Environmental and Enviroment-related Acronyms
"http://kaos.erin.gov.au/general/acronyms.html"

Activism:

"http://anthfirst.san.ed.ac.uk/EnvironmentalActivism.html"

African Studies

"http://www.african.upenn.edu/African_Studies/Home_Page/WWW_Links.html"

Tracking Environmental Change in West Africa - USAID
"http://sun1.cr.usgs.gov/doc/edchome/usaid/tap.html"
Urgent Action, Appeals & Commentary

"http://www.african.upenn.edu/African_Studies/Urgent_Action/menu_Urge nt.html"

Agenda 21 - see UNCED

Aberdeen University Department of Agriculture
"http://www.abdn.ac.uk/~agr342/index.html"

AgInfo (College of Agriculture University of Arizona)
"http://ag.arizona.edu"

Agriculture and Forestry
"http://galaxy.einet.net/GJ/agriculture.html"

Brazilian Agricultural Research Enterprise - EMBRAPA
"http://www.embrapa.br/index-english.html"

Center for Agricultural and Rural Development (Iowa State University)
"http://www.ag.iastate.edu/centers/CARD.html"

DLO-NL (Netherlands)
"http://www.bib.wau.nl:80/dlo/"

Institute of Agriculture & Natural Resources (University of Nebraska - Lincoln)
"http://unlvm.unl.edu"

The National Agricultural Library (NAL)
"http://www.nalusda.gov/"

North Carolina Department of Agriculture
"http://www.agr.state.nc.us/"

The Swedish University of Agricultural Sciences (SLU)
"http://www.radek.slu.se/suas/sluallm.htm"

The Swedish University of Agricultural Sciences (SLU) :Radioecology
"http://www.radek.slu.se/"

Air Pollution:
"http://web.fie.com:80/web/fed/agr" US Department of Agriculture

GRNSD Theme Group about Atmospheric Dispersion of Chemicals
"http://dutw239.tudelft.nl/GRNSD/GT-ATMDC"

Measurement of Air Pollution from Satellites (Maps)
"http://stormy.larc.nasa.gov/press.html"

Alternative Technology:

"http://www.foe.co.uk/CAT/index2.html"
Center for Alternative Technology : Index (Machynelleth, Wales)

Antarctica:

"http://www.awi-bremerhaven.de/"

The Alfred-Wegener-Institute

"gopher://infoserver.ciesin.org:70/11/catalog/Politics/gc_policy/intl/treaties/100755.World_Treaties/Antarctica"

Antarctica Treaties

"http://www.belspo.be:80/antar/"

Belgian Antarctic Research Programme

"http://www.nerc-bas.ac.uk/"

The British Antarctic Survey (BAS)

"http://icair.iac.org.nz" Gateway to Antarctica

"http://quest.arc.nasa.gov/livefrom/livefrom.html"

Live from Antarctica

"http://www.crseo.ucsb.edu/lter/lter.html" Palmer Station (LTER)

Arctic:

"http://spirit.lib.uconn.edu:80/ArcticCircle/

Arid Lands:

"http://ag.arizona.edu:80/OALS/IALC/Home.html"

Atmospheric Research:
"http://info.er.usgs.gov/network/science/atmosphere/index.html"

Atmospheric Sciences
"http://grads.iges.org/home.html"

National Center for Atmospheric Research
"http://http.ucar.edu/metapage.html"

National Oceanic and Atmospheric Administration Environmental Information Services

"http://www.esdim.noaa.gov"

The University Corporation for Atmospheric Research (UCAR)
"http://www.ucar.edu/UCAR.html"

Baltic Sea:

"http://biomac.io-warnemuende.de/baltic"

Baltic Sea Resources Home Page

"http://130.238.187.204/BaltUniv/BaltUniv.html"

Biodiversity:

Biodiversity and Biological Collections WWW Server

"http://muse.bio.cornell.edu"

Biodiversity and Ecosystem Network
"http://straylight.tamu.edu/bene/bene.html"

Biodiversity and its Value

"http://kaos.erin.gov.au/life/general_info/op1.html"

Biodiversity Convention - A Guide

"http://kaos.erin.gov.au/life/general_info/convention.html"

Biogeography Laboratory (Center for Remote Sensing and Environmental Optics. University of California at Santa Barbara)

"http://www.crseo.ucsb.edu/biogeog/biogeog.html"

NBS Gap Analysis

"http://www.nr.usu.edu/gap/gaphome.html"

WEB of Life: Exploring Biodiversity

"http://www.envirolink.org:80/orgs/wqed/"

Biofuels:

"http://www.ftpt.br/ws/linking.html"

Bioinformatics:

"http://www.esd.ornl.gov/BFDP/BFDPMOSAIC/binmenu.html"
"http://life.anu.edu.au:80" ANU Bioinformatics Hypermedia Serevice

Biology:

American Institute for Biological Sciences

"gopher://aibs.org/"

Biocenter/Biozentrum (University of Würzburg)

"http://www.biozentrum.uni-wuerzburg.de/"

Biocomputing/Biozentrum (Basel University)

"http://www.ch.embnet.org/"

Biological, Agricultural and Medical Resources (INFOMINE)

"http://lib-www.ucr.edu/bioag"

Biosciences

"http://golgi.harvard.edu/biopages.html"

BIOSIS

"http://www.biosis.org/htmls/common/home.html"

Environmental Management Technical Center: National Biological Survey
"http://www.emtc.nbs.gov"

Planet Earth
"http://teal.nosc.mil/planet_earth/biology.html"

Biosphere:

Man and the Biosphere
"http://ice.ucdavis.edu/MAB/MAB_main_page.html"

Biotechnology:
"http://www.biospace.com/"

Biospace

"http://www.inform.umd.edu/EdRes/Topic/AgrEnv/Biotech"
The Biotechnology Information Center

Global Agricultural Biotechnology Association (GABA)
"http://www.lights.com/gaba/"

The National Center for Biotechnology Information (NCBI)
"http://www.ncbi.nlm.nih.gov"

United Nations International Centre for Genetic Engineering and Biotechnology
"http://base.icgeb.trieste.it"

Brazilian Ecosystems:
Ecossistemas Brasileiros: Mata Atlantica
"http://www.ftpt.br:80/mata.atlantica/"

Business and Environment:

GLOBE 96 (International Trade Fair and Conference,
"http://www.apfnet.org/apfweb/globe/globeinfo.html"
Vancouver, Canada March 26-29, 1996)

Mullins Media Limited
"http://www.mullins.com/"

Canada:
"http://www.ns.doe.ca/how.html"

Environmental Canada Atlantic Region

Carbon Dioxide (CO_2):
Carbon Dioxide Information Analysis Center (CDIAC)
"http://www.esd.ornl.gov/programs/cdiac/cdiac.html"

Central and Eastern Europe Environment:
Central European Environmental Data Request Facility (CEDAR)
"http://pan.cedar.univie.ac.at"

Czech Ministry of Environment
"http://www.env.cz/index.html"

Regional Environmental Center for Central and Eastern Europe (REC)
"http://www.rec.hu/"

CIESIN:
CIESIN Gateway - Data and Information Search and Access
"http://www.ciesin.org/gateway/gw-home.html"

"http://www.ciesin.org"
Information for a Changing World - The Consortium for International Earth Science Information Network

Climate Change:
"http://www.unep.ch/iucc.html"
Climate Change: United Nations Framework Convention on Climate Change (UNFCCC) and the UNEP/WMO Information Unit on Climate Change (IUCC)
"http://www.cyberstore.ca/greenpeace/climate/Default.html"

Climate Crisis (Greenpeace)
"http://www.cyberstore.ca/greenpeace/climate/berlin.html"
Climate Summit, Berlin 1995 (Greenpeace)

"http://www.etla.fi/pkm/pkm.html"
ETLA (The Research Institute of the Finnish Economy)

Climate Protection:

"http://www.iclei.org:80/co2/"
Cities for Climate Protection

Climate Research:

"http://www.acru.uq.oz.au/"
The Applied Climate Research Unit's Home Page (the University of Queensland)

"http://ceo-www.jrc.it/"
Center for Earth Observation

"http://www.cicero.uio.no"
CICERO (Center for International Climate and Environmental Research - Oslo)

"http://nic.fb4.noaa.gov" Climate Prediction Center

"http://www.dkrz.de/index-eng.html" Deutsches Klimarechen Zentrum

"http://metolab3.umd.edu/EARTHCAST/earthcast.html"
Earthcast (Department of Meteorology University of Maryland)

"http://hickory.egs.uct.ac.za" Environmental & Geographical Science

"http://www.ucar.edu/esig/esighp.html"
Environmental and Societal Impacts Group (ESIG)

"http://wwwghcc.msfc.nasa.gov:5678/ghcc_home.html"
Global Hydrology and Climate Center
"http://ferret.wrc.noaa.gov/ferret/main-menu.html"
Live Access to Climate Data

"http://www.meteo.mcgill.ca/welcome.html"
McGill Center for Climate and Global Change Research

"http://www.ncdc.noaa.gov/ncdc.html" The National Climatic Data Center (NCDC)

Coastal Ecosystems:

"http://cceh.noaa.gov"
Center for Coastal Ecosystem Health (CCEH)

Coffee:

"http://mmink.com/mmink/dossiers/cafemam.html"

Conservation:

"http://boris.qub.ac.uk/cvni/cv1.html"
Conservation Volunteers Northen Ireland
"http://gaia.earthwatch.org/"
Earthwatch

"http://infoserver.ciesin.org:80/IC/iucn/IUCN.html"
International Union for the Conservation of Nature (IUCN)

"http://tor.ngb.se/"
Nordic Gene Bank (A Centre for the Conservation and Utilization of Plant Genetic Resources)

"http://www.oslonett.no/home/nvern"
Norges Naturvernforbund (The Norwegien Society for Conservation of Nature)

"http://seaserver.nos.noaa.gov"
Office of Ocean Resources Conservation and Assessment (ORCA)

"http://www.rr.ualberta.ca/~lmorgant/index.html"
Resources Development and Wildelife

"http://metro.turnpike.net/S/sam2/index.html"
Wildlife and Conservation Links

"http://www.wcmc.org.uk/cgi-bin/imagemap/icons?287,26"
World Conservation Monitoring Center

Dams and Reservoirs:

"http://www.sandelman.ocunix.on.ca:80/dams/Overview.html"
DRWG + CPHJB's Dam-Reservoir Archive

Deforestation:

"http://pubweb.acns.nwu.edu/~fishe/Deforestation.html"
Overview

Demography:
"http://www.iiasa.ac.at/~heilig/demogrph/home.html"
A Demographic Database <i (by Gerhard K. Heilig) </i

"http://coombs.anu.edu.au/ResFacilities/DemographyPage.html"
The World-Wide Web Virtual Library: Demography & Population Studies

Design:

"http://euler.berkeley.edu/green/cgdm.html"
Consortium of Green Design and Manufacturing

Earthday:

"http://www.igc.apc.org:80/earthday/"
EcoNet's Earth Day Resources

EC (The European Commission):

"http://rea.ei.jrc.it/"

Environment Institute (Joint Research Centre, Commission of the European Communities)

"http://www.cec.lu/Welcome.html"

EUROPA

"http://www.cec.lu/cgi-bin/ice-form.pl" ICE Indexing Gateway
"http://www.cordis.lu/" CORDIS

Eco Travel:

"http://www.txinfinet.com/mader/ecotravel/ecotravel.html"

Eco Travel in Latin America
"http://www.internet-cafe.com/eco-adv-oz/"

Eco-Adventures Australia

"http://www.bcu.ubc.ca/~megill/res_orgs_hp.html"

Ecological Economics:

"http://193.45.158.3/utskott/megha/"
MEGHA (EnvironmentalBusinessGroup, Stockholm School of Economics Student Union)

"http://kabir.umd.edu/miiee/miiee.html" Maryland International Institute for Ecological Economics

"http://www.u-net.com/gmlets/home.html" LETSystems - the Home Page

Ecology:

"http://ww.pop.bio.aau.dk/geneco.html"
Aarhus University - Department of Ecology and Genetics

"http://teal.nosc.mil/planet_earth/environment.html"

Ecology and Environment

"http://ecology.umsl.edu/"
International Center for Tropical Ecology (the University of Missouri-St Louis)

"http://boris.qub.ac.uk/cvni/nvqlev2.html"
Landscapes and Ecosystems

"http://kabir.umd.edu/Welcome.html"
Multiscale Experimental Ecosystem Research Center (MEERC)

"http://culter.colorado.edu:1030/"
Niwot Ridge Long-Term Ecological Research (Colorado)

"http://lternet.edu" U.S. Long Term Ecological Research Network (LTER)

Education:

"http://www.circles.org/"
Earth System Science Community Curriculum Testbed

"http://ecolu-info.unige.ch/"
Ecolu-info (Centre universitaire d'ecologie humaine de l'Université de Genève)

"http://www.nceet.snre.umich.edu"
Environmental Education on the Internet

"http://www.globe.gov/"
The GLOBE Program (An International Environmental Education and Science Partnership)

"http://www.ub2.lu.se/~anki/hgur/hgur.html"
Integrated Environmental Education (Council for the Renewal of Undergraduate Education, Högskolans Grundutbildningsråd, Sweden)

"http://www.pacificrim.net/~nature/"
The University of Global Education (Project NatureConnect)

El Nino:

"http://www.pmel.noaa.gov/toga-tao/el-nino/home.html"
An El Nino Theme Page: Accessing Distributed Information related to El Nino

Electric Cars:

"http://cyberzine.org/html/Electric/ecomotion.html"
Eco-Motion Electric Cars

Electrolux:

"http://mmm.wwa.com/elux/elt4.html"
The Group's Environmental Activities

Energy:

"http://web.mit.edu/afs/athena/org/c/ceepr/www/ceepr.htm"
Center for Energy and Environmental Policy Research (CEEPR) - MIT

"http://snake2.cr.usgs.gov"
Division of Energy and Mineral Resources - Bureau of Indian Affairs

"http://www.luth.se/depts/mt/ene" Division of Energy Engineering (Högskolan i Luleå.
Luleå University, Sweden)

"http://www.eerc.und.nodak.edu"
Energy & Environmental Research Center (University of North Dakota)

"http://zebu.uoregon.edu/energy.html" Energy and the Environment

"http://www.nutek.se/"
NUTEK (Swedish National Board for Industrial and Technical Development)

"http://www.channel1.com:80/users/tellus/seib.html"
The Stockholm Environment Institute - Boston Center (SEI)

"http://nn.apc.org/sei/"
The Stockholm Environment Institute - Stockholm Center (SEI)

"http://erg.ucd.ie/opethermie.html"
THERMIE

"http://www.risoe.dk/sys/syshom3.html"
UNEP Collaborating Center on Energy and Environment

"http://www.acl.lanl.gov/DOE/OER.html" U.S. Department of Energy

"http://eagle.em.doe.gov/"
U.S. Department of Energy: Office of Environmental Management (EM)

Environmental Chemistry:

"http://helios.cr.usgs.gov/gips/aii-inl4.htm"
Understanding Our Planet Through Chemistry (A U.S.Geological Survey HTML Poster Session)

Environmental Engineering:

"http://cct.seas.ucla.edu" Center for Clean Technology (University of California, Los Angeles)

"http://www.nmt.edu/~jjenks/engineering.html"
The World-Wide Web Virtual Library: Environmental Engineering

Environmental Information Sources:

"http://www.gold.net/ecosystem/index.htm"
The ECOSYSTEM home page

"http://ftp.clearlake.ibm.com/ERC/overview.html"
The Environmental Resource Center (ERC)

Environmental Policy:

"http://www.pitt.edu/~ian/Resources/iat-tech.html"
The World-Wide Web Virtual Library: IANWeb Resources - Technology, Science,

and Environmental Policy

Environmental Quality:

" http://129.229.1.100/ceq/ceq.html"
Council on Environmental Quality

Environmental Research and Sciences:

"http://www.umu.se/cmf/cmfpage.eng.html"
The Centre of Environmental Research (Umeå, Sweden)

"http://www.uio.no/www-other/cicero/"
CICERO (Center for International Climate and Environmental Research - Oslo)

"http://www.inhs.uiuc.edu/niewww/cnie.html"
The Committee for the National Institute for the Environment (CNIE)

"http://interchange.idc.uvic.ca/communicopia/index.html"
Communicopia - Environmental Research and Communications

"http://www.cfe.cornell.edu/"
Cornell Center for the Environment

"http://dutw239.tudelft.nl/EnvEnrg/"
The Environment & Energy Directory (Delft University of Technology)

"http://www.erl.gov/erlhome.html"
Environmental Research Laboratories (NOOA)

"http://www.esd.ornl.gov/ern/index.html"
Environmental Research News

"http://www.uminovac.umu.se/UEE/UEE.HTML"
The European University for the Environment

"http://ice.ucdavis.edu/"
Information Center for the Environment (the University of California, Davis)

"http://www.nerc.ac.uk/"
National Environment Research Council (UK)

"http://www.esd.ornl.gov"
Oak Ridge National Laboratory (ORNL): Environmental Sciences Division (ESD)

"http://www.rockefeller.edu/phe/"
Program for the Human Environment (The Rockefeller University)

"http://www.er.doe.gov/production/oher/oher_top.html"
US Department of Energy, Office of Energy Research: Office of Health and Environmental Research Biological and Environmental Research Program

Environmental Software Products:

"http://www.pacific.net/~earthsoft/"
EarthSoft

Environmental Studies:

"http://www.brown.edu:80/Departments/Environmental_Studies/"
Center for Environmental Studies (Brown University)

Environmental Writing:

"http://www.lehigh.edu/injrl/public/www-data/semenu.html"
Science and Environmental Writing Program (Dept of Journalism and Communication, Lehigh University)

Environmentally Friendly Products:

"http://www.mcs.net/~energy/home.html"

The Energy Efficient Environments
EPA:

"http://www.epa.gov/enviro/html/ef_home.html"
Envirofacts (A Relational Database Integrating EPA's Information Holdings)

"http://www.epa.gov" Environmental Protection Agency

"http://kaml1.csi.uottawa.ca:3000/bin/waisform/epafutures"
Environmental Protection Agency Futures Project <i (Database) </i
"http://www.epa.gov/docs/GCDOAR/glb-home.html"
Green Lights Program. Voluntary Pollution Prevention at a Profit

Erosion:
"http://purgatory.ecn.purdue.edu:20002/NSERL/nserl.html"
Agriculture Research Service: Soil Erosion

"http://purgatory.ecn.purdue.edu:20002/NSERL/projects.html"
Agriculture Research Service: Water Erosion

"http://athena.wes.army.mil/CERC/CERC_homepage.html"
Coastal Engineering Research Center

"http://www.cecer.army.mil/grass/viz/erosion.html"
Terrain Analysis and Erosion Modeling

"http://www.weru.ksu.edu/werm.html"
Wind Erosion Simulation Models

Forestry:

"http://www.metla.fi/~saarikko/doc/forestry-resources.html"
Forestry Information Resources on the Internet

"http://gopher.orst.edu:80/Dept/fmc/"
Forestry Media Center (College of Forestry, Oregon State University)
"http://gaia1.ies.wisc.edu/research/pngfores/"
Gaia Forest/Biodiversity Archives

"http://www.icfrnet.unp.ac.za" Institute for Commercial Forestry Research

"http://www.iiasa.ac.at:80/Research/FOR"
The Siberian Forest Sector Study - IIASA

"http://www.metla.fi/info/Forestry.html" The World-Wide Web Virtual Library: Forestry

Friends of the Earth:

"http://www.foe.co.uk" Friends of the Earth Home Page

Fourth World:

"http://www.halcyon.com/FWDP/fwdp.html" Fourth World Documentation Project
"http://ananse.irv.uit.no/trade_law/gatt/nav/toc.html" The General Agreement on Tariffs and Trade/World Trade Organization

Geographic information systems (GIS):

"http://www.gisworld.com/"
GIS World Inc.

Geology:

"http://agcwww.bio.ns.ca" Atlantic Geoscience Center

"http://exodus.open.ac.uk/index.html"
Department of Earth Science Homepage (The Open University, Walton Hall/Milton Keynes. UK)

"http://www.nsm.uh.edu/geosciences.html"
Department of GEOSCIENCES at the University of Houston

"http://www.gfz-potsdam.de/welcome.html"
GeoForschungsZentrum Potsdam

"http://zephyr.rice.edu/department/dept_intro.html"
Geology & Geophysics at Rice University

"http://www.indstate.edu/gga/geol/index.html"

Geology Homepage (Indiana State University)

"http://geomatics.com/"
Geomatics International

"http://lthgt.tg.lth.se"
Geotechnology (Lunds University of Technology, Sweden)

"http://gtri.harc.edu"
Geotechnology Research Institute (GTRI)

"http://www.ngdc.noaa.gov/ngdc.html" National Geophysical Data Center

"http://atm.geo.nsf.gov/index.html" NSF Geosciences

"http://www.usgs.gov" U.S. Geological Survey

"http://www.ngdc.noaa.gov/mgg/aboutmgg/wdcamgg.html"
World Data Center A for Marine Geology & Geophysics

Global Change:

"http://www.cgrer.uiowa.edu"
The Center for Global and Regional Environmental Research

"http://spso.gsfc.nasa.gov/eos_reference/TOC.html" Earth Observing System Reference Handbook

"http://www.crseo.ucsb.edu/esrg.html"
Earth Space Research Group

"http://gcmd.gsfc.nasa.gov/" The Global Change Master Directory (GCMD)

"http://gcmd.gsfc.nasa.gov/gcmdonline.html"
Servers with Global Change/Environmental Data and Information

"http://infoserver.ciesin.org:80/IC/SEDAC/SEDAC.html"
Socioeconomic Data and Application Center (SEDAC)

Global Futures:

"http://www.quiknet.com/globalff/globalfu.html"
Global Futures Foundations

Global Security:

"http://www.gsp.cam.ac.uk"
The Global Security Programme (University of Cambridge, UK)

Global Warming:

"http://www.ncdc.noaa.gov/gblwrmupd/global.html"

Global Warming Update

Great Lakes:

"http://www.cciw.ca/glimr/intro.html"

Great Lakes Information Management Resource

"http://epawww.ciesin.org/"

Great Lakes Regional Environmental Information System

Green Plans:

"http://www.rri.org/index.html"
The Green Plan Center

Greenhouse Gases:

"http://antenna.nl:80/greentie/index.html"
Greentie (Greenhouse Gas Technology Information Exchange)

"http://www.channel1.com:80/users/tellus/seib.html"
The Stockholm Environment Institute - Boston Center (SEI)

"http://nn.apc.org/sei/"
Stockholm Environment Institute - Stockholm Center (SEI)

Greenpeace:

"http://www.eunet.ch/Local/greenpeace/greenpeace.html"

Greenpeace Switzerland

"http://www.cyberstore.ca/greenpeace/index.html"

Greenpeace WWW Information Page

"http://www.greenpeace.org/"

Greenpeace World Wide Web International

Groundwater:

"http://www.isc.tamu.edu:80/PICS/"

Grand Challenges in Groundwater Remediation (PICS)

Hazards/Hazardous Waste and Substance:

"http://atsdr1.atsdr.cdc.gov:8080/hazdat.html"
ATSDR - HazDat (ATSDR's Hazardous Substance Release/Health Effects Database)

"http://atsdr1.atsdr.cdc.gov:8080/cxcx1.html"
ATSDR - Hazardous Waste Conference 1993

"http://ATSDR1.ATSDR.cdc.gov:8080/cx.html"
ATSDR Science Corner (Agency for Toxic Substances and Disease Registry Atlanta, Georgia)

"http://www.ehmi.org"
The Environmental Hazards Management Institute

"gopher://infoserver.ciesin.org:70/11/catalog/Politics/gc_policy/intl/treaties/100755.World_Treaties/Hazardous_Waste"

Human Rights:

"http://www.traveller.com/~hrweb/ai/ai.html"
Amnesty International

"http://seralph0.essex.ac.uk:80/law/human-rights"

Human-Rights Information Through Essex

"http://www.traveller.com/~hrweb/hrweb.html"

The Human Rights Web Home Page

"http://www.iiasa.ac.at/docs/IIASA_Research.html" Environmental Research

"http://www.iiasa.ac.at:80/Research/IEC"
The International Environmental Commitments Project

"http://www.iiasa.ac.at/docs/Admin/PUB/Catalog/PUB_SUBJECT_Environment.html"
International Institute for Applied System Analysis - Publication Catalog: Environment

Indigenous Studies:

"http://www.halcyon.com/FWDP/cwisinfo.html"
Center for World Indigenous Studies

"http://www.halcyon.com/FWDP/fwdp.html"
Fourth World Documentation Project Home Page

Law:
"http://freenet.vancouver.bc.ca/local/wcel/"
The Environmental Legal Information Base (ELIB)

"http://www.law.indiana.edu/law/intenvlaw.html"
The WWW Virtual Library: Environmental Law

Libraries:

"gopher://poniecki.berkeley.edu:570/1"
Central European Environmental Libraries Database

"http://www.mannlib.cornell.edu/"
Mann Library (Cornell's College of Agriculture and Life Sciences, College of Human Ecology, and Divisions of Biological and Nutritional Sciences)

Marine Research:

"http://me-www.jrc.it/dms/dms.html"
DMS (Dimethylsulphide) Model: Introduction

"http://www.ices.inst.dk/"
International Council for the Exploration of the Sea

"http://me-www.jrc.it/me_open.html"
Joint Research Center, Ispra (Institute for Remote Sensing: Marine Environment Unit)

"http://www.kmf.gu.se/"
Kristinebergs Marina Forskningsstation (Kristineberg Marine Research Station)

"http://metro.turnpike.net/O/ocean/index.html"
Marine Plankton Ecology and Biological Oceanography via WWW

"http://www.pmel.noaa.gov/pmelhome.html"
Pacific Marine Environmental Laboratory (PMEL)

NAFTA:

"http://the-tech.mit.edu/Bulletins/nafta.html"
The North American Free Trade Agreement

Natural Resources:

"http://sfbox.vt.edu:10021/Y/yfleung/nrrips.html"
Natural Resources Research Information Pages (NRRIPS)

Oceanography:
"http://www.ngdc.noaa.gov/paleo/aslo/aslo.html"
American Society of Limnology and Oceanography (ASLO)

"http://biudc.nbi.ac.uk/bodc/bodcmain.html"
British Oceanographic Data Centre (BODC)

"http://www.nodc.noaa.gov/"
National Oceanographic Data Center (NODC) Home Page

Oil Spill:

"http://www.alaska.net:80/~ospic/ "
Oil Spill Public Information Center (OSPIC)

Organisations:

"http://action.org/"
The Action Coalition

"http://envirolink.org:80/orgs"
Environmental Organisations On-Line With the EnviroLink Network

"http://www.lead.org/"

LEAD (Leadership for Environment and Development Program)

"http://www.oslonett.no/home/nvern/index.html"
Norges Naturvernforbund (The Norwegien Society for Conservation of Nature)

Ozone:

"http://www.essential.org/orgs/Ozone_Action/Ozone_Action.html"

Ozone Action

"http://www.ciesin.org/TG/OZ/oz-home.html"
Ozone Depletion and Global Environmental Change <i (from CIESIN thematic guides) </i

Peace Reasearch:

"http://www.sipri.se/"
Stockholm International Peace Reasearch Institute (SIPRI)

Pesticides:

"http://sulaco.oes.orst.edu:70/1s/ext/extoxnet/pips"

Pollution:

"http://www.und.ac.za/prg/prg.html"
Pollution Research Group (University of Natal, Durban)

Pollution Prevention:

"http://146.138.5.107/EPIC.HTM"
DOE Pollution Prevention Information Clearinghouse (EPIC)

"http://www.epa.gov/docs/GCDOAR/OAR-APPD.html"
US EPA (Atmospheric Pollution Prevention Division)

Rainforest:

"http://www.ran.org/ran/"
Rainforest Action Network

"gopher://gopher.igc.apc.org/11/orgs/ran"

"http://mh.osd.wednet.edu/"
Rainforest Workshop Home Page

"http://www.euronet.nl/users/mbleeker/suri_eng.html"
The Tropical Rainforest In Surinam

Resource Development and Wildlife:

"http://www.rr.ualberta.ca/~lmorgant/index.html"

Recycling:

"http://www.ece.cmu.edu/afs/ece/usr/ego/recycle/FARQ.html"
ECE FARQ (Frequently Asked Recycling Questions)

"http://www.branch.com:80/grn"
Global Recycling Network

"http://granite.sentex.net:80/recycle/"
Recycler's World

Recycling: Computers

"http://www.cybermalls.com/cymont/bluechip/bluechip.htm"
Blue Chip Design Homepage

"http://www.utw.com/computerRecycle/cr.html"
Computer Recyclers

Renewable Energy:

"http://solstice.crest.org"
Internet Information Service of the Center for Renewable Energy and Sustainable Technology (Solstice)

"http://gopher.nrel.gov:70"
National Renewable Energy Laboratory

"http://www.eren.doe.gov/"
U.S. Department of Energy.Energy Efficiency and Renewable Energy Network

Sierra Club:

"http://www.sierraclub.org/"
Sierra Club - One Earth, One Chance

"http://www.IslandNet.com:80/~jwight/enviro"
Sierra Club - The Deep Green Exchange (Victoria Group Homepage)

Solvent Alternatives:

"http://clean.rti.org/"
SAGE Solvent Alternatives Guide

Standards:

"http://www.iso.ch/welcome.html"
International Organization for Standardization (ISO)

Sustainable Development:

"http://terra.ecouncil.ac.cr/ecweb.htm"
Earth Council (San José, Costa Rica)

"http://www.earthpledge.org/"
Earth Pledge Foundation

"http://www.mbnet.mb.ca:80/linkages"
International Institute for Sustainable Development (IISD) - Linkages

"http://curry.edschool.Virginia.EDU:80/~solarark/"
The Yellow Mountain Institute for Sustainable Living

Third World:

"http://www.ictp.trieste.it/TWAS/TWAS.html"
Third World Acadamy of Science (TWAS)

Toxicology:

"http://atsdr1.atsdr.cdc.gov:8080/atsdrhome.html"
Agency for Toxic Substances and Disease Registry (ATSDR)

"http://atsdr1.atsdr.cdc.gov:8080/hazdat.html"
ATSDR - HazDat (ATSDR's Hazardous Substance Release/Health Effects Database)

"http://ATSDR1.ATSDR.cdc.gov:8080/cx.html"
ATSDR Science Corner (Agency for Toxic Substances and Disease Registry Atlanta, Georgia)

"http://sulaco.oes.orst.edu:70/1/ext/extoxnet"
EXTOXNET - EXtension TOXicology NETwork

Trade:

"http://www.ciesin.org:80/TG/PI/TRADE/tradhmpg.html"
Trade and the Environment <i (from CIESIN thematic guides) </i

"http://opus.natp.iftea.com/ooed/unisote/unisote.html"
World Symposium on Trade Efficiency

Transportation:

"http://its02.leeds.ac.uk"
Institute for Transport Studies (ITS, Leeds University, UK)

UN (United Nations):

"http://www.undcp.or.at/unlinks.html"
The World-Wide Web Virtual Library: United Nations Information Services

UNCED:

"http://infoserver.ciesin.org:80/datasets/unced/unced.html"
UNCED Collection - The United Nations Conference on Evironment and Development <i (from CIESIN) </i

"http://www.undp.org"
UNDP (United Nations Development Programme)
UNEP:

"http://www.unep.ch/welcome.html"
United Nations Environment Programme (UNEP), Geneva

"http://grid2.cr.usgs.gov/grid/grid.htm"

UNEP/GRID (United Nations Environment Programme's Global Resource Information Database)
"http://www.gsf.de:80/UNEP/index.html"
UNEP (United Nations Environment Programme) / HEM (Harmonization of Environmental Measurement):
The Information Highway to the Global Environment

Urban Environment:

"http://www.iclei.org:80/co2/"
Cities for Climate Protection
USAID:

"gopher://gaia.info.usaid.gov"
U.S. Agency for International Development

Waste Management:

"http://www.awma.org/index.html"
Air & Waste Management Association's Home Page

"http://vendela.math.kth.se/ima/edu/sem01/seminar.htm"
Waste Management and Waste Handling - University programmes and Industrial Demands
(The 4th SEFI WGEE Seminar)

Wastewater:

"http://www.halcyon.com/wastewater/welcome.html"
The WWW Virtual Library: Wastewater Engineering

Water Resources:

"http://www.dwr.csiro.au/"
CSIRO Division of Water Resources (Australia)

"http://wwwghcc.msfc.nasa.gov:5678/ghcc_home.html"
Global Hydrology and Climate Center

"http://dutcg16.tudelft.nl/~bernard/iwm/iwm.html"
Intergrated Water Management (Delft University of Technology)

"http://ageninfo.tamu.edu/~twri/"
Texas WaterNet (Texas Water Resources Institute)

"http://www.uwin.siu.edu"
Universities Water Information Network (UWIN)

"http://www.inform.umd.edu/EdRes/Topic/AgrEnv/Water"

Water Quality Information Center (the National Agricultural Library of the USDA)

"http://ag.arizona.edu/AZWATER/"
Water Resources Research Center, the University of Arizona (WRRC)

Whaling:

"http://tirpitz.ibg.uit.no/wwww/ss.html"
Tirpitz whaling on the WWW site

World Bank:

"gopher://gopher-gw.micro.umn.edu:70/7waissrc%3a/WAISes/Everything/environment-newsgroups?world+bank"
WAIS Environment Newsgroups: World Bank
"http://www.ciesin.org/IC/wbank/WBank-home.html"
The World Bank (from CIESIN)

"gopher://gopher.worldbank.org:70/1"
World Bank-Gopher

WHO (World Health Organization):

"http://www.who.ch/"
The World Health Organization World-Wide Web Server

WWF (World Wildlife Fund):
"http://www.envirolink.org:80/orgs/wqed/wwf/wwf_home.html"
World Wildlife Fund

Technology Transfer Sites on the Internet

There are many other WEB sites related to Technology Transfer located at other Department of Defense (DoD) organizations, as well as other (non DoD) Federal Laboratories.

The following pages are included here as a service to anyone who can not find technologies suitable for their purposes at this site. The listing below is not meant to be exhaustive. We add related sites to this page as we find them on our own, or as they are brought to our attention.

http://www.zyn.com/flc/ for the Federal Laboratory Consortium (FLC) Home Page

The FLC is a consortium of the over 600 Federal Laboratories. These pages discuss the FLC organization itself, as well as have direct links to several hundred Federal Laboratory Technology Transfer Offices.

http://www.nalusda.gov/ttic/guide.htm for the Federal Laboratory Technology Transfer Internet Directory

Links on these pages can take you directly to at least 250 of the over 600 Federal Laboratories. These pages are maintained by the US Dept of Agricuture. After the FLC home page, which also mirrors these pages, there is no other listing that we know of, that is anywhere near as complete!

http://www.dtic.dla.mil/lablink/ for the DoD-Lablink Home Page

Lablink is run by the Defense Technical Information Center (DTIC).

http://www.dtic.dla.mil/techtransit/ for the DoD-TechTRANSIT Home Page

TechTRANSIT is run by the Office of Technology Transition (OTT) under the Deputy of Defense Research & Engineering.

http://oracle.mtac.pitt.edu/WWW/MTAC.html for the Mid-Atlantic Technology Applications Center (MTAC)

MTAC serves as a focus for technologies and scientific and engineering expertise within the Federal laboratory system in five mid-Atlantic states and the District of Columbia. This site also has references to the NASA Regional Technology Transfer Centers.

http://www.nttc.edu/ for the National Technology Transfer Center (NTTC) at Wheeling, WV.

NTTC is the hub of a national network linking US companies with federal technologies. This site has extensive information, with search tools and links to many other TT sites.

http://www.rl.af.mil:8001/Technology/rl-techno-main.html for the DoD-Air Force

Tech Transfer Office at the Rome Labs, Rome NY.

http://www.afmc.wpafb.af.mil/TTO/ for the DoD-Air Force Tech Transition Office at Wright Patterson AFB, Ohio

http://www.afmc.wpafb.af.mil/TTO/techconn/index.htm for the DoD-Air Force TechCONNECT Program at the Wright Patterson AFB, Ohio

http://infonext.nrl.navy.mil/~techtran/ for the DoD-Navy TT Office at the Navy Research Laboratory in Washington DC.

The World Wide Web Virtual Library: Law: Intellectual Property

This web page is maintained by the Indiana University School of Law - Bloomington.

Juliet Casper Smith, Electronic Services Librarian, jcsmith@law.indiana.edu>jcsmith@law.indiana.edu

The following list of links is fully searchable as well as being arranged alphabetically.

If you know of online legal information not in these lists, please let us know about it by

Please send corrections to mailto:wwwlaw@polecat.law.indiana.edu

http://access-iplaw.com address for Access - Intellectual Property Law A central source for intellectual property law.

http://alw.com/ address for American Lawyers on the Web

Turn-Key Web Solutions for Lawyers by Lawyers -- offers web development and hosting services to fellow lawyers nationwide.

http://www.azlink.com/lawyers address for Glenn S. Bacal's Indispensable Website for Lawyers

Comprehensive, topically organized list of the best links for lawyers with detailed annotations for intellectual property sites. Intellectual property articles and learning charts from the author of Legal Research on the Internet, an interactive article posted on the ALI-ABA home page.

http://www.bstz.com address for Blakely Sokoloff Taylor & Zafman

BSTZ is a law firm specializing in all aspects of intellectual property law including: patents, trademarks, copyrights, trade secrets, and related agreements and litigation.

http://www.bmhm.com address for Brown Martin Haller and McClain

Patent Trademark and Copyright Law Firm. The site contains Featured Patents, Patent Gallery, Summaries of Intellectual Property Law topics and Published Articles.

http://www.cdt.org/ address for Center for Democracy and Technology

http://www.cislo.com address for Cislo & Thomas

Cislo & Thomas is a full service intellectual property law firm providing patent, trademark, copyright and tradesecret law services to the business and entertainment community, both locally and worldwide through our network of associates in every major country in the world.

http://www.crblaw.com address for Cole, Raywid & Braverman, L.L.P.

A law firm specializing in telecommunications and intellectual property law.

http://www.digidem.com/legal/domain.html address for Comparative Domain Dispute Resolution

How different countries deal with trademark issues and domain names.

http://www.cae.wisc.edu/~brillr address for Computer, Electronics, Mechanics

Patent Attorney Bob Brill I am developing skills in emerging electrical and computer engineering as well as computer sciences technologies.

http://www.acsu.buffalo.edu/~hlmeyer/Complaw/complaw.html address for Computers & Law Info Pages

This site contains a wide range of law student written papers dealing with all aspects of Cyber Law. Get both historical and current information on topics ranging from Critical Path Method for Lawyers to more general information like software piracy and clipper chip.

http://fairuse.stanford.edu/ address for Copyright and Fair Use

From Stanford University Libraries, a collection of links to Primary Material, Current Legislation, Cases, Issues, Other Resources on the Web, and a General Overview.

http://www.directory.net/copyright/

Copyright Clearance Center

http://www.cis.ohio-state.edu/hypertext/faq/usenet/Copyright-FAQ/ top.html address for Copyright Law - Usenet FAQ

http://www.law.cornell.edu/usc/17/overview.html address for U.S. Copyright Law

http://lcweb.loc.gov/copyright/ address for U.S. Copyright Office

Contains U.S. Copyright Office General Information and Publications.

http://kspace.com/intertainment address for Creating Internet Entertainment:

A Guide for Industry Professionals and Web Developers

The web site provides online support for the new book from John Wiley (NYC) which covers all aspects of Internet-based entertainment. An introductory chapter on entertainment cyberlaw is provided.

http://www.portal.com/~cyberlaw/ address for CyberLaw (tm) & CyberLex (tm) An educational service focusing on legal issues concerning computer technology.

http://gahtan.com/techlaw/ address for The Cyberlaw Encyclopedia

A comprehensive reference source for information on cyberlaw.

http://www.cybersquirrel.com/clc/clcindex.html>Cyberspace Law Center

http://www.sccsi.com/DaVinci/davinci.html address for Da Vinci Design Company

http://www.domain-name.org address for Domain Name Rights Coalition

The Domain Name Rights Coalition is a non profit organization dedicated to the rights of domain name holders worldwide. This page gives critical information on domain name disputes and litigation as well as how to join.

http://www.dsmo.com/ippage.htm address for DSM&O Intellectual Property

Resources on the Internet Links to hundreds of IP resources on the Internet, legal articles, court decisions, IP FAQ, current IP developments and a Patent of the Month.

http://www.eilberg.com/ address for William H. Eilberg, Attorney at Law

Jenkintown, Pennsylvania-based attorney specializing in patents, trademarks and copyrights. Website includes FAQs on patents and trademarks.

http://www.leepfrog.com/E-Law/ address for E-Law Home Page

contains past articles from the monthly Technology Law column published in the Chicago Daily Law Bulletin. Home of "E-Law 3.0: Computer Information Systems Law and System Operator Liability." by David Loundy Contains links of interest to practicing attorneys, especially those interested in "Cyberspace Law."

http://www.bna.com/hub/bna/legal/eiphigh.html address for Electronic Information Policy and Law Report (from BNA)

http://www.crypto.com/ address for Encryption Policy Resource Page

Encryption technology is the key to the future of the information revolution. It allows businesses and individuals to communicate securely over any inexpensive communication platform without fear of eavesdropping. This page is dedicated to pointing out the failure of the Administration in attempting to squash encryption through it's failed Clipper Chip schemes and antiquated export regulations.

http://www.laig.com/law/entlaw address for Entertainment Law Resources for Television, Film and Multimedia Producers

Mark Litwak, a veteran entertainment attorney and award-winning author, provides a wealth of information on the legal side of the entertainment and multimedia industry, including copyrights and distribution.

http://www.escrowtech.com/escrows/ address for EscrowTech International, Inc.

Home Page Software escrows and intellectual property protections services. Includes deposits for source code, copyrights, and trade secrets.

http://www.batnet.com/oikoumene/FWHome.html address for Fenwick & West Electronic Papers

http://jurix.bsk.utwente.nl address for Foundation for Legal Knowledge Based Systems (Jurix)

This site is maintained by the (Dutch) Foundation for Legal Knowledge Based Systems (Juirx). It provides details about the participants in Jurix as well as publications, both in HTML and PostScript format, published by Jurix.

http://www.fplc.edu address for Franklin Pierce Law Center

Intellectual property (patent, trademark, copyright) resources

http://gahtan.com/alan/ address for Alan M. Gahtan -

Computer and Information Technology Law Canadian lawyer practicing in the computer and information technology law field.

http://www.rjg.com/rjg address for Richard J. Greenstone, Attorney at Law

A law firm in San Francisco specializing in copyright, trademark, trade secret, licensing, business and transactional law for the computer, entertainment &

publishing industries. Site includes articles about entertainment and copyright law.

http://www.netcom.com/~patents2/thefirm.html address for A Guide: Patents, Trademarks and Copyright Information Resources and Links

A basic guide and index for inventors, entreprenuers, and small business entities to understand intellectual property, how to secure and protect such property with links to helpful resources, forms, circulars and governmental agencies.

http://www.drealms.co.uk/hc/ address for Herrington & Carmichael

English Solicitors We are an English firm of Solicitors who can advise clients on all aspects of the law of cyberspace, Information technology law, company law, business law, acquisitions, sale of goods,European Union Law, commercial propery and commercial litigation.We can also advise clients on insurance for litigation relevant to intellectual property rights infringement.

http://www.hpcc.gov/ address for High Performance Computing and Communications (HPCC) National Coordination Office for the HPCC

http://www.patent-jp.com/hiroe address for Hiroe & Associates Patent and Trademark firm

Gifu Japan A resource of information on intellectual property laws in Japan, compiled by one of the leading I.P. firms in practice.

http://users.aol.com/lawhusick address for Lawrence A. Husick, Esq. Technology and Patent Law

Lawrence A. Husick is a registered patent attorney and a member of the firm of Lipton & Stapler of Media, Pennsylvania, near Philadelphia.

gopher://marketplace.com/11/ila address for Information Law Alert

Focuses especially on wireless communications, intellectual property, and battles between the cable and telephone industries

http://seamless.com/rcl/infolaw.html address for The Information Law Web

http://inprop.law.net address for INPROP interactive

INPROP interactive is an online service for the US patent, trademark and copyright community. Registered users can post messages to our forums, use the chat service to talk to other lawyers, set up their personalized news service and keep in touch with the IP community.

http://www.ipmag.com/ address for Intellectual Property

a quarterly magazine about legal and policy issues in high-tech industries

http://www.eff.org/pub/CAF/law/ip-primer address for Intellectual Property Law Primer

http://www.laig.com/law/intnet address for International Entertainment/ Multimedia Law & Business Network

Articles and other useful information on the business and law of Entertainment, Multimedia and Intellectual Property. Includes a calendar of multimedia events, direct links to film fesitval Web sites, and international links to professional, legal and business services.

http://www.strath.ac.uk/Departments/Law/ijlit.html address for International Journal of Law and Information Technology

Home page of the international IT Law paper journal - Access to abstracts of current volume and subscription details.

http://town.hall.org/ address for Internet Town Hall

Includes address for U.S. Patent/Full Text APS Search and address for SEC EDGAR Documents

http://elj.warwick.ac.uk/elj/jilt/ address for Journal of Information, Law and Technology

An on-line only journal accessible through the Web focussing on IT Law and IT applications relating to law.

http://www.wm.edu/law/publications/jol/ address for The Journal of Online Law

An electronic publication of scholarly essays about law and online communications-- law and cyberspace.

http://web.bu.edu/LAW/publications/science_technology.html address for Journal of Science & Technology Law From Boston University School of Law,

this Journal publishes articles on legal questions raised by science and technology. The Journal gives primary attention to recent developments in the law relating to biotechnology, biomedical technology, computer and communications law, high-technology financing, intellectual property, and technology transfer.

http://www.asu.edu/law/jurimetrics address for Juriemtrics Journal of Law, Science, and Technology Quarterly,

refereed publication of the American Bar Association Section on Science and Technology and the Arizona State University Center for the Study of Law, Science, and Technology.

http://ww.csra.net/ragnog/rm119.html address for John R. Kahn's Homepage

Attorney handling computer law; bankruptcy law; real estate law; and general civil transactions in San Jose, CA.

http://www.trytel.com/~pbkerr address for Law Office of Philip B. Kerr

This law firm, located in Ottawa, Canada, practises exclusively patent,trademark, copyright and franchise law.

http://www.kuesterlaw.com/>Jeff Kuester's Technology Law Resource

http://www.island.com/LegalCare/welcome.html address for Legal Care for Your Software Legal Care for Your SOFTWARE by Daniel Remer and Robert Dunaway -

A Step-by-Step Legal Guide for Computer Software Writers, Programmers and Publishers

http://www.legalethics.com address for Legalethics.com

This Web Page Set offers the legal profession links and references to ethics rules, regulations, and articles relating to the integration of the Internet into the practice of law. The two goals are to help: (1) establish practical rules, regulations, and guidelines to protect attorneys, their clients and the general public as the profession migrates to the Internet; and,(2) attorneys find information and resources relating to their ethical obligations associated with Internet use.

http://www.cam.org/~arajhou address for Legal Multimedia

Midialaw offers its expertise in the creation of a multimedia publication for virtual classroom and library. The page is about the impact of information technology on legal publication.

http://www.insync-corp.com/LRC address for The Legal Research Centre

The Legal Research Centre is a unique online service for lawyers and legal professionals. The Legal Research Centre helps potential clients locate lawyers through its RFP (Request for Proposal) section. All Legal Research Centre members (lawyers and legal professionals) are automatically listed in the LRC

Electronic Directory. The Legal Research Centre has over 400 free, ready-to-use legal forms and agreements for virtually any legal situation. Tax law, real estate, wills and trust, copyright and patent law, securities and much more. The Legal Research Centre's Financial Information pages gives members continuously updated views of business and finance from around the world via newsgroups and retrieval services.

http://www.netcom.com/~lugpress/ address for Lugo & Press, P.C.

Lugo & Press is a law firm specializing in entertainment, intellectual property and sports law, primarily from the transactional (contractual) aspect.

address for Master-McNeil's Trademark Resources

http://www.cyberspace-law.com address for McCormick, Paulding & Huber Hartford, CT

An intellectual property firm specializing in Computer Law, Electronic Commerce, Patents and Trademarks.

http://www.mandw.com address for Michaelson & Wallace

We are a rapidly expanding intellectual property law firm with offices in both New Jersey and California. We have been in business for over 12 years and primarily serve large domestic and multi-national corporations, academic and governmental organizations in all facets of intellectual property law -- both foreign and domestic. Our practice is heavily concentrated in electronic, computer and software based technologies.

www.umich.edu\~mttlr address for Michigan Telecommunications and Technology Review

http://www.associated.com/patent007/ address for Thomas Moses' Official Intellectual Property Web Page

This Intellectual Property Web Page is maintained by the Law Offices of Thomas L. Moses. It contains an IP primer, a list of patents for sale, a page featuring cool patents, information about my practice, and a great set of links for Intellectual Property professionals, inventors, and anyone remotely interested in Technology law.

http://www.batnet.com/oikoumene/ address for WWW Multimedia Law

http://www.eff.org/pub/CAF/law/multimedia-handbook address for Multimedia Law Handbook

http://www.music-law.com address for The Music Law Offices

Authored by a music lawyer in Chicago, this site emphasizes practical steps musicians can take to protect their careers. It covers copyrights, contracts, managers, etc.

http://www.patent-jp.com/onda/index.htm address for ONDA TECHNO Intl. Patent Attys.

ONDA TECHNO International Patent Attorneys is a law firm specializing in intellectual properties. Our home page presents information about our services and recruitment.

http://www.islandnet.com/~wwlia/ca-pat1.htm address for Patent Law in Canada

Plain language, comprehensive description of the patent protection scheme under Canadian federal law.

http://www.bmhm.com address for The Patent Trademark and Copyright Home Page

Provides information on Intelectual Property Law, including Featured Patents, Information Extras with descriptions of procedures to protect and enforce patents, trademarks and copyrights world wide.

http://www.spo.eds.com/patent.html address for Patent Search Service: U.S. Patents 1972-present

The Electronic Data Systems (EDS) Shadow Patent Office (SPO) offers on-line, easy-to-use, highly effective patentability and infringement searches against the full-text of the 1.7 million U.S. patents issued since January, 1972.

http://www.patentec.com address for PATENTEC

Full-service professional patent services, including patent documentation, patent searching and patent drafting and prosecution, specializing in advanced technologies such as robotics, genetic engineering, and complex electronic circuits. Discount high-quality patent documents. Custom patent collections on CD-ROM.

<dt><A HREF"http://www.piperpat.co.nz/ address for James W. Piper & Co.

Patent Information Service Worldwide listing of patent attorneys, useful links for patent law and intellectual property, and legal information for New Zealand.

http://www.publaw.com address for The Law Offices of Lloyd L. Rich

Provides legal services to the publishing community including copyright, trademarks, contracts, rights, negotiation, and other publishing related legal issues.

http://www.urich.edu/~lta/lawtech.html address for Richmond Law & Technology Association

http://www.sgpdlaw.com address for Schwab Goldberg Price & Dannay

Schwab Goldberg Price & Dannay is a New York City law firm specializing in the law of copyright, trademarks, publishing, computer software, trusts and estates, and general corporate law.

http://www.sixbey.com address for Sixbey, Friedman, Leedom & Ferguson, P.C.

Provides a full service approach to patent, trademark, and copyright law for corporate clients in all industries.

HREF="http://www.mit.edu:8001/afs/athena/org/t/techreview/www/tr.html address for Technology Review

Contains some articles about Law and Technology

http://execpc.com/~mhallign/ address for Law of Trade Secrets

http://www.twmlaw.com address for True, Walsh & Miller

Full-service law firm in Ithaca, NY, with emphasis on immigration and intellectual property law.

http://www.muchmusic.com/muchmusic/cyberfax/trademark.html address for Trademark Wars

An ever-growing list of web sites that have had trouble with trademark lawyers.

http://www.compulink.co.uk/~willpower/ukinfo.htm address for United Kingdom Patent Information

Information on obtaining patent protection in the United Kingdom.

http://www.alabama.com/patents/ address for Veal & Associates

Veal & Associates is a law firm that specializes in securing and protecting an individual's intellectual property rights.

http://www.FPLC.edu/tfield/usnwr.htm address for What do U.S.News IP Program Rankings Mean?

Tom Field answers the question with: Not much!

http://www.bekkoame.or.jp/~shupatnt/ address for Shusaku Yamamoto Patent Law Offices

A progressive and well-established legal office conveniently located in Osaka Business Park, Shusaku Yamamoto specializes in protecting our client's Intellectual Property Rights by providing legal counsel and assistance both in Japan and in many other countries throughout the world in cooperation with our established foreign associates. Homepage provides information about Intellectual Property rights in Japan.

GNET Business & Finance

Many resources exist to help businesses gain a competitive edge in the global marketplace. These resources include government programs, such as those run by the Small Business Administration, as well as others run by non-profit organizations and other private concerns. GNET provides information and links to many of these which might be of interest to environment and technology companies, including sources of loans, grants, and venture capital.

Business Incubators

National Science Foundation Grants and Program Areas
http://www.em.doe.gov/tie/index.html

DOE Technology Information Exchange Workshops gnet/images/new1

Environmental

http://www.EXIM.gov for the Export-Import Bank of the United States

http://www.OPIC.gov for the Overseas Private Investment Corporation (OPIC)

The Overseas Private Investment Corporation is an independent U.S. Government agency that assists U.S. companies investing in some 140 emerging economies around the world.

http://www.unisphere.com/uni/public/aboutuni.html for the UNISPHERE

An international organization based in Washington, DC supported by public & private partners in 23 countries. It operates a virtual venture market for firms with advanced technology products and services.

http://www.nato.int/science/homepage.htm for the NATO Science Programme

Provides assistance for international collaboration between either NATO-country scientists or between scientists in NATO countries and scientists in NATO's Cooperation Partner Countries.

Grant Possibilities

http://www.nato.int/science/homepage.htm for the NATO Science Fellowships Programme

Provides opportunities for scientists of NATO countries to pursue their work or to continue their training at the most prestigious institutions in other NATO member countries

http://w3.arl.mil/tto/ARLDTT/dtthp.html for the The Army Research Laboratory Domestic Technology Transfer Program Home Page

Your firm or university can leverage its technology expertise with Army resources through Cooperative Research and Development Agreements (CRDAs) and

Patent License Agreements (PLAs). The resulting synergy gives you the opportunity to achieve goals that might not otherwise be realized.

http://www.ita.doc.gov/ for the U.S. Department of Commerce International Trade Administration

"... dedicated to helping U.S. businesses compete in the global marketplace..."

http://www.ta.doc.gov/otphome/otp.htm for the The United States Department of Commerce Office of Technology Policy

Works in partnership with the private sector to develop and advocate federal policies that maximize the impact of technology on industrial competitiveness, job creation and economic growth. http://es.inel.gov/ncerqa/rfa/current97.html for the National Center for Environmental Research and Quality Assurance FY97 RFAs

Also available -- http://es.inel.gov/ncerqa/rfa/ for the Application Instructions & Forms and Eligibility Requirements

http://www.ita.doc.gov/advocacy for the The Advocacy Center

A unique, central coordination point marshalling the resources of 19 US Government agencies in the Trade Promotion Coordinating Committee (TPCC) to ensure that sales of US products and services have the best possible chance abroad.

http://www.vanderbilt.edu/VCEMS/VCEMShome.html for the Vanderbilt Center for Environmental Management Studies

To promote and develop partnerships between industry, government and academia concerning the relationship of environmental policy to business management and operations.

http://www.govcon.com/yp/G-L/kpmg-tag2.html for the FREE Government Contractor Hotline

KPMG Peat Marwick's Government Contractor Practice offers the Government Contractor Hotline newsletter to our clients and contacts at no cost.

HREF="gopher://www.sbaonline.sba.gov:70/11/Local-Information/Business-Information-Centers/Bics for the U.S. Small Business Administration's Business Information Centers

The U.S. Small Business Administration's (SBA) Business Information Centers (BICs) provide a one-stop location where current and future small business owners can receive assistance and advice.

http://es.inel.gov/partners/acctg/acctg.html#benefits for the EPA'S Environmental Accounting Project

Implementing environmental accounting will make environmental costs more visible to company managers, thus making those costs more manageable and easier to reduce.

http://ctn.nrc.ca/ctn/ctn.html for the Canadian Technology Network

Get in touch with members of the Canadian Technology Network, a joint venture of Industry Canada and the National Research Council, for assistance on technology and related business issues.

http://www.os.kcp.com/cgi-bin/imagemap/inlinemap?298,53 for the Partnering with Allied Signal Aerospace's Kansas City Plant (KCP)

For Small Business, Large Business, Academia, State/Local Government, Federal Agencies

http://www.irap.nrc.ca/irap/irap2e.html for the IRAP/PARI - The Industrial Research Assistance Programme of the National Research Council

http://www.eba-nys.org/eba_dir.html for the The Environmental Business Association of New York State, Inc.

EBA/NYS is the trade association dedicated to supporting the growth of the environmental industry in New York State

http://nctn.hq.nasa.gov/nctn/STI/STI.html for the Space Technology Innovation

NASA's Office of Space Access and Technology bi-monthly publication covering current developments and opportunities in technology commercialization, advanced technologies and the commercial development of space.

http://www.nttc.edu/assist/sbdc.html for the SBA Small Business Development Center Program

Provides management assistance to present and prospective small business owners to enhance economic development by providing management and technical assistance to small businesses.

http://ctoserver.arc.nasa.gov/ATCC/atcc.html for the Ames Technology Commercialization Center

ATCC provides opportunities for start-up companies utilizing NASA technologies to grow in a "business incubator" environment

http://www.nttc.edu/aft2e.html for the Association of Federal Technology Transfer Executives (AFT2E)

A professional society dedicated to fostering high standards of professionalism among its members who mostly engage in the transfer of technology developed in the nation's more than 700 federally-funded laboratories.

http://www2.echo.lu/echo/databases/en/er88.html for the EUREKA Set up to serve as a Europe-wide framework to encourage further collaboration on advanced technology projects. It encourages cross-border civilian projects between firms and research institutes in different EUREKA member countries, regardless of size or structure.

http://shekel.jct.ac.il/jctech/ministry.html for the Technological Incubators Program

The program, established over the last three years, endeavors to create a tool that will be used on a continuous basis to support the first stage of technological entrepreneurship and to integrate these activities with the very special circumstances created in Israel by the recent massive immigration. It provides the support and environment essential for innovative ideas to develop and bloom.

http://www.libertynet.org:80/~bftc/ for the Ben Franklin Technology Center

The Ben Franklin Technology Center of Southeastern Pennsylvania is a leading non-profit venture capital investment group dedicated to bringing the emerging technologies and ideas of small Pennsylvania companies to market.

http://www.vcapital.com/ for the Venture Capital Online TM A service for entrepreneurs seeking venture capital and investors seeking investments in entrepreneurial high growth companies.

http://www.worldbank.org/html/gef/intro/gefintro.htm for the Global Environment Facility

The GEF provides grants and concessional funding to recipient countries for projects and programs that protect the global environment and promote sustainable economic growth. The Facility, originally set up as a pilot program in 1991, was restructured and replenished with over US$ 2 billion in 1994, to cover the agreed incremental costs of activities that benefit the global environment in four focal areas: climate change; biological diversity; international waters; and stratospheric ozone. Activities concerning land degradation, primarily desertification and deforestation, as they relate to the four focal areas, are also eligible for funding.

http://iridium.nttc.edu/technews/tap.html for the State and Local Technical Assistance Programs

http://www.nsf.gov:80/bfa/cpo/outreach/cornwww.htm for the NSF and Cornell University Host Regional Grants Conference

On October 21 and 22, 1996, Cornell University will host the first NSF Regional Grants Conference of fiscal year 1997. Workshops and presentations by NSF staff will cover the following topics: proposal preparation; the merit review process; electronic initiatives, policies, and special issues; grant administration, compliance, and accountability; new programs and initiatives; and future directions and strategies for a national science policy.

/gnet/gov/usgov/sba/bvd/bvd-toc.htm for the Bridging the Valley of Death: Financing Technology for a Sustainable Future (white paper)

http://www.usbusiness.com/capquest/home.html for the Capital Quest

iidpgms.htm for the Department of Energy Inventions and Innovation Programs mrc93.htm for the Directory of Manufacturing Research Centers

http://bizserve.com/ten for the The Entrepreneur Network

/gnet/news/press/releases/other/poland.htm for the EX-IM Bank Signs Agreement with Poland's National Fund and Bank for Environmental Protection

/gnet/gov/stgov/nasda/nasdaindex.htm for the NASDA State Environment and Technology Resources

http://www.nsf.gov/nsf/homepage/grants.htm for the National Science

Foundation Grants

pcloan.htm for the Small Business Administration Pollution Control Loans Program

sbdc.htm for the Small Business Development Center Program

World Bank Conference on Environmentally Sustainable Development White Papers

effctive.htm for the Effective Financing of Environmentally Sustainable Development in Eastern Europe and Central Asia

esddrft.htm for the Overview of Environmental Funds and Other Mechanisms of Financing Environmental Investments in Some CEE and CIS Countries

Pollution Prevention Bulletin

Partners for the Environment

Formation of the Partners for the Environment umbrella organization to coordinate U.S. Environmental Protection Agency (EPA) voluntary programs was announced by Administrator Carol Browner in November l995. Partners efforts reflect an important strategy for protecting the environment: an emphasis on cooperative and voluntary activities with a variety of groups -- including small and large businesses, citizen groups, state and local government and institutions -- to achieve environmental protection. Partners for the Environment includes the following programs:

- AgStar (more efficient agricultural waste handling)
- Climate Wise (Global Climate Action Plan to reduce greenhouse gases)
- Common Sense Initiative (industry-sector specific efforts)
- Design for the Environment (industry requirements for sectors)
- Environmental Accounting Program (adding environmental considerations)
- Environmental Leadership Program
- Energy Star Programs (energy-efficient residences, buildings, transformers, electronic equipment, etc.)
- Green Lights (upgrade or install energy-efficient and profitable lighting)
- Pesticides Environmental Stewardship Program
- Voluntary Standards Network (ISO 14,000, etc.)
- WasteWi$e (source reduction of solid waste)
- Water Alliance for Voluntary Education (water conservation, mainly in hotel/motel business)
- 33/50 Program (local industry cooperative efforts to reduce waste)

The Partners programs are making a real difference by demonstrating that significant environmental improvements and cost savings result from voluntary efforts. For example, together the participants have reduced toxic emissions by 375,000 tons, prevented 1.8 million tons of solid waste from entering our landfills, and reduced greenhouse gas emissions by preventing 13.4 million metric tons of carbon dioxide emissions a year.

These participants don t just reduce pollution, they also save energy. The Partners saved 110 trillion BTUs in 1995, enough to light 11 million households for a year. The success of the programs is growing dramatically, and, as the chart below indicates, by the year 2000 the number of participants could triple without any regulatory requirements driving them. Projecting the accomplishments of the Partners indicates major improvements will be realized by the year 2000.

Partners programs had more than 6,000 participants from every major sector of the economy in 1995, from Fortune 500 companies to small "Mom and Pop" shop owners and family farms. The programs have different audiences and focus on unique environmental problems that complement each other by preventing pollution, reducing operating costs, and helping protect the voluntary partnerships that make good business sense and prove that pollution prevention and energy efficiency pay. Together, these Partners saved $360 million in 1995 and expect to save nearly $7 billion annually by the year 2000.

A Pollution Prevention Coordination Council (PPCC) has been created within EPA. It is led by Nikki Roy of the Administrator s Pollution Prevention Policy Staff and Michelle Price of the Office of Pollution Prevention and Toxic Substances and has representation from all of the voluntary programs. The PPCC is developing the policies needed to coordinate the programs and helping define the interfaces between the voluntary programs and other programs, such as enforcement and permitting. The objective is to have common policies and gather information in a consistent manner so that all of the environmental gains can be noted as progress is made. The Partners are developing joint outreach efforts, exploring and strengthening synergies among the programs, adopting common measures for environmental and economic benefits of the programs and coordinating with the Vice President s National Performance Review.

More information about the PPCC and Partners for the Environment is available from Jim Callier, Manager, Region 7 Toxic Substances Prevention & Planning Branch, (913) 551-7646. He can also direct you to regional or national contacts on any of the umbrella programs.

Region 7 P2 Award Winners for 1996

Regional Administrator Dennis Grams has announced the Region 7 Pollution Prevention Environmental Excellence Award winners for 1995. There were 11 winners from the four-state area. The annual awards recognize environmental excellence through pollution prevention efforts that work toward a cleaner environment.

"Pollution Prevention is an integral part of EPA's environmental strategy for protecting health and the environment," Grams said. "Prevention is the most cost-effective method of environmental protection, because it promotes source reduction and efficiency, reduces the need for expensive end-of-pipe treatment and disposal technologies and reduces long-term liabilities."

Award categories were: environmental, community and non-profit organizations, large and small business/industry, trade and professional organizations, and federal, state and local governments. The primary achievement areas included education, communication, technology transfer, cooperative geographic efforts, and technologies, initiatives, and innovative incentives that prevent pollution.

The 11 winners from 40 nominations received were:

Individual Citizens

James S. Tira, Overland Park, Kansas, an individual citizen who uses different communication media to promote P2 to individuals, manufacturing and service industries, educational institutions, government agencies and technology centers. Tira is also a consultant to the Department of Defense for P2.

Prasad S. Kodukula, Ph.D., Overland Park, Kansas, was formerly employed by Woodward-Clyde, where he participated in their P2 program. His basic objective with the program was to provide education, communication, and training in different facets of P2 by publishing articles, making presentations at conferences, conducting workshops and seminars, teaching courses and participating on various committees.

Local Government

Overland Park, Kansas, has a citywide project to reduce the potential for pollution by using proactive measures such as analyzing the city's solid waste and implementing strategies and procedures designed to reduce, reuse or recycle. The basis and root actions for this project are waste minimization through source reduction and inventory control.

Lindsborg, Kansas, under the direction of Wes Adell, Project Director, began an experimental composting project in August 1991. Lindsborg was the first rural community in Kansas to receive a Kansas Department of Health & Environment permit. Since then, they have expanded by adding an annual Composting Works Conference and the Lindsborg Regional Tree Growing-out Center.

Community or Non-profit Organization

The St. Louis Regional Commerce Growth Association has formed a St. Louis Regional Clean Air Partnership with a community-based effort aimed at: informing the public in advance when air quality standards for ozone might be exceeded; working with industry to take voluntary actions to improve air quality; working with news media to provide information on ozone issues; and coordinating workshops on P2.

Keep Nebraska Beautiful, Lincoln, started the Nebraska Materials Exchange Program and the Household Hazardous Waste Education Program in 1994. The material exchange program actively promotes reuse and recycling of business and industrial wastes in Nebraska. The hazardous waste program helps Nebraskans learn about household hazardous wastes, including proper disposal and less-toxic alternatives.

Small to Mid-size Business/Industry

Chance Operations Inc., Wichita, Kansas, has implemented programs to reduce acetone and toluene emissions. The acetone project was implemented to reduce the use of acetone in the fiberglass lay-up operation. The toluene project was implemented to improve the quality of the paint on the company's products. This enabled Chance to save money and meet the P2 requirements for the future.

Dayco Products Inc., Springfield, Missouri, put a P2 task force into place in January 1990 to reduce air emissions and solid waste at Dayco. This task force has the authority to reduce waste from all environmental media and includes source reduction, chemical substitutions, waste minimization, energy savings programs and water conservation. All programs implemented in 1990 remain in effect today.

Large Business/Industry

Winnebago Industries, Forest City, Iowa, converted spray adhesive application equipment to a roll coating production process. The change eliminated this area as a major source of volatile organic compound (VOC) emissions. It also allowed lamination materials scrap to be reprocessed into plastic feedstock instead of being discarded in a local landfill.

Hallmark Cards Inc., Select Drive Facility, Leavenworth, Kansas, developed and implemented a high-quality water-based gravure printing process for producing gift wrap and five party products. Benefits include reducing hazardous waste generation, VOC emissions and hazardous materials usage; decommissioning a solvent recovery system with an annual operating budget of $1.4 million; and providing a more user-friendly printing environment for the 200 employees who work with the process.

Hallmark's Kansas City Production Center, Kansas City, Missouri, began to implement a variety of water-based printing techniques in 1992 with the intent of reducing VOC/solvent usage. The techniques have dramatically reduced air emissions and production of hazardous waste and improved employee working conditions.

Contact Steve Wurtz, (913) 551-7315, for more information about the P2 Awards of Excellence.

From the Regional Administrator

An important change in our national strategy for protecting the environment has been taking place over the last several years. EPA, through an array of partnership programs that we collectively refer to as "Partners for the Environment," is demonstrating that voluntary goals and commitments achieve real environmental results in a timely and cost-effective way. In addition to traditional approaches to environmental protection, EPA is building cooperative partnerships with a variety of groups, including small and large businesses, citizen groups, state and local governments, universities and trade associations.

Results of these Partners for the Environment efforts are impressive. Thousands of organizations are working with EPA to set and reach such environmental goals as conserving water and energy and reducing greenhouse gases, toxic emissions, solid wastes, indoor air pollution and pesticide risk. Our partners are making pollution prevention a central consideration in doing business. Partnership also means that we are working with the private sector to provide effective tools to address environmental issues. These partners are achieving measurable environmental results, often more quickly and with lower costs than would be the case with regulatory approaches. EPA views these partnership efforts as key to the future success of environmental protection. EPA's Partners for the Environment initiative, which unites 20 of the Agency's leading voluntary programs, demonstrates that voluntary goals and commitments achieve real environmental results quickly and efficiently. Some of these successful voluntary programs include:

Green Programs -- Green Lights, Energy Star

buildings, and computers are among EPA's voluntary efforts with thousands of private groups to improve energy efficiency and reduce adverse environmental effects.

33/50 Voluntary Reduction Program -- This effort was aimed at encouraging industry to voluntarily reduce emissions of 17 toxic substances by 33 percent by 1992, a target which many of the 1,300 participating firms met or exceeded. The goal of 50 percent reduction by the end of FY 1995 should also be surpassed.

WasteWi$e -- Firms in this program make commitments with EPA to reduce their municipal solid waste through prevention, recycling and buying or manufacturing recycled products.

Design for the Environment -- This program, through collaborative ventures, promotes the design of safer products and processes in such areas as dry cleaning, screen printing and electronics. It provides environmental information, especially by accountants, bankers and insurers, to advance new prevention approaches and technologies among business and industry.

Other new EPA programs promote national waste minimization, reductions in pesticide use, environmentally conscious building design, alliances to improve indoor air, reductions in carbon dioxide emissions from vehicles, and improved water quality management by major suppliers.

Final Policy on Compliance Incentives for Small Businesses

EPA's policy on Compliance Incentives for Small Businesses, effective June 10, 1996, is intended to promote environmental compliance and provide them with special incentives to participate in compliance assistance or to conduct environmental audits and promptly correct any violations.

This policy is one of the 25 regulatory reform initiatives announced by President Clinton March 16, 1996. It implements, in part, the Executive Memorandum on Regulatory Reform, issued April 21, 1995.

The policy sets forth how EPA expects to exercise its enforcement discretion in deciding on an appropriate enforcement response and determining an appropriate penalty for violations by small businesses. It also expands upon EPA's August 12, 1994, policy for Clean Air Act small business assistance programs by applying the same principles to other environmental programs.

Contact Diane Callier, (913) 551-7459, for more information.

U.S. DOE Support Offices: New Partnerships, New Opportunities

EPA Region 7's geographic area is now served by two Department of Energy (DOE) Regional Support Offices (RSOs) -- one in Chicago (which picked up Iowa and Missouri) and one in Denver (which picked up Kansas and Nebraska) -- following a recent DOE reorganization.

RSOs come under DOE's Office of Energy Efficiency and Renewable Energy. There are six RSOs, in Boston, Philadelphia, Atlanta, Chicago, Denver and Seattle. The function of the RSOs is to promote energy efficiency and renewable energy awareness, practices and technologies. RSOs work with state agencies, local governments, joint public/private programs, universities, private industry, and not-for-profit organizations by providing information, networking opportunities and technical and financial assistance.

Through many partnerships, RSO-supported energy efficiency efforts affect the building, transportation, utility and industrial sectors.

DOE, like EPA, has come to understand the value of programs that emphasize the critical linkage between energy efficiency, pollution prevention and economic competitiveness. In many ways, DOE, EPA and major stakeholder and customer groups share objectives. We all benefit by increasing our awareness and understanding of the many program initiatives and offerings available in any given area, allowing us to pool our resources, combine and reinforce each other's efforts, and provide the widest range of available assistance to our customers.

DOE, particularly in its work with the industrial sector, promotes a number of initiatives through the RSOs that focus on energy efficiency and pollution prevention. The initiatives, briefly described below, share several characteristics. They represent and attempt to provide technical and financial assistance and resource support so that U.S. industries can put more of their resources into product and less into waste, which includes the industrial waste stream, emissions and unnecessary energy consumption.

Climate Wise -- This program, jointly sponsored by DOE and EPA, provides technical assistance and resource support to help industry reduce greenhouse gas (GHG) emissions. Climate Wise participants achieve GHG reductions by pledging to adopt cost-effective measures such as altering production processes, making energy-efficient building-related improvements, deploying alternative-fuel fleet vehicles and implementing employee commuting options. Climate Wise partner companies enjoy many opportunities to share their challenges and success stories and to go on record as voluntarily contributing to our Nation's goal of reducing the global effects of greenhouse gas emissions. At the same time, they are improving their competitiveness, their product and their bottom line.

NICE3 (National Industrial Competitiveness through Energy, Environment and Economics) -- This program seeks a number of cost-shared, industrial-based energy efficiency/pollution prevention projects each year. Projects are selected on a competitive basis and require collaboration between industry and a sponsoring state agency. NICE3 specifically targets proven technologies that demonstrate a high potential for use in other industrial settings. Those who want to find out if their projects are good candidates for NICE3 can submit a two-page pre-proposal abstract through the appropriate state agency and receive some initial feedback. Formal solicitation for the next round will open September 3, 1996.

Motor Challenge -- Motor systems -- including motors, drives, pumps, fans, compressors and their control systems and mechanical-load components -- account for nearly 75 percent of the electricity used by industry. Motor Challenge focuses on converting electric motor systems to high efficiency by providing technical assistance, networking opportunities and analytical tools. Entries involved in this initiative include industrial end users, motor and drive manufacturers and distributors, utilities, research institutes and state energy offices.

Industrial Assessment Centers -- Thirty of these university-based centers throughout the nation provide a limited number of no-cost industrial assessments to small and medium-size manufacturers in their area. University centers initially operate as energy analysis and diagnostic centers, conducting energy assessments only. The centers become industrial assessment centers (IACs), qualified to conduct productivity and waste reduction analyses, after two years of experience and training, . Plants in 43 states and from all industrial manufacturing sectors have significantly improved their operations by implementing a high percentage of IAC recommendations. IACs in EPA Region 7 are at Iowa State University at Ames, the University of Kansas and the University of Missouri (Rolla).

Ad Hoc Regional Initiatives -- RSOs, in addition to these specific DOE-wide program initiatives, may be involved in regional-specific initiatives that focus on energy efficiency and pollution prevention. In the Chicago RSO, for example, work has begun to inventory the industrial assessment resources available throughout the region. This could lead to a comprehensive technical assistance strategy that incorporates industrial efficiency and concepts of sustainable economic development.

We like to think of energy efficiency and pollution prevention as the diet and exercise of the industrial efficiency regimen. Of course we can realize benefits by improvements in either area, but long-term, sustainable, holistic benefit can best be achieved by improving both. And speaking of working in tandem -- if there are opportunities for us to work together, or more information on any of the initiatives described above is needed, contact your nearest RSO.

Contact Juli A. Pollitt, Program Manager, Chicago RSO, or your nearest Regional Office, for more information about the DOE .

U.S. Department of Energy Chicago Regional Support Office Denver Regional Support Office 1 South Wacker Drive, Suite 2380, 1617 Cole Blvd., Building 17 Chicago, Illinois 60606

Golden, Colorado 80401

(312) 353-6749 (303) 275-4800

FAX: (312) 886-8561   FAX: (303) 275-4830

Watch for upcoming information on the EPA Region 7 Pollution Prevention Awards in the next edition of the Pollution Prevention Bulletin.

Environmental Justice Pollution Prevention Grant Funds Announced

EPA has announced the availability of an estimated $1.5 million in grant funds for Environmental Justice Pollution Prevention (EJP2) projects to provide financial assistance to national or regional environmental and environmental justice organizations. The grants help these organizations work with and provide financial and/or technical assistance to community-based and grassroots groups and tribal organizations for projects that address environmental justice concerns and use P2 as the proposed solution. This program is designed to fund projects that have a direct impact on affected communities. This complements EPA s approach in last year s EJP2 program, where approximately $4 million in grants was awarded directly to community-based and grassroots organizations.

EPA is particularly interested in innovative approaches that can be applied to other communities. The Agency strongly encourages cooperative efforts between communities, business and industry to address common P2 goals.

Project funded under this grant program may involve public education, training, demonstrations, research, investigations, public-private partnerships, or approaches to develop, evaluate, and demonstrate non-regulatory strategies and technologies.

Contact Steve Wurtz, (913) 551-7315, for more information.

Agriculture Compliance Assistance Center Update

EPA, with the support of the Department of Agriculture, has developed a national Agriculture Compliance Center (Ag Center) here in the Region 7 Kansas City office to provide the agricultural community a base for "one-stop-shopping." The Ag Center, a program offered by EPA's Office of Compliance, seeks to increase compliance by helping the agricultural community identify flexible, common-sense ways to comply with the many environmental requirements that affect its business. The Ag Center is designed so growers, livestock producers, other agribusinesses and agricultural information/education providers can access its resources easily -via telephone, fax, mail and EPA's Enviroene bulletin board.

The Ag Center plans to provide information on a variety of topics, including pesticides, non-point source pollution, groundwater, surface water and drinking water protection, animal waste management, agriculture worker protection and wetlands protection. The Ag Center will also support regional and state regulatory agencies in their efforts to provide compliance assistance to local agricultural communities.

Contact Ginah Mortensen for more information at (913) 551-7207, FAX: (913) 551-7270.

Do You Have Any Questions???

- Do you need help setting up a P2 program at your place of work?
- Do you want your name or anyone else's added to or deleted from the mailing list?
- Do you have any suggestions or comments about this publication?

If you answered yes to any of the above questions, please call:

Gary Bertram
U.S. EPA Region 7
726 Minnesota Avenue
Kansas City, Kansas 66101
(913) 551-7533
Toll-free Environmental Action Line: (800) 223-0425 FAX: (913) 551-7065

From the States

Iowa - Ombudsman's Report 1995

Iowa's Ombudsman's 1995 annual report features a new, more readable format. The newspaper-style report describes how the office performed in 1995 and gives valuable tips for dealing with complaints about Iowa's state or local governments. The report helps people be better "consumers" of government services. It has a list of 38 toll-free telephone numbers and includes an article on practical hints for resolving complaints with government agencies. William P. Angrick II, Iowa's Citizens' Aide/Ombudsman, said his office received 4,617 requests for help in 1995, including contacts from each of Iowa's 99 counties and

176 requests from outside Iowa. Angrick introduced a special section in this year's report recognizing state and local government employees who have gone the "extra mile" in providing services.

Iowa appointed its first Ombudsman in 1970, when Governor Robert Ray established the position in his office. In 1972, the Legislature approved the Ombudsman Act, now in Chapter 2C of the Code of Iowa. The Ombudsman's office became an independent office working under the auspices of the Iowa Legislature.

The Ombudsman's position is selected by the bipartisan, bicameral Legislative Council subject to the approval of the General Assembly. The appointment is for a term of four years, renewable for additional terms.

The Citizens' Aide/Ombudsman, as an agent of Iowa's General Assembly, is often described as the watchdog of Iowa's state and local governments. It has the authority to review government actions that seem unreasonable, arbitrary, unfair, or contrary to policy or law. Under Chapter 2C, the Ombudsman is generally charged with answering questions and receiving complaints about most agencies of state and local government in Iowa. Chapter 2C gives the Ombudsman authority to investigate administrative actions that might be:

- contrary to law or regulations;
- unreasonable, unfair, oppressive or inconsistent with the general course of an agency's functioning, even though in accordance with law; - based on a mistake of law or arbitrary in ascertainments of fact;
- based on improper motivation or irrelevant consideration; or
- unaccompanied by an adequate statement of reasons.

Requests for copies of the report or questions about the office should be directed to the Ombudsman's office at (800) 358-5510 or, in the Des Moines area, at 281-3582. The office can be reached by TDD at (515) 242-5065, by fax at (515) 242-6007, and through the Internet at: ombd@legis.state.ia.us.

Iowa - State Trims Waste

Iowa recently held its first "Clean Out Your Files Day," and 4,600 state employees in Des Moines purged 46.5 tons of paper, cardboard, computer software and books from their offices in less than five hours.

The effort was lauded by Governor Terry E. Branstad as he proclaimed 1996 "Recycle At Work Year." Branstad is encouraging business leaders statewide to initiate waste reduction programs, recycle at work and become models in their communities' solid waste reduction plans, as state employees have done since 1989.

"The goal of the Clean Out Your Files Day event is not only to recharge employee awareness of the existing waste reduction and recycling program, but also to pull more recyclables out of the offices and keep them from the landfill," according to Beth Hicks, the event's coordinator and the Department of Natural Resources' recycling specialist. Iowa has taken significant steps to promote alternatives to landfilling by establishing solid waste reduction goals of 50 percent by the year 2000.

Contact Beth Hicks at (515) 281-4367 for more information on recycling at work.

Iowa's 'Buy Recycled' Effort Making Strides

Iowa's "Buy Recycled" program, in an effort to reduce the amount of waste going to landfills by closing the recycling loop, encourages the purchase of recycled products. The Iowa Department of Natural Resource's (IDNR's) Waste Management Assistance Division has developed initiatives to promote and support the purchase of recycled products by Iowa businesses.

"Recycled products are no longer a special-order item only. By encouraging the demand for recycled products, we can reduce their costs, improve their quality and increase their availability," said Hicks, recycling specialist with IDNR. "To do this, businesses and their purchasing agents need to become more aware and motivated so they can make economical decision that are good for their profit and the environment." (See Publications of Interest for two new publications released by IDNR on recycled products.)

Beth Hicks can be reached for more information at IDNR, Wallace Building, Des Moines, IA 50319, telephone (515) 281-4367.

Kansas SBSSTECAP

The Kansas Small Business Stationary Source Technical and Environmental Compliance Assistance Program (SBSSTECAP) contains three components: a Public Advocate, a Small Business Environmental Assistance Program (SBEAP) and a Compliance Advisory Panel (CAP). The Kansas Department of Health and Environment (KDHE) is the lead agency, with program responsibilities delegated to KDHE's Office of Pollution Prevention, directed by Theresa Hodges.

The Public Advocate, Janet Neff, is in the Office of Pollution Prevention. This office has been providing services since November 1993. Neff has also been serving as secretariat to the CAP and liaison for the KDHE Bureau of Air and Radiation and the university components of the program.

The SBEAP, providing technical and compliance assistance, has been contracted to the University of Kansas (KU) Center for Environmental Education and Training, directed by Dennis Murphy. The program manager is Frank Orzulak. The (KU) component coordinates a newsletter, presents workshops, and develops brochures. KU has a subcontract for technical assistance from Kansas

State University's Pollution Prevention Institute (PPI), directed by Gene Meyer. Jean Waters and Tim Piero, air toxics specialists with PPI who participated in a permitting workshop in July, provide audits, develop manuals, present workshops and answer technical questions for businesses. KU also has a subcontract with Wichita State University (WSU) to develop a computer database for small businesses. Marshall Owens, of the Center for Technology Application, Mid-America Manufacturing Technology Center, located within WSU, is developing the computer database to assist small businesses to access air-related information from their personal computers. Owens is also developing a listing by SIC codes for the program references.

CAP is comprised of two members representing the general public, four representing small business and one representing KDHE. The panel has met several times and provides oversight for the small business program, which includes reviewing materials and writing an annual report to EPA.

Contact Theresa Hodges, KDHE, (913) 296-6603, FAX

(913) 291-3266, or Janet Neff, Public Advocate, (800) 357-6087, FAX (913) 291-3266, for more information.

Kansas - Catalytic Industrial Group in Independence Awarded NICE3 Grant to Demonstrate Infrared Wood Drying System

One of 17 cost-sharing grants from the U.S. Department of Energy (DOE) will be used by the Catalytic Industrial Group (CIG) of Independence, Kansas, and the Kansas Department of Health and Environment (KDHE) Office of Pollution Prevention to demonstrate a commercial-scale 10-ton per hour wood drying unit. CIG and KDHE were selected for the grant by DOE's Office of Industrial Technology, as part of its National Industrial Competitiveness through Energy, Environment and Economics (NICE3) program.

NICE3 was established in 1991 to encourage industry to reduce energy requirements and waste at its source by providing grants through state agencies. These one-time grants help companies overcome regulatory, economic and other barriers that prevent testing, demonstration and commercialization of innovative new technologies and processes that may be transferrable to a broad range of applications within and across industrial sectors.

CIG has been working with a research team to identify the properties of natural gas and propane-fueled catalytic devices that produce infrared light in a specific wave length. That wave length has shown the ability to separate water from wood more efficiently. The process would replace convection heaters used by companies that convert wood to fuel and make fiberboard from wood pulp. The companies accept waste wood fibers from paper and other wood product manufacturers. Manufacturers usually send waste wood that has a 50 percent to 60 percent moisture content, which the companies must reduce to 10 percent to 15 percent for use in their products. Huge amounts of energy are required for this process, resulting in very high air emissions. CIG's process dries the wood waste more efficiently with lower air emissions.

The new dryers are expected to save 45 trillion BTUs of energy annually and reduce emissions (including carbon dioxide, particulates, sulfur and nitrogen oxides, volatile organic compounds and other wastes) by about 41 million tons annually by the year 2010. The dryers are expected to pay for themselves within two years, making them very cost-effective. Numerous companies have already expressed an interest in them.

More information about this project is available from: Theresa Hodges, KDHE, (913) 296-5572, FAX (913) 296-3266; Alan Schroeder, U.S. DOE-OIT, (202) 586-7114; or Virgil Macaluso, CIG, (316) 331-0750, FAX (316) 331-3402.

Missouri

Missouri has received Title V approval, and the Technical Assistance Program is providing air operating permit training sessions around the state.

The Technical Assistance Program is sponsoring a teleconference September 18, 1996, titled "Clean Air Compliance for Wood Furniture Manufacturing Operations." The teleconference is designed to provide answers relating to the NESHAPs (National Emissions Standards for Hazardous Air Pollutants).

The Technical Assistance Program is developing a booklet of technical bulletins for the vehicle maintenance industry. The booklet will include technical bulletins covering almost every aspect of environmental regulations in the daily activities of a vehicle maintenance shop. Pollution prevention opportunities will be discussed as well as disposal methods and the pertinent regulations and their requirements.

Contact Byron Shaw for more information at (573) 526-6627, FAX: (573) 526-5808.

Nebraska

We want to welcome Ben Hammerschmidt as the Pollution Prevention representative for the Nebraska Department of Environmental Quality. Hammerschmidt comes with an impressive set of credentials. He has his master's degree from the University of Nebraska-Lincoln and is working on his Ph.D. in environmental engineering. Hammerschmidt developed and taught ecology, field biology, environmental science and math curricula for 21 years. He worked in the industrial sector for six years and directed and managed all the environmental issues of the nation's largest producer of residential natural gas meters and regulators, American Meters, at their Nebraska City plant. He designed, built and operated an industrial wastewater pretreatment system, and he was a safety, environmental and transportation consultant to small businesses. He also has an agriculture background in hybrid seed corn production and plant nurseries and experience in construction as an electrician and plumber. Last but not least, Hammerschmidt is certified in hazardous materials.

Those who want to wish Ben Hammerschmidt much success in his new venture can reach him at (402) 471-6988.

Publications of Interest

The Office of the Administrator has just released a publication titled Partnerships In Preventing Pollution, EPA 100-B-96-001, Spring 1996, a catalogue of the agency's partnership programs. This document is an expansion of the document GEMI Reference to EPA Voluntary Programs, published in 1994.

Listed are 28 voluntary pollution prevention programs, which are the results of the Partners for the Environment efforts. Each program is fully described and includes such topics as: history, goals, participation, benefits of membership, progress and future.

This document lists contacts for all the programs. Comments can be sent to Michelle Price, Office of Pollution Prevention and Toxics (7408), 401 M Street, SW, Washington, DC 20460.

Another recent document is Preventing Pollution Through Regulations, The Source Reduction Review Project, An Assessment, EPA-742-R-96-001. It was published in February 1996 and contains case studies of seven Source Reduction Review Project rules so readers can better evaluate the conclusions drawn by the assessment team. This assessment was conducted over a two-year period and marks the first time EPA has made such a coordinated effort across media offices to take a cross-media perspective and foster P2 through regulations.

Call Gary Bertram at (913) 551-7533, FAX (913) 551-7065, for a copy of this document, or contact him by E-mail: bertram.gary@epamail.epa.gov.

Kansas Small Business Environmental Assistance Program (SBEAP) has published an informative pamphlet titled, Autobody Shops - A Primer on Environmental Regulation and Pollution Prevention. The pamphlet is designed to help auto body refinishers reduce air emissions (VOCs and HAPs) and paint-related waste while maintaining high-quality products, saving money and avoiding the need for expensive pollution control equipment.

General information, other fact sheets, or other SBEAP publications can be obtained from the SBEAP Resource Center, (913) 864-3968. Assistance with audits, technical information, or permits is available from the SBEAP Hotline, (800) 578-8898. If you have a complaint, a question, or are unsure of whom to call, contact the Office of the Public Advocate, (800) 357-6097 (in Topeka, 296-0669).

Pollution Prevention Works for Iowa: Health Care Case Summaries has recently become available. The Waste Reduction Assistance Program of the Iowa Department of Natural Resources (IDNR), with a set-aside grant from EPA Region 7, conducted 11 on-site waste reduction opportunity assessments at seven health care facilities. The case studies represent some of the projects that health care facilities are doing to prevent pollution and save money. Annual savings of at least $261,000 and one-time capital savings of at least $700,000, in addition to other benefits, are reported.

Contact Julie Nelson, IDNR, (515) 281-8499, or Brent Laning, IDNR, (515) 281-8489, for more information.

The U.S. Department of Energy (DOE) has conducted a project to determine the usefulness of benchmarking as a waste minimization tool, specifically focusing on common waste streams at DOE sites. A team of process experts from a variety of sites, a project leader, and benchmarking consultants completed the project with management support provided by the Pollution Prevention Division. The results are provided in five volumes titled, Using Benchmarking to Minimize Common DOE Waste Streams:

- Volume I. Methodology and Liquid Photographic Waste
- Volume II. Used Motor Oil
- Volume III. Aqueous Cutting Fluid Waste
- Volume IV. Sulfuric Acid Waste in Plating Shops
- Volume V. Office Paper Waste

Another study conducted by DOE, Identifying Industrial Best Practices for the Waste Minimization of Low-Level Radioactive Materials, was just published. This project's focus was to identify and document commercial nuclear power industry best practices for radiological control programs supporting routine operations, outages and decontamination and decommissioning activities.

Contact Victoria Levin, Environmentally Conscious Life Cycle Systems Department, Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185, for further information about the publications. Levin can be called at (505) 271-7949. Copies of the documents can be ordered by calling (615) 576-8401 or FTS 626-8401.

The Institute for Environmental Education, University of Northern Iowa, has re-released three teaching manuals titled, Outlook on Groundwater; Elementary, Middle School/Junior High, and Senior High. Each manual is designed to help teachers stress to youth the importance of water conservation. Each manual offers lesson plans, notes to teachers, problems for the class to solve, a glossary of terms and appendices. They help explain: 1) the phenomenon of groundwater, 2) mechanisms by which contamination may occur and 3) the effects of contamination on all forms of life.

Contact Dr. David McCalley, Center for Energy & Environmental Education, Cedar Falls, IA 50614, for more information or call (319) 273-2581, FAX (319) 273-7140.

For you Internet/World Wide Web buffs, there is a publication titled Internet Resources Relating to Pollution Prevention. Contained therein are the following resource categories and the number of sites available for each:

- Federal Government, 34 (EPA-10, DOE-8, Department of Commerce-2, miscellaneous federal government sites- 14)
- International, 4
- Business and Industry, 16
- Pollution Prevention Research & Information Centers,16
- Energy Efficiency, Renewable & Sustainable Energy, 7
- Recycling and Materials Exchange, 5
- Sustainable Resource Development & Management, 4
- Great Lakes P2 & Environmental Information, 2
- Other Environmental Resources, 18
- World Wide Web Search Engines, 5

Contact any of the authors for more information about this document: Mike Ebner, Ohio Office of Pollution Prevention, mike_ebner@central.epa.ohio.gov; Rick Yoder, P.E., Lincoln/Lancaster County Health Department, Lincoln, NE, eh5303@itec.net; or Dr. Wayne Woldt, Jan Hygnstrom, and Mike Engel, Biological Systems Engineering, University of Nebraska-Lincoln, bsen107@unlvm.unl.edu or bsen010@unlvm.unl.edu.

Two recent publications on recycled products, published by the Iowa Department of Natural Resources (IDNR), are: 1) Recycle Iowa - A Business Guide to Buying Recycled, and 2) Iowa Recycled Product Directory (1995). The first contains available guidelines, tools and strategies that many companies have found helpful in implementing a substantial and cost-effective buy-recycled program; the directory lists 10 categories with 73 products.

Contact Beth Hicks, Recycling Specialist, IDNR, Wallace Building, Des Moines, IA 50319, for more information about Iowa's "Buy Recycled" program, or call her at (515) 281-4367.

The National Pollution Prevention Center (NPPC) for Higher Education has released a new educational resource: Overview of Environmental Problems, as part of the NPPC's educational resource compendia on pollution prevention. This document presents a comprehensive background of environmental issues, intended to help faculty and students who need to become more familiar with and knowledgeable about environmental issues by providing background information, including scientific concepts and terminology, on a range of environmental issues. This 125-page document encompasses 10 subject areas: Energy, Global Climate Change, Stratospheric Ozone Depletion, Resource Depletion, Land Use and Development, Waste, Air Quality, Water, Ecological Health, and Human Health.

Copies are available for $19 each from the National Pollution Prevention Center, 430 East University, Ann Arbor, MI 48109-1115. All NPPC orders must be prepaid. (Please mention the following code when ordering: EPIC). Make checks payable to "University of Michigan/NPPC." Credit cards or cash are unacceptable. Their federal tax ID is 38-6006-309.

Call (313) 764-1412 for a complete list of NPPC educational resources. FAX (313) 936-2195.

If you wish to speak to someone about NPPC, call Jennifer Santi at (913) 936-2637, FAX (913) 936-2195, or E-mail jsanti@umich.edu.

The Kansas Small Business Environmental Assistance Program (SBEAP) has published a manual titled, Environmentally Conscious Painting. The manual provides general background on painting technology, with specific emphasis on minimizing adverse environmental effects through pollution prevention. It reviews surface preparation, coating types, curing characteristics, coating applications, pollution prevention, testing, personal protective equipment, and environmental regulations. A pollution prevention checklist, coatings vendor list, additional resources, regulatory information and a glossary are included in the appendix. Contact the Kansas SBEAP, (800) 578-8898, for information on how to obtain a copy of the manual.

The Institute for Local Self-Reliance (ILSR), a non-profit research and educational organization that provides technical assistance and information to city and state government, citizen organizations and industry, has published the results of three studies it conducted relevant to reuse, recycling and financing the startup of a recycling-related enterprise. The reports are listed below:

- - Reuse Operations: Community Development through Redistribution of Used Goods. The study surveys 67 reuse operations, defined as entities that accept used, overstocked, outdated, and below-standard materials (e.g. furniture, building materials, appliances, office equipment, and other durable goods) and make them available at low or no cost to public-interest organizations, government, low-income individuals and even arts councils that distribute the salvaged materials to students and local artists. Contact Andrea Torrice, (202) 232-4108, for more information or for a copy of the report.
- - A New Industry Emerges: Making Construction Materials from Cellulosic Wastes documents the growth of a new industry -- the manufacture of construction materials from cellulosic wastes such as wastepaper, sawdust, straw, and other vegetable fibers. This study highlights 12 companies representing the many diverse products and processes that comprise this industry. Contact David Lorenz, (612) 379-3815, for more information for a copy of this report.
- - Financing Recycled-Related Ventures: Options for Community Development. This guide provides basic and sophisticated information

useful for entrepreneurs; for ventures in any phase of startup, operation or expansion; and for organizations that provide technical assistance to recycling-related ventures, including community development organizations, small business development centèrs, and minority business development centers. Contact Andrea Torrice, (202) 232-4108, for more information or a copy of this report.

New on the Internet

The following information is available on the EPA Region 7 Home Page:

The Toxic Substances Prevention & Planning (TSPP) Branch Roles and Responsibilities. Have you ever been transferred several times before someone is able to assist you and answer your questions? TSPP is trying to eliminate this annoyance by providing you with a list of TSPP staff, a list of each person's responsibilities, and their phone numbers and electronic addresses.

Hazardous Waste, Pollution Prevention and Waste Minimization Publications Available from Region 7. Although this document has been on the Internet for some months now, it has been improved. Visitors will now have the ability to select publications and submit their request to EPA electronically before leaving the page.

Freedom of Information Request Act Information. The vast majority of information retained by EPA is available to the public upon request. This page will provide you more information about how to submit a Freedom of Information request. You will also have the option of submitting your request while visiting the page.

Please contact Gary Bertram at bertram.gary@epamail.epa.gov or call (913) 551-7533 for more information about the EPA Region 7 Home Page.

Internet Workgroup Update

The EPA Region 7 Pollution Prevention Roundtable has formed a workgroup to address the use of the Internet to better share information with the industry and consumers. The workgroup hopes to develop an Internet page that will provide information on the Roundtable members, including the services they can provide and links to their home pages. Contact Gary Bertram for further information on the Internet Workgroup, bertram.gary@epamail.epa.gov, or call (913) 551-7533.

EPA REGION 7 POLLUTION PREVENTION CONTACTS

IOWA
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(515) 281-8499 FAX: (515) 281-8895
Julie Kjolhade or Cathy Zeman, IWRC
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Craig Arterburn, Ombudsman
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Somhath Dasgupta, Small Business Contact (319) 273-2079FAX: (319) 273-2926
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Waste Min.....Gary Bertram..................(913) 551-7533
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Solid Waste...David Flora...................(913) 551-7523 FAX: (913) 551-7947

Army Research Lab Technology Transfer Success Stories

The U.S. Army Research Laboratory's mission is to provide America's soldiers a formidable technology edge through scientific research, technology development, and systems analysis. But in addition to providing this support to the soldier, ARL has provided scientific and technological innovation in a variety of technical disciplines, through direct in-house laboratory efforts as well as joint programs with other government agencies, as well as providing Technology Transfer to private industry and academia.

The following stories describe ARL's recent successes in accomplishing Technology Transfer.

1995's Successful Transfers

Advancements in Soldering Technology

Helping Graduate Students Advance Science

Muscle Performance Meter

New Ferrite Devices

Permanent Magnets, New Designs Make Them Smaller and Lighter

Superstrength Fiber Optics for "Life-Shear" Rescue Tools

1994's Successful Transfers

ARL Licenses Improved Head Support Stand

Beating Missile Canisters into Hockey Sticks

Capacitors, New Dielectrics Make Them Smaller and Lighter

Dielectric Resonance Oscillators

Enormous Strides are Made in Data Compression

High Performance Composite Products

JACK, A New Member of the "Virtual Reality Group"

This page and the pages to follow in this section were created automatically by exporting data from ARL's TTO Information System. The TTO Information System is a FoxPro v2.6 program developed by Paul Ritchey of UHD under Contract to the ARL DTT Program Office. Both the export program and the TTO Information System program can be made available to other Government Agencies for use by your own Tech Transfer Offices. For further information please contact mclaffy@arl.mil

How Do You Receive More Information on Technology Information Exchange (TIE)

Need more information on the National Technology Information Exchange (TIE) Workshops, the TIE Quarterly, or related activities? Here's how to get it:

Call the contact person listed at the end of each TIE Quarterly article.

Access this TIE Home Page on the Department of Energy Environmental Management World Wide Web Server via http://www.em.doe.gov under "Environmental Restoration." For more information on the TIE Home Page, contact Sherie Earle/International Development and Resources, Inc. (301) 916-7348.

Call us. To subscribe or contribute to the TIE Quarterly or participate in a National TIE Workshop, call the TIE Information Center at (540) 231-3572 [fax: (540) 231-4261],

or e-mail, mailto:tie@perform.vt.edu for the tie@perform.vt.edu.

Environmental Technology Transfer Resources for Small Businesses

For small businesses interested in the transfer of environmental technologies, a number of programs are available. Each of these are listed below

National Technology Transfer Center

The National Technology Transfer Center serves as an information clearinghouse for businesses, particularly small businesses seeking information about developing and commercializing technology products and processes. The center's Gateway service is an entryway to the federal laboratory system of more than 700 labs. Small business representatives can call Gateway at (800) 678-6882 with a technology idea or need. Gateway is a free service that will search the complete Federal R&D Resource Information System for opportunities related to the business's needs. Searches include exploring licensing opportunities and assistance for those pursuing Cooperative Research and Development Agreements. NTTC will also put businesses in contact with the appropriate people at various national labs to access information or equipment.

Business Gold, another NTTC service, is a publicly accessible database that includes announcements of available federal technologies, recent solicitations, and descriptions of previously funded projects. Business Gold has only a portion of the resources accessible through Gateway, however users can conduct their own searches. This database can be reached on a dial-up bulletin board (set data bits to 7, stop bits to 1, parity to even and emulation to vt100; 300-2400 baud modems dial (304) 243-2561; 9600 modems and higher dial (304) 243-2560; for help/information, call (304) 243-2570; first time sign-ons login as guest, no password required) or via Internet (Telnet to iron.nttc.edu or 192.188.119.50; login as visitor, use your e-mail address for a password). Note: When Initiatives staff logged on, the database operated slowly, so patience is recommended.

Center for Environmental Technology

The Center for Environmental Technology in Oak Ridge, Tennessee, was founded in 1993 to facilitate the exchange of technology both into and out of the Department of Energy. Technology transfer is accomplished through accelerated evaluation, demonstration, commercialization, and public acceptance of rapidly evolving environmental technologies. DOE promotes the transfer of DOE-developed technology into the private sector, however, most of the activity at CET has focused on small businesses demonstrating their technologies for use by DOE. The center invites small companies to demonstrate developed technologies related to one of DOE's five focus areas for technology development: contaminant plume containment and remediation; landfill stabilization; mixed waste characterization, treatment and disposal; high-level waste tank remediation; and facility transitioning, decommissioning, and final disposition. Technologies are evaluated for efficiency, cost effectiveness, and potential use within the DOE complex. CET provides a wide range of technical and support resources for companies coming into the center to conduct demonstrations. These resources include state-of-the-art laboratories and demonstration facilities, and access to 3,000 environmental scientists and other technical experts; some funding is also available. Businesses interested in CET should call Sam Meacham at (615) 435-3239.

Small Business Administration

The Small Business Administration [SBA] offers a number of advisory and financial assistance programs for small businesses. The Small Business Innovation Research Program is a three-phase program administered by SBA to facilitate technology transfer. SBIR, extended by the Small Business Research and Development Enhancement Act of 1992, involves eleven federal agencies' extramural research programs. These agencies, including DOE, the Environmental Protection Agency, and the Department of Defense, set aside a certain percentage, currently two percent, of their extramural research program funds for small businesses. Each agency selects topics it would like researched or developed in the three-phase program.

In phase I, grants or contracts are awarded for up to six months to conduct feasibility studies for research ideas that appear to have commercial potential. The amount varies from agency to agency, but usually ranges from $60,000 to $100,000. In phase II, small businesses that have successfully competed in phase I are selected for funding of principal research and development of the product or process for one to two years; funding ranges from $150,000 to $750,000. Phase III of the program involves commercializing the product or process with the small business owning all intellectual property rights. SBIR funds do not support phase III activities, however, other agency funds can be used if the agency buys the product or process with programmatic funds. For DOE, $70 million will be granted to small businesses as part of the SBIR in fiscal year 1995. The Small Business Administration publishes all federal opportunities for small businesses on the SBA Bulletin Board; using a modem, dial (800) 697-INFO (4636). Technical support is available by calling (202) 205-6400.

The SBA Bulletin Board is also available via Telnet at telnet://sbaonline.sba.gov>sbaonline.sba.gov.

The Small Business Technology Transfer Pilot Program

The Small Business Technology Transfer [STTR] Pilot Program was also established by the Small Business Research and Development Enhancement Act of 1992. All federal agencies with extramural research budgets exceeding $1 billion are authorized to spend a certain percentage, 0.1 percent in FY95, on the STTR program. Five agencies (DOD, DOE, Department of Health and Human Services, National Aeronautics and Space Administration, and National Science

Foundation) are participating in this three-year pilot program. Similar to the SBIR program, the STTR program is a three-phase process in which research proposals are funded to develop a scientific or technological innovation with plans for commercialization. Unlike the SBIR, the STTR program requires research and development be jointly conducted by the small business and a research institution. The small business must perform at least 40 percent of the phase I and II activity, and the research institution must perform at least 30 percent of the phase I and II activity. Further details of the program and current solicitations can be obtained from the SBA Bulletin Board

SBA has three loan programs: the Certified Development Company Program (504 Loan Program), the General Business Loan Program (the 7(a) Loan Program), and the Small Business Investment Companies Program. The 504 Loan Program is designed to fund fixed assets, such as land, equipment, and buildings; loans are made for ten- or twenty-year periods. These loans are made through more than 300 Certified Development Centers around the nation. Borrowers must provide ten percent of the value, lenders provide 50 percent, and SBA provides the remaining 40 percent. SBA's portion of this program was $1.35 billion in FY94. The 7(a) Loan Program, the largest of the three SBA programs, loaned $8.176 billion in FY94. Under this program a small business must have been rejected for a standard loan from a private bank and then must apply for this SBA guaranteed loan. Unlike the 504 Loan Program, this money can be used for any business purpose and the loan period may extend to 25 years. The third program, SBIC, involves private venture capital companies investing in small businesses. These companies are licensed, regulated, and partially funded by SBA. SBIC investments totaled approximately $1 billion in FY94.

SBA's Small Business Development Centers help businesses solve a wide range of problems and provide access to other SBA programs. SBDCs, located in each state, tailor their services to the needs of local small businesses. These services include free one-to-one counseling on business topics, training, and technical assistance. In addition, the SBDCs also provide assistance to businesses applying for SBIR grants from federal agencies (see above).

Research Opportunity Announcements

Although not strictly designed for small businesses, DOE's Office of Environmental Management's Research Opportunity Announcements include a small business set-aside. This program supports research in the development of technologies that meet EM program needs. The solicitations run for one year, with 20 percent of the awards set aside for small businesses. This program is currently in its second year; during the first year more than half the awards went to small businesses, totaling $4.6 million. The current ROA proposal deadline is April 28, 1995; another ROA solicitation is not planned at this time. ROAs are published in the Federal Register and their availability is listed in Commerce Business Daily. ROA information is also on the Internet on the Federal

Information Exchange page (see below).

The Internet

The Federal Government page on the Internet at http://www.gov.mci.net:80/fed/fed.html> http://www.gov.mci.net:80/fed/fed.html provides a variety of options, including Commercial Links, which connects users to several information sources. Both the Commerce Business Daily and the Federal Register can be accessed via Commercial Links. CBD is a daily list of U.S. government procurement invitations, contract awards, subcontracting leads, sales of surplus property, and foreign business opportunities. This database can be searched by keyword and is available on the Internet the day before it is published on paper.

Another valuable Internet resource is the Federal Information Exchange, Inc.- FEDIX Home Page at http://web.fie.com:80/web/fed/. This page provides links to several information sources, including Cross Agency Searches and Lists, which allows users to search for information on a variety of subject areas spanning numerous federal agencies. For example, users can conduct a keyword search of Procurement, Grants, and Assistance, a database containing information from DOE http://www.doe.gov, NASA http://www.nasa.gov, the Office of Naval Research http://www.nrl.navy.mil, the Air Force Office of Scientific Research http://www.hq.af.mil, the Department of Agriculture http://www.usda.gov, and other federal agencies. Individual agency databases can also be searched from this page by the title, deadline, or release date of the project.

The Small Business Innovation Research (SBIR) Program

SBIR is a highly competitive program that encourages small business to explore their technological potential and provides the incentive to profit from its commercialization. By including qualified small businesses in the nation's R&D arena, hi-tech innovation is stimulated and the United States gains the entrepreneurial spirit as it meets its specific research and development needs.

Competitive Opportunity for Small Business

SBIR targets the entrepreneurial sector because that is where most innovation and innovators thrive. However, the risk and expense of conducting serious R&D efforts are often beyond the means of many small businesses. By reserving a specific percentage of federal R&D funds for small business, SBIR protects the small business and enables it to compete on the same level as larger businesses. SBIR funds the critical start-up and development stages and it encourages the commercialization of the technology, product, or service, which, in turn, stimulates the U.S. economy.

Since its enactment in 1982, as part of the Small Business Innovation Development Act, SBIR has helped thousands of small businesses to compete for federal research and development awards. Their contributions have enhanced the nation's defense, protected our environment, advanced health care, and improved our ability to manage information and manipulate data.

SBIR Qualifications

Small businesses must meet certain eligibility criteria to participate in the SBIR program.

- American-owned and independently operated
- For-profit
- Principal researcher employed by business
- Company size limited to 500 employees

The SBIR System

Each year, eleven federal departments and agencies are required by SBIR to reserve a portion of their R&D funds for award to small business.

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Education
- Department of Energy
- Department of Health and Human Services

- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation
- Nuclear Regulatory Commission

These agencies designate R&D topics and accept proposals.

Three-Phase Program

Following submission of proposals, agencies make SBIR awards based on small business qualification, degree of innovation, technical merit, and future market potential. Small businesses that receive awards or grants then begin a three-phase program.

Phase I is the start-up phase. Awards of up to $100,000 for approximately 6 months support exploration of the technical merit or feasibility of an idea or technology.

Phase II awards of up to $750,000, for as many as 2 years, expand Phase I results. During this time, the R&D work is performed and the developer evaluates commercializa-tion potential. Only Phase I award winners are considered for Phase II.

Phase III is the period during which Phase II innovation moves from the laboratory into the marketplace. No SBIR funds support this phase. The small business must find funding in the private sector or other non-SBIR federal agency funding.

SBA Role

The U.S. Small Business Administration plays an important role as the coordinating agency for the SBIR program. It directs the 11 agencies' implementation of SBIR, reviews their progress, and reports annually to Congress on its operation. SBA is also the information link to SBIR. SBA collects solicitation information from all participating agencies and publishes it quarterly in a Pre-Solicitation Announcement (PSA). The PSA is a single source for the topics and anticipated release and closing dates for each agency's solicitations.

For more information on the SBIR Program, please contact:

U.S. Small Business Administration
Office of Technology
409 Third Street, SW
Washington, DC 20416
(202) 205-6450

All of SBA's programs and services are extended to the public on a nondiscriminatory basis.

Manuscripts

Environmental Auditing

Stewart Milne Group

Two to three years ago, Stewart Milne Group, a rapidly growing Aberdeen-based construction company, found itself at the sharp end of the environmental agenda. Discharges of surface water from its premises were found to be heavily contaminated with the pesticides the company was using in its timber treatment process. The company was complying strictly with the operating procedures specifies by the plan supplier, but despite this pollution was finding its way into a local stream, a tributary of the River Dee, famed for its salmon fishery. AURIS was contracted to identify the source of the problem and recommend remedial action. Following a structured investigation of the surface water drainage system, AURIS was able to positively locate the source of the problem as attributable to rainwater leaching of pesticides from unprotected treated timber in the company's storage year. Key changes in management practice followed, including:

- realignments of the drainage system
- covering stored timber
- introduction of anew preservative formulation with much reduced environmental toxicity

The changes have resulted in:

- reduced costs of regulatory compliance
- discharges well within consent levels
- a much improved working environment
- a unique marketing opportunity for the company

The company is now working towards the consolidation of this progress through the introduction of a formal environmental management system for certification to BS7750

Environmental Audit of BAXTERS

Baxters is a food processing company with an international market and reputation, based at Fochabers on the River Spey in North Scotland. An innovative company (its motto is "Be different, be better"), its management recognised the importance of environmental issues to its operation , and contracted AURIS to undertake an environmental review of its operations. This review focused mainly on issues of regulatory compliance and the extent to which existing management practice would be improved to ensure the firm continued to operate within the requirements of the relevant environmental legislation.

Company management was very limited, and so AURIS undertook the review with a team of six people whose time on site was limited to just one day. The company received a verbal close-out report within one week of the visit during which the key findings of the review were described. A full written report followed on week later.

Environmental Law Courses

CEMP has developed Courses on Environmental Law. In November 1995 Tim Curtis was invited to deliver a course at the Macaulay Land Use Research Institute in Aberdeen. The course covered an introduction to Scottish and UK law, the regulatory agencies, water pollution, contaminated land, atmospheric pollution, waste, integrated pollution control and was illustrated by case studies.

If you are interested in developing programmes on environmental law, please contact Tim Curtis at CEMP.

Environmental MSc Course on Rural and Regional Resources Planning available at Aberdeen University

A one-year course, that has now run for 26 years, is available at Aberdeen University. In it, students can specialise in environmental topics including EIA and environmental pollution.

Full details and an application form from:

Professor Brian D. Clark, Course Director.

From Invention to Innovation: Commercialization of New Technology by Independent and Small Business Inventors

prepared for

U.S.Department of Energy s Inventions and Innovation Division

by

Mohawk Research Corporation, Rockville, MD 20854

Preface

This is a copy of the Book From Invention to Innovation: Commercialization of New Technology by Independent and Small Business Inventors , prepared for the U.S.Department of Energy s Inventions and Innovation Division by Mohawk Research Corporation, Rockville, MD 20854. This version contains only text, the illustrations and figures are not included. The book is available from the Department of Energy. Please call (202) 586-1478 to receive a free copy as well as information on DOE s Inventions and Innovations Programs.

This handbook emerged from the commitment of Energy-Related Inventions Program personnel to supporting the commercialization efforts of independent and small business inventors with new technologies. As you read this document, you will face questions that may seem far removed from technological concerns--questions about the market, your competition, your business structure, and about legal and regulatory requirements. These may seem peripheral to your present and future work. But, make no mistake, you must carefully and honestly consider and answer these if you expect to penetrate the market in a sustained way and profit from your work. Over four hundred of your peers--some by success, others by failure have shown us the lessons incorporated in this volume. By using it, and by commenting on it, you benefit from their collective experience, and make invaluable additions to it. We wish you well in your pursuit of success in the marketplace.

We dedicate this volume to the late Jack Vitullo, who toiled tirelessly to improve the climate for innovation, both within the Government and throughout the nation.

Marcia L. Rorke Harold C. Livesay David S. Lux

Mohawk Research Corporation

Part 1 - You, Your Technology, and The Innovation Process

If you have a technology, or the idea for a technology, that you want to market profitably, you confront a long, vexing journey across tough terrain littered with the hulks of abandoned ideas, many of them good ideas. Some new technologies, however, do survive the trip. Dozens of them reach the market every year, sustaining the energy of the American economy and enriching their creators, at least sometimes. The purpose of this document is to increase the probability that you and your technology will make it.

The first step in making your idea one of the survivors consists in learning the obsta-

cles lying between you and the market; the second step involves learning to plan a strategy that will see you safely through the barriers--in effect, learning to navigate; the final step requires actually making such a plan and executing it. We have designed this document to help you with the first two steps by showing that the major obstacles to commercialization fall into definable categories. By breaking these obstacles down into their components, and then translating them into sets of sequenced tasks, you can overcome them. Mastering this process, will in turn provide you with the foundation for step three: systematic, professional caliber planning and execution.

To get an innovation into the market you must do more than just develop a technology that works. You must mate technical development to an appropriately synchronized, increasingly sophisticated assessment of both your market and the channels through which you may reach it. At the same time, you must evolve a business structure appropriate to more than just your stage of technical development. At the very least, business structure must meet needs for market research, requirements for capital, obligations to government agencies (e.g., paying taxes, meeting environmental regulations, keeping records to support patent claims, etc.), and the necessity to protect your (and other people's) investment in your technology.

This coordinated linkage of technical, market, and business development of a new technology comprises the "Innovation Process." Without comprehending that process you cannot plan effectively; unless you plan effectively you have little chance of seeing your idea commercialized. The "Innovation Process" necessitates planning for a variety of reasons, not least because without a persuasive plan you will not succeed in attracting the people and capital you will need to reach the market.

Ultimately you will almost certainly require a formal business plan, but long before then you must begin to assemble the components of one by planning, in writing, your technical, marketing, and business strategies. The sooner you master this process the better; moreover, a process of ongoing planning will help you organize your activities and accustom you to integrating technical, market, and business data. Unless you do these things you will ultimately exhaust your resources without having shaped your technical insight into an attractive investment opportunity. Remember always that relying on sheer technical merit will surely lead to failure; on the other hand, while systematic planning based on the Innovation Process does not guarantee success, it vastly improves the odds. Systematic planning begins with learning the process that confronts you.

The Innovation Process

The Innovation Process table (next page) shows, in outline form, the relationship between technical, market, and business steps in the Innovation Process, as well as listing some of the skills and people required as the process advances. This table, like all such linear, bi-dimensional representations of complex human processes, embodies some shortcomings, primarily in oversimplification (the actual process requires many more skills and people than could be shown here) and truncation. (The "Managerial Stage," if represented in scale proportionate to the two preceding stages would have required a piece of paper six feet long or so). It nevertheless reflects the essential realities of commercialization of new technologies by independent or small business innovators.#1 Above all, it accurately represents the relative relationships you should maintain between the columns as you proceed through the steps of technical development.

Thus, for each step in the "Technical" column, "Market" and "Business" steps run par-

allel. This arrangement embodies the hard reality that only the existence of a market justifies full technical development, and that effective market analysis and technical development absolutely require simultaneous attention to the creation of an appropriate business structure. Among these factors, you should keep in mind the primacy of the market, as well as the fact that as you seek support to continue technical development, you will increasingly have to define your market and back up that definition with evidence, not assertions.

While developing a new technology, however, most innovators tend to focus primarily on the invention itself: Does it work? Can it be made to work? If it works, does it do its task as well as or better than existing methods? In fact, the most crucial question that confronts any new technology is not "Will it work?" but: "Assuming it works as well as I think it will, will anybody buy it?"

TABLE 1: THE INNOVATION PROCESS (available from DoE) [1]"

Unless the answer is that enough people will buy it at a price that will yield an adequate profit, it doesn't matter whether or not it works; it makes no sense to

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[1] The Innovation Process" table merits a few minutes study because the pages that follow contain frequent references to it and to the terms in it (defined in Appendix A, Part 1.)

spend time and money on technical development. Many inventors ignore this most crucial of all questions or, starting from the self-evident truth that unless the thing works, no one will buy it, reason their way to the comforting but spurious conclusion that if and when it works, everyone will want it.

Don't get caught up in this "Better Mousetraps mythology. Take a trip to your neighborhood hardware store and ask the man for his "better mousetrap." See what he shows you, and ponder the lesson carefully. Of course your technology will have to work in order to market it. Moreover, you may need persuasive, documented evidence assembled (expensively) by some independent, nationally recognized institution to persuade folks that it does work, but you will only reach that point if you get compelling, detailed answers to the ongoing question, "Who will buy it?"

No matter where you stand at this moment, from now on the question of how and to whom you will sell your technology should influence every decision you make, every step you take. Eventually, the task of selling your technology will absorb more time, energy, and money than further perfecting it technically. People with whom you will have to interact in order to obtain the resources you will require will increasingly concern themselves with you, in addition to your invention. Your invention may provide proof of technical skills, but extensive support will additionally require demonstrated business skills from you or your associates.

Once you accept these linkages between the components of the Innovation Process, you will realize that you must broaden your scope beyond technical development into such things as commercialization strategies.

Commercialization Strategies

In order to reach the market, somebody has to produce your technology, and somebody has to sell it. In fact, as your invention moves toward the market, business skills become more important than technical skills. You will need increasing quantities of time from people who have these skills, and of course you will need more and more money. Because many innovations compete for these limited resources, however, you will need the kind of plans that impress--the people who thoroughly understand the Innovation Process, or at least the business side of it. You will vastly improve your prospects of getting help from these folks by demonstrating your own comprehension of the process, and your determination to commercial your invention as soon as possible, in a plan that emphasizes overall business prospective, not just technical elegance. For example, venture capitalists, the professionals who invest their own and other people's money, have a maxim that goes: "We'd far rather take a chance on a first-rate manager with a second-rate product than on a first-rate product in the hands of a second-rate manager." First-rate managers are, by definition, first-rate planners. As an innovator, you may lack experience, but you can start the learning process by planning for a clear and stable goal: reaching the market.

Basically, there are two ways to commercialize a technology: either you license some-

one else to produce and/or sell it, or you do the job yourself. Most other options are variations of these two possibilities. Both of the principal commercialization strategies have implications you'll need to consider as you go along.

The Licensing Option

Licensing tempts many inventors because the amount of money, as well as the catalog of tasks, skills, and people required, may seem considerably less than in running your own business. That doesn't necessarily mean it's the right alternative for you. In the first place, you may not find a licensee, and you can bet none will find you. Secondly, even when it's possible, licensing has its pros and cons. Here are some considerations:

First, the Negative Side.

You lose control of the technology. Usually total control, for a long time, and often forever.

Your own involvement is reduced. In most cases, you'll have no further direct involvement at all. You may stay around as a consultant to the licensee, but usually for a limited time only.

Finding the right licensee is tough. The right one may make you rich. The wrong one may bury your technology, or butcher it. Even if you can eventually get it back, it may be too late.

Protecting your interests is crucial. But it's also extremely difficult to do. Negotiating with licensees means playing with the big boys. They confront you with the immense staff resources of the corporation--lawyers, market analysts, production engineers--a tough team for you to take on by yourself. Licensing agreements, when properly done, result from tough negotiations between two parties. The other side has professionals to represent it, so you better have one of your own. If you're an amateur at the game- -and you almost certainly are-- you need the help of a lawyer with experience in such negotiations.

Now, the Positive.

Licensing multiples the resources to develop your invention. The licensee, if it's a dynamic firm--and you don't want to license any other kind--can immediately put whole teams of professionals to work developing, producing, and marketing the technology. Insurmountable financial mountains to you may be petty case molehills to them.

They see things you don't. Licensees often perceive uses--and therefore markets--for your inventions that you didn't see. One licensee turned a salt-water taffy machine into a new and highly efficient type of concrete mixer. The more markets, the more potential income.

You may make some money and you may make it soon. The licensee may pay you money up front, although probably not as much as you hope. In addition, they may agree to a minimum amount of royalties for some period.

Licensing frees you to do something else. If what you want to do is retire, or go back to inventing, then giving up control of the technology may serve your interests rather than defeat them.

If you have a technology with a demonstrably strong potential market, thriving businesses out there may want your invention. Some large corporations regularly acquire new products that way, but you should also keep in mind that smaller firms, though they may be less well-known, offer possibilities as well. Many of them can't afford expensive research and development programs, but nonetheless need new products. Furthermore, smaller firms often operate much more dynamically than big ones, so don't write them off.

Before considering licensing, however, you should be able to answer yes to all these questions:

1. Do you have a patent, copyright, or other legal protection? If not, you won't get far, because no company will risk investing in an unprotected innovation. Why should they pay you for something you don't own
2. Do you have a working model, or better yet, an engineering prototype? If not, you can't prove the thing will work with competitive efficiency (unless it's self-evident that it will, which doesn't happen often). If you haven't made it work, your licensee will have to, which will cost them money, which will weaken your bargaining position. Indeed, licensing may succeed or fail on the basis of your technical development prior to licensing, for your licensee may have neither the skill nor the commitment that you bring to the task.
3. Do you have credible data about the size of the market, including probable impact of selling price on quantity demanded
4. Do you know what it will cost to produce at various levels of output

You may have thought licensing would enable you to avoid the last two of these questions. On the contrary, if you don't know the answers, then you don't know what your invention will be worth to your licensee; therefore, you don't know what payments you can reasonably demand. Your licensee will work up his version of all these figures. If he's reputable, he won't cheat you, but his estimates of sales and profits will be on the low end, and costs on the high side. You can count on it.

In short, you not only have to demonstrate technical feasibility, you also have to prepare a package of information about production and marketing so close to that required for a business plan that you might consider, in fact, writing one. Such a document will help you decide whether you want to venture or license in the first place, and then help you carry out that decision by supplying you with the data you need to raise money for your own business, or to persuade a prospective licensee to talk you out of it.

At the very least, if you decide to license your invention, you'll have to complete the steps on the Innovation Process table through a Working Model; reaching the Engineering Prototype stage would greatly increase both your chances of finding a licensee and the amount of money you may convince him to pay. By contrast, if you want to start your own business, or develop the technology within a business you already operate, you'll have to do everything on the table through the "Entrepreneurial Stage."

Doing It Yourself: The Venturing Strategy

Starting your own business, or "venturing," as its often called, will require more from you, but has its own advantages and disadvantages to consider:

First the Disadvantages.

It's risky. Many new businesses fail. A new business built around a new product runs a double risk, especially since the list of reasons for new business failures reads like a catalog of many inventors' weaknesses. These include (among many, many others):

inadequate financing lack of management skills, such as personnel, accounting overestimating the market poor choice of location inability to delegate responsibility

Resources remain limited. You'll have whatever money you yourself can raise, and raising the kind of money required to set up production and marketing usually takes a professional. If you aren't one, you'll have to find one.

You'll be spread increasingly thin. As the number of tasks and skills required multiplies--and it does, with a vengeance--you'll spend more and more time either doing them, or finding someone who can--and will. You probably won't make much money for quite a while. Building a business gobbles cash, and a lot of it will continue to be yours. If you can found a company and finance it adequately, you may be able to pay yourself a salary, but it'll probably be modest-- your backers will expect you to be frugal with their money.

On the Other Hand, Doing It Yourself Can Have Advantages.

Running a company can be exciting. If you have the will and skill, you may enjoy it more than inventing. Some inventors are entrepreneurs by experience, and some by instinct. The inventor/entrepreneur can sometimes achieve powerful things, as Edwin Land at Polaroid and Steven Jobs at Apple have shown. The combination, however, occurs rarely.

In the long run, you may make a lot more money. If your invention turns out to be a big success, your rewards could vastly exceed the royalties you could expect from any licensing agreement.

Even if it's your company, you may not have to run it. Building a successful business involves hiring all kinds of people, as the table shows. This could include a chief operating officer. There are plenty of examples of inventors who retained a large or controlling interest in their companies, but turned the management of it over to someone else. Edwin Land did it several years ago, and Steven Jobs did it recently.

Obviously, being in business for yourself can mean a lot of different things. You may decide you want a company that engages in the whole range of activities involved in designing, manufacturing, and selling your product. More likely, you will focus on some parts of the process while making arrangements with other firms to do the rest of it. (After all, even General Motors buys a lot of its parts from independent suppliers, and lets franchised dealers do the retailing.)

As the sponsor of an invention, you may already be in business formally. Even if you think that you don't have a company in the legal sense, the day you commit yourself to making a financial success of your invention you embark on a business enterprise in the eyes of the Internal Revenue Service however small and informal that enterprise may seem to you.

Therefore, if you haven't yet thought of the time and money you've invested getting this far in terms of a business proposition, start now, whether you think your business will stay small or grow. If you haven't created a structure that provides you with limited liability (that is, a structure that legally insulates your personal assets against losses you may incur in your business) you should see a lawyer soon. Prospective investors will concern themselves with this issue, even if you haven't.

If you intend to develop your business around your technology, experience suggests that your company will have to grow, even if it's sometimes possible to get an invention into the marketplace without involving yourself in the complexities of building a large company. If, for example, you've invented a specialized tool with a large profit per sale, you may be able to "bootstrap" your business by selling one, taking the proceeds and making two more, selling them and making four, etc. Even in such rare cases, however, you will ultimately have to decide to stay small (running the risk that some larger firm, seeing your success, may invade the market with a competitive product), or to expand.

If you run a growing business you'll eventually need capital from outside sources, which means you'll need a formal business structure providing limited liability to investors--one in which tasks are subdivided functionally (manufacturing, marketing, etc.) and assigned to professionals hired to carry them out. The two things intertwine, because no rational investor will put up the kind of money you'll need for a company of even modest size unless you have at least a plan for such a formal structure. Investors know, even if you won't admit it, that inventors generally prefer doing everything themselves; moreover, they know that building a successful enterprise absolutely requires genuine delegation of authority, something most inventors find extremely difficult to do. If you hope to grow a business, therefore, you must accept the ironic proposition that to keep overall control yourself, you'll have to delegate a lot of specific authority to other people.

Successful management of a business requires launching, mastering, and controlling a dynamic process, as well as dealing with continuous change caused by such things as the business's growth, new technology in the industry, revisions in tax laws, behavior of competitors, etc. A successful, growing, and dynamic business rests on a foundation of continuous planning, involving constant updating to reflect changing circumstances, goals, organization, etc. The plan will help keep you on track, and it's an invaluable tool with which to sell yourself and your business to prospective investors, customers, and suppliers--as well as to the people you want to recruit for your company. This last has crucial importance, because you can't grow much without first-class help, and people worth hiring want to know what they're getting into--especially in terms of future prospects.

Prerequisites Common to Licensing and Venturing

Despite the apparently great differences between licensing and venturing as commer-

cialization strategies, they prove to have a lot in common, including certain prerequisites. Some things you simply have to do whether you hope to persuade someone else to buy the rights to produce and distribute your invention, or decide to do it yourself. Remember that either way somebody will have to spend money, a lot of money. Whatever you may have spent so far will shrink in comparison with what's required henceforth. So whether you want to go on and market it yourself, or convince someone else to buy the rights to do it, you have to put together a convincing package. This includes:

Proof that it works. This means a working model, better yet, an engineering prototype. There's no substitute for showing investors or would-be licensees something they can see, touch, and watch do its stuff. Without at least a working model, you haven't much chance of interesting people beyond your family and friends who put their trust in you personally. Strangers (and friends who are experienced investors) demand:

A market analysis. This means a serious breakdown of who the potential customers are, how many of them there are, how much they will pay, what the competition is, and how you will beat it. In addition, you need to know exactly what the market channels are through which products like yours reach the market. You should be able to show three significant points of difference between your product and the competition. If you can't, you've got a problem. You had better be sure your invention has no fatal flaws. For example, one inventor had a device that depended on a manufacturer converting an experimental glass product into a mass production item. When the manufacturer quit making the glass, he effectively killed the invention at the same time. Above all, you have to be able to show why people will buy your product, and show this through statements from prospective customers, backed up with believable figures in dollars and cents. The surest way to turn off any prospective investor who asks about the market is to say, "When they see it, they'll jump for it." It ain't necessarily so. Your market analysis determines whether it's worth going on with your invention, regardless of its technical elegance, and that analysis forms the basis for the next thing you need, which is:

A commercialization plan. This is a detailed analysis showing what you intend to do to develop, market, and sell your technology, how much all this will cost, and who will do the work required--with all this information translated into a year-by-year, dollars and cents projection five years into the future. Investors (other than friends and family) will absolutely demand such a plan; prospective licensees may insist on one. And even if they don't, you should have one. Without it you have little ammunition with which to combat their campaign to beat down your price.

Other Factors in Choosing A Commercialization Strategy

In deciding to license or venture, you should accept that, either way, you will have to give up some measure of ownership and/or control. In a sense, therefore, you're not deciding whether to get out, but when, how completely, under what circumstances, and by what method. In other words, you're looking for an exit strategy at the same time you're looking for a commercialization strategy.

In addition, no matter which commercialization strategy you follow, you will increasingly have to involve yourself with people from the business world. These folks have different imperatives, different expectations, and speak a different language from yours. Many of them care nothing about technology except as a possible money spinner. Like it or not, you will increasingly need these people, so you have to learn to deal with them pretty much on their terms. They're no more inclined to translate their professional language for you than Parisians are to speak English to American tourists. Understanding these realities of the business world is just one of the skills of the entrepreneur, a role you'll have to understand and that someone--you, a partner, a licensee--will have to play. Building a business absolutely requires the skills of the entrepreneur; that is, the know-how to assemble all the components, make them function harmoniously, and sustain growth. If you yourself have run a business, you have a first-hand idea of what it takes. If you haven't, then you have a lot to learn. Whether you have the aptitude for it is something you have to ask yourself, and answer honestly. If you decide that you aren't cut out to be an entrepreneur, or don't want to be one, that doesn't mean you can't create a business around your invention. It does mean you'll have to get an entrepreneur on your team, and soon. They don't come easy; you'll have to do sufficient spade-work to turn up enough evidence to persuade one to cast his lot with you and your technology. And they don't come cheap; he'll want a piece of the action, probably a big piece. But he may be worth it: Chester Carlson was an inventor who couldn't balance his checkbook, much less run a company, but an entrepreneur named Joe

Wilson made him a multi-millionaire by building a company called Xerox.

Every library has do-it-yourself handbooks containing self-administered tests that will help you decide, but you can begin dealing with the question of whether you want to be an entrepreneur by looking at the Innovation Process table and answering these questions:

1. Which four tasks do you do best
2. Which four do you do worst, or think you would do worst
3. Which four tasks do you enjoy most, or think you would enjoy most
4. Which four do you enjoy least, or think you would enjoy least

If at least half your answers to Question 1 don't come from columns other than the "Technical" column, or if more than half of your answers to Question 2 don't come from the "Business" or "Market" columns, you probably aren't much of an entrepreneur.

If at least half your answers to Question 3 don't come from columns other than the "Technical" column, or at least half the answers to Question 4 don't come from the "Business" or "Market" columns, then you probably don't want to be an entrepreneur. (Of course the reverse applies as well.)

These questions about what you do best and enjoy most aren't just a gimmick to help you decide if you're an entrepreneur, or whether you want to license your invention or run your own business. They also serve to introduce another dimension you should consider carefully in deciding how to commercialize your technology--the dimension of costs.

Think About Costs At All Costs

As you know, there are three kinds of costs; money, time, and personal. You also realize that the three of them are intertwined, and to some extent interchangeable. If you think you can't afford to hire a model maker, for example, you may decide to save money by building it yourself at a cost of your time, which in turn often involves a personal cost to your health, your marriage, and so on, not to mention the fact that you may produce a poor model.

To measure these costs accurately in relationship to one another, you must understand and apply the principle of "opportunity cost." In terms of money, it's the interest lost by putting it somewhere other than in the safest investment you can find, such as US government securities. That's exactly what you've done when you've put your money into your invention. It's also what you'll be asking investors to do, and you can bet your last dime that professional investors never lose sight of opportunity costs. Since the current rate of return on sure-fire investments runs between 7 and 10 per cent, they'll demand a steep price for putting money into your high-risk venture.

Opportunity costs, however, also apply to time and personal costs. While you're doing one thing, you can't be doing something else, and if you spend a lot of time doing things you don't do well, you may be wasting something more precious than money. In the long run, money costs may be the least expensive of all because, if you run out of money, there's always bankruptcy. If you run out of time, there's only the grave. Financial bankruptcy is as American as apple pie, and plenty of people have survived it to go on to later success. Bankruptcy in time or spirit, on the other hand, is a disaster from which there often is no recovery.

All this argues for riding the expert express instead of the do-it-yourself local. The Innovation Process table should convince you that eventually you'll have to get expert help. (If you have a patent attorney, in fact, you already have.) Look at the table and at your answers to the previous set of questions. Keeping in mind the interplay of the three kinds of costs, including the opportunity cost factor, ask yourself again: "What's the best way to commercialize my invention, and what help do I need first to get the show on the road?" Many innovators will of course respond "Whatever strategy I choose, whatever step I decide to take next, whatever role I see for myself, the help I need is money."

Sources of Capital: Where the Money Comes From

This subject--finding money to finance perfecting a technology, producing it, and getting it into the market--concerns every inventor. Unhappily, as you will see, it turns out to support only a brief discussion here. No easy answers, sure-fire solutions, or readily accessible pools of funds exist. In addition, the process by which small firms and individual inventors finance technologies hasn't had enough systematic study to permit an extended discussion of just what does happen.

What we do know about financing innovation in the American economy suggests that the funding process resembles an onion. The visible outer layer consists of formal investment capital companies, including Small Business Investment Companies, the investment banking network, the stock market, and so forth. At the core of the onion sits the inventor himself, supporting his research out of the family income--while contributing his time, skill, and labor-building a "sweat equity" in his technology. Between these two extremes, the makeup of the intervening layers remains somewhat unclear. As we describe it, bear in mind that exceptions exist to every general statement, but that planning based on exceptions runs high risks.

The layers of the capital "onion" relate to the stages of development shown on the Innovation Process" table. As the inventor moves down the table, he moves from the core toward the outer skin of the onion, but only if he takes the steps in the "Marketing" and "Business" columns more or less in parallel to the "Technical Steps." As we've argued throughout, the farther you go, the more money you'll need; the more money you need the more you'll have to present formal, systematic evidence, in the form of a plan, of your product's market potential and your firm's business capacities.

At the outset, we can dismiss the two extremes, the core and outer skin of the onion, and focus on the intervening layers. On the one extreme, no one has to tell inventors about sweat equity; on the other, no formal venture capital organization will invest in a technology (with a few, rare exceptions) before the engineering or production prototype stages. If you are an inventor and are still reading this document, you probably haven't advanced that far.

As they move from concept to concept development to working model, inventors have to find more and more money or its equivalents, such as credit, unpaid contributions of labor, etc. This in turn requires widening the circle of investors--in effect, moving outward from the core of the onion. Once the inventor has poured in everything he can (or will), relatives, friends, and personal acquaintances usually provide the next source. Relatively unsophisticated as investors, these people want to help the inventor for personal reasons, because they have faith in him though they know little or nothing about his technology. Some may simply feel it's a good gamble to get in on the ground floor; nobody wants to miss out on the next Xerox.

In most cases, however, the inventor uses up all the funds he can get from these personal sources without having reached a stage of development that will attract professional investors. The inventor then enters the "Valley of Death," (next page) from which many never emerge.

Figure 1: Valley of Death (available from DoE)

Here, the search for money begins in earnest, as the inventor moves beyond his immediate circle of relatives, friends, and close acquaintances into the layer made up of strangers and people who are professional rather than personal associates (i.e., third party investors). These include:

Employees--actual or potential: It you have people working for you, they may contribute their time, and some of them may have some money they'll invest. If you can attract an entrepreneur into your organization, he may assume some of the financial burden, as Joe Wilson did for Chester Carlson in Xerox's early years.

Professionals for whom you're a client: Patent attorneys, accountants, and business consultants, for example, sometimes find a project attractive enough to supply their services in return for a share of the business. In addition, many of them keep an eye out for promising investments, both for themselves and for friends who have money with which to speculate on early-stage technologies. If this happens, you may tap into:

The "Old Boy Network" of Wealthy Individuals: This includes not only the kinds of people mentioned above, but also doctors, dentists, lawyers, and retired businessmen.

These kinds of people invest for a variety of reasons: to make money, obviously, but also for tax advantages, for fun and excitement, or to do something to bolster their community. They have several things in common: they tend to be aware of one another, often have had previous investments in common, and restrict their activities to local enterprises; therefore, they form local (or at most, regional) and highly personal networks.

In addition, they may invest informally, but that doesn't mean they throw their money around casually. If you seek support from these people, they'll want to know a lot more about your experience, business abilities, and the market for your technology than your relatives and friends demanded. They'll succumb much less readily than your relatives did to wondrous tales of your invention's technical wizardry. In fact, a problem that congenitally plagues encounters between inventors and would-be investors, no matter what the stage of technical development, is the inventor's inveterate tendency to dwell ad nauseam on the technical virtues while brushing aside the business problems--when investors would prefer precisely the opposite emphasis. At whatever stage you have to seek these people out, you better have done your business and marketing homework, as well as your technical sums.

If you have, and if you've reached the working model stage or farther, some other sources may open to you. These include:

Potential suppliers and customers: These people stand to gain from your success. They probably won't throw any cash your way, but suppliers may extend credit, and prospective customers may give you advance orders. If they do, this gives you something you can take to:

The bank: A prevailing axiom says banks won't finance inventors generally, that seems to be true, but startling exceptions to the rule do sometimes turn up. In addition, the late Al Shapero, a professor at Ohio State who did most of the empirical research in this area, found banks more willing to lend to new businesses than the conventional wisdom and literature would suggest. Shapero suggested some basic principles to keep in mind when trying to borrow from banks: First, don't take no for an answer, even within a specific bank. He found instances where loan officer B approved an application that loan officer A had tossed in the waste basket. Second, try more than one. If bank A says no, go to bank B, and so on until you run out of banks. They don't all have the same loan policies, especially for small business. In addition, you may find small banks more receptive than big ones. Business tends to gravitate to big banks; small ones often have to scramble for it.

New banks may prove more receptive than old ones. Four centuries ago, Machiavelli recommended to the ambitious that they attach themselves to rising new-comers who need followers, rather than hunt for a place near the established greats, who already have their retinue of retainers. It works in politics, and sometimes applies in banking as well.

Obviously you can't approach any banker armed only with a lot of last talk about your invention's technical capacities. Even the most liberal banker has a business outlook, so you'll need to have a business-like proposition, which means once again you have to have your homework done and refrain from nonsensical statements on the order of, "When they see this, they'll have to buy it." He won't. On the other hand, if you do have a business proposition that the banker won't take a chance on, he may know somebody in the informal investment network to whom he'll refer you

If no one in the private sector will take a chance on you, there remains:

The Government: The Federal Government has numerous sources of support for innovations (write your senators and congressman), and you should not neglect state and local governments as potential sources of assistance. California, Connecticut, Massachusetts, Ohio, and other states have venture capital funds. Buffalo, New York, has one as well. The so-called "enterprise zones" that have appeared in many cities offer various kinds of assistance to business start-ups, and often have contacts with prospective investors.#2.[2]

Beyond The Valley of Death

If you put together a combination of resources permitting you to build an engineering or production prototype that works--and if you couple that to the appropriate components of a professional-class business plan--then, you may emerge from Death Valley on the magic wings of a licensee's technical and financial resources, or the powerful thrust of professional investors' venture capital. All these things go hand-in-hand. If you have assembled proof of business and market viability as you approach the point of demonstrating technical viability, then you'll be nearing the market and the outside layer of the capital onion. You'll have in hand the foundation on which to build a competitive enterprise. You'll also have the arguments you need to persuade the most hard-headed backers that you have a commercial vehicle worth getting aboard.

For many inventors that happy day lies somewhere in the future, but you should start now developing credible answers to the non-technical questions you'll confront as you look for ever-larger quantities of capital.

In summary, then, remember that informal investor networks operate on a local, personal basis. Look close to home. Remember that investors beyond the immediate circle of friends and family have a different outlook; you must prepare to show them that you'll make money for them. The closer you get to institutional sources of capital, the more polished your business package must become.

The final, hard truth lies in the relationship between money and ownership--not the same thing as control. To get money, you'll probably have to give up some ownership. Just how much you'll have to trade for capital varies from case to

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[2] If you have an innovation that saves energy, or generates it efficiently, you might consider submitting it to the Federal Government's Energy-Related Inventions Program. See Appendix B for details.

case, but if you need a lot of money, you will have to surrender a considerable, quite possibly a majority, share of your interest. Some inventors find this the toughest decision of all. Some find they can't do it, prefer to stay small, and some die broke. Others bite the bullet, decide that twenty or thirty or forty percent of something beats 100% of nothing, and move on. It's a highly personal decision. Some inventors have likened it to deciding whether to put a child out for adoption. No one can tell you what to do, only what options and consequences you may confront. Because it's a personal decision, you must weigh the personal factors. As you confront the choice of giving up one thing to get another, ask yourself what kind of person you are now, what kind of person you want to become as time goes by, what you want your invention to do for you. If your invention succeeds, it will change your life beyond recognition. Make sure it changes your way. That control you don't have to surrender to anybody.

Summary of Part 1

Thus far in this document we have:

1. Provided a glimpse of the road ahead, the Innovation Process
2. Summarized the basic characteristics of commercialization strategies, pointing out the looming necessity to choose the one best suited to you
3. Sketched the basic contours of innovation financing

Throughout, we have repeatedly emphasized the indispensable role that planning must play for a technology to succeed, regardless of its technical merit. For most inventors, much of the Innovation Process lies ahead. The immediate challenge is henceforth to advance systematically according to plan. We turn now to a discussion of ways to do just that.

Part 2 - Assessing Your Current Status: A Precursor to Planning

The Innovation Process, commercialization strategies, tough personal assessments and choices, funding, and the necessity for systematic planning--all this rigmarole may seem an impossibly formidable array. You can, however, master it step by step. You begin to deal with the manifold details of these specific requirements by making a general assessment of where you are, where you want to go, and how you hope to get there. To this end, the Innovation Process table shows the steps through which a successful invention passes from first inspiration to national market penetration. The process may vary slightly in specific cases, but most inventions, including blockbusters such as Xerox, Polaroid, Apple Computers, and Velcro have trod this well-worn path. Unless you don't want to make more than pocket change, the odds are very high that you'll have to travel some distance down the table.

The technical development steps occupy only one column, and should occupy only a portion of your time. The tasks in the other columns have to be performed as well, not necessarily in exactly the parallel time frame the table suggests (such are the limitations of tables), but if you get far down one column while the others lag, you'll eventually bog down completely.

If you're like most inventors, you have advanced primarily down the left-hand column, while lagging in the others. If so, you must begin to think about the tasks you've neglected. By analyzing where you stand now, you will take a first step toward deciding on a plan to commercialize your invention. In addition, you can isolate the areas in which you most need help, which in turn will aid the process of preparing a plan to move forward toward the market. To locate yourself, put the Innovation Process table in front of you and:

1. Go down the "Technical," "Business," and "Market" columns and draw a line through every task you've completed.
2. Go down the 'Skills" and "People" columns. If you have the skill yourself, or if you have made definite arrangements for the help of someone who has, draw a line through the item.
3. Look at the result. The pattern should give you a pretty good indication of how close you are to commercialization, bearing in mind that licensing will require completing all or most of the steps of the Innovation Stage, and producing it yourself will require everything in both the Innovation and Entrepreneurial Stages. You should also be able to see the kind of help you will need to move on, and the kind of people you'll have to deal with.

If you are like most inventors, your marked-up table will show that you've paid least attention to the market. You will need to consider in detail where you stand with respect to each of the three columns--Technical, Market, and Business--on the left hand side of the Innovation Process table. We will, therefore, begin with the Technical column, the one with which most innovators feel most comfortable. We will then take up the others in turn, showing how you can assess your current status and initiate forward planning in the form of sequenced tasks directed at specific obstacles.

Steps in Cadence: Prototype Development and the Engineering Process

Organizing Your Thoughts

Before you make a substantial investment of time, money, or effort in technical development, you should have lucid, credible answers to the four basic questions below. If you decide to continue technical development, you must also concurrently address market and business development issues; indeed, as we have said so often before, the intertwining of market, business, and technical development (shown on the Innovation Process table) means that you must address all these questions continuously and repeatedly, while revising your plans according to any changes that emerge in the answers.

1. Is it new

Your invention, that is, or does it already exist? Can you patent it? How do you find out

2. What does it do

In describing the possible applications of your technology, remember that two heads are better than one. You think you've invented the perfect product to do a certain job. Someone else may look at it and say: "what an ideal thing to do..." and suggest something that never occurred to you.

Does your idea fall in an area where you're not the expert? An honest answer to this question might just point out that you're not the one to "invent" it. If it's not within your field or your educational background, beware. You're starting out at a disadvantage. Most inventions, innovations, new ideas emerge as an outgrowth of years and years of innovators' experience in the same field or discipline as the "new product."

3. Who needs it

Thousand of un-needed inventions are conceived, developed, perfected, and patented each year. These go nowhere, so be honest with yourself or get honest, non-biased, outside help in answering this question. Don't spend the money to patent your idea or to develop it further if no one needs it.

4.Does it pencil

You may have a business plan; you may have a patent or a license; you may believe you have the necessary financing; but, does your project really pencil? That is, can you make it at a cost and sell it at a price that will yield enough profit to make your business viable? If everything goes wrong, what's the down side? Have you checked your numbers with more than one source? An unbiased source

Face this "Does it pencil?" question now. Prospective investors will want to see the answer and "see the work" that produced it.

IF YOU DON'T KNOW, OR CAN'T FIGURE OUT WHETHER IT PENCILS, STOP WHERE YOU ARE. DON'T SPEND ANOTHER DIME ON TECHNICAL DEVELOPMENT UNTIL YOU DO KNOW.

If, on the other hand, you can demonstrate to yourself and to a neutral party that your invention has strong profit potential, then you can turn your attention to the technical development steps ahead of you.

From Concept to Production: The Steps

From a technical standpoint, there are six major steps to the marketplace:

1. The Concept/Idea 2. Concept Analysis 3. Working Model/Proof of Concept 4. Engineering Prototype 5. Production Prototype 6. Qualified Production Item

Bridging the gaps between these steps might be straightforward for a simple product such as the "Hula Hoop," or it might be very complicated, cost millions (or even billions), and take years--witness space technology.

Whatever the complexity of your own technology, as you develop it you will probably build (or have built for you) most if not all of the model prototypes shown in Table 2 below.

Table 2 INSERT TABLE (available from DoE)

If you have already built a model or prototype, the table will help you locate yourself on the technical development continuum. The column below each prototype specifies first the purpose for building that particular form, and second, its general characteristics.

Let's define and discuss the technical development steps and models/prototypes that demonstrate the completion of those steps:

1. The Concept/Idea: The inventor's first thoughts about the new product or process or apparatus or method--organized and put down on paper.

You should obtain legal advice on how your idea should be reduced to writing the "correct way," with dates, in a bound book, etc. Also, find out how you should explain it to a disinterested party who can both understand and remember just what you've done.

2. Concept Analysis: A translation of your idea into a preliminary design; initial calculations and drawings that demonstrate theoretical validity of an invention.

At this stage spend lots of time and very little money. Be very critical of your own thoughts. Review the literature in depth. Don't let any assumption get by without challenge. Build a mockup and show it to friends, family, co-workers, colleagues, friendly professors. Answer all their questions. Pay particular attention to the "Devil's Advocates." Why don't they like it? Why do they think it won't work? Remember, this analysis mostly costs you time, so use it--lots of it.

3. Working Model/Proof of Concept: A reduction to practice, proof of concept. The working model is often less than full-scale, inexpensively and crudely constructed, and need not function optimally. It is intended to test the most basic operating parameters and to aid in the design of an engineering prototype.

At this point you've got to quit making excuses and achieve real feasibility. Build this model yourself only if you have the ability and the manual dexterity to produce it to professional standards. Otherwise, have it done by a pro--pay to have it done right. Remember, this model has to work; it must prove the idea, the concept. If you really think you've done it right, and it still.doesn't work, go back to step 1, then step 2--expand on step 2 in greater depth and then build another. Don't go further till you have your "Proof of Concept Model."

4. Engineering Prototype: An actual working version of a product, apparatus, or process used to gather data on operating performance, and production requirements. Most often one-of-a-kind and commonly fitted with special instrumentation, this model is usually hand-made, but always of sufficient technical quality to determine whether a production prototype can (or should) be built.

The transition or scaling-up in sophistication from a working model to an engineering prototype follows logically in terms of technical development. And, as pointed out, you almost certainly will have to do this in order to "sell" your invention to investors or licensees. These people will want to see systematically derived and independently validated test results, not a lot of guess work. Taking this step usually requires not one but a series of improved versions that culminates in the actual engineering prototype.

At this point the costs, time, and frustrations really mount. Your hand-made working model will require parts that are:

expensive hard to get proprietary secret, or unheard of

Worse yet, your first "real" prototypes probably won't work as well as your own original working model. So you will have to refine, redesign, rebuild, re-test and spend more money. Time becomes a nightmare, because time is money.

5. Production Prototype: A full-scale, completely operational model designed to determine production and fabrication requirements for the production item. Also it is used to generate the final pre-production performance data on operation and durability. Usually hand-built, the production prototype must conform as closely as possible to the design standards for the final full-production product or process.

Here you plunge into the real world of high-priced help including (to name a few): tool and die makers, design engineers, expediters, facility planners and that most perverse of experts, the production engineer. You will need all these people and more to build a true production prototype. The items you built in steps 3 and 4 above just won't make it in the real marketplace because they will cost too much to make, not embody sufficient safety factors, and most serious of all, won't perform to specifications through a reasonable product life cycle. Lots of inventors have gone broke trying to prove otherwise. Your reputation will depend on efficient, durable, and safe products, fully production qualified. You can destroy that reputation by forcing an unready prototype prematurely into the market.

6. Qualified Production Item: A full-scale, fully operational model manufactured in an initial, limited production run under conditions as close as possible to final production. It is used to ensure that final production runs will produce a product meeting design standards. Product qualification prototypes are often subjected to independent third-party testing, especially if the product must meet industry or government regulatory standards.

Getting here means getting to the brink of market entry. The process of qualifying a product consumes staggering amounts of time and money, for you'll inevitably run into things that never occurred to you in the beginning or along the way--such things as safety, legal liability, wear-and-tear, product infringement, break-even cycles, pollution problems, etc. These qualification tests, however, put the finishing touches on the technical development process, which in one sense consists of constructing a series of prototypes for the purpose of conducting more sophisticated tests leading to better designs.

Testing Your Technology

Few inventors/innovators have ever seen a development test plan, much less written or executed one. Hiring an expert in this field as early as possible might, therefore, be a good investment. Testing must be properly planned, executed, and evaluated to provide the optimum return for its usually very substantial cost.

Your Technology and Its Market

Even if you haven't built a working model, we probably don't have to convince you that you should. An inventor's natural inclination to see his invention work usually provides sufficient motivation. Scaling up from working model to engineering prototype follows logically in terms of technical development; moreover, as we pointed out previously, you may have to do this in order to "sell" your invention or process to investors and licensees. To repeat, these people want to see systematically derived test results, not a lot of guess work. The closer you are to production prototype, the more convincing you can be--if you have these test results.

None of this means that you should automatically go from concept to working model to engineering prototype. Whether you should depends not only on whether it's technically feasible, but equally (at least) on whether the potential market justifies the expense. In other words, you shouldn't go to the expense of continued technical development unless there's a market big enough to repay you, and to provide your backers with a decent return on their money. It doesn't make sense to build the thing just to see if it will work If you persist in developing it without hard-nosed exploration of the market, you're not in business, you're supporting a hobby. If that's what you want to do, and you can afford it, that's all right. Just don't kid yourself; you certainly won't fool any of the business professionals with whom you'll have to deal more and more as you develop increasingly sophisticated versions of your technology. And deal with them you will, unless you have the skills of Leonardo Da Vinci and the wealth of the Indies (in which case you probably wouldn't be reading this document in the first place), because, as you can see, moving toward production prototype requires a multi-

tude of skills and a lot of money.

The kinds of people who have the skills and money you need have one thing in com-

mon: they're not hobbyists. They're professionals who want EVIDENCE--NOT ASSERTIONS (and you can make this a slogan; paint it on your workshop wall.) Certainly they don't want assertions such as "Everybody needs one," "When they see it work, they have to buy it," and "If the stockholders found out they passed this up, there'd be a new management tomorrow." These kinds of comments mark you as an amateur, and as one professional investor said, "We don't have time for 'amateur night.'" For these people, as for many others whose help you'll need, the hallmark of the professional is assiduous, unrelenting attention to the market, manifested in systematic market analyses.

The first step, then, in planning to take a product into the marketplace (commercialization) is to develop your concept, checking frequently as the concept clarifies, to verify market requirements. Don't think that you or anyone else can dictate to the buyer--not without a lot of market preparation. Market knowledge, advertising, salesmanship, reputation, quality--these things sell products. Not wishful thinking and dreams. Technology doesn't sell itself. You have to sell it and you have to prove it can be sold in order to justify further development. The Innovation Process table will show you where you should stand in terms of market analysis relative to your current stage of technical development. If you've lagged behind, start catching up. Above all, if you haven't begun a systematic analysis of the market, you should start right away.

Market Analysis: So It Works...Who'll Buy It

We have argued that while any commercialization strategy requires a working prototype, a market justification should exist for every dollar spent developing one. We can't repeat too often the fact that just because something works doesn't mean enough people will buy it to support the expense of producing it. As you move through the stages of technical development, you will come under increasing pressure--from potential investors, licensees, etc.--to demonstrate who your customers will be, what channels exist to distribute your product to them, what competition you will face, and how your product will compete successfully.

Market analysis, like the other tasks you have to perform, gets more complex the closer your technology gets to the market. Whether you decide to license or venture, a full-scale analysis forms a basic part of your appeal to prospective licensees or investors. Either way, an appropriate market analysis becomes an essential component of your commercialization plan. At every step of technical development, you should have appropriately detailed and documented responses to the questions incorporated into the commentary on the following pages. Ask yourself how prepared you are right now to supply the required information.

Market Identification

What specific customer needs does your product satisfy? Who will buy your product? Can you list specifically the people or companies that you consider likely customers? Why will they buy

?What product characteristics encourage these customers to buy? Does your product have these characteristics? Is the timing right? Do some events have to occur (or conditions exist) before people will buy your product? Is there any chance that the "time" for your product has come and gone (or is almost gone)?

Or is now the time, and, if so, why? Does a market exist right now for your innovation? If not, you had better have some compelling reason to think that one will emerge soon. If one does exist, you should be able to say something about it, and about the way your technology relates to it.

Market Size

Define the market for your product in detail; identify segments of that market and specify their size in terms of units that can be sold:

Although this information is difficult to obtain and it may seem like an excursion into fantasy land, this is the beginning point of an investor's or licensee's decision. After all, if you can speculate on the technical potential of your innovation, you can speculate on its market potential.

Your Customers

Who is the end user of the product? The end user may not be your customer, but your product obviously will have to satis-

fy his needs. You will need to analyze in detail those characteristics of the end user that might affect his demand for your product. If your end user is a retail consumer, you confront different characteristics from those presented when the end user is a manufacturer.

Distribution

Knowing your market means knowing more than who the end users are. You have to know the existing channels of distribution that pass goods from producer to end user. In an economy as sophisticated as the one in the United States, complex distribution networks exist for almost every conceivable product. If such a channel doesn't exist, that constitutes a major barrier in its own right, and you'll need a strategy to overcome it. In fact, the structure of many major American industries resulted not so much from the needs of manufacturing, but rather from the fact that existing distribution channels couldn't be adapted to market a new product. Examples include the meat packing industry, farm machinery, automobiles, sewing machines, and office equipment.

Distribution networks suitable to your product probably exist already. This fact refines the question, "Who are your customers?" For example, if you have invented a carburetor that you hope to persuade automobile companies to put on new cars, and the driving public to install on cars they already own, you have identified two different end users, neither of them your customer. To find your customer, you'd have to locate the chain of distributors that supplies the new and replacement markets in carburetors, and focus your efforts there. Lots of inventors have wasted valuable time and money trying to sell the end user, who wasn't, in fact, the customer, or trying to sell to the customer without considering the end user's needs. In fact, your product must accommodate every link in the marketing chain.

You must therefore know the distribution channels through which your product moves from manufacturer to end user. This includes knowing each intermediate step and the kind of firm that performs it. For example, carburetors go direct from manufacturer (large corporation) to auto assembler (large corporation) on the other hand; on the other they also go from manufacturer to jobber (usually medium-sized corporation) to regional jobber (usually a family firm or partnership) to local distributor to parts department of new car dealer (may be family firm, partnership, or owned outright by auto company), or to local parts store (franchised or otherwise). It makes a difference.

Do you know the distribution chain for your product, complete with company names? Are your customers the end users, or members of the distribution network?

Your Competition

To succeed in the marketplace you have to know your competition as well as your competitive advantages and disadvantages. You should be able to list your competitors in detail. If you think you have none, you'd better be prepared to prove it. Ask yourself how the customer solved his problems before your product came along. If in fact you confront no competition, you must consider the possibility that no competition may, mean no market.

You should also be able to list the specific characteristics that differentiate your tech-

nology from products now in the market. And you should be able to describe the differentiation. If at any point in the development of your product you can't identify at least three points of difference, it may be time to quit. Moreover, your answers to these questions should enable you to explain why your potential customers will make two decisions: to quit buying from your competition, and to buy from you.

As you develop your technology you should continually integrate estimates of manufacturing costs (no matter how crude) and market potential (no matter how preliminary) into consideration of your commercialization strategy. As you advance toward a market-ready prototype, the multiplication of tasks and skills, the increasing number of people, and swelling flow of information will press upon your capacity to manage your enterprise. You will need to adapt the structure of your firm to support your evolving technical development and commercialization strategy.

Business Development: The Strategy and Structure of the Innovation Process

The Innovation Process table implicitly embodies the progressive development of an appropriate business structure, just as the "Valley of Death" diagram embodies the development of innovation finance. Indeed, successfully negotiating the trail from concept to market requires an appropriate business structure, an axiom obvious in the "Skills" and "People" columns of the Innovation Process chart, which shows that technical progress necessitates a team operation too complex to run like a corner grocery or a hair-bending establishment. Less obvious, perhaps--but equally certain--the process of acquiring sufficient capital for a development that forces innovators into a business format that both persuades investors that development will go forward successfully and provides them with legal safeguards such as limited liability.

If you do not have a functioning business already, you too will confront the necessity of either:

Building a business from scratch Entering a joint venture with an existing firm Finding a licensee

Neither of the latter two strategies will, however, dispose of the problem entirely, for you will have to develop your technology (and therefore your business structure) sufficiently to make it an attractive acquisition for an existing firm. In fact, opting for any commercialization strategy has implicit structural consequences for your business, since the moment you decide to develop your technology for the purpose of profit, you have activated a business, whether you know it or not. (If you doubt this, try persuading the Internal Revenue Service to exempt you from those portions of the tax laws relating to business activity.) It therefore behooves any innovator to have at least a rudimentary familiarity with business structures and their relationship to the Innovation Process, including the search for capital.

A business grown from scratch usually passes through some or all of the following structural stages:

1. Sole Proprietorship (The "Default" Condition)
2. Sole Proprietorship with Limited Liability (A Personal Incorporation)
3. Partnership (The "Double Fault" Condition)
4. Partnership with Limited Liability (A Limited Partnership)
5. Close Corporation (Stock not Publicly Traded)
6. Public Corporation (Stock Publicly Traded)

These stages result from the pursuit of strategies that achieve two general objectives en route to the final goal of successful, sustainable market penetration:

Creating a legal form appropriate to securing capital, building a management team, and producing a marketable product

Organizing the "People" and "Skills" in a structure that optimizes the ratio between inputs and outputs

The former of course involves an expanding corpus of legal documents (and of course lawyers' fees) required to:

Secure limited liability for investors

Trade ownership shares for capital infusions and "keymen" services

Obtain liability insurance

Meet the array of local, state, and federal laws regarding the environment, safety, employee benefits, etc.

Secure liability insurance; and finally, if the big dream comes true, to take the company public

The latter objective involves (among other things):

Prioritizing the required skills

Obtaining those skills by appropriate, sequential hiring

Arraying people and tasks in a structure producing accountable results; that is, it both achieves the specified goals and objectives of the original plan and collects data to update and revise it

Revising the structure to accommodate the demands of success, or to eliminate the causes of poor performance

The results of this structural evolution will manifest themselves in the firm's organization charts, as skills are articulated in functionally specialized departments, arranged in a line and staff organization. This nomenclature may conjure images of Fortune "500" giants, but even the smallest business should function systematically in the present, guided by a plan anticipating structural change to support new strategies appropriate to revised goals and objectives. Without such planning, even the most promising technology has a high probability of joining the ranks of small business casualties.

No matter where you stand now, no matter how far your idea may be from the market, you cannot begin too soon considering both your choice of commercialization strategy and the structural foundation you will need to support it. Forget Emerson and that better mousetrap nonsense. Remember what Coolidge said ("The business of America is business"), and plan accordingly. You should survey the list of firm structures and locate your own. Then peruse the other lists that follow, marking those goals and objectives appropriate to your current state of technical and market development. You should then be able to ask the question: "Is the current structure of my firm appropriate; that is, will its structure support the strategy I'm following? And, how long will it remain adequate?"

To some extent you should be able to answer the question yourself. For example, if your organization chart looks something like either Figure 2 or Figure 3, your structure will not support a move to finance the development of a production prototype by selling stock to the general public. On the other hand, if you currently have a balsa wood mockup in your garage, you don't need to worry yet about creating a structure like that diagrammed in Figure 4.

Figure 2, Figure 3, Figure 4 (available from DoE)

In general, however, only an attorney can provide expert advice on such subjects as tax implications of business structures, suitability of a given structure to provide various kinds of legal advantages, and the relationship of structure to various methods of raising capital. When you seek professional legal advice, you will find your lawyer absolutely adamant on the subject of planning, without which his ability to counsel you (and your ability to remain in compliance with the law) will be strictly limited.

In this section, we have argued that you must select a commercialization strategy for your technology, and an appropriate, satisfying role for yourself on the trek to the market. We have repeatedly emphasized the need for you to engage, starting right away, in systematic analysis and planning that integrates the technical, market, and business dimensions of your project.

By now, you should have a fairly clear assessment of where you stand in the Innova-

tion Process. You should also have a sense of the kind of information you'll need to engage in systematic planning. We will therefore turn now to the planning process itself.

Facing the Planning Task

We realize that few inventors have had the training or the opportunity to engage in planning and that many have little inclination to begin. Some day you may write (or sponsor the writing of) a complex, polished, professionally turned out, full-blown business plan, but that task lies in the future for most inventors. The trick is to begin now, and to realize that planning, like developing a technology, is an incremental, ongoing process--not the instantaneous creation of a finished product. Start crawling now in order to sprint later.

In fact, your plan should evolve in much the same way as your technology. At first simple and brief, then more detailed and complex as you refine your understanding of the marketplace and decide what role you yourself will take. Also, as circumstances force you to deal more frequently with strangers, rather than with family and friends, you will have to provide greater detail about complex issues. Despite its inevitably greater complexity, your plan must remain framed in plain, simple, declarative sentences that tell what you want to achieve, and how you plan to achieve it. Above all, your plan must always reflect you and your objectives.

Who Writes the Plan?

For the moment the answer must be, "You do." And, even if now or later someone else assumes responsibility for it; you must remain a major contributor, reviewer, and user of the plan. After all, it contains your goals and objectives. You will supervise its implementation. It deals with your technology. Who then is better qualified than you to do your plan, no matter what the level of your skills? Remember after all, "practice makes perfect." And when better to begin planning than now, no matter what the stage (even at the concept level) of your technology's development? If you do begin now, by making an assessment of your current technical, market, and business development (as discussed in previous pages), when the time comes for third parties (e.g., investors, bankers, prospective employees) to see it, you will be far ahead of the game.

What Level of Complexity Is Required?

The kind of plan you produce and its level of complexity depend on several factors, including, but not limited to:

Your stage of technical development

The commercialization strategy you select

The growth strategy you select (e.g., bootstrap, slow and steady, high growth)

The amount of capital you will need for development

The sources of capital you will approach (e.g., family, informal investors, bankers, institutional equity investors)

Your plan may begin as a simple description of your project--not just the technology, the whole project--including information on management, commercialization strategy, resources required for development, and so forth. As you progress through the Innovation Process, however, you will become more knowledgeable about your market and your plan will change to reflect that increased knowledge. Later, when you have commercialized your invention, your old plans will seem to your business as snapshots seem to your childhood.

How to Get Started

Start by writing a goal in general terms, either long or short range. Then, factor the goal into specific tasks prerequisite to achieving the goal, and arrange these sequentially. These must be finite tasks with observable results; that is, you and others must be able to tell that you have finished them. More important, perhaps, you must be able to demonstrate to others--prospective investors, for example--that you know how to define objectives and achieve them. For instance, you might set yourself the goal of producing parts for your technology more efficiently. No one could fault this as a goal, but it contains no finite means of measuring its achievement unless broken out into tasks such as: "Using a competitive bidding process, find a machine shop sub-contractor by July 1."

Let's look at another example:

Goal, set on January 1: To make a "go or no go" decision by July 1 on whether to begin scaling up a working model to an engineering prototype.

Specific objectives to reach in order to achieve the goal

1. Complete working model test series and analyze data

2. Do preliminary market survey to establish probable price/volume parameters

3. Estimate capital required to build prototype

Each of these objectives will involve completing sub-objectives (sometimes called enabling objectives):

1. Complete working model test series and analyze data

a. Attach and calibrate instrumentation b. Set up logs to record data

2. Do preliminary market survey to establish probable price/volume parameters

a. Compile list of prospective customers b. Make appointments and conduct interviews c. Go to library and find U.S. Department of Commerce data on industry

3.Do estimates of capital required to build prototype

a. Obtain cost estimates from:

Metal jobbers

Machine shop

Electricians

b. Estimate overhead An easier way to think out your objectives is arrayed below- although you may find it difficult at first, it can quickly become instinctive.

Table 3 - (available from DoE)

Note that:

1. The "given" column specifies the resources you need to achieve your objective, as well as the assumptions you have made.

2. Action verbs ("run," "establish," "write," "prove") describe the tasks ("thinking," "concluding," "inferring" simply won't do) in directly observable, therefore measurable terms. Thus you and any interested party will know when you have achieved an objective.

If you think out your goals, objectives, and enabling objectives carefully in terms of required resources, tasks, and measures of achievement, your plan will emerge clear and specific.

Writing a comprehensive plan means scaling up and integrating the plans you develop for specific dimensions of your project. In the next few pages we consider the planning process, and the plan itself. This subject deserves your most concentrated attention and efforts, for the commercial future of your technology almost certainly depends upon it.

Planning to License or Venture

The Role of the Commercialization Plan

In the preceding pages we have dealt with such topics as:

- Choosing a commercialization strategy for your technology, and a role for yourself
- Translating your commercialization and personal strategies into a coherent, constructive commercialization plan
- Locating your technology's current status on the technical development process, market analysis, and business structure continuums, and emphasizing the subordinate relationship of technical development expenditures to market potential
- Assessing your market and ways to reach it
- Detailing the licensing and venturing strategies; asserting the need to plan effectively in order to follow either successfully
- Raising money, and relating potential funding sources to various stages of development

These topics coalesce in the writing of a commercialization plan, a document of potentially immense value. In this brief treatment we don't pretend to convey you from your current status in terms of information and planning (whatever that may be) to the point where you have in hand a polished commercialization plan, and even less a "business plan" in the formal sense. Indeed, we focus not so much on doing quickie "plans" as on persuading you of the need to plan systematically, and on showing you ways of planning to write formal plans.

Writing a commercialization plan means a major step, and you should maximize its benefits. One way to achieve this "profit maximization" lies through hard work generating answers to questions like the ones we have raised. When you have answered them, you will have assembled the bulk of the material required for an effective document. The more detailed and accurate your answers, the better off you will be. A commercialization plan must honestly and comprehensively describe the technology and the method chosen for moving it into the marketplace. Framed in positive language, it should discuss the project developers, market, marketing strategy, and all aspects of financing. Remember that truth and evidence underpin a credible, useful plan.

You will derive multiple benefits from developing a plan:

- It will crystallize your ideas about how you want to commercialize your technology

- It lets you manage project development rather than letting the project manage you
- It will help you develop the information necessary to entice others to consider licensing your technology or investing in it
- It establishes an action plan to which you can--and should--refer continually
- It helps you establish goals and performance targets
- A completed plan may serve as a marketing tool

Writing a long-range, detailed plan not only generates the kind of material you need to make an effective presentation to prospective licensees or investors, but also shows you the resources your project will require. Your plan will help you decide what part you yourself will play in developing the project and running the resulting enterprise. Make no mistake about it, if you have a technology that works--one for which a large enough market exists to make it worth producing--you'll still need a business plan or its near equivalent in order to succeed. As a precursor to that step, and as a means of assembling data to make decisions about the further development of your technology, a commercialization plan makes a good start.

Developing or formulating a commercialization plan forces you to organize your thoughts, formalize your assumptions, translate these into projections (perhaps as far as five years ahead depending on the stage of development your technology has reached), and [3] reduce everything to writing.

Few people have much experience along these lines; most find it a challenge. On the other hand, practically everybody operates on the basis of informal planning. If you've ever sat down and figured out where to get the money to keep your invention going, how to allocate your time, or whom you might get to help you solve some technical problem, you've engaged in informal planning. What you must do is convert that informality to a systematic process encompassing all the steps necessary to move your technology into the marketplace. In fact, you began that thought process when you crossed out the various tasks, skills, and people on the Innovation Process table.

If you decide to venture your technology, you will eventually need a formal business plan, and you may need professional assistance putting one together. In fact, the business plan has emerged as a document with a widely recognized generic format; it can be written at several levels of complexity, as well as for various purposes and audiences. You can obtain free information about business plans from major accounting firms, the Small Business Administration,

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[3] A corollary benefit of developing a commercialization plan emerges in the form of whatever sorting and filing system you develop while working on the plan. Even if this turns out to be nothing more than a set of shoe boxes labelled "Licensing," etc., that's a start, and a lot better than nothing

or state and local agencies that assist small firms. In Appendix A, Part 4, you will find a sample business plan outline from one such source. If you are considering venturing, you should familiarize yourself with the basics because even if someone else writes the actual plan, the principal burden of developing the necessary information falls on you. Creating a commercialization plan can give you a long head start. Keep that in mind as you consider the material that follows.

You can develop your commercialization plan at several levels: as a basic outline; as a simple, step-by-step guide through the earliest stages of developing your technology; as a reminder to collect information you will need during market analysis or other tasks; or as a way to articulate both long and short range goals. As time passes, your plan should begin to look and sound like a formal business plan, and may ultimately prove useful in seeking capital. Whether you intend to license or venture, you need this plan; only the specific content and level of detail differ. The eventual audience for your plan includes your development team, potential licensees, prospective investors, and anyone else from whom you would like assistance, technical or otherwise.

Basic Components of the Plan

The plan for either licensing or venturing should consist of the following components:

- Cover page
- Table of contents
- Executive summary
- Detailed discussions of
- The project
- The product
- The market

If you plan to start your own business, you will also need to include sections detailing the company, your marketing strategy, an operations plan, and a management plan. Each major section of the plan contains sub-sections, as illustrated in the discussion below:

The Project.

The purpose of this section is to provide the reader with background information on your project as well as detailed information about the project team. This is not the place to tell your reader all about how you got the idea, or about the technical elegance of the invention, but rather to present:

- A succinct statement telling the reader what you want to do (i.e., license, venture, joint venture, sell) and what the advantages of this *commercialization strategy are*

- A description of your enterprise, its structure (e.g., sole proprietorship, corporation), what does it does, and how it does it
- A description of your project team, including evidence of your technical and management qualifications to complete the project while providing similar information about your associates now in business, as well as information about the officers of your company.
- A description of your other professional commitments--what they are and how, if at all, they will affect your plan

The Product.

Here you tell the reader about your invention in technical language, remembering that non-technical people--potential investors and prospective licensees--will also need to understand your plan. Reduce your description to the simplest terms that will convey a full understanding of the technology, including:

- What it is
- What it does
- What potential applications it has
- What tasks remain to make it market ready

The Market.

In this section of your plan you must demonstrate the size and nature of your market to convince the reader your project is a good bet. Be realistic. Potential investors and prospective licensees will check your assertions using their own staff of paid experts. Furthermore, if you plan to license, this estimate will become your negotiating tool. If you haven't done a thorough job, or if you don't believe the numbers, you may lose your shirt. Finally, if you aren't sure which strategy you should select, completing this work may tell you.

Venture Planning

If you want to produce and/or sell your invention yourself, you will have to have a business plan (unless you plan to operate indefinitely at "mom and pop" size). An effective, polished commercialization plan can serve as a strong foundation; however, a business plan demands a significant step upward in sophistication of information and presentation. Thus, if you intend to venture your invention, you will probably have to add some sections to your commercialization plan, and you will probably want to have a professional review and polish it. The additional sections may include: Marketing strategy

- Operations plan
- Management plan
- Financial information and risk analysis

- Management Functions in New Venture

The "Management" section of any business plan deserves special attention. If you decide to license, it may not matter, but if you go into business and look for outside capital, it may well make or break you in the minds of prospective investors. If you refer to the Innovation Process table, you will see that as you pass from the Innovation to the Entrepreneurial Stage, moving from Working Model toward Production Prototype, the variety of tasks an skills required multiplies significantly. This should help convince you of the necessity of building a team, delegating responsibilities, and moving toward a structure of systematic management.

Management remains the most important factor in the success of a new business. As we have said before, it is axiomatic in the new venture field that a "second rate" product with a "first rate" management team has significant advantage over a "first rate" product in the hands of "second rate" management. Obviously, the greatest advantage of all goes to a first-rate management commercializing a first-rate technology.

The most important thing an innovator/entrepreneur can do is distinguish those tasks he can perform well from those that he should--and must--delegate. The next most important things are to determine what additional management is needed and then to recruit that management.

In addition to elaborating on the plans you have with respect to management, you may need to include more detailed discussions of your technology, including confidential information. You may also want to include articles published about your technology, as well as testimonials from satisfied customers, or from prospective users. Such information should be included in appendices. A completed plan--either commercialization or business--may run 20-40 pages.

Summary of Part 2

Planning requires an on-going process of information collection that supports a coordinated, systematic approach to technical development, market assessment and marketing strategy, as well as the assembly of an appropriate business structure. The Innovation Process not only provides a template for planning in these areas, it also facilitates the first planning step: deciding exactly where you stand now.

Conclusion

If this document has convinced you that planning takes a lot of work and that you should begin now, we have succeeded in our purpose. But the work will pay off if you do it well. Many's the inventor who moaned and groaned his way through his plan and lived to describe it as the best thing that ever happened to him.

With a plan, you may control the Innovation Process Without a plan, the Process will surely control you.

Appendix A: The Innovation Process - Supporting Materials

Part 1: Glossary of Commercialization Terms

This glossary contains terms often used in discussing commercialization strategies and the innovation process. This glossary, however, does not include many of the standard accounting, business, and legal terms you will need to know in order to plan an individual commercialization strategy. You can find such standard terms in textbooks or in specialized dictionaries at most public libraries.

TERMS.

art-technology: An art-technology is one whose invention (or use) follows from know-how, craft skill, or experience, rather than from formal scientific and engineering knowledge.

Inventions based on art-technology occur in virtually all fields. In many applications, such inventions are readily accepted. When they occur in industries based on formal scientific and engineering principles, however, art-technologies can face formidable market barriers. Roentgen's X-ray photography, which preceded scientific knowledge of radiation, was an art-technology that led to new scientific knowledge. In the computer industry, by way of contrast, the tantalizing possibilities inherent in art-technology, in the form of new software, or modifications to existing software packages, has created a market for art-technology that often results in the fragmentation of supposedly standardized technology into locally distinct usages largely dependent on know-how.

best-available-technology: In some highly regulated industries (such as hazardous waste disposal) government regulations mandate purchasing equipment or processes under a best- available-technology standard. Thus, if testing can establish that quality, a technology has a clear-cut marketing strategy. When the technology fails to prove itself "best," however, or when testing criteria work against innovation, best-available-technology regulations erect virtually insurmountable market barriers.

Common mythology also ascribes variants of best-available-technology standards to other, non-regulated industries: "When they see it they'll have to buy it," says the inventor. In fact, counting on best-available-technology standards seldom, if ever, constitutes a viable marketing strategy outside those few closely regulated industries. Even there, marketing strategies relying on best-available-technology standards are likely to become time-consuming, frustrating, and very risky. (See 20/30 rule; market barrier.)

boiler plate: Those standard, legal sounding paragraphs appearing in all contracts, such as licensing agreements, and in most venture capital and investment documents.

bootstrapping: (See financing.)

business plan: A standard business document, the business plan (typically 25-35 pages long) is a written statement intended to crystallize business objectives, inform readers about the business, and provide a guidebook for managing the company. Often used as a prospectus when seeking financing, the standard business plan will contain a brief executive summary, a history and description of the business, and sections detailing the company's market analysis, marketing strategy, financial projections, organization, and capitalization. A typical business plan may also contain appendices detailing such things as patents, financial projections, explanations of special problems or capabilities, and resumes for the company's key personnel.

capital: The total money and property a business owns or has at its disposal. It is important to recognize how the various specific types and sources of capital typically correlate with the technical, marketing, and business development steps in the commercialization process for small businesses:

- **sweat equity**--The unpaid effort and labor the owner of an intellectual property brings to the commercialization process. Actually a form of capital, sweat equity (along with personal and family savings) will usually suffice to move from concept to working model and to-make the first serious passes at market analysis and business planning. In some cases sweat equity and personal savings will take a technical development program through the engineering prototype.
- **seed capital**--Early stage, limited capital (typically in the 25,000 to 100,000 range for the very earliest stages, 100K to 500K later). Usually raised locally through networks of friends and informal investors, seed capital will probably bring a technical development program to production prototyping while market analysis and business planning become formalized.
- **pre-venture capital**--Typically in the 500K to 1M range, pre-venture capital often brings more active involvement from investors. This is the capital that commonly produces product qualification models, limited production, and the first introduction of the product or process into the market. Market strategy and business planning must be set, even as they still require fine tuning.
- **venture capital**--Formal (or institutional) venture capital is almost always the last form of equity capital to appear in the commercialization process (other than an SEC regulated stock offering). Usually 1M and up, venture capital is most often available to businesses that already have achieved market penetration and are headed toward the break-even point. Formal venture capitalists are only interested in businesses that have potential for rapid growth. Anyone seeking venture capital must recognize the

implications of the 10/15 rule (as a basic standard, formal venture capitalists expect start-ups to produce a 10 times return on investment in 5 years). Full production capability, a real market and defined marketing strategy, and a working business structure--these are the things that attract venture capital.

captive inventor: Inventorship and ownership of an invention are actually separate issues. Ownership, which by definition involves "property," can become a contractual matter. A captive inventor is one who works under an arrangement that assigns ownership to some-

one else (usually a situation specified among the terms of employment). Determining own-

ership of an invention can become a complex legal matter, and some states have enacted laws governing the circumstances under which ownership of an invention is assigned to an employer, rather than to the employee-inventor.

cash flow: One of the most important financial measures for any business. Cash flow is the difference between the amount of money coming in during a given time and the amount going out over the same time (usually the short term--calculated in months, or even in weeks or days). When the money coming in is greater, there is positive cash flow. When expenses exceed income, a business has a negative cash flow.

The importance of a positive cash flow is seen in the plight of any small company with few cash reserves, a large backlog of new orders and a negative cash flow. At blest, such a business will need substantial new credit or loans to meet short-term expenses; at worst, negative cash flow will spell disaster for an otherwise healthy firm.

cross-licensing: In many industries--such as automobiles, petroleum, equipment manufacturing, and communications--individual companies commonly exchange technology through cross-licensing agreements. Under such agreements, firms typically grant royalty-free licenses to other participants, in exchange for reciprocal rights to their competitors' technologies. In effect, such cross-licensing agreements create industry-wide technology pools. (See licensing; royalty-free license.)

due-diligence: A legal term, due-diligence refers to the formal investigative procedures a business must undergo when entering into certain regulated financial arrangements, such as making a public stock offering. More generally, inventors and small businessmen might be well advised to pursue their own "due-diligence investigations" when negotiating with investors or prospective licensees.

end user: The actual user of a technological product or those products derived from technological processes. The significance of this term appears when the end user is distinguished from the customer. Frequently the customer (the person who actually buys) and the end user are different individuals, as is almost always the case with industrial tools, supplies, or products--always the case with sales to an OEM (original equipment manufacturer). The customer and the end user do not always share the same incentives to buy a new technology, and the difference in their willingness to employ innovations often forms a critical market barrier. Distinguishing the end user from the customer can be the most crucial step in developing an effective marketing strategy.

engineering prototype: See prototype.

entrepreneur: A person who undertakes to start and operate a business, usually assuming the greater part of the financial risks involved--and consequently reaping a large part of any rewards earned. In the commercialization of new technologies, the entrepreneur is frequently someone other than the inventor.

equity: Normally describes the total value of the preferred and common stock of a business. The term equity is also used frequently in describing the percentage of ownership a person or group holds in a business.

exclusive license: See license.

exit: The sale of equity (ownership) in a business.

exit strategy: The plan or method those holding shares of ownership intend to use when liquidating equity.

financing: A general term used to describe the ways to acquire capital necessary for estab-

lishing, operating, or expanding a business. While financing strategies vary considerably in complexity, those most small businesses can use for sustainable commercialization fall into just three types:

bootstrapping--Self-generated financing from current income (requires a reliable positive cash flow).

- **debt financing--**Borrowed money.
- **equity financing--**Sale of a share in ownership to acquire capital.

intellectual property: A general term describing the legally protected ownership of copyrights, inventions, know-how, logos, patents, service marks, trademarks, tradenames, or trade secrets.

invasionary technology: A technology or technological process whose commercialization requires competing directly with other technologies already dominating that particular market.

license: An agreement under which the owner of an intellectual property allows someone else to make, use, or sell things protected by ownership. With an exclusive license the licensee gains sole right to employ the intellectual property governed by the license, although such a license may carry limitations on territory, field of use, product, or time. Under a limited or nonexclusive license the person granting the license is free to grant other similar licenses on the same intellectual property. (Also see cross-licensing; royalty-free license.)

licensee: The person or company gaining rights to an intellectual property under a licensing agreement.

licensing: The general term describing the legal process in which a license is granted on an intellectual **property**. One of the two basic commercialization strategies available to individual inventors. (Also see venturing; cross-licensing.)

licensor: The person who grants use of an intellectual property under a licensing agreement.

limited license: See license.

linchpin technology: A technology for which commercialization increases the market potential for other supporting or ancillary technologies. In some cases, commercialization of a linchpin technology will actually call for the invention of new technologies, just as inventing the light bulb called for new electrical generating, transmission, and distribution technologies. In other cases, the linchpin technology will reorder or revitalize existing technology, as the automobile did to the petroleum refining industry.

Generally, linchpin inventions face formidable market barriers.

market barrier: Those obstacles other than the needs for technical development, market analysis, and business planning that must be overcome in commercializing a technology.

Indeed, the normal commercialization activities (technical development, market analysis, and business planning) will expose market barriers, which can be things like extraordinary capital costs, user acceptance problems, the need to establish extensive advertising, sales, distribution, user education, or maintenance capabilities, the NIH syndrome, linchpinning, or an inability to meet the 20/30 rule. Obviously, no list of market barriers can be exhaustive, but all such barriers must be identified and addressed before sustainable commercialization is really possible.

market channels: The step-by-step paths along which technologies move from producer to the end user. Writing these out (or diagraming them) is one of the basic first steps in mar-

ket analysis.

marketing: Those activities involved in analyzing the sales potential of a product or process, as well as those activities involved in customer service, advertising, distribution, and selling. In the commercialization process marketing actually breaks down into three vital parts:

market research and planning--Analysis and evaluation of the market, which includes such tasks as identifying market barriers, channels of distribution, market size, and who will buy. Market research should begin at the concept development stage, and play a continuing role in technical development as well as in developing market strategy and business organization.

market management--Advertising, promotion, and customer service. These critical service functions play a central role in sustaining the commercialization process.

- **sales and distribution--**Management of the channels of distribution and sales force. By definition, sales and distribution are the obvious goals of any commercialization effort. Less obviously, perhaps, these activities can also furnish important information leading to product improvements, the development of new applications, or even to new technologies.

model: See prototype.

negative cash flow: See cash flow.

NIH: Initials standing for "Not Invented Here," a phrase used to describe industry reluctance to adopt innovations originating outside that industry's normal R & D channels. The NIH syndrome can form a crucial market barrier, especially in some of the older, more established technology-based industries such as automobiles, steel, oil, metallurgy, or transportation.

OEM: Initials standing for Original Equipment Manufacturer. Such firms typically purchase various parts, supplies, or even sub-assemblies from other manufacturers. (See end user.)

paid-up license: See royalty-free license; license.

positive cash flow: See cash flow.

product qualification model: See prototype.

production prototype: See prototype.

prototype: A prototype can be a mock-up, model, or actual working version of a technological device or process. Prototypes are used to generate information that will help design or perfect the final production process.

- **working model--**A reduction to practice, proof of concept. The working model is often less than full-scale, inexpensively and crudely constructed, and need not function optimally. Intended to test the most basic operating parameters and to aid in the design of an engineering prototype.
- **engineering prototype--**An actual working version of a product, apparatus, or process used to gather data on operation, performance, and production requirements. Most often one-of-a-kind and commonly fitted with special instrumentation, this model is usually hand-made, but always of sufficient technical quality to determine whether a production prototype can (or should) be built.
- **production prototype--**A full-scale, completely operational model

designed to determine production and fabrication requirements for the production item. Also used to generate the final pre-production performance data on operation and durability. Usually hand-built, the production prototype must conform as closely as possible to the design standards for the final full-production product or process.

- **product qualification model**--A full-scale, fully operational model manufactured in an initial, limited production run under conditions as close as possible to final production. Used to ensure final production runs will produce a product meeting design standards. Product qualification prototypes are often subjected to independent third-party testing, especially if the product must meet industry or government regulatory standards.

Together, the sequential development of these various prototypes and models forms the core of a complete technical development program, one that will lead to a viable production item or process.

royalty-free license: A license requiring no further royalty payments. Also called a paid-up license. At times such licenses are granted with an up-front, one-time cash payment. Oth-

er times they are granted without any financial consideration involved; this is particularly the case under cross-licensing agreements and with government use of inventions developed under public funding.

seed capital: See capital.

sweat equity: See capital.

technology: Commonly thought of simply as mechanical or science-based ways of doing work, this word actually warrants careful attention. "Technology" comes in all varieties, and on all scales, from the smallest consumer item to vast industrial complexes. For the sake of clarity it is worthwhile to point out that all technologies, large or small, will fall into one of four categories:

- **product**--An actual thing to be manufactured, used, or consumed.
- **process**--A way of doing things, making things, or controlling a manufacturing activity.
- **tools**--Those things needed to make products or implement a process. (Something will be a tool to end users, even while those who manufacture and sell it consider it a "product.")
- **know-how**--Knowledge or experience allowing effective and economical use of technological products, processes, or tools. Often mistakenly considered intangible, or even of negligible commercial value, know-how actually constitute s one of the most marketable intellectual properties inventors can bring to the commercialization pro cess in some industries, electronics for example, know-how often furnishes the only basis for

commercialization, whether through venturing or licensing.

All four of these technological entities can be protected as intellectual property and any of the four can become the object of commercialization. Indeed, with some inventions commercialization may be possible through more than one of these four technology categories. In that case, deciding whether to commercialize the invention as product, process, tool, or know-how constitutes a crucial first step toward the market. When commercialization requires developing an invention through more than one of these forms, the invention is probably a linchpin technology.

10/5 rule: See venture capital under the glossary listing for capital.

20/30 rule: A very general rule of thumb for assessing market potential with an invasionary technology. Variously stated by different people, the 20/30 rule really just says that to succeed in the market a new technology must do its job 20% better and 30% cheaper (or vice-versa) than existing technology. (Also see best-available-technology.)

venture capital: See capital.

venturing: A general term to describe a commercialization strategy based on creating a new business. Sometimes the meaning of venturing is expanded to describe a commercialization involving significant expansion of an existing small business. One of the two basic commercialization strategies available to individual inventors. (See entrepreneur; also see licensing.)

working model: See prototype.

Part 2: Bibliography of Useful References

An enormous body of literature is available to anyone interested in reading further on the topics covered in this Pamphlet. Any professional researcher will tell you, however, that a few good starting points serve better than enormous lists. You can find plenty of material in libraries, particularly if you can get to a university that has an engineering college or a business school. (Don't be put off if you're not a student or faculty member. As a taxpayer, you have the right to use the libraries at most public universities, and at a lot of private ones as well.)

Libraries not only stock books, journals, and government publications, but most now do computer searches of the literature--usually at relatively low cost. Such service--even at a small public library--can save a lot of legwork. Don't be shy. Remember, librarians need to justify their technology too. Asking them to do a search spreads costs across one more use. Usually, they are only too glad to help.

The following pages list some useful sources, organized by major topics

Studies of General Interest.

Aitken, Hugh G.J. Explorations in Enterprise. Cambridge, MA, 1965. A collection of essays on entrepreneurship, this will give you the best of scholarly opinion, mostly in readable form

Baty, Gordon. Entrepreneurship for the Eighties. Reston, VA., 1981. Anecdotal, and very good.

Chandler, Alfred D., Jr. The Visible Hand. Cambridge, MA, 1977. The foremost scholar on the growth of American business, Chandler sees the process as primarily driven by technology, some of it contributed by individual inventors. Anyone seriously interested in the development of modern corporate management and business strategy will also want to look at an earlier Chandler work entitled Strategy and Structure: Chapters in the History of American Industrial Enterprise (Cambridge, MA, 1962).

DiBacco, Thomas V. Made in the U.S.A.: The History of American Business. New York, NY, 1987. A recently published work intended as a basic textbook, this is American busi-

ness history made fun to read--chocked full of whimsical anecdotes about business, inventors, and people's reactions to new technology. Bet you didn't know the commercialization of the electric iron is what finally led some electric companies to extend their service to daylight hours for the first time--only on Tuesdays.

Drucker, Peter. Innovation and Entrepreneurship: Practice and Principles. New York, NY, 1985. Not the usual definition of entrepreneurship, but an excellent book.

Livesay, Harold C. American Made: Men Who Shaped the American Economy. Boston, MA, 1979. An enjoyable book that also says a great deal about technological innovation and the commercialization process in American history. Telling its story through the biographies of businessmen and inventors such as Eli Whitney, Cyrus McCormick, Thomas Edison, and Edwin Land, this book is a good starting point for any reading list on commercialization.

Schmookler, Jacob. Invention and Economic Growth. Cambridge, MA, 1966. Now over twenty-years old, this is a genuine classic. A careful study of how the market affects inventive success. Also reveals a great deal about how to classify technology and how one invention can beget many.

Helpful Information of All Kinds.

The best place to start is by writing for information from:

Small Business Administration P.O. Box 15434 Ft. Worth, TX 76119

Ask them for a complete list of all their publications. You're bound to find several you want.

Or write to:

Bank of America Small Business Reporter Dept. 3120 Bank of America Box

37000 San Francisco, CA 94137

Inc. magazine now also publishes a series of pamphlets under the general series entitled Inc. Special Reports. Topics include: Family Business, Marketing and Selling, Finding Capital, Business Strategy, Money (personnel), and a special volume called The Roots of the Corporation, which deals with management techniques and formulating corporate philosophy. Try your library, but if these pamphlets aren't there, you can get information by writing to:

Inc. Special Reports 138 Commercial Wharf Boston, MA 02110

Lots of textbooks on starting and managing small businesses exist. At least two are written for ordinary mortals:

Church, Olive D. Small Business: Management and Entrepreneurship. Chicago, IL, 1984. This takes you step-by-step, with charts, checklists, and a number of forms to help you analyze your own potential as an entrepreneur.

Timmons, Smollen, and Dingee. New Venture Creation. Homewood, IL, 1977. Somewhat more sophisticated, but covers the basics thoroughly and in accessible language.

Market Analysis.

Start by getting the relevant Small Business Administration booklet, culled from the list of their publications. Chances are they've got something on your particular industry. One SBA publication dealing with the subject generally is:

DeBoer, Lloyd M. "Marketing Research Procedures." Small Business Bibliography No. 9, 1982.

A sample of the general surveys and statistical data that the U.S. government publishes is:

U.S. Department of Commerce 1984 Industrial Outlook: Prospects for over 300 Industries.

Write the Department of Commerce and ask for any material they may have on your particular industry. If Commerce isn't the right Department (the government has idiosyncratic ways of allocating jurisdictions), they'll tell you where else to write.

For textbook treatment of marketing try:

Kotler, Philip. Marketing Management: Analysis, Planning, and Control. 5th ed. Englewood Cliffs, NJ, 1984. When you've covered this, you've gotten it all. You might also want to look at the same author's Principles of Marketing. Englewood Cliffs, NJ, 1983. Many business schools use these texts.

Patents and Other Intellectual Properties.

Mercifully, a lucid, plain English primer exists:

Blair, Homer. Understanding Patents, Trademarks, and Other Proprietary

Assets and Their Role in Technology Transfer and Licensing: The Practical View. You can get this by writing Homer himself at 10 Maguire Road, Lexington, MA, 02173.

Other works that may prove useful include:

Amernick, Burton A. Patent Law for the Nonlawyer: A Guide for the Engineer, Technolo-

gist, and Manager. New York, NY, 1986. Rather stiff reading if you try it cover-to-cover, but this really is a well-organized, succinct reference work that will serve any nonlawyer well. Contains 20 appendices; many are worthwhile.

Confederation of British Industry. The New European Patent System and its Implications for Industry. London, 1974. The title is somewhat misleading. While there is a great deal on the new European patent system (1973) and how it works, there is surprisingly little in the way of discussion on implications in an broad sense. Anyone interested in the European patent system should also look below at the work listed for Raymond Maddison in the licensing section.

Grosswirth, Marvin. The Mechanix Illustrated Guide to How to Patent and Market Your Own Invention. New York, NY, 1978. Too general to serve as anything more than a first primer, this "how to" guide deserves mention just for what it says about getting a patent: ". . . it is the consensus of all the experts, including those at the PTO, that the task will be quicker, easier, and, in the long run, probably cheaper if you engage the services of a registered practitioner." (p. 27) See, it isn't just Mohawk Research Corporation's faculty giving that advice.

Hale, Alan M. Patenting Manual. Buffalo, NY, 1983. If you really want to write your own patent, this will tell you how. A good basic guide, particularly worthwhile for the appendices, which contain sample patents and an extensive glossary.

Oathout, John D. Trademarks: A Guide to the Selection, Administration, and Protection of Trademarks in Modern Business Practice. New York, NY, 1981. Discusses an important (and too often neglected) intellectual property in a straightforward and readable way.

Schepps, Solomon J., ed. Concise Guide to Patents, Trademarks, and Copyrights. New York, NY, 1980. A good basic source.

Spanner, Robert Alan. Who Owns Innovation? The Rights and Obligations of Employers and Employees. Homewood, IL, 1984. A useful guide if you work for someone who might claim rights in your invention, or if you need to hire people during the course of the innovation process.

Stiling, Marjorie. Famous Brand Names, Emblems and Trademarks. London, 1980. Why not have some fun while you're in the library? Find out how England's Bass Brewery managed to get trademark registrations 1, 2, and 3. Or,

find out how the words "play well" produced the LEGO trademark.

Licensing.

Start with the ABCs, which you can find in:

Licensing Executives Society. The Basics of Licensing. Stamford, CT, 1984. Write them and they'll send you one free.

Then you can move on by consulting a bibliography of licensing literature compiled for the Department of Energy:

Levine, Harold and John Montgomery. Bibliography of Publications Dealing with Licensing which are Especially Useful for Independent Inventors, Small Business Enterprises, and Entrepreneurs. This pamphlet also lists sources of information on patents, trademarks, copyrights, and other means of protecting intellectual property in the U.S. and abroad.

To get a copy contact:

Energy-Related Inventions Program Inventions and Innovation Division, EE-521 U.S. Department of Energy 1000 Independence Ave., S.W. Washington, DC 20585 202-586-1478

For some useful insights on how licensing system really works, try:

Lovell, Enid Baird. Domestic Licensing Practices. New York, NY, 1968. This little work is number 18 in the Experiences in Marketing Management series published by the Conference Board. It's full of insights into the corporate mentality on licensing.

For a more thorough (and more formal) treatment of licensing there is:

Current Trends in Domestic and International Licensing, 1976. New York, NY, 1976. This publication is number 69 in the Patents, Copyrights, Trademarks and Literary Property Course Handbook Series published by the Practicing Law Institute. In that same series, number 126 is entitled Domestic and International Licensing of Technology, 1980. New York, NY, 1980.

To explore the possibilities for licensing in Europe, see:

Maddison, Raymond. Patent and Patent Licensing Law in Europe. London, 1981. Written by a barrister, this is a comprehensive guide to exactly what the title claims. It is intended for a lay audience.

Business Planning.

A lot of material in print, much of which says pretty much the same thing. Start with:

Pellissier, Raymond. "Planning and Goal Setting for Small Business." U.S. Small Business Administration Management Aid Number 2.010.

The so-called "Big-Eight" accounting firms publish material on business planning.

They also run seminars on the subject at their various local offices. Typical publications include:

Peat, Marwick. "Business Planning." Tells you why, and what goes in one. Also plugs their services and lists their offices. To get pamphlets, write any office. You'll find an address in most city telephone directories.

Price Waterhouse, "Every Business Can Benefit from Developing a Business Plan," in Business Review (the Price Waterhouse small business news-letter), Fall 1983, Number 83-3.

For some do's and don'ts of business planning, explained in trendy prose, there's:

Russell, Sabin. "What Investors Hate Most about Business Plans," Venture, June, 1984, pp. 52-53.

Among the many business planning books recently published, these each offer something worthwhile:

Bangs, David H., Jr. The Business Planning Guide: Creating a Plan for Success in Your Business. Portsmouth, NH, revised edition, 1987. Working with a case study, this book leads the reader through the preparation of a business plan. Good basic definitions for key business concepts; especially good sections on book keeping and accounting for non-specialists.

Mancuso, Joseph R. How to Write a Winning Business Plan. Englewood Cliffs, NJ, 1985. Maybe an overly slick text, but this work has an excellent appendix, which includes sample business plans and a source directory.

Siegel, Eric S., Loren A. Schultz, and Brian R. Ford. The Arthur Young Business Plan Guide. New York, NY, 1987. Analyzing a hypothetical case study, the authors stress the need to read business plans with the investor's eye (rather than the entrepreneur's).

Financing Innovations.

Entrepreneurship gets a lot of attention these days. You can find anecdotal material that makes fun reading, but has problematical practical value. Samples include:

Inc., April, 1984.

Venture, December, 1984, with a cover story entitled "How Inventors Build Their Own Businesses."

Far more systematic, specific, and therefore more useful are:

Cladstone, David J. Venture Capital Handbook. Reston, VA, 1983. Surveys the whole problem of raising venture capital. Tells you how to find formal venture capitalists, and some hard truths about what you'll find. Read them and weep--and learn. Emphasizes the importance of the business proposal, with a lot of "How to...."

Pratt, Stanley E. How to Raise Venture Capital. New York, NY, 1982. A compilation of articles by experts on various dimensions of the problem.

Shapero, Albert. The Role of the Financial Institutions of a Community in the Formation, Effectiveness, and Expansion of Innovating Companies. U.S. Small Business Administration, 1983. Absolutely the best map of paths through the "Valley of Death."

Silver, A. David. Up Front Financing. New York, NY, 1982. Useful and authoritative.

Most major accounting firms publish brochures or pamphlets that can be helpful in dealing with venture capitalists. The firm of Deloitte Haskins & Sells, for example, has one that will serve well:

Raising Venture Capital: An Entrepreneur's Guidebook. 1982. Approaches venture capital through writing a business plan. The appendices are particularly valuable for the glossaries and the sample accounting forms. There are even simple outlines for standard accounting forms explaining what goes into a cash flow statement, an income statement, and a balance sheet.

Part 3: Legal Considerations

Ignorance Excuses Nobody.

More than many other societies, Americans rely on the law to order their affairs and settle their disputes. (Illinois alone has more lawyers than all of Japan.) The law intertwines business just as it does all dimensions of American life.

Inventors, like other businessmen, should keep abreast of the legal implications of their activities, and make decisions based on that information where appropriate. Keeping straight with the law while using it to your advantage can be an expensive, time-consuming nuisance. Failing to do so can lead to ruinous, career-wrecking disaster. As Ambrose Bierce said, "A lawsuit is a machine that you go into as a pig and come out as a sausage."

Brief List of Potential Problems.

Only a lawyer can give you legal advice. We list below some areas where you may need it:

Patents, copyrights, trademarks, trade secrets: Protecting your interest is vital. Few laymen know how to do it.

Liability: If you've got a workshop, some damned fool may impale his hand on a scratch awl; if you have a factory, one of your employees may get hurt; some delivery man may fall off your loading dock. If you've got a product that injures somebody, you may be liable for faulty design, manufacture, or both.

Business structure: Should you incorporate? If so, in what form? Where? Maybe a limited partnership would better serve your interests. Do you want to sell stock in your company? Meet the folks from the Securities and Exchange

Commission (among others).

Rules and regulations: Federal, state, local; safety and health, environmental, zoning--the list goes on and on. Do you have a list? Are you in compliance? Do you have all the licenses you need

?Labor: You can't just hire anybody you please, pay them whatever they'll take, and work them any hours to which they'll agree.

Some day some union official may show up to tell you he plans to organize your employees. Then what? Taxes: A big one. You're subject to property taxes, local, state, and Federal income taxes (corporate and personal), excise taxes, and an assortment of license fees when, where, and if they apply. You may also have to collect and hand over state and local sales taxes.

If you hire people, you may have to withhold and account for Social Security and income taxes for your employees. Then there's workmen's compensation.

On the other hand, you may be able legally to avoid or reduce some of these obligations if you know how. Hiring certain types of workers can reduce your taxes, as can buying certain kinds of equipment, etc., etc.

Tax laws also have a dynamic effect on investors. A change in the rules governing capital gains or other tax shelters might bring investors to your door. On the other hand, the wrong changes might make them vanish overnight. You need to know not only what the rules are now, but some sense of changes in the offing.

Finally, a common way of financing early-stage enterprises is to "pay" key employees with founders' stock. Do this the right way and your success might make them rich; do it wrong and they may wind up with a tax bill that will eat them alive.

Licensing: See the "Licensing" section.

Advertising: You can't claim just anything about your product; somebody may ask you to prove it.

Is That All?.

No, as a matter of fact, the list above doesn't begin to cover every legal contingency you may encounter. As you can see, "Free Enterprise" doesn't mean the liberty to do whatever you like. Freedom is liberty constrained by law, and you, like everybody else, have to live within the applicable constraints.

If you decide to get a lawyer, choose carefully. You want someone experienced in the kind of work you need. You don't want some guy who'll write his first contract for you. Ask around, get referrals, then interview your choice by asking him the questions to which you need answers. If you don't like what you hear, get a second opinion. Watch out for the fine print. Make them tell you what it means. They can translate that gobbledegook into English, and will if you push hard enough.

The chances are that you already have consulted an attorney, if only with respect to patents. If not, you'll probably find one a necessary member of your professional team. Choose well and he'll prove one of your most beneficial assets.

Part 4: Business Plan Format

With the material in this booklet, you can develop:

an evaluation of the current status of your company, your industry, and your environment

a set of objectives with specific tactics, assigned responsibilities, time frames, and reporting structures

the financial analyses and projections required to support those objectives

Once you have that material you can begin work on a written business plan for your company. If so, you should follow the outline#4 below, keeping each section as brief as possible, and stressing the points you wish to make with the plan's audience(s), whether these are investors and lenders, your internal staff, or other groups such as boards of directors or stockholders.

Business Plan Outline.

Cover Sheet One page, which should include the name of the business, address, phone numbers, principals, date of plan, and any other appropriate information about your company or plan.

Executive Summary

This is a brief summary of your plan and is what sells someone the remainder of the plan. In a few pages describe the major objectives, product or service, its marketing, the financial projections, and the purpose of the written plan (financing or operations). Include any unique or truly significant aspects of your plan. (This should be written after you have completed all of the detailed sections of the plan.)

Table of Contents

This single page should be specific enough to enable the reader to locate any particular item of interest. Some readers will judge the plan's thoroughness based upon what is included on this page alone. (Use major headings indicated in this outline, plus subheadings you include in your plan.)

---- Footnote #4: Source: Peat, Marrwick and Main.

History

This section is tailored to your needs as either a start-up venture or an existing business. If your history is brief, this section should explain how your venture came to exist, its organization to date, and the backgrounds of the founders. If yours is an existing company, you should explain the major highlights of your history, keeping it brief and adding detail through appendices as needed.

Definition of the Business

This section describes exactly what needs your business meets, whose needs these are, and how you meet those needs.

Definition of the Market

This section outlines in more detail the customers you target, describing your customer profile, the size and location of your market, your projected market share, and why you will be able to obtain this share. This is the portion of the plan where you discuss your competition and the tactics you use to participate in the marketplace. Your advertising and promotion campaign should be briefly explained.

Description of the Products or Services

This section of the plan may well be placed before the marketing section if your product or service is new or requires extensive explanation. Here is where you explain now you will meet an identified need with a specific product or service. The status of your R & D efforts should be detailed with any information pertaining to copyrights, patents, trade-

marks, etc. Technical information and catalogue sheets or pictures may be appended as appropriate.

Management Structure

This section describes who will enact the plan, providing the basic background information on the principals, the organizational structure, staffing, employee policies, and the reporting structure. Much of this detail should be appended (such as resumes and organizational charts).

Objectives and Goals

This section includes varying amounts of detail depending upon the purpose of your plan. This is where you list your objectives, the specific tactics you will use to achieve those objectives, the time frames involved, and why you think the set of objectives is do-able and advantageous.

Financial Data

This section explains how you will fund your operations over the planning period. You may include forecasted balance sheets, forecasted cash flow analyses, forecasted statements of earnings, forecasted statements of changes in financial position, cost-volume-profit analysis, and the company's projected break-even point. This section should be detailed and as well documented and supported as possible. Disclose the accounting policies and the major assumptions made in your plan. Any financing requests made with the plan as a backup should be justified in this section.

Appendices

Include in appendices any specific supporting information or detail that you feel your plan requires, but that does not fit into the context of the sections above. A business plan for an external audience that is too lengthy will probably be unable to hold that audience's attention. Keep it brief.

Appendix B: The Energy Related Inventions Program

Introduction

Congress established the Energy-Related Inventions Program (ERIP) in 1974, at the height of the energy crisis, to nourish the technological creativity small businesses and independent inventors might bring to bear on the country's energy problems. In establishing ERIP, Congress acted not only out of faith in the inventive powers of individuals, but also responded to popular reactions to the President's pleas for conservation. Many Americans wanted to take more direct action, and submitted to their legislators ideas for resolving the crisis. By including the Energy-Related Inventions Program in the 1974 omnibus energy bill, Congress established both a referral point for such submissions and a system in which inventors with viable energy-related idea; can find support.

Since its inception, the ERIP has embodied a low-cost strategy designed to spark the creative potential of individuals and small businesses. The ERIP is unusual in several ways, both in its services to inventors and in its operations. In dealing with inventors the Program has two noteworthy characteristics: First, as one of the few continuing Federal innovation programs, the ERIP now offers the sole source of Federal support available to any individual or small-company inventor, regardless of the sophistication of the technician or the technology. Second, while the Program supports only "energy-related" inventions, that definition ha; a broad scope, encompassing all energy-related inventions, including those improving the conservation, extraction, and production of energy, as well as those proposing the development of alternative energy sources.

Operationally, the Energy-Related Inventions Program has these distinctive characteristics: First, the ERIP is a Federal program operated jointly by two agencies: The U.S. Department of Energy (DOE) and the U.S. Department of Commerce, National Institute of Standards and Technology (NIST--formerly the National Bureau-of Standards--NBS). Second in 1979--just four years after its creation--the Program's officers proposed an ongoing effort at independent, third-party assessment. Since 1981, these assessments have enabled program officers to make numerous improvements, streamlining operations and enhancing effectiveness.

Today, the Energy-Related Inventions Program stands as a model of low-cost, highly leveraged government assistance to inventors and small businesses. The Program not only continues to earn praise from its participants (and from a "blue ribbon" critical review panel's report submitted in 1988), but the model and the staff's expertise are also gaining increased attention as more public agencies attempt to formulate programs assisting inventors and small-business innovation.

The Legislation

The Federal Nonnuclear Energy Research and Development Act of 1974 (PL 93-577) mandated the establishment of the ERIP. More specifically, Section 14 of the Act directed NBS to assist the Energy Research and Development Administration (then ERDA, now DOE) by evaluating promising energy-related inventions. The language of Section 14 also specified that: "particular attention" be given to those inventions "submitted by individual inventors and small companies for the purpose of obtaining direct grants from the Administrator [ERDA]."

In June 1975--when the Federal Register listed the program and its functions--the ERIP opened for business. At that point, more than 100 requests awaited evaluation, and requests for evaluation have come to the program at an average rate of more than 150 a month ever since. As of October 1993, NIST had received and processed over 31,000 ERIP applications; of these, NIST has recommended 600+ inventions for DOE support.

Description of the Program

The Clientele.

Section 14 of the Federal Nonnuclear Energy Research and Development Act of 1974 mandates the ERIP target audience as "all promising energy-related inventions, particularly those submitted by individual inventors and small companies . . . ." While such language does not specifically exclude the possibility of larger firms submitting technologies, NIST has rarely recommended inventions emanating from sources other than the primary categories specified in the legislation. Both agencies involved in the ERIP seek primarily to reach and to serve those groups designated in the legislation.

The ERIP strives to give timely and appropriate assistance to the commercialization of as many submissions as possible. Two base-line standards for gauging effectiveness are:

Comparing the number of market entries (110+) against the number (450+) of DOE grantees (24%)

Comparing the number of NIST recommendees (600+) against the 31,000+ submissions (<2%) to the Program.

While that record since 1975 represents a noteworthy accomplishment, any effort to improve the ERIP effectiveness must rest at least in part on increasing the number of quality submissions. To this end, the Program disseminates information and application materials as widely as possible through many channels, including the six NIST-DOE sponsored National Innovation Workshops held each year at various locations around the country. The Program actively seeks new, high quality submissions from inventors and small businesses.

Program Operation.

The ERIP is a two-stage program jointly operated through the Inventions and Innovation Programs Division at the U.S. Department of Energy and the Office of Energy-Related Inventions (OERI) at the National Institute of Standards and Technology. In the first stage, all ERIP submissions are directed to the OERI. NIST evaluates all inventions submitted and recommends to DOE those judged technically sound and commercially feasible. In the second phase, DOE reviews all recommended inventions to determine whether it can offer Federal assistance; where such a possibility exists, a program staff member negotiates a statement of work, and then administers a grant award.

National Institute of Standards and Technology. As specified by Congress, NIST assists the DOE by evaluating energy-related technologies submitted to the ERIP. To fulfill this function, NIST employs several staff engineers and regularly employs the services of reviewers from a network of over 250 individuals working in private practice, universities, and government laboratories. The NIST evaluation process has several noteworthy characteristics. First, its evaluators often perform a significant technical service simply by helping inventors organize their presentations more effectively. Second, while a very high percentage of submissions are rejected (98%+), inventors rejected at any point in the evaluation process many resubmit for re-evaluation--provided they can supply new, additional, or better information. Since 1975 fully 15% of the inventions recommended to DOE have been rejected at least once at some point during the NIST evaluation process. Third, NIST can--and will--take a chance on promising submissions by deciding in favor of the inventor when the evaluation process yields ambivalent results.

As supplementary activities supporting the ERIP, NIST contributes to the Program development and support, especially through its sponsorship of the National Innovation Workshop series and its efforts to encourage the formation of inventor organizations. Such initiatives contribute significantly toward the goal of increasing both the number and the quality of submissions to the ERIP.

Department of Energy Support. As a recommendation passes from NIST to DOE, the primary ERIP task shifts from the first-stage focus on evaluation of technical merit to the second stage goal of providing the best possible assistance package designed to help move the technology toward the market. Operationally, this translates into decreased emphasis on technological assessment and increased concern with the inventor's potential. Experience has shown time and time again that an inventor's qualifications--experience, expertise, abilities, and personal preferences--constitute key variables in planning, executing, and sustaining viable commercialization efforts. Designing an assistance package to complement an inventor's qualifications constitutes DOE's most critical task.

The Program accepts submissions from anyone claiming to possess a novel idea for an energy-related invention or innovation, and the list of NIST recommendees furnishes over-

whelming proof that significant technical creativity flourishes at all levels of education accomplishment, technical expertise, and innovative experience. DOE staff members routinely assemble flexible assistance packages for recommendees holding educational credentials ranging from grade-school certificates through a Ph.D. in science or engineering. Among the ERIP recommendees one finds some with absolutely no previous technical experience as well as others whose inventions represent a culmination of more than forty or fifty years' experience in a specialized technical field. Likewise, while many recommendees have neither an educational background nor work experience demonstrating an ability to plan for commercialization, some come to the Program with long experience in new venture formation, entrepreneurship, or business management. The Program's success depends on the DOE staff's ability to work with all these diverse recommendees.

An ERIP assistance package can take many forms, ranging from little more than the credibility the NIST evaluation gives new and unproven ideas, to a full-scale package including financial assistance, participation in a DOE Commercialization Planning Workshop, assistance in arranging third-party independent testing, preparation and dissemination of technical briefs, evaluations and recommendations concerning the best "next step" in the commercialization process, and ready access to the deep professional experience of the ERIP staff itself. No two assistance packages are exactly alike, but most share a number of common characteristics. The DOE staff begins planning an assistance package by analyzing the NIST recommendation and accompanying technical reports. Each recommended technology is then assigned to an Invention Coordinator who contacts the inventor and opens discussions on the type and amount of support (if any) to be provided. That Invention Coordinator assumes primary responsibility for negotiating an acceptable statement of work for grants and continuing administration of DOE assistance through the term of the grant. Unfortunately, inventors, especially those with early-stage technologies, often have needs exceeding DOE's capacity for financial support. Grants currently range from $20,000 to $100,000, averaging about $70,000, and are most often granted to support "next-step" technical research, or third party scientific testing, and may include business planning. DOE cannot support direct marketing or sales efforts, although it can help inventors obtain market information and market analysis. The ERIP policy has always been to focus financial support on assisting inventors in taking that next critical step toward the marketplace. As the program has evolved, the DOE staff has sought ways to fine-tune financial support to the needs and abilities of individual inventors and their technologies, and to expand the range of non-financial services.

The independent, third-party review of the ERIP (commissioned in 1980 and ongoing since 1981) has provided many useful insights into the innovation process while furnishing program officers the information necessary to implement numerous improvements in the ERIP's operations. Many of the review panel's recommendations involve ways of increasing funding effectiveness, expanding public outreach, and improving the assistance packages offered to inventors. One noteworthy result of these recommendations is the DOE Commercialization Planning Workshop (CPW). Since 1984, four of these CPWs, which bring together ERIP recommendees and a faculty of private sector consultants, have been held each year at various locations throughout the country.

The DOE CPWs are four-day workshops in which 12-14 recommendees and 9 faculty/consultants engage in formal seminar presentations, one-on-one consulting interviews, and the development of an individualized presentation of each inventor's commercialization strategy. Grounded in the belief that knowledge is power, the DOE CPWs include specialized faculty presentations on such topics as the Commercialization Process, Requirements for Planning, the Technical Development Process, Marketing, Legal Dimensions of Intellectual Property and Licensing, Financing Innovation, and Developing the Planning Process. The one-on-one interviews between inventors and faculty then focus on bringing that knowledge to yield from each inventor a written statement on commercialization strategy and planning. In the CPW's final session, each inventor presents the results of his or her commercialization planning to a faculty panel, which responds with comments on the presentation and recommendations; for "next-step" tasks.

A mix of education with individualized consultation, planning, and evaluation, the DOE CPWs have proven themselves an effective ERIP innovation. Designed to meet the ERIP recommendees' broad-ranging needs--while allowing for specific variations in technical development, background, expertise--inventors and entrepreneurs across the spectrum of ERIP recommendees have described the CPW as one of the most useful items in a DOE assistance package. Neophytes find the overall presentation of the innovation process particularly useful. More experienced entrepreneurs gain access to specialized consulting, and the opportunity to fit their individual experiences into the broader contours of the innovation process. All benefit from the emphasis on planning, including arraying commercialization tasks in a "next-step" format. For the Invention Coordinators and Program staff, the knowledge inventors gain and plan they produce at a CPW often prove valuable both in designing a more effective assistance package and in negotiating a more comprehensive statement for DOE grants.

Conclusion

Since 1975 the Energy-Related Inventions Program staff has directly assisted more than 450 recommendees. Indirectly, the Program's technical evaluations have also served the more than 25,000 inventors who have submitted ideas--often by saving the expense and heartache associated with efforts to commercialize an unsound technology, or a technology for which market potential cannot justify development costs.

One of the first DOE program directors perceived the ERIP as a pre-venture capital program. While there have been many changes in the Program since that point, that basic concept remains firmly fixed as the cornerstone of current operations. The NIST technical evaluations help reduce the risks of the innovation process, making the ERIP technologies more attractive investments. The DOE grants and assistance packages help inventors implement more effective commercialization strategies, thus also improving a technology's attractiveness to investors. No one can guarantee successful commercialization of any technology, but the ERIP program officers and staff have good reason to believe their efforts can enhance the commercialization potential for ERIP technologies. Such thinking characterizes every stage in the ERIP operations and finds its best expression in an ongoing commitment to a philosophy the current Program Director summarizes as "helping each inventor help himself."

Bridging the Valley of Death: Financing Technology for a Sustainable Future

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Prepared by

U.S. Small Business Administration

for

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Bridging the Valley of Death: Financing Technology for a Sustainable Future

Executive Summary

Ever since the government began taking action to preserve the environment, there has been debate over whether environmental protection is a drag on the economy. If America were the only country among all of our competitors taking such steps, a case could be made that we were spending scarce resources on environmental preservation while our competitors were not, thereby causing our cost of production to rise above that of our economic rivals.

Even in that case however, one could argue that in the long run it was worth doing. The U.S. was merely recognizing that the environment is a scarce resource that can be depleted and was taking steps to preserve it. Competitors would find this out later and be forced to spend even more to undo their damage.

But the U.S. is not the only Nation concerned with environmental protection. Advanced countries all over the world have environmental preservation policies. Even newly industrializing countries are moving in the same direction.

There are two important results to this sea change:

- Taking steps to preserve the environment does not put America at a competitive disadvantage even in the short run, because our trading partners are following the same path. Some countries, most notably Germany, have even more stringent policies than does the U.S.
- A new industry has been created: environmental technology. Worldwide sales in 1992 amounted to nearly $300 billion and are expected to reach $425 annually by 1997. The United States has the largest segment of the industry, with total estimated domestic and international sales of $134 billion.

Therefore, far from being a drag, environmental preservation can be a boom to the economy. The U.S. has the largest domestic market and the largest producers of environmental technologies. However, our competitors, especially Germany and Japan, are moving ahead rapidly. In some applications they have already surpassed us.

We must do better.

Small business has been shown to be more efficient than larger businesses at technological innovation, but is perceived as not fulfilling its potential in environmental technology. Consequently, the Environmental Protection Agency (EPA) asked the Small Business Administration (SBA) to study the issue and recommend needed changes.

The Clinton Administration is committed to a future where our economy and environment both thrive. In the words of John H. Gibbons, Assistant to the

President for Science and Technology, "technology must be the bridge to that future." It is in this spirit that the SBA and EPA -- for the first time -- have joined forces on a national level to serve a common constituency.

The study is divided into two categories of small businesses: developers and users. "Developers" include small businesses and entrepreneurs who seek to create and market new environmental technologies. The study attempts to identify the size of developers' financing needs, barriers to obtaining financing, and the stages in the development cycle where funding is most critically needed. Where funding needs are beyond the scope of the SBA's programs

or where regulations and/or permitting procedures create additional large funding needs for these businesses, alternative (non-financial) solutions to these problems are considered.

Users are small businesses that seek financing in

order to adopt environmental technology for compliance or pollution prevention purposes. As with the developers, the study focuses on the size of the users' financing gaps and the obstacles that they face in obtaining funding.

Methodology

The study team utilized a number of methodologies to collect data for this study. In addition to reviewing the literature, three Roundtables, comprised of developers, members of the financial community, and small manufacturers, were held in Raleigh, North Carolina, Dallas, Texas, and Boston, Massachusetts. In addition,

the study team conducted site visits to small businesses in Massachusetts and southern and northern California. To get the lenders perspective, the study team canvassed twenty lenders from the SBA's list of Preferred and Certified lenders.

In formulating the policy alternatives prepared for discussion, the study team looked for ways to use existing programs to better serve the environmental technology industry, rather than creating new programs.

Technology Developers

Environmental technology ventures follow a development path similar to that of other kinds of technology. Several models illustrate

capital availability with respect to the various stages of technology development. Though the terminology varies from author to author, all display the process as an inverted bell curve (See Chapter 2).

Funding Needs, Sources, and Availability

As a technology developer moves successively between the six stages, the capital needs almost always rise substantially. Unfortunately, capital availability does not follow the same pattern. As with most start-up companies, the source of capital in the early stages is from the developers' "sweat equity," personal savings and small investments from family and friends. Research and development (R & D) money may also be obtained from foundations and local, state, and federal government sources.

These initial sources are usually depleted before the entrepreneur has a final model or has commercialized the product, plunging the entrepreneur into the "Valley of Death." It is from this juncture that many technology ventures either never emerge or are left with no alternative other than to sell out to foreign investors.

Demonstration activities require substantial amounts of capital. Unlike the early R & D stage(s), there is little government funding. Moreover, venture capitalists and potential customers typically wait until a technology has proven itself in the demonstration -- usually after the product has become established in the marketplace -- before making an investment or purchase. Thus, if a technology developer is unable to survive the demonstration phase, all of the funding up to this point - including large sums of government investment dollars -- is wasted. Moreover, if foreign investors purchase the rights to the technology, the benefit accrues toa foreign purchaser.

Only five percent of U.S. venture capital firms actively invest

in the environmental industry. According to a 1993 Environmental Business Journal survey, venture capitalists prefer environmental technology companies in the earlytomid revenue earnings phases. Venture capitalists have little interest in startup investments, and even less in the pre prototype phases.

Perhaps most discouraging, the survey shows that none of the stages were rated as "high interest" or "very high interest." Moreover, compared with a similar survey two years earlier, there is a trend for venture capitals to steer toward laterstage investing.

Barriers to Obtaining Funding

The study team found a number of serious financial barriers. They include:

- Entrepreneurial Obstacles

While technology entrepreneurs are creative and have a grasp of scientific concepts, they often lack business skills. In the 1993 *Environmental Business Journal* survey of venture capital firms, lack of seasoned management was identified as the top reason why venture capitalists turn down environmental technology deals.

Regulatory Obstacles

- Permitting Processes -- Uncertainty

Nearly every investor and developer in the environmental arena has suffered losses due the following issues: multiple permitting requirements at various levels of government; the lack of materials that explain the process; and multi-year delays. Dag M. Syrrist, a California venture capitalist who invests in environmental technologies, points out that small companies are at a particular disadvantage because they typically do not have the personnel, expertise, or capital base necessary to survive the process. From the investor's perspective, the problem is not so much the time and cost requirements but the uncertainty of the process to predict return potentials.

- The Permitting Process -- Market Fragmentation

The permitting procedure is complicated by the state authorization process, where States may opt to be more stringent in their adoption of the federal regulations. Moreover, permits are granted on a

site specific basis, not on a technology, creating a market partitioned into 200-300 regional and local regulatory districts. By having vast numbers of separate regulatory districts, each requiring

new testing and demonstration procedures independent of one another, significant costs are generated without the resulting benefits. This redundancy is a major inefficiency in the system.

- Regulatory Uncertainty

Developers evaluate the technology needs presented by proposed regulations and try to raise capital for a technology design and product based on the expectation that the regulation will in fact be promulgated. However, after a significant amount of time and

money have been spent on developing a product, the proposed regulation may be altered or even rescinded, so that the standard is set at a level different than originally proposed. The developer's product may be rendered unnecessary.

- Enforcement

Developers claim that environmental regulations are weakened due to poor enforcement of the regulations.

- Testing

There are few venues available for pilot-scale or full-scale testing and testing is costly. Current regulations do not encourage industrial producers to test promising technologies while maintaining compliance with existing standards. Consequently, testing innovative technologies

are not given compliance relief for any kind of "best effort."

- Technology Lock-in

Customer fear of noncompliance for using innovative, untested technologies creates a tremendous marketing barrier for environmental technology developers and leads to what is termed "technology lock-in".

- Lack of Information

Accurate and current information is critical to investors and developers to assess the market's needs. However, such information is not readily available in the environmental industry because of an absence of SIC codes for the environmental industry and

the reluctance of the industrial community to publicize its environmental problems.

Government Contract and Procurement Inefficiencies

Government Technology Programs Do Not Provide Commercialization Support

Government technology programs emphasize the R & D aspects of technology development but provide little or no assistance for the commercialization of the technologies.

Lack of Investment Model

Since the environmental technology industry is new, there are few success stories.

Financial Institutions' Lack of Familiarity with the Industry

Banks do not generally have the resources to conduct the necessary technical research to understand innovative niche technologies. Technology Users

Evaluation of Current Financial Resources

Financing for environmental compliance and pollution prevention projects is available through commercial lenders, various state pollution control and remediation loan and reimbursement programs, and local environmental organizations. In addition, a few private organizations, like Coastal Ventures in Maine, have developed funds to finance these types of investments. Moreover, the SBA's 7(a) and 504 loan programs can be used for many environmentally-oriented purposes.

A recent Dunn & Bradstreet survey found that the most popular source of financing for small-business owners was credit from suppliers. Specifically, the survey found that 65 percent of small business owners depend on credit from suppliers, 40 percent use credit cards and 35 percent rely on commercial bank loans for funding.

Barriers to Obtaining Financing to Purchase Technologies Lender Liability

Since the mid-1980's, the SBA and lenders have become increasingly aware of their potential liability for environmental contamination. By obtaining title to real estate that has served as loan collateral, or by becoming intimately involved in operations of failing borrowers in order to prevent a loan-default, lenders have been considered by courts and governmental enforcers to be the "owner" or the "operator" of contaminated property. This determination may result in the lender bearing the entire cleanup costs. The costs are often staggering, particularly if other owners or operators cannot be located or lack sufficient resources to perform the remediation.

Congressional reauthorization of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the EPA's proposal to restrict lender underground storage tanks (UST) liability will be helpful for lenders in mitigating their potential liability for the cleanup of hazardous contamination. Nevertheless, they are far from a complete solution to the problem. Neither proposal would adequately shield lenders or the SBA from liability under state laws, which will continue to deter the provision of credit to technology users.

Responses by SBA and Lenders

Both the SBA and lenders have been compelled to alter their lending practices in response to the threat of environmental liability. Many larger banks have set up separate divisions staffed with environmental professionals to develop and manage lending standards to minimize the risk. Other lenders have adopted an informal policy of refusing loans to selected businesses (e.g. gas stations, dry cleaners, chemical companies).

An American Bankers Association's poll in the early 1990's showed that 43 percent of small banks had cut off or were curtailing lending to "certain types of businesses, such as small enterprises...that routinely handle toxic substances."

The SBA has also revised its lending policies in response to the threat of contamination. Its standard operating procedures (SOPs) reflect a wariness about incurring environmental liability in connection with both the provision of financing and in liquidation actions taken after default.

The Center for Neighborhood Technology noted the hardest hit businesses are gas stations, dry cleaners, auto repair shops, metal fabricators and finishers, electronics and utility industries, tool and die shops, bottling and canning plants, waste removal and chemical companies, scrap yards, and farming operations that use pesticides.

Lenders' protective measures can create prohibitive costs for small businesses. The consulting and engineering costs of environmental audits are almost always borne by the borrower.

Other Financing Issues

One of the most difficult obstacles is that the equipment for which the loans are requested does not increase business operating revenues. Hence, it effects cash flow negatively and the debt burden is increased.

Regulatory Awareness

Many small businesses are unaware of environmental regulations. Moreover, companies that seek to comply with environmental regulations often do not know how to comply. Industry Working Groups of the Small Business Forum on Regulatory Reform (Forum) found that although most small businesses want to comply with regulations, they often lacked the necessary information to do so.

Technical Guidance

The Forum's Chemicals and Metals Working Group found that there are not enough technical guidance and educational materials to help industry comply with regulations. When technical guidance is available, it often does not include specific, understandable information on regulatory responsibilities and requirements, or proven technical procedures and approaches for managing and controlling environmental emissions.

Policy Alternatives for Discussion

The Regulatory Process

Underlying all of the discussion points is the understanding that both demand for the products of this industry and their supply are strongly influenced by the nature of the regulatory process. Without regulations, the demand for the goods and services of this industry would be very low. And we have found, through the course of this study, evidence of an important feedback loop between the regulatory process as it exists today and the willingness of capital providers to invest in new technology for this industry. In each of the following ways, the regulatory environment is an important determinant of the perceived shortfall of capital for new environmental technology from small companies.

- Delays and Uncertainties Surrounding the Permitting and Approval Process.
- Performance Standards versus Specific Technology.
- The Lack of a Nationwide Process for Certifying the Effectiveness of New Technologies
- The Lack of "Hold Harmless" Testing of New Technologies The Lender Liability Problem

Each of these can be expected to retard the development of new technologies, and indeed each of them does. This should come as no surprise. The economic system is functioning as one would predict. None of the remedies discussed below will be effective so long as these problems persist. Fortunately, the EPA is well aware of these factors and they are at the forefront of the Environmental Technology Initiative.

The President has issued an Executive order requiring agencies to identify and address available alternatives to direct regulation, such as user fees or marketable permits. The Order also requires agencies to consider incentives for innovation and to specify performance objectives if possible, rather than specifying the behavior or manner of compliance that regulated entities must adopt.

Permitting

Developers and investors uniformly request that the permitting process be streamlined. Many investors suggested a certification process for streamlining permits (See Chapter 3). A technology certification process would eliminate the engineering review process required for permit decisions. State and Federal permit writers would use the specific certification claims as their engineering decision in the permit process.

State environmental offices and the U.S. EPA realize the problems contained in current permitting procedures and are taking steps to reform them.

Testing and Certification

Developers and investors uniformly request that the EPA put more resources into testing technologies for their ability to meet standards, either by conducting this testing itself or contracting it out to a non-government entity.

The shortage of testing venues can be partly eliminated by making use of contaminated federal facilities. Another important improvement is to allow selected sites to be used for testing new technologies with a hold-harmless provision if the technology doesn't meet the target standards.

Current practice creates a disincentive to allow one's business or property to be used to test a new technology, because if the technology fails to meet the standards, the business has undergone the expense of the new technology and it is still liable for further cleanup or to buy yet another technology. One expert recommended that a user be allowed to contract with a developer to test a technology so that if it worked, the user would pay a previously agreed upon price for the service. If it did not meet specifications, the user would not have to pay for the technology, nor would it be liable for further cleanup. The cost would be borne by the developer, the government, or by cost-sharing.

Many of the study team's contacts call for a national technology certification process that functions much like the FDA drug approval process. Under such a scenario a product must pass through one set approval process. Once it passes those tests it receives a "stamp of approval" for use anywhere in the country for similar types of clean-ups.

Such a process would serve to streamline the permitting process because it would eliminate the need for a series of site-specific tests. This would drastically reduce permitting delays and therefore reduce one of developers' major financing gaps. It would also help greatly in selling U.S. products abroad. The

EPA stamp of approval that "this technology works" is a powerful selling tool for American businesses.

Lender Liability

Lenders are not going to make loans unless their concerns are addressed, because their obligations to their stockholders and account holders place upon them an obligation to exercise due diligence in avoiding unacceptable risk in their loan making. Bank regulators will put loans with unacceptable liability risk into special classifications, with undesirable consequences for the bank and the employee that made the loan.

All-out pursuit of the deep pockets of lenders may increase funds for environmental cleanup in the short run, but at present and for the future it is stifling the flow of funds to businesses in which there is a risk of lender liability.

The economy is an interrelated system. Actions result in reactions. Suboptimizing in one part of the system can result in a failure to optimize the system overall.

At a minimum, Congress should clarify and expand the protection given lenders under the Superfund statute, and extend this protection to other environmental laws. Congress and the EPA should also eliminate the contradiction between SBA's role as a lender of last resort and its exposure to environmental liability by specifically limiting the liability of SBA under federal and state laws, which would greatly enhance the SBA's ability to provide credit to needy small business.

In formulating our policy alternatives, we have looked for ways to use existing programs to better serve the needs of this industry, rather than creating new programs and new bureaucracies. Fortunately, there are a number of existing programs that can be better targeted at this industry.

We have also used the framework set forth in the President's Technology for a Sustainable Future: A Framework for Action. Our discussion points follow the strategy of focussing upon regulatory policy, market stimulation, fiscal policy, partnerships, education & training, and information dissemination.

In addition, we must recognize the budget realities of the 1990s. There are no funds available for a new program of grants, loans, or loan guarantees targeted at the environmental technology industry, and no such programs have been recommended here. Policies calling upon additional SBA resources, both dollars and staffing, are assumed to be funded out of appropriations for the Environmental Technology Initiative.

The Federal budget for environmental technology programs was more than $4 billion in fiscal year 1994. "These programs are primarily focused on the front end of the continuum --technology research, development, and demonstration -- with little funding, in comparison, directed to commercialization. . ."

Policy Alternatives for Financing Developers

The Environmental Technology Bank of the United States (Envirobank)

Even though we believe that regulatory problems are an important determinant of the financing shortfall, we nevertheless think that to optimize this industry's performance, improvements in financing are needed as well as improvement in the regulatory process. There are two principal reasons for this:

- Public Good. Because of the public good nature of environmental preservation, there is a rationale for public sector involvement.
- In general, the private market will not bring forth an optimum amount of environmental preservation because many of the benefits accrue to the public at large rather than to individual customers, and providers do not receive revenue from these beneficiaries.

International Competitiveness. This is an industry in which in most areas the U.S. is still pre-eminent in the technology. However, Japan and Germany are gaining. In some areas they have already surpassed us. The growth potential of this market world-wide is enormous. Eastern Europe, Asia, Africa and South America will have a huge and growing demand for these services in the next decade. This industry should be on our list of critical technologies. Upon the success of this industry will depend many high paying jobs, exports, and part of America's technological prestige world-wide. We should not let this be another industry in which we were once pre-eminent but lost our lead to others.

The proposal is to create the Environmental Bank of the United States. The bank would be a small business investment company (SBIC). SBICs, licensed and regulated by the SBA, are privately owned and managed investment firms. They use their own funds, plus funds obtained by borrowing at favorable rates with an SBA guarantee and by selling their preferred stock to SBA, to make venture capital investments in small businesses. The SBICs provide equity capital, long-term loans, debt-equity investments and management assistance to qualifying small businesses. Their incentive is the chance to share in the success of the small business as it grows and prospers.

We have found that there is a variety of types of financing that these businesses need, depending upon the stage of development of the firm and of the technology. We also found that only about five percent of U.S. venture capitalists actively invest in the environmental technology industry and that even among those, there is a movement away from early-stage investing.

The Envirobank can provide a wide variety of financing to small environmental technology businesses: equity, debt, debt with equity features, strategic partnerships with large businesses, promoting the use of informal investors, etc. As a venture capitalist it can also provide the management assistance many of these firms badly need.

The Envirobank would concentrate on the environmental technology industry.

And it would, by design, fill a gap and provide more upstream funding than venture capitalists are doing today. However, it would be operated by professional venture capitalists with the goal of providing a competitive risk-reward structure to its investors. This cannot be an organization that shovels money out the door simply in order to say that it is helping firms with great ideas for saving the environment and no one else will listen to them because they don't have a track record.

The Envirobank's investments must be profitable. It must invest in companies with sound management or provide the assistance necessary to add good management to a promising technology. Otherwise Envirobank will not survive, and the government's and the private sector's investments will be lost.

Financing commitments can be secured from a number of sources:

- Foundations.
- Investment Banks. Pension Funds
- Trade Associations
- States, cities, counties. Private Investors.

SBA's funding will come from a transfer of funds from EPA. The next step would be to do a rigorous feasibility analysis of the desirable size of the organization in terms of staffing and funding, a risk-return analysis, etc. Next, the SBA and the EPA would facilitate communication with potentially interested participants, such as investors, venture capital experts, environmental technology experts, etc. It would be appropriate for the EPA to take the lead role in this next phase in order that the SBA's licensing, funding, and regulatory role with respect to the SBIC industry not be compromised.

More Effective Use of the SBIR Program for Environmental Technology

The Small Business Innovation Research (SBIR) program was designed to assist small technology-based firms that are in the "valley of death" stage of their development. Each federal agency with an extramural research and development budget in excess of $100 million must establish an SBIR program, under which it sets aside at least 1.5 percent of its R &&; D budget in 1993 and 1994, at least 2 percent in 1995 and 1996, and not less than 2.5 percent thereafter. Eleven agencies currently participate.

The program is working well across the board. However, the flow of funds into the environmental technology industry has been rather small. Although precise estimates are difficult to make because there are no unique SIC codes for the environmental technology industry, SBA's Office of Innovation, Research and Technology estimates that government-wide in fiscal year 1991 only $3.6 million out of $483 million in total awards went to environmental technology. At the EPA, only 45 such awards out of more than 2,000 were made.

Because of the importance of this industry both to the protection of our environment and to America's international competitiveness, we recommend that agencies whose research mandates include activities falling under the environmental technology umbrella, consider targeting more research topics and funds into this area. Since these budget allocations are normally made on a decentralized basis by each agency, Office of Management and Budget involvement may be necessary to realize a significant funding increase.

Technical Assistance Centers

Lack of information by lenders is an impediment to the flow of capital into small environmental technology companies. If a lender is not comfortable with his understanding of the amount of risk involved in a business, it is not prudent for him to make a loan. There exists across the country many organizations that could be configured to provide technical assistance to lenders on various aspects of environmental technology. These would include, *for developers,* an assessment of the firm's technology (both the technology it is selling and the technology it uses to manufacture what it sells) and management. *For users* of environmental technology (discussed in the following section), the assessment would focus on the technology to be purchased by the firm, its technical feasibility and its effect on the firm's rate of return.

Consider environmentally-friendly ink for the printing industry as an example. An assessment would answer such questions as "does it work, if so does it require more down-time to clean the presses, what effect does this have on profits, is there an alternative process that is as friendly to the environment but not so costly to the bottom line, etc.?"

Existing government-financed technical assistance networks include Small Business Development Centers, National Institute of Science and Technology Centers, and centers that are in the network of the National Coalition for Advanced Manufacturing, among others. Technical assistance could be provided via training courses, a national computer network or on a case-by case basis. The facility could be created initially with government funding and its ongoing expenses paid for as much as possible by fees charged to its customers.

Strategic Partnerships and Informal Investors

The study team encountered a great deal of support for developers bridging the financing gaps and obstacles mentioned earlier by joining forces with a "strategic partner." These partnerships may be with medium to large businesses, potential users, public sector groups, equipment manufacturers, larger environmental vendors, academia, R & D institutions, or some combination thereof. These alliances can various many forms, such as joint ventures and licensing agreements.

Strategic partnerships make sense as capitalizing upon unique aspects of American competitive advantages, joining small technology-based firms that are world-renowned as the most efficient producers of technological innovation and larger firms that are better at raising capital and manufacturing and selling a product.

Examples abound of how environmental technology developers have used strategic partnerships to their advantage - if only to stay alive. Unfortunately, out of an inability to secure sufficient financing or partnership agreements with domestic organizations, many environmental technology developers opted or were forced to develop partnerships with foreign companies and other investors. One of the consequences of this situation is that technologies that were originally developed in the United States - many with public R & D monies - are sent overseas to be manufactured into products that are exported back into the U.S.

On future grants and contracts the government may wish to require that, if owners of technology financed in whole or in part by the U.S. taxpayer wish to sell to or form partnerships, etc. with foreign-owned companies, the government funds used to develop the technology be repaid with interest to the government. The repayment should be placed in a special fund at the Envirobank

to finance environmental technology development and commercialization. Requiring repayment would help close a leak in the system in which the benefits of government-financed R & D are going to the competitors of American business.

Another source of financing that appears underutilized is the wealthy private individual investor, sometimes referred to as "angels" or "informal investors." The private investor's resources are considerable, with their venture investment portfolios aggregating in the neighborhood of $50 billion according to a study carried out by William Wetzel for the SBA in 1989. Acting alone or through a syndicate of friends and acquaintances, he can raise as much as $1 million for a given deal.

Occasionally the prospective individual investor participates in local groups like the MIT Enterprise Forum, where early-stage entrepreneurs present their aspirations and problems. Such investors rely heavily on the advice of their friends and other backers when making investment decisions. Few make a detailed analysis of the situation, evaluating the company primarily on the basis of its management. The investments are usually straight equity. Thus, the entrepreneur needs only to find the right angel for his company. This is not easy.

The SBA or the EPA could provide or facilitate a mechanism to match environmental technology developers with potential strategic partners and informal investors. The study team found tremendous support for the idea. Small businesses do not have the resources to gain the necessary information and contacts to locate suitable partners. Thus, an inexpensive, efficient and neutral arbitrator for partner matching would be of great assistance to them. The SBA act could as a clearinghouse for a partnering system, with data collected locally or regionally and maintained in one central location. The Envirobank could also play a role.

The SBA's Commercialization Matching System might be adapted to this purpose. It currently lists the 22,000 SBIR awards given during the last 11 years. 600 private venture capital firms are

also listed. The list for can be searched and sorted by geographical location, investment amounts, type of financing and industry or technology preference.

The SBA or EPA could also facilitate the expansion of the MIT Forum concept to other areas of the country in which the environmental technology industry is concentrated.

Policy Alternatives for Financing Users

A nation's firms gain competitive advantage if domestic buyers are, or are among, the world's most sophisticated and demanding buyers for the product or service. Such buyers provide a window into the most advanced buyer needs. . . Sophisticated and demanding buyers pressure local firms to meet high standards in terms of product quality, features, and service. . . The presence of sophisticated and demanding buyers is as, or more, important to sustaining advantage as to creating it. Local firms are prodded to improve and to move into newer and more advanced segments over time, often upgrading competitive advantage in the process.

The strategy set forth in these pages recognizes the interplay between technology developers and technology users. We aim not merely to facilitate the ability of small business users to attract capital for their purchases of environmental technology, but to help them become world-class consumers. "Buyers are demanding where the product needs in an industry are especially stringent or challenging because of local circumstances." There is no necessary conflict between stringent environmental standards and economic advance. Stringent domestic standards can help keep the American environmental technology industry world-class. Lender and small business education as set forth below are aimed at facilitating the growth of user and lender sophistication.

Environmental Protection Fund.

Due to the existence of the lender liability problem and in an effort to help the market over a time of transition to more stringent environmental requirements, policy makers may wish to consider creating a fund for small business-dominated polluting industries, such as dry cleaners, printers, jewelry manufacturing, etc. All firms in the named industries would pay a small percentage of their revenues into the fund. Then they could receive financial assistance (grants, zero or low interest loans, etc.) to fund their purchases of pollution control or prevention technology. In this way, the industry and its customers would finance the pollution costs associated with the industry in the form of user fees. The industry's customers would thus finance the environmental preservation costs produced by the products they buy. The cost of preventing environmental damage would thereby be internalized to that industry rather than being paid by society at large.

Lenders would not be asked to fund investments that do not add to the bottom line or that subject them to potentially costly liability. All firms in the industry would be treated the same. This would be analogous to the fund to finance the cleanup of underground storage tanks in Texas and to programs in Germany, Japan, and Sweden.

Lender Education

We recommended earlier the creation of a national network of technical assistance centers. These centers would also work with lenders and technology users.

Small Business Education

As Michael Porter noted, sophisticated domestic buyers of technology help producers become world class by demanding the best products. The Small Business Development Center (SBDC) program, sponsored by the SBA in a cooperative effort with the private sector, the educational community, and Federal, state, and local governments, is ideally suited to provide education to small businesses on how to buy and use environmental technology.

The 57 SBDCs provide management and technical assistance counseling services and training opportunities for present and prospective small business owners in over 960 locations nationwide. The SBDCs work with paid, private sector consultants, engineers, and testing laboratories to provide clients with specialized expertise.

The SBA and EPA are already looking into ways to utilize the SBDC network for educating small business owners on adopting environmental technologies. The FY 94 Environmental Technology Initiative funded four pollution prevention assistance pilot programs which will assist technology users to become, among other things, sophisticated buyers. A nationwide program, delivered through the SBDC network, is recommended.

Policy Alternatives: A Final Word

We have attempted with these policy alternatives to design remedies built upon the complex and interrelated nature of the environmental technology industry: the interplay between regulators, developers, users, and sources of finance. Our discussion points address each of these. It would be simplest to recommend freely available loans and grants, but funding on demand would not accomplish the goal of developing an ever more flourishing industry. Instead we stress the importance of improving the regulatory environment, using existing programs better to provide capital and management assistance to qualified developers, providing technical assistance to lenders in understanding environmental technology, promoting strategic partnerships and informal investors, providing a new and better source of financing to users, and educating small businesses to become world-class consumers of environmental technology.

Chapter 1

Introduction

Ever since the government began taking action to preserve the environment, there has been debate over whether environmental protection is a drag on the economy. If America were the only country among all of our competitors taking such steps, a case could be made that we were spending scarce resources on environmental preservation while our competitors were not, thereby causing our cost of production to rise above that of our economic rivals. Even in that case however, one could argue that in the long run it was worth doing. The U.S. was merely recognizing that the environment is a scarce resource that can be depleted and was taking steps to preserve it. Competitors would find this out later and be forced to spend even more to undo their damage.

But the U.S. is not the only Nation concerned with environmental protection. Advanced countries all over the world have environmental preservation policies. Even newly industrializing countries are moving in the same direction.

There are two important results to this sea change:

- Taking steps to preserve the environment does not put America at a competitive disadvantage even in the short run, because our trading partners are following the same path. Some countries, most notably Germany, have even more stringent policies than does the U.S.
- A new industry has been created: environmental technology. Worldwide sales in 1992 amounted to nearly $300 billion and are expected to reach $425 annually by 1997. The United States has

the largest segment of the industry, with total estimated domestic and international sales of $134 billion.

Therefore, far from being a drag, environmental preservation can be a boom to the economy. The U.S. has the largest domestic market and the largest producers of environmental technologies. However, our competitors, especially Germany and Japan, are moving ahead rapidly. In some applications they have already surpassed us. We must do better.

The Clinton Administration is committed to a future where our economy and environment both thrive. In the words of John H. Gibbons, Assistant to the President for Science and Technology, "technology must be the bridge to that future." It is in this spirit that the U.S. Small Business Administration (SBA) and the U.S. Environmental Protection Agency (EPA) -- for the first time - have joined forces on a national level to serve a common constituency. Memorandum of Understanding

On November 15, 1993, Erskine B. Bowles, then Administrator of the SBA and Carol M. Browner, Administrator of EPA signed a Memorandum of Understanding (MOU) to "ensure that the U.S. Government effectively encourages, supports and enables U.S. small businesses to develop, market and/or adopt cost-effective environmental (including pollution prevention) technologies to achieve economic growth and environmental compliance." (See Appendix 1)

The MOU has seven objectives that address the management, regulatory, exporting, and financing issues faced by environmental technology developers and users. Research has shown small businesses to be the most efficient creators of technological innovation. The perception prevails however, that such businesses have been underutilized in the development of environmental technology because of a shortage of capital. Hence, as one it its first joint initiatives, the EPA has asked the SBA to study the issue and recommend policies to correct any problems discovered.

The Study

The study team was comprised of Allan Mandel, Ph.D., Director of SBA's Office of Economic Development & Rural Affairs, Natalie Birk, SBA's Assistant Advocate for Innovation and Technology Policy, and Michael Forlini, Program Specialist, in EPA's Technology Innovation Office. In addition, Susan McLaughlin, a recent MBA graduate from the University of Texas School of Business, provided research support.

For purposes of this study, the definition of environmental technology cited in H.R. 3870 -- the Environmental Technologies Act of 1994 -- was used. The bill defines the term as "a technology that is primarily intended to improve the quality of the environment through pollution prevention, pollution monitoring, pollution control, pollution remediation, reuse, recycling, or disposal, or that is capable of cost-effectively offering significant environmental benefits when compared with a technology it replaces." (Title I, Sec. 104, Paragraph 3).

The study is divided into two categories of small businesses: developers and users. "Developers" include small businesses and entrepreneurs who seek to create and market new environmental technologies. The study attempts to identify the size of developers' financing needs, barriers to obtaining financing, and the stages in the development cycle where funding is most critically needed. Where funding needs are beyond the scope of the SBA's programs or where regulations and/or permitting procedures create additional large funding needs for these businesses, alternative (non-financial) solutions to these problems are considered.

"Users" are small businesses that seek financing in order to adopt environmental technology for compliance or pollution prevention purposes. As with the developers, the study focuses on the size of the users' financing gaps and the obstacles that they face in obtaining funding.

Methodology

The study team utilized a number of methodologies to collect data for this study. In addition to reviewing the literature, three Roundtables, comprised of developers, members of the financial community, and small manufacturers, were held in Raleigh, North Carolina, Dallas, Texas, and Boston, Massachusetts. In addition, the study team conducted site visits to small businesses in Massachusetts and southern and northern California. In Nevada, where the Small Business Development Center sponsors a thriving pollution prevention program, the study team met with representatives of trade associations and users of environmental technologies.

At least one member of the study team was in attendance at each of the Environmental Technology Initiative public hearings were held in the spring of 1994 which generated additional individuals to be interviewed. Moreover, the study team met with other leaders in the environmental technology community including representatives from the California Environmental Business Opportunities (CEBO), the Environmental Business Council (EBC), Environmental Business Cluster, California Environmental Protection Agency, etc.

To get the lenders perspective, the study team canvassed twenty lenders from the SBA's list of Preferred and Certified lenders. Two lenders were chosen from each of SBA's ten regions representing varying sizes of metropolitan areas, no more than one bank in any state, and no more than one branch of any particular financial institution. The discussions with the PLP lenders took place by telephone August 10, 1994 to August 19, 1994 and are incorporated into the Developers and Users chapters.

In formulating the policy alternatives, the study team looked for ways to use existing programs to better serve the environmental technology industry, rather than creating new programs.

Chapter 2

Developers

Environmental technology ventures follow a development path similar to that of other kinds of technology. Several models illustrate capital availability with respect to the various stages of technology development; though the terminology varies from author to author, all display the process as an inverted bell curve.

The first step, "Idea Development," refers to product conceptualization and initial drawings, calculations, and theoretical validation. The developer at this stage may construct a crude, inexpensive, non-functioning model for feedback from colleagues.

The next stage, "Proof of Concept," refers to the construction of a rough, yet functioning model of the technology. This model may be less than full-scale. Its purpose is to test the most basic operating parameters and to aid in the design of an engineering prototype (pilot).

The "Pilot" phase is an actual working version of the technology of adequate technical quality. It tests the technology's operating performance and gauges its production requirements and feasibility.

The "Prototype" stage is the last model built before actual use of production machinery. It is a full-scale, completely operational model built to conform as closely as possible with final production design standards. The prototype is used to determine the product's production requirements as well as the product's operational performance.

In the "Application/Demonstration" stage, an actual market-ready model is manufactured in a limited production run. This stage tests the production process and produces a product that is used in third party testing; e.g. for obtaining a federal or state government permit. Application/Demonstration requires a great deal of private sector capital since very little government funding is available.

Finally, "Commercial Sales" is the result of the first five stages and especially of extensive marketing and manufacturing activities (commercialization activities). The name of the stage may be misleading, as it is sometimes characterized more by commercialization activities than by sales.

Funding Needs, Sources, and Availability

As a technology developer moves successively between the six stages, the capital needs almost always rise substantially. Unfortunately, capital availability does not follow the same pattern. As with most start-up companies, the source of capital in the early stages is from the developers' "sweat equity," personal savings and small investments from family and friends. Research and development (R & D) money may also be obtained from foundations and local, state, and federal government sources.

These initial sources are usually depleted before the entrepreneur has a final model or has commercialized the product, plunging the entrepreneur into the "Valley of Death" (See Figures 1, 2 and 3). It is from this juncture that many technology ventures either never emerge or are left with no alternative other than to sell out to foreign investors.

Demonstration activities require substantial amounts of capital. Unlike the early R & D stage(s), there is little government funding. Moreover, venture capitalists and potential customers typically wait until a technology has proven itself in the demonstration -- usually after the product has become established in the marketplace -- before making an investment or purchase. Thus, if a technology developer is unable to survive the demonstration phase, all of the funding up to this point - including large sums of government investment dollars -- is either wasted, or, if foreign investors purchase the rights to the technology, accrues to the benefit of a foreign purchaser.

Environmental industry experts generally agree that a greater amount of government funding is available in the early developmental stages and that more financing is needed for commercialization activities. Organizations such as the Environmental Business Cluster, an environmental technology incubator in San Jose, CA, attempt to serve companies ready for commercialization. However, this type of assistance is the exception rather than the norm.

At the 1993 meetings of the California Environmental Technology Partnership, members lamented that few funds are available for commercialization, advertising and other marketing activities. They concluded that existing capital markets do not adequately fund environmental technologies at the commercialization stage.

Only five percent of U.S. venture capital firms actively invest in the environmental industry. According to a 1993 *Environmental Business Journal* survey, venture capitalists prefer environmental technology companies in the earlytomid revenue earnings phases. Venture capitalists have little interest in startup investments, and even less in the preprototype phases.

Perhaps most discouraging, the survey shows that none of the stages were rated as "high interest" or "very high interest." Moreover, compared with a similar survey two years earlier, there is a trend for venture capitals to steer toward laterstage investing.

The study team spoke to 20 active SBA lenders (PLP lenders) about their views on environmental technology. Fourteen of them had never received a loan application from an environmental technology developer. The other six had received loan applications ranging from $100,000 to $1,500,000.

Three of the six banks approved those loans. One bank has made two SBA loans to environmental consulting companies that are developing management information systems. Both companies are ongoing, growing concerns that sought roughly $500,000 for operating capital and equipment purchases.

A second bank made loans to two recycling companies, both of which were also ongoing concerns. The third bank, made a SBA 7(a) loan of $900,000 to an expanding reclaimer of combustion engine fuels.

The PLP lenders were asked for their reasons for not being inclined to lend to environmental technology firms. Most of their reasons had no relevance to the environmental industry, but had to do with young companies in general. In fact, of the 20 PLP lenders, only three gave reasons that were specific to this industry.

At the SBA/EPA Roundtable in Dallas, TX on May 19, 1994, one lender said that the banking community is not willing to lend to young, unestablished companies. The lender further stated that banks do not "invest" in companies. Unlike venture capitalists, banks receive no benefit from taking on additional risk, unless they charge prohibitively high interest rates, which is self-defeating. Thus, banks typically provide funding only when a company has a proven product that already generates income.

The PLP lenders' comments concur with what was said in Dallas. Even with the added security of SBA guarantees, PLP lenders do not consider loans to companies that are not ongoing concerns (typically businesses with two to three years of revenue generation).

Loan applicants in earlier stages are referred to SBA's Small Business Investment Companies (SBIC) or venture capitalists. Only one banker said that he might consider making a loan to a startup if it could show letters of interest from customers.

The three remaining PLP lenders that did not approve the loan applications claiming that the funding requests were too high. In addition, one lender said that an applicant demonstrated inadequate managerial background.

The uncertain regulatory arena and the banking community's lack of familiarity with the industry were the most cited concerns and will be addressed later in this study. Other PLP lenders argued that these barriers are not unique. Generally, bankers lend money to clients that have a good customer base. Until a developer achieves this base, bankers will still have a great deal of apprehension.

Barriers to Obtaining Funding

Entrepreneurial Obstacles

Environmental entrepreneurs typically face a series of cash flow crises while developing and commercializing their technologies.

When bank loans are obtained, small companies often pay more for capital than larger companies.

The extra cost is due to several factors. These factors include: the lack of liquidity, the risks associated with commercialization, and the limited understanding of environmental entrepreneurs' new technologies.

As a result, many developers turn to venture capitalists. In return for their investment however, venture capitalists require some form of control over the business.

The loss of some or most of the company's ownership and the loss of independence is simply unacceptable to some developers, and to others, an unattractive option at best. Many developers expressed their concern about what they considered unreasonable demands imposed by the venture capitalist. To the venture capitalist, these are viewed as a necessary quid pro quo for the risky investment. Consequently, many developers try to avoid venture capital as much as is possible.

While technology entrepreneurs are creative and have a grasp of scientific concepts, they often lack business skills. Thus, developers often do not have the management experience necessary to successfully market their products and to build a successful business.

It is important to note, that when trying to obtain financing, especially for marketing the product, the quality and benefits of the technology matter less than the ability of the developer to present a good argument and convey a sense of credibility.

Specifically, the developer needs to place greater emphasis on a business plan than on the benefits of the technology.

Entrepreneurs usually overestimate the potential and demand for their products to prospective investors. The inability to realistically identify and document their market can scare away potential investors; even when the technology is sound. Hence the saying familiar among venture capitalists: "We'd far rather take a chance on a firstrate manager with a secondrate product than on a firstrate product in the hands of a secondrate manager."

In the 1993 *Environmental Business Journal* survey of venture capital firms (See Table 1), lack of seasoned management was identified as the top reason why venture capitalists turn down environmental technology deals.

Despite the growing public sentiment for companies to provide products and services in an environmentally sensitive manner, it is recognized that governmental regulation is the principal driver behind the environmental technology industry. *Thus, an efficient, predictable regulatory arena* is extremely important to the success of the industry. Governmental permitting and regulation setting procedures create the barriers that environmental industry participants cite most.

Regulatory Obstacles

Permitting Processes -- Uncertainty

Dag M. Syrrist, a California venture capitalist who invests in environmental technologies, believes that the uncertain permitting process is one of the greatest impediments facing these technologies.

According to Syrrist, nearly every investor and developer in the environmental arena has suffered losses due the following issues: multiple permitting requirements at various levels of government; the lack of materials that explain the process; and the multi-year delays.

Syrrist also pointed out that small companies are at a particular disadvantage because they typically do not have the personnel, expertise, or capital base necessary to survive the process.

From the investor's perspective, the problem is not so much the time and cost requirements but the uncertainty of the process to predict return potentials.

The EPA is well aware of these issues. In numerous agency publications, including the *Technology Innovation Strategy*, the EPA identified the following concerns: varying regulatory requirements and processes; uncertainties to permit issuance; and the scarcity and credibility of a technology's performance date with respect to compliance requirements. Moreover, the EPA recognizes that simply having a technology that produces significant environmental benefits is not enough to make it a good investment.

Permitting Process – Market Fragmentation

The permitting procedure is complicated by the state authorization process (40 CFR 271 requirements). In this process, federal regulations are developed based on the federal statute and requires state adoption. Thus, federal regulations such as permitting requirements serve as a blueprint for state authorization. States may opt to be more stringent in their adoption of the federal regulations. This is turn becomes a nuisance for developers since regulations may differ in stringency from state to state.

Moreover, permits are granted on a site specific basis, not by technology, creating a market partitioned into hundreds regional and local regulatory districts. By having vast numbers of separate regulatory districts, each requiring new testing and demonstration procedures independent of one another, significant costs are generated without the resulting benefits. This redundancy is a major inefficiency in the system.

Regulatory Uncertainty

Some developers looking for a competitive edge will evaluate the technology needs presented by proposed regulations. In doing so, these developers will raise capital for a technology design and product based on the expectation that a proposed regulation will be promulgated. However, after significant amount of time and money have been spent on developing a product, the proposed regulation may be rescinded or altered so that the promulgated standard is set at a different level than originally proposed. Hence, the developer's product may be rendered unnecessary.

Sometimes a developer may be in a position to alter and redirect the technologies market audience as in the case of AirXchange, a Massachusetts company with an indoor air purification system. Initially the technology targeted the problem associated with indoor formaldehyde air emissions in mobile homes. The developer was almost certain that formaldehyde federal standards would be developed but were not. Fortunately, the developer was able to broaden the scope of the technology after the regulatory provisions had been dropped.

Stephen S. Miller, President of Stephen G. Miller Associates, a marketing consulting firm, presented another example. Three years before the promulgation of a final EPA ruling, a group of Arizona entrepreneurs built a continuous leak detection system for underground storage tanks (USTs). At the onset, it appeared that the EPA would require a continuous leak detection system in the final ruling. At the end however, the promulgated regulation allowed owners of USTs to conduct annual tightness tests for up to ten years.

In this case, the regulation resulted in a much slower demand for the technology. Consequently, the developers were forced to put their technology aside and go into the annual testing business.

Rules are developed on the basis of a more limited group of technologies currently available at the time the rule is written, since the development cycle for technological innovations is usually ten years or more. Furthermore, without greater predictability, developers run the risk of producing innovations that either over or under comply with the new standard. In short, since it is difficult to synchronize innovation and production with uncertain demand, the financial community is unable to calculate the risks of investment.

Enforcement

Enforcement of EPA standards and other environmental regulatory entities is also extremely important to technologies, especially those technologies designed to meet a demand created by regulation.

However, developers claim that environmental regulations are weakened due to poor enforcement of the regulations. Thus, many small businesses find it difficult to survive. According to the *Environmental Business Journal*, weak enforcement is a major reason for market stagnation the last three years.

In June, 1994, the EPA established a new Office of Enforcement

and Compliance Assurance (OECA), consolidating a number of functions formerly shared among several different EPA programs. One major component of OECA is the Office of Compliance, whose overriding mission is to improve compliance with environmental laws. The office will accomplish this goal by working with the 10 EPA regions, states, municipalities, citizen groups and industry. OECA plans to improve the targeting of the enforcement actions against the worst violators, while at the same time reduce the transaction costs of understanding and complying with statutory and regulatory requirements.

Testing

The demonstration stage of an environmental technology's development is a critical step, since demonstration is needed not only for government permitting agencies, but also for potential customers and investors.

Full-scale testing under real-world conditions place a heavy burden on developers. There are few venues available for pilot-scale or full-scale testing and testing is costly. Furthermore, when the testing process must be repeated in multiple jurisdictions or regions, the developer must continue to absorb the same costs.

One reason for the lack of testing sites is the inability of developers to gain permission from potential customers to use their sites.

Ideally, developers would test their technology on an area where the environmental problem exists. The California Environmental Technology Partnership (CETP) discovered however, that due to the penalties for non-compliance, potential customers rarely allow unproved technologies to be used on their premises.

Current regulations do not encourage industrial producers to test promising technologies while maintaining compliance with existing standards. Consequently, testing innovative technologies are not given compliance relief for any kind of "best effort."

Technology Lock-in

Customers' fears of noncompliance for using innovative, untested technologies creates a tremendous marketing barrier for environmental technology developers and leads to what is termed "technology lock-in". At the SBA/EPA Roundtable in Dallas, TX, two developers said that potential customers constantly ask them if their products are "EPA approved" or "EPA certified." Since EPA does not offer such services, the developers face a marketing impasse.

EPA realizes that even though most EPA standards are technically performance-based and do not require a specific technology, the regulated parties are reluctant to depart from using the technology on which the standard is based and which EPA describes in the control technology guidance documents accompanying the regulation. Therefore, even the developer with a less expensive or more effective technology often finds it difficult to penetrate the market.

Permitting officials are also reluctant to risk the potential environmental consequences of approving an innovative technology.

Enforcement personnel do not normally grant exceptions for businesses that make bona fide attempts to comply using innovative approaches, but fall just short of regulatory level. The result is, as EPA's *Technology Innovation Strategy* aptly states, the nation has fewer technologies to choose from as it moves to the next generation of environmental protection goals.

Lack of Information

Accurate and current information is critical to investors and developers to assess the market's needs. However, such information is not readily available in the environmental industry.

Investors have blamed this deficiency on two factors: (1) An absence of SIC codes for the environmental industry; and (2) The reluctance of the industrial community to publicize its environmental problems. Thus, the more acute the problem and the higher the immediate need, the less likely it is that the marketplace will learn of it.

Additionally, according to the July, 1994 Task Force Report of the California Environmental Technology Partnership, industry often attempts to shield itself from negative publicity and protect proprietary information. Consequently, they will not disclose environmental technology products they have developed themselves, thus "hiding" many environmental solutions from the marketplace.

Government Contract and Procurement Inefficiencies Many developers who have focused on the government market are frustrated by the fact that procurement is conducted by individual laboratories or contractors rather than on a national basis.

For example, procurement for DOE cleanup efforts has traditionally been conducted by individual laboratory contractors who do not necessarily view cleanup as a national effort. An article in the *Environmental Business Journal* noted that contractors are reluctant to be the first to try an innovative technology even if the technology was developed at a Department of Energy lab in the first place.

The costplus structure of contracts serves as a further disincentive for contractors to use procurement methods that minimize the public's expenditures. Stephen Miller provided the study team with the following example. A small company developed a portable testing system to detect quantities and types of contaminants at a contaminated site. The use of this system was less expensive and time-consuming than sending samples off-site for laboratory testing. The developer attempted to sell its system to EPA contractors hired to clean up Superfund sites. However, services of off-site EPA laboratories are free to Superfund contractors. Consequently, no cost was incurred by the contractor, whereas the portable testing system would come out of the contractors' profits. Thus, contractors have no incentive to use the more efficient system.

Government Technology Programs Do Not Provide Commercialization Support

Government technology programs focus on the R & D aspects of technology development but provide little or no assistance for the commercialization of the technologies. Some programs go as far as assisting with the demonstration stage of technologies, but do not do enough to commercialize the product. In an article that he wrote for *Environmental Business Journal*, Andrew Paterson, President of RIMTech in Pasadena, California, said that too many federal agencies, such as DOD testbeds and the EPA-SITE program, "just kick up dust with no pathway to paydirt -real sales. No revenues, no commercialization."

Lack of Investment Model

Since the environmental technology industry is new, there are few success stories. In fact, CETP contends that the venture capital industry's experiences with early-stage environmental technologies has been generally negative. Hence, without a precedent to follow, most investors simply prefer to capitalize technologies in more established sectors.

Financial Institutions' Lack of Familiarity with the Industry

Some financial institutions have shied away from funding environmental technologies because they do not sufficiently understand the industry. The study team encountered industry analysts that said private investors are often reluctant to invest in environment ventures because of their lack of familiarity with the industry. Smalltomidsized banks are known to not generally have the resources to conduct the necessary technical research to understand innovative niche technologies.

Investors look for a competitive return on investments. For reasons typical of all varieties of small companies (e.g., poor management skills, overly competitive market, etc.), and to a list of regulatory and marketing obstacles peculiar to the environmental industry (especially the uncertain cost and length of the permitting process), the investment community does not perceive sufficiently high returns on environmental technology products to justify the perceived high risk of these investments.

There is consensus among the environmental industry that there is a great deal perhaps excessive amounts of capital available in the R & D stages and in the late commercialization period, *after* environmental technology developers have received the necessary permits and established a customer base. However, there is a vast chasm between those stages. If the U.S. environmental technology industry is to prosper, that gap needs to be filled.

Chapter 3

Technology Users

Evaluation of current financial resources

Financing for environmental compliance and pollution prevention projects is available through commercial lenders, some state pollution control and remediation loan and reimbursement programs, and some local environmental organizations. In addition, a few private organizations, like Coastal Ventures in Maine, have developed funds to finance these types of investments. Moreover, the SBA's 7(a) and 504 loan programs can be used for many environmentally-oriented purposes.

A recent Dun & Bradstreet survey found that the most popular source of financing for small-business owners was credit from suppliers. Specifically, the survey found that 65 percent of small business owners depend on credit from suppliers, 40 percent use credit cards and 35 percent rely on commercial bank loans for funding. Representatives of the metal finishing industry concur that suppliers have been the key financier for that industry.

This study is explores federal assistance programs rather than the availability of supplier credit, or credit card financing.

Moreover, the discussion in Chapter 2 suggests that developers have enough of their own financing difficulties. As such, this Chapter will examine the other financing options available and/or what is preventing users from obtaining more traditional sources of credit.

Preferred Lender Program (PLP Lenders)

The literature and the PLP lenders suggest that funding requests for pollution control or prevention technologies normally range from $5,000 to $250,000. The rarely used SBA Pollution Control Loan program which has a $1,000,000 guarantee limit ($250,000 more than the general 7(a) loan program) supports the premise that equipment is in this range.

Ten of the twenty PLP lenders surveyed, specified that they had received loan applications for compliance. Seven lenders indicated that the applications were for underground storage tanks. Another seven applications specifically discussed other types of compliance issues. Six PLP lenders said that they had at some time turned down compliance applications due to liability or credit reasons.

Barriers to Obtaining Financing

Lender Liability

Since the mid-1980's, the SBA and lenders have become increasingly aware of their potential liability for environmental contamination.

By obtaining title to real estate that has served as loan collateral, or by becoming intimately involved in operations of failing borrowers in order to prevent a loan-default, lenders have been considered by courts and governmental enforcers to be the "owner" or the "operator" of contaminated property. This determination may result in the lender bearing the entire cleanup costs. The costs are often staggering, particularly if other owners or operators cannot be located or lack sufficient resources to perform the remediation.

Overview of Relevant Laws

There are principally three statutory bases for potential environmental liability faced by lenders and the SBA. First, the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), establishes the liability of present and certain past owners and operators of property where a release of a hazardous substance has taken place.

Second, lenders face potential liability under Subtitle I of the Resource Conservation and Recovery Act ("RCRA"), as an owner or operator of an underground storage tank that leaked petroleum or hazardous materials. RCRA also imposes criminal penalties on persons who "knowingly" violate regulatory requirements.

State environmental laws serve as the third source of liability for lenders and the

SBA, whose sovereign immunity from such state laws has been waived by Congress along with that of other federal agencies. Although the variety and number of state laws prohibit their discussion here, these laws often contain language similar to that contained in CERCLA and RCRA.

This study does not address environmental laws that require the reduction of pollutants created during the active operation of a facility or the management and disposal of waste materials. These laws frequently require the use of highly expensive environmental technology or procedures, and thus have had a considerable impact on small business users. However, lenders are more likely to face cleanup liability as a result of foreclosure than for violation of these operational regulations.

CERCLA

In 1980, Congress enacted CERCLA in response to environmental and public health threats posed by improper disposal of hazardous materials. The events at Love Canal, in Buffalo, New York, where extensive contamination was found to have resulted from waste-disposal actions taken in the 1940's, served as a major catalyst for this legislation.

Section 107(a) of CERCLA identifies the following potentially responsible parties ("PRPs") as liable for a cleanup: (1) the current owner or operator of the contaminated facility; (2) any past owner or operator of the facility at the time that a disposal (which is broadly defined to include passive leaking) of a hazardous substance takes place; (3) any person who arranged for the treatment or disposal of hazardous substances at or arranged for transportation of the material to the facility found to be contaminated; and (4) any person who actually transported a hazardous substance for treatment or disposal at the subsequently contaminated facility.

Under CERCLA, any PRP can be liable for all cleanup costs, regardless of whether that party had any responsibility for or contributed to the contamination, and regardless of the volume of waste that a party might have contributed to a site. A PRP may be liable for an actual release of a hazardous substance and a "threatened release," which has been held to include the mere ownership of "corroding and deteriorating tanks." State of New York v. Shore Realty Corp., 759 F.2d 1032, 1045 (2d Cir. 1985).

CERCLA expressly limits the liability of lenders in the so-called "secured creditor exemption," which defines the term "owner or operator" so as to exclude a person who "[1] without participating in the management of a ... facility, [2] holds indicia of ownership primarily to protect his security interest in the ... facility". These terms are not defined, and courts have issued varied interpretations.

In one of the earliest decisions interpreting the exemption, a court held that a lender that was involved in managing the day-to-day operations of the borrower may be liable for the cleanup costs. United States v. Mirabile, 15 E.L.R. 20884 (E.D. Pa., Sept. 4, 1985) No. 84-2280. However, the court held that another lender that had foreclosed on the property was not liable because its actions "were plainly undertaken in an effort to protect its security interest in the property." The court also held that SBA was not liable, even though the loan agreement with the borrower allowed for "some degree of involvement which could be characterized as participation in day-to-day management," and imposed certain restrictions on the borrower's finances. The court held that this capacity to become involved in management of the facility did not trigger liability: "participation in purely financial aspects of operation, of the sort that occurred here" is insufficient "to bring a lender within the scope of CERCLA liability."

In another decision, the court held that the bank's purchase of the property at a foreclosure sale classified it as the "current owner" of the facility, and subjected it to cleanup liability. U.S. v. Maryland Bank & Trust Co., 632 F. Supp. 573 (D. Md. 1986). The fact that the bank was not responsible for the contamination did not exempt it from liability.

A 1990 decision generated considerable alarm in the lending community by suggesting a broad expansion of a lender's CERCLA liability. U.S. v. Fleet Factors Corp., 901 F.2d 1550 (11th Cir. 1990), cert. denied, 498 U.S. 1046 (1991). The court indicated that liability could arise from a lender's "capacity to influence the corporation's treatment of hazardous wastes," id. at 1557, or from a lender's financial control over a firm that was "sufficiently broad to support the inference that it could affect hazardous waste disposal decisions if it so chose." Id. at 1558. In finding potential liability, however, the court also pointed to a number of other factors, including the fact that the creditor had hired an auctioneer to dispose of some of the machinery and equipment, and had arranged for the removal of the rest. Other courts have disagreed with the Fleet court's reasoning. See, e.g., In re Bergsoe Metal Corp., 910 F.2d 668 (9th Cir. 1990) ("there must be some actual management of the facility before a secured creditor will fall outside the exception").

The EPA subsequently issued a regulation to mitigate the potential liability of lenders under CERCLA as a result of the Fleet decision. The rule provided that, prior to foreclosure, lenders would not incur liability by monitoring a borrower's financial condition or requiring a borrower's environmental compliance or remediation prior to default. Lenders that were active in the operational management and control of the company prior to default were not exempt. The rule also protected lenders that obtain title to property through foreclosure or other means if they make prompt efforts to sell the property and do not refuse a "bona fide" offer to purchase the property.

In February 1994, a court vacated this regulation holding that it exceeded EPA's statutory authority and was, thus, invalid. The Solicitor General's Office is currently deciding whether to file an appeal. CERCLA will expire in 1995 unless reauthorized by Congress. Both houses of Congress are currently considering broad reform legislation, which includes amendments to CERCLA's secured creditor exemption.

The House version would overrule Kelley by retroactively endorsing EPA's secured creditor rule. The Senate proposal would revise the secured creditor exemption to provide greater protection for lenders and exempt federal lending agencies, including the SBA, from any CERCLA liability unless they had "caused or contributed" to the problem. Other measures that would be beneficial to lenders, among other parties, would limit the liability of certain small businesses and of parties that were only responsible for a minute percentage of the contamination at a site, and encourage the allocation of liability based on a party's actual contribution rather than imposing the entire cleanup responsibility on a party.

However, prospects for passage of the reform legislation in 1995 remain uncertain.

RCRA

Lenders and the SBA also face liability under Subtitle I of RCRA for the release of petroleum or hazardous substance from an UST. Although not discussed in this study, Subtitle C of RCRA establishes requirements for the storage, transportation, and disposal of hazardous waste. The statute also establishes civil liability for the failure to report contamination or to comply with a governmental directive to undertake cleanup of contamination, and imposes fines and criminal penalties for certain violations.

Congress has authorized the EPA to review a State's UST or hazardous waste program and to delegate the primary enforcement authority for each program to that State. A state program may be more stringent than its federal counterpart. Even without federal delegation, Congress has made federal departments and agencies, such as the SBA, subject to state and local requirements.

Underground Storage Tanks

Subtitle I imposes liability upon an UST owner or operator that has leaked petroleum or hazardous materials. EPA or an authorized state agency may issue a cleanup order to an owner and/or operator to address a leak or, if the owner or operator will not comply, recover cleanup costs of a leaking UST from these parties. The statute imposes strict liability in such cost recovery actions. Under EPA regulations, an UST owner or operator must report any leak to the EPA (or the implementing state agency) within 24 hours of discovery. The owner or operator is directed to investigate any suspected release, and to undertake corrective action to remediate any leak that is discovered. A party that fails to comply with the regulations risks a civil penalty of up to $10,000 for each tank for each day of violation.

Subtitle I contains a secured creditor exemption, similar to that in CERCLA, for the owner of an UST. However, the exemption does not apply to the "operator" of a tank, a term that is broadly defined. The exemption, thus, may have limited relevance to a lender that forecloses on property where a leaking UST is located and that exercises operational control over the property. In June, 1994, EPA issued a proposed rule to restrict the liability of lenders from UST contamination. 59 Fed. Reg. 30448, 30463 (June 13, 1994). The proposal extends protection to an UST operator, and limits the liability of secured creditors with respect to actions taken before and after foreclosure, as set forth in EPA's CERCLA regulation. However, to obtain the benefit of the proposed rule, a lender must empty any UST with petroleum or a hazardous substance within 15 days of foreclosure. A foreclosing lender must also "close" the tank in compliance with regulations, a process that may prove sufficiently costly that it undermines the collateral value of the property. EPA declared that it will not require states with an approved UST program to implement a security interest exemption.

Criminal Liability Under RCRA

Another area of concern is the potential criminal culpability of lending and SBA officials involved in the liquidation of businesses.

The law provides criminal sanctions for anyone who "knowingly" transports certain types of hazardous waste to a facility which does not have a permit. Similarly, the law requires a permit for the storage, treatment, or disposal of certain types of hazardous waste at a site. If the site does not have a permit, such storage, treatment, or disposal may constitute a felony. In addition, certain releases of hazardous waste above threshold quantities must be reported to EPA. Failure to report such releases can constitute a felony. Thus, lenders have the additional concern of potential criminal liability for disposing of hazardous waste improperly.

A number of appellate decisions have sanctioned a liberal use of circumstantial evidence to establish the necessary knowledge that a permit was required. One such case involved the prosecution of a company official that had sent hazardous waste to a facility that was believed to hold a valid permit. The court upheld the conviction, stating in this regulatory context a defendant acts knowingly if he willfully fails to determine the permit status of the facility.

Summary

Congressional reauthorization of CERCLA and EPA's proposal to restrict lender UST liability will be helpful for lenders in mitigating their potential liability for the cleanup of hazardous contamination. Nevertheless, they are far from a complete solution to the problem. Neither proposal would adequately shield lenders or the SBA from liability under state laws, which will continue to deter the provision of credit to technology users.

Responses by SBA and Lenders -- General Discussion

The potential liability for the cleanup of contaminated property at sites throughout the country has had a considerable impact upon the lending decisions of banks and the SBA. The scope of the problem facing the SBA can be gauged from the fact that as early as 1989, in response to an inquiry from Congress, the Agency conducted an informal survey which determined that, with respect to at least 140 sites, the SBA had either abandoned collateral because of the risk of incurring cleanup costs or had actually incurred liability for such costs. Thus, the risk of liability has compelled lenders and the SBA to exercise considerable caution in providing financing to borrowers which use petroleum or chemical products in their business operations and/or which generate hazardous waste as a result of those operations.

The concerns of the lending community result not only from the prospect of incurring liability for cleanup costs, but also from the ramifications of potential environmental contamination upon collateral given to secure a lien and upon the borrower. As a practical matter, real estate that is actually or potentially subject to contamination has little or no collateral value to a lender seeking to recover a debt on a loan. Foreclosure may result in liability; even absent liability, however, prospects for sale of contaminated property are minimal, except at a price that is far below the property's "clean" market value. Moreover, the high costs of environmental liability may so financially impair a borrower that it triggers a default on a loan.

The credit concerns of lenders are even more acute with respect to small businesses that often have little real collateral to secure a loan other than real estate, and which are more vulnerable to the financial impact of environmental liability. SBA faces a similar concern; the Small Business Act mandates that "all loans ... shall be of such sound value or so secured as reasonably to assure repayment." SBA, thus, cannot grant requests for financial assistance where this statutory criteria is not met. Both the SBA and lenders have been compelled to alter their lending practices in response to the threat of environmental liability. A recent survey by Dun and Bradstreet as well as studies conducted by the EPA and SBA revealed that prior to approving real estate and environmentally risky loans, most lenders employ site visits, environmental audits, reviews of state enforcement actions regarding a particular site, or a combination of all three.

Even when a loan is granted, lenders may require covenants in the loan agreements that require the borrower to submit periodic environmental reports and allow the lender to conduct environmental inspections over the course of the loan. The lenders take these measures to ensure that borrowers stay in compliance with all environmental laws and take the necessary steps to avoid any future environmental risk.

Many larger banks have set up separate divisions staffed with environmental professionals to develop and manage lending standards to minimize the risk. Other lenders have adopted an informal policy of refusing loans to selected businesses (e.g. gas stations, dry cleaners, chemical companies). An American Bankers Association's poll in the early 1990's showed that 43 percent of small banks had cut off or were curtailing lending to certain types of businesses, such as small enterprises...that routinely handle toxic substances.

The PLP lenders interviewed shared a wide range of opinion about liability issues. A few expressed little concern about environmental liability risk. However, that was mainly because they have had little cause to worry about such issues in their market (e.g., the community has little manufacturing activity to create any significant contamination problems). At the other extreme, a few lenders have completely restricted lending to certain small businesses solely because of potential environmental risk. For example, one lender said that he declines requests from gasoline stations unless it is backed by a large oil company. Another lender said that although his bank sometimes makes general-purpose loans to retail gasoline stations, dry cleaners, and metal fabricators, they have also backed away from a number of loan requests to these types of businesses due to the potential for on-site contamination - even if the business is "clean" at the time of the loan application. Moreover, the lender says that higher interest rates and/or periodic audits of the business' facilities do not sufficiently mitigate the problem to warrant a loan approval.

The majority of the PLP lenders interviewed are concerned about environmental issues, but do not completely eliminate lending to any particular industry. Rather, they handle each loan on a case-by-case basis. In general, these banks are unwilling to lend to businesses that have any environmental problems. A PLP lender in New York said that contamination "killed" many of his bank's real estate deals. However, he and others indicated that exceptions are made when the borrower has sufficient non-real estate assets to provide as collateral and is in good financial standing.

SBA Policy Under The Standard Operating Procedures

The SBA has also revised its lending policies in response to the threat of contamination. Its standard operating procedures (SOPs) reflect a wariness about incurring environmental liability in connection with both the provision of financing and in liquidation actions taken after default.

The SOPs governing review of applications for financial assistance under the business loan program require a Phase I environmental audit in two instances: 1) If a loan applicant falls into one of the "frequently polluting industries" listed in Appendix 7 of SOP 50 10 (1991); or 2) For companies not so listed, if a loan officer's site visit and/or the applicant's responses to an SBA questionnaire, set forth in Appendix 9 of SOP 50 10, indicate the existence of an environmental problem. A Phase I audit entails a historical review of relevant files and interviews with individuals knowledgeable about site operations. If the audit reveals significant contamination problems, the SOPs require, at the applicant's expense, a Phase II audit, which includes actual physical sampling and analyses of soil and groundwater, which should clearly identify the contamination problem, and which should contain an estimate of the cost of any necessary cleanup.

With respect to the 504 loan program, the SOP mandates that a loan authorization require that the borrower certify and warrant that no contamination has or is likely to occur, that the borrower is, and will remain, in compliance with all environmental laws, and that the borrower will indemnify SBA for any liability resulting from past, present or future contamination or cleanup responsibilities.

The SOPs also require that the applicant make available the results of any environmental checklist, analysis or audit performed by any third-party lender who is providing interim financing. The SOPs place the responsibility for determining a borrower's compliance with environmental laws and the absence of contamination upon the Certified Development Company ("CDC") that makes the loan. The CDC is required to proceed with a Phase I audit if a previous site visit has indicated the existence of contamination or the likelihood of contamination. In the event that the audit indicates "problem areas and unanswered questions," a Phase II audit is required.

In 1993, the SBA revised its SOPs for loan liquidation. Some of the most significant changes are guidelines to minimize liability for contaminated property. After a loan is placed into liquidation, the loan officer is directed to make a field visit on all loans which are secured by real estate, except residential real estate, to inspect the site for environmental problems and to complete an environmental questionnaire. A Phase I audit is required if this questionnaire indicates the possibility of site contamination or if the borrower is within one of the frequently polluting industries.

A Phase II audit is necessary if the questionnaire or the Phase I audit reveals the possibility of significant contamination problems. The SOPs advise that the high cleanup costs of contamination may render collateral worthless; abandonment of collateral may be appropriate if "the estimated costs of its disposal ... exceed the estimated sales proceeds, leaving no amount available for credit on the debt ....".

Effect Upon Small Businesses

Banks' recent measures to minimize their environmental risk have had a heavy impact on small businesses that handle dangerous chemicals or produce contaminated waste. Large companies often have a variety of assets to offer as collateral to cover any potential environmental liability that small businesses do not. Although a 1991 survey by the National Association of Manufacturers indicated that only three percent of small manufacturers had been turned down for a bank loan for environmental risk reasons, many other sources argue that the problem is much more extensive within specific industries. The Center for Neighborhood Technology noted the hardest hit are gas stations, dry cleaners, auto repair shops, metal fabricators and finishers, electronics and utility industries, tool and die shops, bottling and canning plants, waste removal and chemical companies, scrap yards, and farming operations that use pesticides.

Discussions with representatives of the metal finishing industry indicate that banks' lender liability concerns prohibit some businesses from obtaining financing for *any* purposes, including for the purchase of environmental technologies. For example, the owner of a Michigan metal finishing company said that although his facility is not contaminated and his manufacturing operations are in compliance with environmental regulations, bankers will not accept his real estate or building as collateral. He believes the problem is that most lenders are not familiar with the industry and are therefore unable to evaluate the cleanliness of the business' processes. Thus, once lenders learn that the business uses regulated chemicals, they deny the business a loan out of fear that the entire property could be contaminated - or could become so in the future.

It is important to note that not all metal finishers that the study team spoke with have faced such financing obstacles. One industry representative insisted that the only issue that concerns the banks is the creditworthiness of the borrower. However, in this case, the business owner enjoyed a long-standing relationship with his bank. Hence, the bank was familiar with the business' operations and trusted the business' management. Many small businesses do not enjoy such relationships.

While a few of the PLP lenders said that they had received loan requests wholly or partially for pollution control or prevention purposes, overwhelmingly the environmental problem faced by their customers was the cleanup of contaminated sites, particularly leaks from gasoline underground storage tanks (USTs). Small businesses under the UST umbrella include service stations, any business that sits on a site that covers USTs installed for businesses previously at that site, or any business that sits on land that has been contaminated by leaking USTs from neighboring property. The willingness of the lenders to assist customers in cleaning up UST contamination varies from state-to-state and from bank-to-bank. California has a fund that reimburses businesses for UST cleanup beyond a deductible of up to $20,000. However, the turnaround time on the fund - from completion of cleanup to receipt of reimbursement - ranges from four weeks to two years. Although it is essentially assured of eventual reimbursement, banks are often unwilling to lend the money for the cleanup because it is concerned about collateralizing a dirty piece of property. Remediation contractors are also often unwilling to wait for payment from the reimbursement fund.

Wisconsin also has a reimbursement fund for the correction of leaking USTs and petroleum spills. The Petroleum Environmental Cleanup Fund Act (PECFA) has a deductible of $2500 plus 5 percent of the cleanup costs, with a $7500 limit. The fund covers up to $1 million per case. PECFA is thought of as well-funded and very reliable. However, many banks in Wisconsin will only supply these loans to existing customers. Other banks supply PECFA loans to new customers, but only when the customer has sufficient non-contaminated assets to secure the loan. Since there are a number of service stations and small businesses that do not have the banking relationships or the collateral to secure the necessary funding, many contaminated sites are unable to take advantage of the program.

Lenders' protective measures can create prohibitive costs for small businesses.

The consulting and engineering costs of environmental audits are almost always borne by the borrower. Phase I audits generally cost approximately $1500, but range between $500 and $7,000. On the other hand, phase II audits, average around $8000, but can be as high as $60,000 or more. The PLP lenders indicated that they typically require the borrowers to pay for the audits up front and, if the loan is approved, the cost of the audit may be added to the loan principal. A few of the PLP lenders indicated that for some of their customers, the Phase II audits were cost prohibitive causing would-be borrowers to withdraw their applications. The PLP lenders also indicated that if a bank senses environmental risk in a loan, it may still approve the loan, but at less favorable terms. For example, the lenders might offer the loan at a relatively high interest rate or offer a level of principal lower than the borrower originally requested. Banks might also require their customers to purchase environmental insurance, especially for real estate loans.

Although the SBA is very reluctant to guarantee loans to contaminated facilities, a 1993 EPA study showed that some banks have managed to use the SBA's guarantee program to minimize their own risk of liability. According to the EPA's report, "one lender noted that loans to gas stations for tank conversions could only by done with a SBA guarantee."

Finally, environmental regulations create many transaction costs for small business. Environmental questionnaires, ongoing reporting requirements and audits required by lenders create paperwork as well as direct costs for small businesses. Additionally, federal, state and local environmental agencies' numerous and redundant reporting requirements put a time and financial strain on small businesses, making it more difficult to comply. Other Financing Issues????Some of the respondents of the 1991 survey of the National Association of Manufacturers noted that there is a credit crunch hitting many segments of the business community, and that lender liability is one, but certainly not the primary concern. This section addresses the non-liability issues that contribute to the difficulty that small businesses face in obtaining financing compliance equipment or pollution prevention technologies.

One of the most difficult obstacles is that the equipment for which the loans are requested does not increase business operating revenues. For example, the replacement of USTs or the installation of air pollution prevention equipment bring the business into compliance with environmental regulations (and therefore allow the business to legally remain open), but productivity and revenues do not increase. Instead, it effects cash flow negatively and the debt burden is increased.

One owner of a dry cleaning operation said that most businesses in her industry do not have established relationships with their bankers. Although her operation is large enough to support the purchase of environmental compliance equipment, she believes that many of the smaller dry cleaners are not able to afford the required equipment.

Representatives from the dry cleaning and printing industries told the study team that competitiveness in these industries prohibits businesses from passing on the costs of environmental equipment and materials to their customers. Specifically, one printing company owner said that companies need help in classifying environmental equipment for the lenders. He used the following example: "Is monitoring equipment a capital expenditure or should it be considered part of working capital needs?" The same printer had difficulties switching to the use of an environmentally-sound cleaning agent because the new cleaning agent is more labor-intensive and requires more machine down-time. His bank would not make loans that reduced productivity.

As is the case with developers, lenders appear uncomfortable working within an arena of stringent and changing government regulation. Bankers and borrowers alike are concerned that a technology or standard which is required today may change within a few years, wasting money, and possibly requiring another investment in equipment. Norman F. Peters, Executive Vice President at Texas Commerce Bank told the study team that banks are also concerned about the "intrinsic value of the environmental technology as collateral." A lack of familiarity with environmental technologies makes it difficult for lenders to estimate the resale value of the technology. Indeed, the uncertain nature of environmental regulations makes it difficult for banks to not only anticipate the technology's obsolescence factor, but to determine the number of years over which to amortize the loan.

One recurring theme the study team encountered was that business owners who did enjoy a good banking relationship prior to a compliance requirement, or before discovering contamination on the property, had a much better chance at having their loan approved. Therefore, a bank's long standing familiarity with the business appears to be crucial.

Regulatory Awareness

Many small businesses are unaware of environmental regulations. An EPA Region III study of the banks in that area reports that "many of the lenders commented that they found themselves educating, or counseling, the small businesses about environmental regulations. They cited instances when companies only became aware of certain regulations or that they were in violation because they requested bank financing and needed an environmental audit." Companies that seek to comply with environmental regulations do not always know how to comply. For example, one PLP lender said that small businesses are sometimes aware that they were using regulated hazardous materials, but did not comply with hazardous waste disposal regulations because they did not know where to dispose of the waste. Representatives of the printing industry also told the study team said that within that industry there is considerable confusion as to what environmental regulations require of them. According to EPA's 1994 Permit Improvement Team's study, many small businesses have no understanding of the State and Federal regulatory requirements. These businesses are too apprehensive to seek Federal or State regulatory assistance. Others wait until an enforcement action is levied against them to come into compliance.

These comments are consistent with the findings of the Small Business Forum on Regulatory Reform (the Forum). The Forum was co-sponsored by the SBA and Office of Management and Budget's Office of Information and Regulatory Affairs (OIRA) in 1994 to "address both the concerns of small business and the need for more effective regulatory compliance."

Industry Working Groups of the Forum found that although most small businesses want to comply with regulations, they often lacked the necessary information to do so. Two of the main issues and concerns that the Forum identified were: 1) The uncertainty of small business owners as to which regulations apply to them and the need for more effective communication of compliance requirements to small business; and 2) The inability of small business owners (because of limited temporal, financial, legal and technical resources) to comprehend overly complex regulations and those that are overlapping, inconsistent and redundant.

It is clear that small business needs a better understanding of the regulatory arena both for the purpose of learning what environmental regulations require of them and for the purpose of commenting on proposed regulations. The Environmental Products, Recycling and Waste Management/Disposal Industries Working Group of the Forum reported that many small businesses do not subscribe to the *Federal Register*. Instead they rely on accountants, attorneys, and trade associations for their regulatory information. However, the former two groups are too expensive for small businesses to afford on a continual basis, and the trade associations reportedly only able to focus on the proposed regulations with the biggest potential impact.

As mentioned earlier, the Chemicals and Metals Working Group discovered that many small businesses were reluctant to contact regulatory agencies for advice on regulatory compliance out of fear that the agency will send inspectors to the inquiring business and punish any violations uncovered. Along the same lines, the Environmental Products, Recycling and Waste Management/Disposal Industries Working Group found that small businesses perceive that agencies are more concerned with assessing penalties and fines than helping small businesses achieve compliance.

Lack of financial incentives for environmental compliance and pollution prevention was frequently cited as a reason that small businesses do not expend the time and effort to learn of environmental regulations and examine the possibilities for pollution control and prevention. The Forum noted that tax policy does not encourage capital expenditures to comply with environmental regulations. Moreover, the EPA Region III report stated that most of the lenders contacted in the study felt that, given small businesses' time and resource constraints, it is difficult to convince them of the merits of pollution prevention unless there were tangible benefits or monetary incentives.

Technical Guidance

The Forum's Chemicals and Metals Working Group found that more technical guidance and educational materials are warranted to help industry comply with regulations. The available technical guidance does not include specific, understandable information on regulatory responsibilities and requirements, or proven technical procedures and approaches for managing and controlling environmental emissions. Among the suggestions offered by small business were: Industry specific guidance that cuts across all regulatory programs; The development of more technical information and delivery systems, such as use of limited third-party assistance, to communicate requirements; Additional educational materials and information kits suitable for the small business audience; and more consultation with small business trade associations, state and local government; and other agencies when developing educational guidance on compliance methods.

Chapter 4.

Policy Alternatives for Discussion

The Regulatory Process

Underlying all of the discussion points is the understanding that both demand for the products of this industry and their supply are strongly influenced by the nature of the regulatory process. Without regulations, the demand for the goods and services of this industry would be very low. And we have found, through the course of this study, evidence of an important feedback loop between the regulatory process as it exists today and the willingness of capital providers to invest in new technology for this industry.

In each of the following ways, the regulatory environment is an important determinant of the perceived shortfall of capital for new environmental technology from small companies.

- Delays and Uncertainties Surrounding the Permitting and Approval Process. Regulatory approval of new technologies is slow and uncertain. Regulatory jurisdiction is fragmented.

Every state has its own regulatory bodies, and approval in one state does not automatically bring approval in any other jurisdiction. All of this adds cost and risk to the developers and those who finance them.

- Performance Standards versus Specific Technology.

Many environmental regulations specify that a particular technology must be used, thus stifling the development of new technologies that might do the job better or cheaper. Instead, specifying a performance standard and leaving the technology for the marketplace to decide can lead to new technologies and improvements to existing ones.

- The Lack of a Nationwide Process for Certifying the Effectiveness of New Technologies
- The Lack of "Hold Harmless" Testing of New Technologies The Lender Liability Problem

Each of these can be expected to retard the development of new technologies, and indeed each of them does. This should come as no surprise. The economic system is functioning as one would predict. None of the remedies discussed below will be effective so long as these problems persist. Fortunately, the EPA is well aware of these factors and are at the forefront of the Environmental Technology Initiative.

The President has issued an Executive order requiring agencies to identify and address available alternatives to direct regulation, such as user fees or marketable permits. The Order also requires agencies to consider incentives for innovation and to specify performance objectives if possible, rather than specifying the behavior or manner of compliance that regulated entities must adopt.

Permitting

Developers and investors uniformly request that the permitting process be streamlined. Many investors suggested a certification process for streamlining permits (See below). A technology certification process would eliminate the engineering review process required for permit decisions. State and Federal permit writers would use the specific certification claims as their engineering decision in the permit process. Developers also suggested that clarification materials (e.g., a flow chart) be created for developers, and that reciprocal agreements be developed between states. State environmental offices and the U.S. EPA realize the problems contained in current permitting procedures and are taking steps to reform them.

Recently, the EPA established a Permits Improvement Team to improve the process for obtaining environmental permits. The team is currently addressing the recommendations developed by the Agency as part of the Vice President's National Performance Review.

The Permit Improvement Team is made up of regulators from EPA, state, tribal and local governments. The team conducted five national stakeholder meetings throughout the country. The results from the meetings will be presented at the White House Conference on Environmental Technology.

Another measure taken by the EPA to improve the permit process is the Common Sense Initiative. The initiative is designed to achieve greater environmental protection at less cost by creating pollution control and prevention strategies on industry-by-industry basis, rather than by the current pollutant-by-pollutant approach.

The Common Sense Initiative is expected to result in significant improvements to current regulations (including permitting requirements), as well as proposals for Congress to consider in cases where legislative reforms may be required. Consensus proposals generated by the Initiative will be designed to better protect the environment, reduce pollution overall in the U.S., and reduce by millions of dollars the costs that industry faces.

The six industries selected by EPA's Administrator Browner to participate in the "pilot" phase of the initiative are: auto manufacturing, computers and electronics, iron and steel, metal finishing and plating, petroleum refining, and printing.
Testing and Certification

Developers and investors uniformly request that the EPA put more resources into testing technologies for their ability to meet standards, either by conducting this testing itself or contracting it out to a non-government entity.

The shortage of testing venues can be partly eliminated by making use of contaminated federal facilities. The Western Governor's Association has done precisely this by picking 13 sites to test 20 innovative environmental technologies, ranging from mixed waste to groundwater cleanup techniques.

A public/private partnership at federal facilities has been developed to evaluate innovative hazardous waste treatment technologies. The scope of this initiative is to obtain market, regulatory and public acceptance of hazardous waste innovative treatment technologies through full-scale demonstrations. Clean Sites, Inc. (through cooperative agreement with the EPA) is working with a number of organizations to establish partnerships between federal agencies, federal and state regulators, and fortune 500 companies to demonstrate and evaluate innovative treatment technologies. These systems target contamination problems of mutual concern at federal facilities and private sites across the country. Although this initiative is limited to Fortune 500 companies and hazardous waste remediation technologies, small businesses require similar programs to address the generic problem of full-scale demonstration through the use of a federal partnerships.

The EPA's Design for the Environmental Program is a partnership initiative designed to assist small and medium metals manufacturers with innovative treatment technologies, pollution prevention opportunities, and compliance information and assistance. Partners for this project are between industry and government and include: Sandra National Laboratory, the National institute of Standards, The Manufacturing Technology Centers of the Midwest and Great Lakes, and the EPA.

Another important improvement is to allow selected sites to be used for testing new technologies with a hold-harmless provision if the technology does not meet the target standards. Current practice creates a disincentive to allow one's business or property to be used to test a new technology, because if the technology fails to meet the standards, the business has undergone the expense of the new technology and it is still liable for further cleanup or to buy yet another technology. One expert recommended that a user be allowed to contract with a developer to test a technology so that if it worked, the user would pay a previously agreed upon price for the service. If it did not meet specifications, the user would not have to pay for the technology, nor would it be liable for further cleanup. The cost would be borne by the developer, the government, or by cost-sharing. The EPA could work with the thirty-nine state Science and Technology Foundations. These organizations have technical departments that can identify and evaluate environmental technologies. Panels of scientists from these organizations be used to locate environmental technology entrepreneurs, to oversee the testing, and to administer the funds.

Sites should be chosen so that a failure of the technology would not be catastrophic to the local environment. There should be many such sites available. With all the pollution of the earth that is taking place, surely there will be no significant additional deterioration of the environment from such failures of technology, while the potential benefit from technologies that can be proven to work is enormous. Many individuals interviewed call for a national technology certification process that functions much like the FDA drug approval process. Under such a scenario a product must pass through one set approval process. Once it passes those tests, it receives a "stamp of approval" for use anywhere in the country with similar types of clean-up activities.

Such a process would serve to streamline the permitting process because it would eliminate the need for a series of site-specific tests. This would drastically reduce permitting delays and therefore reduce one of developers' major financing gaps. It would also help greatly in selling U.S. products abroad. The EPA stamp of approval that "this technology works" is a powerful selling tool for American businesses.

Developers and investors call for an EPA certification process per se not only because it would eliminate testing repetition (except where state and local standards are higher than those of the EPA), but also because it would give potential users confidence in the technology - domestically and internationally.

Investors are not requesting that the EPA select and support specific technologies. Rather, they prefer to see that the EPA set the standards, create a well-developed body of technology performance data across a range of conditions, and in the certification process simply verify that the technology meets those standards or, more simply, that the product label accurately reflects how the product performs.

Certification measures are being taken in some places of the country. California has just developed its own certification process to streamline that state's permitting practices. The program is well-heralded by investors and there are expectations that it will be replicated in other states. Additionally, the Western Governors Association is examining the possibility of creating approval reciprocity among thirteen states.

Lender Liability

A discussion of the various means of mitigating the effect of environmental liability upon the lending and small business communities would be incomplete without an examination of the current contradiction between the SBA's role as a lender of last resort -- which is generally recognized as being of great significance to small business development -- and its potential liability for environmental contamination for which it is not responsible.

Congress has created and funded the SBA to provide financial assistance to small businesses in recognition of the great difficulty these firms frequently experience in obtaining credit and the importance of the small business community towards the country's economic expansion. This role is hampered by the congressional waiver of the SBA's sovereign immunity from environmental liability under state and federal laws, and the inconsistent and vague statutory protection for lenders from environmental liability generally. Similarly, the historically aggressive role taken by enforcement officials at the EPA and state agencies towards the SBA, which is frequently viewed as a "deep pocket" with the resources to fund a cleanup operation, has contributed towards the Agency's reluctance, and inability, due to limited resources, to provide financing if there is a risk of liability.

In view of the benefit to be gained by facilitating SBA financing, the premise underlying the Agency's environmental liability is questionable since SBA, unlike other federal departments and agencies, has not created or contributed to hazardous contamination around the country. Thus, there is no compelling reason to support the conclusion that SBA should bear the same sort of liability for environmental problems, especially when these are caused by third parties, not the Agency.

Lenders are not going to make loans unless their concerns are addressed, because their obligations to their stockholders and account holders place upon them an obligation to exercise due diligence in avoiding unacceptable risk in their loan making. Bank regulators will put loans with unacceptable liability risk into special classifications, with undesirable consequences for the bank and the employee that made the loan. All-out pursuit of the deep pockets of lenders may increase funds for environmental cleanup in the short run, but at present and for the future it is stifling the flow of funds to businesses in which there is a risk of lender liability. The economy is an interrelated system. Actions result in reactions. Suboptimizing in one part of the system can result in a failure to optimize the system overall.

At a minimum, Congress should clarify and expand the protection given lenders under the Superfund statute, and extend this protection to other environmental laws. Congress and the EPA should also eliminate the contradiction between SBA's role as a lender of last resort and its exposure to environmental liability by specifically limiting the liability of SBA under federal and state laws, which would greatly enhance the SBA's ability to provide credit to needy small business.

In formulating our policy alternatives, we have looked for ways to use existing programs to better serve the needs of this industry, rather than creating new programs and new bureaucracies. Fortunately, there are a number of existing programs that can be better targeted at this industry. We have also used the framework set forth in the President's *Technology for a Sustainable Future: A Framework for Action.* Our policy alternatives follow the strategy of focussing upon regulatory policy, market stimulation, fiscal policy, partnerships, education & training, and information dissemination.

In addition, we must recognize the budget realities of the 1990s. There are no funds available for a new program of grants, loans, or loan guarantees targeted at the environmental technology industry, and no such programs have been recommended here. Policy Alternatives calling upon additional SBA resources, *both dollars and staffing, are assumed to be funded out of appropriations for the* Environmental Technology Initiative.

The Innovation Process

The innovation process consists of a number of stages. Various observers have given them different names but in general they subscribe to the states described in Figures 1 - 3.

The consensus of interviews and the literature is that financing for the early R & D stages is generally adequate. Likewise, once a company and a new product have proven that they can generate sales, financing is available. It is in the in-between stages that capital to finance a working model, engineering prototype, and production prototype is very hard to come by. This is a fact of life for all small firm developers of new technology, but it is especially acute among environmental technology developers for the reasons cited above.

The Federal budget for environmental technology programs was more than $4 billion in fiscal year 1994. "These programs are primarily focused on the front end of the continuum --technology research, development, and demonstration -- with little funding, in comparison, directed to commercialization. . ."

Policy Alternatives for Financing Developers

The Environmental Technology Bank of the United States (Envirobank)

Even though we believe that regulatory problems are an important determinant of the financing shortfall, we nevertheless think that to optimize this industry's performance, improvements in financing are needed as well as improvement in the regulatory process. There are two principal reasons for this:

- Public Good. Because of the public good nature of environmental preservation, there is a rationale for public sector involvement. In general, the private market will not bring forth an optimum amount of environmental preservation because many of

the benefits accrue to the public at large rather than to individual customers, and providers do not receive revenue from these beneficiaries. International Competitiveness. This is an industry in which in most areas the U.S. is still pre-eminent in the technology. However, Japan and Germany are gaining. In some areas they have already surpassed us. The growth potential of this market world-wide is enormous. Eastern Europe, Asia, Africa and South America will have a huge and growing demand for these services in the next decade. This industry should be on our list of critical technologies. Upon the success of this industry will depend many high paying jobs, exports, and part of America's technological prestige world-wide.

We should not let this be another industry in which we were once pre-eminent but lost our lead to others.

The proposal is to create the Environmental Bank of the United States. The bank would be a small business investment company (SBIC). SBICs, licensed and regulated by the SBA, are privately owned and managed investment firms. They use their own funds, plus funds obtained by borrowing at favorable rates with an SBA guarantee and by selling their preferred stock to SBA, to make venture capital investments in small businesses. The SBICs provide equity capital, long-term loans, debt-equity investments and management assistance to qualifying small businesses. Their incentive is the chance to share in the success of the small business as it grows and prospers. Many SBICs specialize in the field in which their management has special knowledge or competency. We have found that there is a variety of types of financing that these businesses need, depending upon the stage of development of the firm and of the technology. We also found that only about five percent of U.S. venture capitalists actively invest in the environmental technology industry and that even among those, there is a movement away from early-stage investing.

Envirobank can provide a wide variety of financing to small environmental technology businesses: equity, debt, debt with equity features, strategic partnerships with large businesses, promoting the use of informal investors, etc. As a venture capitalist, it can also provide the management assistance many of these firms badly need.

The Envirobank would concentrate on the environmental technology industry. And it would, by design, fill a gap and provide more upstream funding than venture capitalists are doing today. However, it would be operated by professional venture capitalists with the goal of providing a competitive risk-reward structure to its investors. This cannot be an organization that shovels money out the door simply in order to say that it is helping firms with great ideas for saving the environment and no one else will listen to them because they don't have a track record. Envirobank's investments must be profitable. It must invest in companies with sound management or provide the assistance necessary to add good management to a promising technology. Otherwise Envirobank will not survive, and the government's and the private sector's investments will be lost.

This would not be an ordinary SBIC. But the SBIC program and structure are flexible enough to enable the SBA and the EPA to facilitate the creation of such an SBIC. Financing commitments would be sought from a number of sources including the following:

- *Foundations. Large and small foundations will be solicited to invest part* of their investment portfolios in the SBIC. They would not have to make grants. Investment Banks.
- Pension Funds
- Trade Associations
- States, cities, counties. These entities can invest

up to 30% of an SBIC's non Federal dollars. They could make grants or invest their investment funds. State x, for example, contributes $1 million. This is matched by $3 million of SBIC federal leverage. The $4 million can be set aside for firms located in state x. This gives these entities a way to leverage their own dollars.

- Private Investors. The SBIC could sell shares to individuals either through private or public offerings. A large part of the American public are sufficiently concerned about environmental preservation that they would invest in an enterprise that would help preserve the environment and earn them a profit at the same time. For example, mutual funds that invest in non-polluting companies have raised millions of dollars from investors.

The key to the success of Envirobank is the quality of its own management. The first step would be to find a high quality investment manager who would be interested in running such an organization. Such an individual will be the magnet for the investors. The next step would be to do a rigorous feasibility analysis of the desirable size of the organization in terms of staffing and funding, a risk-return analysis, etc. Next, the SBA and the EPA would facilitate communication with potentially interested participants, such as investors, venture capital experts, environmental technology experts, etc. It would be appropriate for the EPA to take the lead role in this next phase in order that the SBA's licensing, funding, and regulatory role with respect to the SBIC industry not be compromised.

SBA's funding will come from a transfer of funds from EPA. Forty-five million dollars in private sector funding would leverage $90 million in participating securities, which is the current ceiling. For budgetary purposes, SBA assumes leverage will be drawn down over four years, or at the rate of $22.5 million per year in this case.

With the current Participating Security subsidy rate of 8.9%, subsidy budget authority of $2 million per year for four years would be required to fund Envirobank at this level. With the leverage fully drawn down, Envirobank would have a total initial capitalization of $135 million. This plan achieves the ETI goal of working through partnerships. This would be a partnership between SBA, EPA, and all the private sector entities, states, cities, etc. that would be involved.

More Effective Use of the SBIR Program for Environmental Technology

The Small Business Innovation Research (SBIR) program was designed to assist small technology-based firms that are in the "valley of death" stage of their development. Each federal agency with an extramural research and development budget in excess of $100 million must establish an SBIR program, under which it sets aside at least 1.5 percent of its R & D budget in 1993 and 1994, at least 2 percent in 1995 and 1996, and not less than 2.5 percent thereafter. Eleven agencies currently participate. The program has three phases:

- Phase I awards are funded up to $100,000 and are made for research projects to evaluate the scientific and technical merit and feasibility of an idea.
- Phase II awards are for the most promising Phase I projects, and are made to further develop the proposed idea for one or two years. Most of these awards are for $750,000 or less.
- In Phase III, an innovation is brought to market by private sector investment and support. No SBIR funds may be used, but Phase III may include follow-on production contracts with a federal agency for future use by the government.

The program is working well across the board. However, the flow of funds into the environmental technology industry has been rather small. Although precise estimates are difficult to make because there are no unique SIC codes for the environmental technology industry, SBA's Office of Innovation, Research and Technology estimates that government-wide in fiscal year 1991 only $3.6 million out of $483 million in total awards went to environmental technology. At the EPA, only 45 such awards out of more than 2,000 were made.

Because of the importance of this industry both to the protection of our environment and to America's international competitiveness, we recommend that agencies whose research mandates include activities falling under the environmental technology umbrella, consider targeting more research topics and funds into this area. Since these budget allocations are normally made on a decentralized basis by each agency, Office of Management and Budget involvement may be necessary to realize a significant funding increase.

Technical Assistance Centers.

Lack of information by lenders is an impediment to the flow of capital into small environmental technology companies. If a lender is not comfortable with his understanding of the amount of risk involved in a business, it is not prudent for him to make a loan.

There exist across the country many organizations that could be configured to provide technical assistance to lenders on various aspects of environmental technology. These would include, for developers, an assessment of the firm's technology (both the technology it is selling and the technology it uses to manufacture what it sells) and management. For users of environmental technology (discussed in the following section) the assessment would focus on the technology to be purchased by the firm, its technical feasibility and its effect on the firm's rate of return. Consider environmentally-friendly ink for the printing industry as an example. An assessment would answer such questions as "does it work, if so does it require more down-time to clean the presses, what effect does this have on profits, is there an alternative process that is as friendly to the environment but not so costly to the bottom line, etc.?"

Existing government-financed technical assistance networks include Small Business Development Centers, National Institute of Science and Technology Centers, and centers that are in the network of the National Coalition for Advanced Manufacturing, among others. Technical assistance could be provided via training courses, a national computer network or on a case-by case basis. The facility could be created initially with government funding and its ongoing expenses paid for as much as possible by fees charged to its customers.

Strategic Partnerships and Informal Investors

The study team encountered a great deal of support for developers bridging the financing gaps and obstacles mentioned earlier by joining forces with a "strategic partner." These partnerships may be with medium to large businesses, potential users, public sector groups, equipment manufacturers, larger environmental vendors, academia, R & D institutions, or some combination thereof. These alliances can various many forms, such as joint ventures and licensing agreements.

Strategic partnerships have already become so critical to environmental technology start-ups that small, entrepreneurial companies are hiring management consulting firms to create linkages into the marketplace, mostly through partnerships.

Strategic partnerships make sense as capitalizing upon unique aspects of American competitive advantages, joining small technology-based firms that are world-renowned as the most efficient producers of technological innovation and larger firms that are better at raising capital and manufacturing and selling a product.

Examples abound of how environmental technology developers have used strategic partnerships to their advantage - if only to stay alive. Unfortunately, out of an inability to secure sufficient financing or partnership agreements with domestic organizations, many environmental technology developers opted or were forced to develop partnerships with foreign companies and other investors. One of the consequences of this situation is that technologies that were originally developed in the United States - many with public R & D monies - are sent overseas to be manufactured into products that are exported back into the U.S.

On future grants and contracts the government may wish to require that, if owners of technology financed in whole or in part by the U.S. taxpayer wish to sell to or form partnerships, etc. with foreign-owned companies, the government funds used to develop the technology be repaid with interest to the government. The repayment should be placed in a special fund at the Envirobank to finance environmental technology development and commercialization. Requiring repayment would help close a leak in the system in which the benefits of government-financed R & D are going to the competitors of American business.

Another source of financing that appears underutilized is the wealthy private individual investor, sometimes referred to as "angels" or "informal investors." Typically such individuals seek out investments not only for economic but for noneconomic reasons such as the excitement of working with bright young people in an exciting growth company, or satisfying their sense of social responsibility. They find out about deals informally, by referrals from friends or acquaintances in the banking, investment, legal or accounting communities.

"The private investor's resources are considerable, with their venture investment portfolios aggregating in the neighborhood of $50 billion according to a study carried out by William Wetzel for the SBA in 1989. Acting alone or through a syndicate of friends and acquaintances, he can raise as much as $1 million for a given deal. . . Occasionally the prospective individual investor participates in local groups like the MIT Enterprise Forum, where early-stage entrepreneurs present their aspirations and problems. . . Such investors rely heavily on the advice of their friends and other backers when making investment decisions. Few make a detailed analysis of the situation, evaluating the company primarily on the basis of its management. . . The investments are usually straight equity. Thus, the entrepreneur needs only to find the right angel for his company. This is not easy. . ."

The SBA or the EPA could provide or facilitate a mechanism to match environmental technology developers with potential strategic partners and informal investors. There was tremendous support for the idea. Small businesses do not have the resources to gain the necessary information and contacts to locate suitable partners. Thus, an inexpensive, efficient and neutral arbitrator for partner matching would be of great assistance to them. The SBA act could as a clearinghouse for a partnering system, with data collected locally or regionally and maintained in one central location. The Envirobank could also play a role.

The Commercialization Matching System (CMS) of the SBA's SBIR program might be adapted for this purpose. This system was designed to link potential sources of capital with high tech firms that are participating in the SBIR Program. This free service provides investors with a list of SBIR awardees, and provides awardees with the names of investors that would consider financing an SBIR company. Currently the 22,000 SBIR awards given during the last 11 years are on the system. Six hundred private venture capital firms are also listed.

Reliable sources of data will be needed. Over the course of this study, the SBA has encountered a number of organizations that might qualify as appropriate partners. The SBA or EPA could also facilitate the expansion of the MIT Forum concept to other areas of the country in which the environmental technology industry is concentrated. Please see the Appendix 2 for additional information.

Defense Conversion and Environmental Technology

The SBA and the Department of Defense are collaborating on the Defense Dual-Use Loan Program on a pilot basis nationwide. Pursuant to a Memorandum of Understanding with the Department of Defense (DOD) and utilizing funds transferred from DOD, SBA will guarantee loans made by its participating lenders to defense dependent small business concerns. The purpose of these loans is to enable such concerns to diversify their revenue sources while retaining them in the national technical and industrial base for the DOD. Recipients of DDLP loans must be dependent on defense contracts as wither prime or subcontractors.a program to assist small defense contractors in adapting to the conversion from defense to civilian production. We anticipate that some of these technology-based firms will be capable of adapting their know-how to the environmental technology industry. SBA will optimize the delivery of these services to firms going into environmental technology activities.

For Future Consideration: A Commercialization Loan Program.

There was considerable interest expressed in a dedicated loan program targeted specifically at environmental technology firms entering the commercialization phase of their development. With rare exceptions, SBA has not targeted its loan programs at a particular industry. Two exceptions are the Pollution Control Bond Program and the Energy Loan Program, in both of which SBA suffered heavy losses. SBA's Energy Loan program provided loans and loan guarantees for small businesses for the design, engineering, manufacture, distribution, market, installation, or servicing of energy measures. SBA was authorized to take greater risks than it does in its other loan programs. The loss rate to date on this portfolio totals 44%.

These results indicate what can happen if, for whatever well-intentioned reason, the element of risk is under-represented in the credit decision. What begins at the outset as an exciting enterprise to further technology can wind up as a liquidating portfolio of mostly dead businesses, tremendous losses to the taxpayer, and little advancement of successful technology.

If the risks are at commercially realistic levels, environmental technology firms can qualify for SBA 7(a) and 504 loans today.

In addition, we believe the alternatives discussed here should be considered as the highest priority. If well-implemented, they will provide the proper basis for attaching this problem, especially the Envirobank, which can offer an array of debt, equity, and hybrid financing tailored to the needs of the individual firm. We recommend, therefore, that a commercialization loan program be deferred for further study, pending the outcome of the other alternatives.

Policy Alternatives for Financing Users

A nation's firms gain competitive advantage if domestic buyers are, or are among, the world's most sophisticated and demanding buyers for the product or service. Such buyers provide a window into the most advanced buyer needs. . . Sophisticated and demanding buyers pressure local firms to meet high standards in terms of product quality, features, and service. . . The presence of sophisticated and demanding buyers is as, or more, important to sustaining advantage as to creating it. Local firms are prodded to improve and to move into newer and more advanced segments over time, often upgrading competitive advantage in the process.

The strategy set forth in these pages recognizes the interplay between technology developers and technology users. We aim not merely to facilitate the ability of small business users to attract capital for their purchases of environmental technology, but to help them become world-class consumers. "Buyers are demanding where the product needs in an industry are especially stringent or challenging because of local circumstances." There is no necessary conflict between stringent environmental standards and economic advance. Stringent domestic standards can help keep the American environmental technology industry world-class. Lender and small business education as set forth below are aimed at facilitating the growth of user and lender sophistication.

Environmental Protection Fund

In 1978, the SBA established a Pollution Control Bond Program to assist small businesses to prevent, control, or abate pollution or contamination. The program offered a 100% guarantee on tax-exempt industrial revenue bonds.

In its ten years of existence, the program guaranteed 263 loans that ranged from $80,000 to the cap of $5,000,000, and averaged $1,200,000. However, the program faced many difficulties. Its twenty-year repayment term was much longer than the life of most of the purchased equipment, allowing for technological innovations and new environmental laws to render the equipment obsolete. Thus, the equipment often lost its value as collateral early in the loan term.

The lengthy repayment schedule combined with liberal collateral requirements and high bond issuance transaction costs resulted in an excessive high-risk program for the SBA. This risk eventually was reflected in the portfolio's performance. Nearly a third of the loans have been charged off.

Other factors contributed to the program's failure. In the early 1980's, the program lost its tax-exempt status. Moreover, in an effort to reduce its portfolio risk, SBA's had to increase its collateral requirements. By the late 1980's, only two or three loans were guarantied under the program per year.

In 1988, the program was replaced with the 7(a) Pollution Control Loan program. The Pollution Control Bond exists today only as a liquidating portfolio.

The Pollution Control Loan program authorizes SBA to provide financial assistance to eligible small business companies for the financing of the planning, design or installation of a pollution control facility. Applicants must meet the eligibility and credit criteria applicable to all 7(a) loans. Since regular 7(a) loans can be used for the same purposes, the only practical difference is that the guarantee maximum is $750,000 for regular 7(a)'s and $1 million if the loan is for pollution control purposes.

One way to address the concerns raised by small business users is to note that the imposition of environmental requirements will have the effect of internalizing the cost of production: production costs will rise more or less proportionately for all firms in the same industry; product prices will rise accordingly, and a new equilibrium will be established in which, depending upon demand and supply elasticities, prices will be higher and output smaller than before. Some firms will leave the industry, and resources will be freed for more productive uses elsewhere. That is the prediction of economic theory, and there is no reason to believe that this will not happen. The policy prescription following from this analysis is that no additional governmental action is necessary.

This is reinforced by the availability of SBA guaranteed loans that can be and are used for such purposes, provided that the risk is within acceptable parameters. However, due to the existence of the lender liability problem and in an effort to help the market over a time of transition to more stringent environmental requirements, policy makers may wish to consider creating a fund for small business-dominated polluting industries, such as dry cleaners, printers, jewelry manufacturing, etc. All firms in the named industries would pay a small percentage of their revenues into the fund. Then they could receive financial assistance (grants, zero or low interest loans, etc.) to fund their purchases of pollution control or prevention technology. In this way, the industry and its customers would finance the pollution costs associated with the industry in the form of user fees. The industry's customers would thus finance the environmental preservation costs produced by the products they buy. The cost of preventing environmental damage would thereby be internalized to that industry rather than being paid by society at large.

Lenders would not be asked to fund investments that do not add to the bottom line or that subject them to potentially costly liability. All firms in the industry would be treated the same. This would be analogous to the fund to finance the cleanup of underground storage tanks in Texas and to programs in Germany, Japan, and Sweden.

Lender Education

We previously recommended the creation of a national network of technical assistance centers in conjunction with the National Coalition for Advanced Manufacturing (NACFAM) that would work with SBA, the EPA, private lending institutions, and certified development companies to qualify small environmental technology firms technically for loans.

These centers would also work with lenders and technology users. They would perform a technical assessment of the loan application to determine whether a firm's purchases of pollution control or pollution prevention equipment, software or processes would increase the firm's performance vis a vis the regulatory requirements and thus its ability to re-pay the loan.

Small Business Education

As Michael Porter noted, sophisticated domestic buyers of technology help producers become world class by demanding the best products. The Small Business Development Center (SBDC) program, sponsored by the SBA in a cooperative effort with the private sector, the educational community, and Federal, state, and local governments, is ideally suited to provide education to small businesses on how to buy and use environmental technology. The 57 SBDCs provide management and technical assistance counseling services and training opportunities for present and prospective small business owners in over 960 locations nationwide. The SBDCs work with paid, private sector consultants, engineers, and testing laboratories to provide clients with specialized expertise.

The SBA and EPA are already looking into ways to utilize the SBDC network for educating small business owners on adopting environmental technologies. The FY 94 Environmental Technology Initiative funded four pollution prevention assistance pilot programs which will assist technology users to become, among other things, sophisticated buyers. A nationwide program delivered through the SBDC network is recommended.

In addition, at the initiative of the EPA Ombudsman, a government-industry working group will be convened in which the EPA, SBA, Internal Revenue Service, and the banking industry will discuss issues and recommend solutions to address the problem of businesses obtaining loans for the installation of pollution control equipment and for the employment of new technologies.

Information gathered from these meeting can be disseminated through the SBDC network.

Policy Alternatives: A Final Word

We have attempted to suggest remedies built upon the complex and interrelated nature of the environmental technology industry: the interplay between regulators, developers, users, and sources of finance. Our points address each of these. It would be simplest to recommend freely available loans and grants, but funding on demand would not accomplish the goal of developing an ever more flourishing industry. Instead we stress the importance of improving the regulatory environment, using existing programs better to provide capital and management assistance to qualified developers, providing technical assistance to lenders in understanding environmental technology, promoting strategic partnerships and informal investors, providing a new and better source of financing to users, and educating small businesses to become world-class consumers of environmental technology.

This Report represents the analysis of SBA staff, and are not the official recommendations or policies of the SBA, the EPA, or the U.S. government. In the interest of improving small businesses' access to capital for the development and utilization of environmental technology, the SBA looks forward to further collaboration with the EPA to bring mutually acceptable ideas to fruition. It is SBA's understanding that funding for such projects and SBA's associated staffing requirements will be provided through the budget of the Environmental Technology Initiative.

Appendices

Appendix 1 - Memorandum of Understanding:

United States Small Business Administration and United States

Environmental Protection Agency on Environmental Technology and Small Business.

I. GOAL

WHEREAS, it is the mission of the U.S. Small Business Administration (SBA) to provide technical, financial, and management assistance to the small business community to foster job creation and economic growth, and the environmental technology industry is identified as a high-growth segment of the U.S. economy with enormous export potential;

WHEREAS, it is the mission of the U.S. Environmental Protection Agency (EPA) to exercise regulatory responsibility for the prevention, control and abatement of pollution in all media: to develop and disseminate technical information that will assist the private sector to achieve environmental compliance and improvement; and to provide leadership in developing voluntary cooperative programs with other Federal agencies and with the private sector to enable U.S. business to develop, demonstrate, evaluate, market and adopt cost-effective environmental (including pollution prevention) technologies and approaches to achieve environmental compliance.

THEREFORE, EPA and SBA agree to work cooperatively, through this Memorandum of Understanding (MOU), to ensure that the U.S. Government effectively encourages, supports and enables U.S. small businesses to develop, market and/or adopt cost-effective environmental (including pollution prevention) technologies to achieve economic growth and environmental compliance.

II. AUTHORITIES

Nothing in this MOU alters the statutory authorities of SBA or EPA. This MOU is intended to facilitate cooperative efforts by both agencies for mutual provision of technical, management, and financial assistance to small businesses developing or adopting environmental (including pollution prevention) technologies. This MOU does not supersede or void exiting understandings or agreements between SBA and EPA.

III. OBJECTIVES

A. SBA and EPA will identify the management assistance needs of environmental technology developers and establish a program where those needs can be met utilizing the Small Business Development Center (SBDC) network, and other SBA resources.

B. SBA and EPA will identify the funding needs of environmental technology developers and determine if existing SBA programs satisfy this industry's requirements and, if not, what SBA can do to meet their needs.

C. SBA and EPA will develop a strategy, utilizing the SBDC network and other SBA resources, to provide multi-media pollution prevention technical and financial assistance to small business.

D. EPA will train SA and SBDC personnel on EPA regulations and develop a strategy to inform and assist small businesses with EPA regulations.

E. SBA and EPA will develop a strategy to encourage environmental technology developers to export.

F. SBA and EPA will work together to identify regulatory reform approaches to ease the burden on small businesses.

G. SBA and EPA will participate in joint conferences to provide both management and technical assistance to small business.

IV. RESPONSIBILITIES

A. On the Part of SBA

1. To designate appropriate Points of Contact to promote coordination and complementary funding, assist in arranging joint program and project planning, and assist in the creation of joint public-private programs.

2. To support selected EPA programs by providing SBA technical expertise, resources, and facilities.

3. To support the exchange of information between the agencies.

B. On the Part of EPA

1. To designate appropriate Points of Contact to promote coordination and complementary funding, assist in arranging joint program and project planning, and assist in the creation of joint public-private programs.

2. To support selected SBA programs by providing resources and/or technical expertise.

3. To support the exchange of information between the agencies.

C. On the Part of EPA and SBA

1. To authorize the Points of Contact designated by the two agencies to arrange for periodic meetings of appropriate management and staff from the two agencies.

2. To provide opportunities for personnel to better learn the policies, programs, and activities of both agencies and to efficiently use the mechanisms and experience of the other agency.

3. To support each other on policy and technical issues.

4. To reference this MOU in any supplemental understandings, amendments, or interagency agreements (IAGs) prepared to implement cooperative efforts carried out by the tow agencies, Such IAGs may provide for the transfer of funds to pay for services, the use of facilities, the expertise of personnel, and the development of cooperative programs and projects, and will be subject to the laws regulations pertaining to the respective agencies.

5. To provide proposed press releases and other public affairs information related to joint efforts or projects under this MOU for review and concurrence of the other agency prior to release.

6. To seek to ensure sufficient funding by each agency to carry out projects that are mutually agreed upon under this MOU.

V. AUTHENTICATION

This MOU becomes effective on the dated of signature by both parties and continues for a period of five years. This MOU may be modified by mutual consent or terminated by either party with ninety (90) days advance notice. This MOU is entered into on this 15th day of November in the year 1993.

Appendix 2 - Strategic Partnerships

Examples of joint ventures

Alternative Remedial Technologies Inc. (ART), a soil washing firm in Tampa, Florida is owned 50-50 by Geraghty & Miller (G&M) of Plainview, NY and Heidemij Realisatie, of Arnhem, the Netherlands. Soil washing has been used in Europe since the early 1980s to clean contaminated soils. G&M essentially bought its way up the soil washing technology curve by partnering with Heidemij Realisatie, one of the European leaders.

Catalytica Inc. of Mountain View, California is a developer of proprietary catalysts and processes to eliminate or minimize the formation of pollutants in industrial processes. Its technologies are principally directed at the electric power generation, gasoline refining and fine chemicals industries. Strategic partnerships with large industrial corporations are critical to Catalytica's business strategy. As of sixteen months ago, Catalytica's partners had collectively invested over $40 million in joint projects. In 1992 about 80% of the company's $9.6 million in revenues were from agreements with four collaborative partners. Conoco Inc., Finnish Oil company Neste Oy, and General Electric agreed to work with Catalytica on the development and demonstration of specific products due to inabilities of their respective in house R&D departments to come up with the products on their own. Catalytica also has agreements with at least two large Japanese firms. One of them is a 10-year technical cooperation agreement with Mitsubishi Oil Co. Ltd. This agreement includes a $10 million investment and the recent appointment of the Japanese company's president and CEO to Catalytica's board of directors. Catalytica's president Ricardo Levy said that "Japanese companies are 'more willing to invest research into... next-generation technology.'" "Ultimately, the strategic alliances will form the basis of joint manufacturing operations, and partners will participate in commercially licensing the process and profits from commercialization." Zapit Technology Inc. of Santa Clara, California develops environmental applications for the electronic beam. "By pursuing an agreement with Raytheon Services Nevada, a subsidiary of Raytheon Corp., Zapit is hoping to enter the lucrative DOD/DOE markets. In return, Raytheon gets a legup in a niche technology."

The wind power industry consists of very small, undercapitalized, unsophisticated companies that compete "against large, independent power developers in gas, coal and oil" for utilities' attention. "As a result, strategic partnerships between companies, utilities and fossilenergy producing competitors may arise. Already, FloWind has partnered with Kaiser Aerospace to manufacture turbines for AWT Inc...Kenetech has a strategic partnership with a subsidiary of IowaIllinois Gas & Electric Co. and a joint venture with a Texas utility. Zond has partnered with some smaller wind energy developers in the Midwest and Northeast to develop projects, and Westinghouse Electric recently gained a minority equity interest in New World Power."

What do environmental technology developers potentially have to gain from strategic partnerships?

- Demonstration facility
- They can quickly move up the technology and manufacturing leaning curves.
- Manufacturing facilities
- Credibility
- Managerial assistance
- Technical assistance
- Access to the larger organization's resources (administrative resources, outside contacts, financial institutions)
- Access to a manufacturers' marketing channels, including in the international sphere
- A first customer (a necessary ingredient in this industry for securing other customers)
- A source of funding not otherwise available
- A reduction in time to market.

What do the partners potentially gain in return?

- Some environmental consulting and engineering firms see access to cleanup technology as a means to differentiate themselves in a tough market.
- Solutions to in-house environmental problems Financial rewards from the success of a new technology

Why might potential partners be reluctant to establish a relationship?

- Environmental consulting firms may "eschew owning technology for reasons of objectivity." ("EC Firms Seek Out New Technologies,"

For reasons of pride, managers and engineers may not want to adopt or nurture a technology that they did not invent themselves. This is known as "not-invented-here syndrome".

When they have the necessary resources and know-how to develop technologies to solve their own environmental problems, companies may prefer to produce the technology themselves and sell it on the market. Some businesses are reluctant to acknowledge publicly that they have any environmental problem. In order to encourage competition among its suppliers and licensors and suppliers, a large company may prefer to purchase or license a product from an environmental technology developer rather than play a part in its development.

The California Environmental Technology Partnership (CETP) recognized the significant benefits of strategic partnerships for the environmental technology industry and in 1993 proposed that the state "(i)nstitute a regular forum to bring together technology developers with strategic partners and other investors." In its "1994 Strategic Plan for Promoting California's Environmental Technology Industry," CETP said that even with the state's regulatory and permitting reforms "there remains the need to attract private sector financing into the final stages of technology development and early stages of commercialization. This can be accomplished by sharing risk through financial and strategic partnerships."

To this end they are pursuing a number of strategic partner avenues, including developing "a trade association or other nonprofit umbrella group to function as a regular forum to identify strategic partners" and organizing environmental technology conferences both to attract potential customers on a worldwide bases and to bring together stakeholder for potential partnerships.

Partners

The Center for Environmental Policy, Economics and Science in Ann Arbor, Michigan has proposed to develop an Environmental Capital Network that will link private informal and corporate investors with environmental entrepreneurs. The knowledge, information, and interests contained in this organization may make it suitable for, and amenable to, broadening its services to include a full-scale partner matching system or to providing the SBA with data. Other organizations that we have learned of have already developed extensive databases; the SBA might want to consider means by which to cooperate with those organizations. For example, the National Environmental Technology Application Corporation (NETAC), a nonprofit organization in Pittsburgh, Pennsylvania, has a database that contains information on over 1500 new technologies. Consultants pay NETAC a nominal fee to gain information on new technologies that might apply to a specific environmental problem.

A database now being developed at the University of Massachusetts. called "Envirotech On-Line" is advertised as the "Global Electronic Information System for Environmental Business and Technology." For a fee it "will make information about a company, government agency or organization easily accessible to thousands of others looking for environmental technologies, services and partners." Envirotech On-Line will gain its information from "millions of reports, newsletters and contacts generated by banks, business associations and government agencies." It remains to be seen whether this database can provide the information that investors, technology users, and the developers themselves require.

The immediate idea of the matching system is to link parties that are already searching for partners. With time, obstacles to broader acceptance of strategic partnerships - such as corporations' liability concerns - could be addressed.

Appendix 3 - Acronyms

CERCLA - Comprehensive Environmental Response, Compensation Liability Act

CETP - California Environmental Technology Partnership

CDC - Certified Development Company

CEBO - California Environmental Business Opportunities

CFR - Codified Federal Register

DOE - Department of Energy

EPA - Environmental Protection Agency

MOU - Memorandum Of Understanding

OECA - Office of Enforcement and Compliance Assurance

OIRA - Office of Information and Regulatory Affairs

P2 - Pollution Prevention

PEF - CAPetroleum Environmental Cleanup Fund Act

PLP - Preferred Lending Program

PRP - Potential Responsible Parties

RCRA - Resource Conservation Recovery Act

R & D - Research and Development

SBA - Small Business Administration

SBIC - Small Business Investment Companies

SOP - Standard Operating Policies

UST - Underground Storage Tanks

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Innovative Ideas from Small Businesses Breaking Barriers

This paper describes an interview held with Joe Paladino, program manager for the U.S. Department of Energy's Technology Exchange Division, which is within the Office of Technology Transfer and Program Integration, on February 14, 1995.

DOE's Office of Technology Development no longer has a small business technology integration program, but even without it, small businesses play a big part in developing the technologies needed for environmental cleanup. Why? "Because they have really good ideas," said Joe Paladino, who worked with the program several years. "I have always thought, and I think Clyde Frank [Deputy Assistant Secretary for the Office of Technology Development] agrees, there is an incredible reservoir of capability in the small business community. Many of the innovative technologies that we need are derived from the small business community."

While working with the small business program, Paladino's focus began to shift. "I started getting involved with technology transfer and commercialization of our technologies because [while] it's possible to work on small business stuff, if we don't fix the way we communicate with industry from a larger perspective, we can't fix the things that are failing the small business community." Now, Paladino is continuing his technology transfer and commercialization work within OTD's landfill stabilization focus area. He is also maintaining his small business ties by serving as a liaison to DOE's Small Business Innovation Research program.

While helping small businesses get involved with DOE's research programs, Paladino became familiar with the barriers small businesses often face. "One of the major hindrances I saw was the lack of information on opportunities to participate in our programs. I started to serve as a broker of information." Paladino observed that, "It's not whether you are a small business or a big business. It's whether you're in the system or not in the system. Once small businesses have task-order-oriented contracts, they're in the system. But it takes a lot of energy to get that opportunity." To help get information to small businesses, Paladino said OTD set up a toll-free hotline that received as many as 800 calls a month. In addition, Paladino helped plan four small-business-oriented workshops where small business operators met face-to-face with people who could provide them with information on business opportunities in DOE.

Paladino said DOE's sites are also starting to become aware of the need to bring in new technologies and pay attention to the businesses that have good ideas. For example, DOE's Savannah River Site had a forum for all the businesses in the region to share the site's needs and to invite proposals for technologies. In a separate pilot program, a Washington, D.C.-based company is taking a hard look at DOE's Rocky Flats site to identify opportunities for the small businesses in the region. "What this company is trying to do is reduce the energy that the small business needs to expend to really get good market information on business opportunities at a site," Paladino explained. "Now they [small businesses] have a champion to actually get them into the DOE."

Another program OTD supports provides business planning assistance to recipients of a Small Business Research Innovation award. Paladino said, "I'm proposing that we provide that same assistance to small businesses that are currently in our technology development program [but] are not SBIR." In addition to teaching the businesses how to write a business plan, the program brings in partners that can provide venture capital to keep the business going during the start-up phase.

Finally, George Mason University is conducting a study for OTD to look at the barriers small businesses face when working with DOE. The research includes looking at case studies of relationships that have been successful and those that haven't worked as well. According to Paladino, "The results will pinpoint where the real barriers are and what DOE could do to improve the way we access these better small business technologies."

For small businesses interested in learning more about DOE's programs and technology needs, Paladino recommended obtaining copies of several documents from EM's hotline, (800) 7EM-DATA (736-3282). Upon checking with the staff at the hotline, Initiatives learned the documents are being revised and are not available at this time. When they are available, it will be announced in the newsletter. In the mean time, call the staff at the hotline with questions. If they don't have an answer close at hand, they'll get one and call back.

For information about small business involvement other than in technology development, Paladino suggests calling Kay Rash, the small business coordinator for the Office of Environmental Management. Her number is (202) 586-5420. Rash can provide one-on-one counseling to small, disadvantaged, or minority businesses interested in working on support services for EM's headquarters operation. She can also get businesses in touch with procurement offices at DOE sites.

America's Water Supply: Status and Prospects for the Future

Author: Kenneth D. Frederick

Dr. Kenneth D. Frederick is an economist and senior fellow at Resources for the Future in Washington, D.C., an independent organization that conducts research on the development, conservation, and use of natural resources and the quality of the environment. Prior to joining RFF he served on the faculty of economics at the California Institute of Technology and as an economic advisor in Brazil for the Agency for International Development.

Water is critical for the health of both humans and ecological systems and an important element in many of our recreational and economic activities. Neither plants nor animals can survive long without it, and water is used in virtually everything we make and do. It is the most widely used resource by industry; it is used both directly and indirectly to produce energy; it provides the basis for much of our outdoor recreation; it is an important part of our transportation network; it serves as a vehicle for disposing of wastes; and it provides important cultural and amenity values. The quality of life, as well as life itself, depends on an adequate supply of freshwater.

Water covers almost 70 percent of the surface of the globe and is the Earth's most abundant resource. About 97 percent of the water is in the oceans and is too salty for drinking, growing crops, or most other human uses. Almost all of the freshwater is held in the ice caps of Antarctica and Greenland or in deep underground aquifers where, for most practical purposes, it is inaccessible for human use. Only about 0.3 percent of the earth's freshwater, less than 100,000 cubic kilometers or 81 trillion acre-feet (the unit of water needed to cover one acre to a depth of one foot, which is about 326,000 gallons), is found in rivers and lakes. These surface waters together with accessible groundwater resources comprise the usable supply .

Water is also one of the Earth's most renewable resources. Globally, the total quantity of water is essentially constant and unaffected by human activities. Driven by energy from the Sun, water constantly circulates from the seas, lakes, and streams (through evaporation) or the plants (through transpiration) to the atmosphere and back to earth (through precipitation). The evaporative process removes salts and other impurities that may be picked up either naturally or as a result of human use, making it possible to use and reuse water virtually indefinitely.

The United States is relatively well endowed with water. Annual precipitation averages nearly 30 inches or 4,200 billion gallons per day (bgd) throughout the conterminous forty-eight states. Two-thirds of the precipitation is quickly evaporated and transpired back to the atmosphere; the remaining one-third flows into the nation's lakes, rivers, groundwater reservoirs, and eventually to the ocean. These flows provide a potential renewable supply of 1,400 bgd, which is nearly fifteen times current daily consumptive use -- the quantity of water withdrawn from but not returned to a usable water source. Moreover, much larger quantities of freshwater are stored in the nation's surface and groundwater reservoirs. Reservoirs behind dams can store about 280,000 billion gallons (about 860 million acrefeet), even larger quantities are stored in lakes, and water stored in aquifers (subterranean bodies of unconsolidated materials such as sand, gravel, and soil that are saturated with water and sufficiently permeable to produce water in useful quantities) within 2,500 feet of the earth's surface is at least 100 times the reservoir capacity. These stocks are equivalent to more than fifty years renewable supply.

Despite the apparent global and national abundance and the renewability of the resource, water adequacy has emerged as one of the nation's primary resource issues. For many of the developing countries of the world the problem is a critical one. In this country concerns about the availability of freshwater to meet the demands of a growing and increasingly affluent population while sustaining a healthy natural environment are based on several factors: (1) uncertainties as to the availability of supplies stemming from the vicissitudes of the hydrologic cycle and the threat that a greenhouse warming might alter the cycle; (2) the high costs of developing additional surface-water supplies; (3) the vulnerability of the resource and the problems of restoring and protecting valued surface and groundwater resources; (4) the importance of reliable supplies of high-quality water for human and environmental health and economic development; and (5) the shortcomings of our institutions for allocating scarce supplies in response to changing supply and demand conditions.

Uncertainty of Supply

Timing, location, and reliability are important dimensions of the potential value of supplies. Because of the spatial and temporal variations in the distribution of water, national and long-term annual averages of precipitation and runoff are poor indicators, for practical purposes, of available supplies and potential problems. Precipitation generally declines as one moves from east to west in the United States. Average annual precipitation ranges from less than 1 inch in some desert areas in the Southwest to more than 60 inches in parts of the Southeast.

Underlying these regional averages are large seasonal and annual variations that can result in droughts and floods. In the absence of flow regulation and storage, the ratio of the maximum to minimum streamflow within a year may exceed 500 to 1. Natural climatic variability results in interannual fluctuations. The ratio of very high annual flows (amounts exceeded in five percent of the years) to very low (exceeded in 95 percent of the years) is 2.9 for the conterminous United States; the ratio for the nation's arid and semiarid regions is significantly higher. But almost any region lacking adequate storage is likely to encounter both periods when supplies are relatively plentiful or even excessive as well as periods of shortages.

Water resource issues tend to be local or regional in nature: abundant supplies in one area are of no help to water-deficit areas unless there are facilities to transport supplies among regions. Water flows naturally within hydrologic basins and can be moved between basins where transfer facilities have been constructed. But water is too expensive relative to its marginal value to transport long distances out of these existing channels in response to climateinduced changes in supply or demand. Thus, large seasonal, annual, interannual, and regional variations in precipitation and runoff pose major challenges for planners and down-to-earth risks for water users and occupants of the flood plains.

Human efforts to alter the hydrologic cycle date back to ancient times. Primitive societies tried to bring rain through prayer, rain dances, human and animal sacrifices, and other rituals. Cloud seeding (dropping silver iodide crystals or dry ice into selected clouds to stimulate ice crystal formation and induce precipitation) represents today a more recent and more scientific, but still uncertain, attempt to influence rainfall. Although it is questionable whether any of these intentional efforts have succeeded in significantly modifying the rainfall, human activities are inadvertently altering the climate. Changes in land use and land cover can affect atmospheric circulation and the movement of moisture locally. Evaporation from neighboring states, which depends on land use, can be the source of as much as one-third of the precipitation of inland areas. The anthropogenic increase in the atmospheric concentration of carbon dioxide and other greenhouse gases is expected to increase the average global surface temperature. Such a change would also affect precipitation patterns, evapotranspiration rates, the timing and magnitude of runoff, and the frequency and intensity of storms as well as the demand for water. But the magnitude and even the nature of these impacts on the supply and demand for water in specific regions are largely unknown.

Rising Costs of Developing New Supplies

The United States has invested large sums of private and public money to adapt to the vicissitudes of the hydrologic cycle. A vast infrastructure of dams, reservoirs, canals, pumps, and levees has been constructed over the years to collect, control, and contain surplus flows and to distribute water on demand during low as well

as high flow periods. As a result, most water users take for granted that virtually unlimited quantities of freshwater will be available at the turn of a tap. Moreover, the nation's water use patterns have come to reflect a disregard for the limits of natural hydrological conditions; the highest levels of use and the lowest prices are often found in the more arid areas of the country. But, as droughts and floods frequently remind us, water often is not where we want it, when we want it.

Dams and reservoirs - the traditional approach to increased supplies

More than 75,000 dams and reservoirs with a storage capacity of about 860 million acre-feet help convert the United States' naturally varying water resources into more reliable and controlled supplies. Even though currently developed storage represents only about 70 percent of the potential reservoir capacity, dam construction has slowed to a trickle in recent years. Moreover, future increases in assured water supplies for municipal, industrial, and irrigation use through the addition of surface reservoir capacity are likely to be modest for several reasons.

First, sedimentation is reducing existing reservoir capacity each year by about 1.5 million acre-feet (maf). Second, sizable investments are required to rehabilitate, maintain, and in some cases, remove dams. A 1992 national dam inventory classified almost a third of all dams in the United States as hazardous: more than 10,000 dams as having

a high hazard potential and another 13,500 with a significant hazard potential. The consequences of a dam failure can be catastrophic. In 1972, 125 people died and more than 3,000 were left homeless when Beaver Creek Dam in West Virginia failed. In 1977, 14 were killed and more than $1 billion in damages resulted from the failure of Teton Dam in Idaho, and 39 were killed when Kelly Barnes Dam in Georgia failed.

Third, the best sites for storing water are the first to be developed within a river basin. Consequently, subsequent increases in storage generally require an ever larger investment. A study of decadal changes in reservoir storage capacity per unit volume of dam for the 100 largest dams in the United States suggests that sharply diminishing returns are already the case: the average reservoir capacity produced per cubic yard of dam declined 35-fold between the 1920s and 1960s.

Fourth, there are diminishing returns in the "safe yield" produced by successive increases in reservoir capacity within a river basin. At some point the increase in evaporation losses due to increased reservoir surface area can more than offset any gains in safe yield associated with additional surface storage. A study of U.S. river basins suggests that safe yield reaches a maximum when the ratio of storage to average annual renewable supply is in the range of 1.6 to 4.6. By this criterion the point of negative returns may have already been reached in three major basins -- the Lower Colorado, the Upper Colorado, and the Rio Grande, where the ratios of storage to average renewable supply are now within this range.

The fifth, and perhaps most important, reason for the inevitability of rising water costs is that the remaining opportunities for adding storage are now far more restricted by environmental concerns: the environmental costs of storing and diverting water increase as the number of free-flowing streams declines and as society attaches more value to water left in a stream. To the extent that water projects control flooding and capture water that otherwise would be lost to human use as a result of evaporation or runoff to the oceans or other unusable sinks, such facilities increase usable freshwater supplies. However, as water development expands and the resource becomes increasingly scarce (that is, when using water for one use adversely affects its availability for other uses), construction of another dam and reservoir on a river may add little, if anything, to the overall supply. Rather, the project may only provide a means of allocating supplies among alternative uses, usually from instream uses such as fish and wildlife habitat and recreation to withdrawal uses such as irrigation or domestic supplies. Examples are found in basins where the flows are already highly controlled and intensively

used, such as the Colorado River Basin. The value of the water that is taken from instream uses (such as hydroelectric power generation and habitat for fish and wildlife) when more water is withdrawn becomes an important factor in the economic costs (both financial and environmental) of augmenting a region's effective supply of water for domestic, industrial, or agricultural use.

Public resistance to the high financial and environmental costs associated with the traditional means of augmenting water supplies has forced suppliers to consider a number of alternative approaches to increasing reliable supplies such as recycling wastewater, desalination, and more exotic schemes.

Recycling

The technology now exists to upgrade wastewater to meet standards for domestic use, and wastewater recycling is certain to become an increasingly important source of new water in the coming decades in many areas. Although public resistance is still a barrier to the use of reclaimed water for drinking, recycling for other uses is more and more common. California, the leading consumer of recycled water in the United States, uses about 325,000 acre-feet of recycled water annually for industrial cooling, groundwater recharge, barriers against salt-water intrusion, and irrigating landscapes, parks, golf courses, and certain crops.

The economics of recycling are driven in large part by the environmental and health regulations that dictate how communities collect and treat waste water. It costs about $430-$490 to recycle an acre-foot of water, which is several times what most cities paid to develop existing supplies. About three-fourths of the cost of recycling wastewater is incurred meeting federal requirements that effluent discharged into waterways undergo certain minimal treatment. The marginal costs of the additional purification needed to make the water suitable for unrestricted agricultural use and of storing and conveying the upgraded water to the user are only about $125 per acre-foot, which is competitive with alternative sources of new supplies in many areas.

Desalination

Almost unlimited quantities of sea water are available to coastal areas, and brackish waters containing salt levels too high for most uses are available in many aquifers and inland seas. The cost of desalination depends on the quantity of salts removed. It is less expensive if the process starts with brackish water -- with salt concentrations well below the 35,000 parts per million characteristic of sea water -- and if the finished water is not treated to meet drinking water standards. Technological advances have reduced desalting costs as much as 50 percent during the last three decades, and future improvements may have the potential of still further reductions. Still, desalination of sea water today costs about $1,800 an acre-foot, and is energy-intensive, making it a supply of last resort. Brackish water, on the other hand, might be upgraded to drinking-water for less than half this cost.

Other potential sources of supply

Weather modification through cloud seeding, though controversial, is still seen by some as a promising, low-cost way to increase water supplies in arid and semiarid areas. While the impact of seeding on precipitation remains difficult to measure, winter orographic clouds (formed by encounters with elevated features such as mountain ranges) have been seeded in areas of the western United States for nearly half a century, increasing seasonal precipitation in some areas, by some reports, by about 10 percent. Recent research suggests that other seeding materials might condense precipitation from clouds of higher temperatures and thus in other seasons.

Proponents argue that in areas with favorable conditions cloud seeding can supplement water supplies for about $10 an acre-foot. But even if the technology is improved and the economics are favorable, the potential impact on water supplies is likely to be small and geographically limited. Moreover, legal barriers may restrict its use. Towns receiving more snow might object to higher snow-removal costs; downstream residents might suffer increased spring flooding; and downwind communities might feel that they are being deprived of precipitation that otherwise would have fallen on them.

Vegetation management, such as removing phreatophytes (high-water-use plants that thrive along streams, such as trees of the willow family) or managing forests for increased water yields, could increase water supplies in some areas. The financial costs of vegetation management may be competitive with other supply augmentation alternatives, but environmental concerns may limit its use: phreatophyte removal is likely to have adverse effects on wildlife habitat, and managing forests for increased water yields may conflict with commercial timber production and recreational opportunities.

Growing water scarcity in the arid and semiarid West has fostered a number of bold proposals to utilize the enormous quantities of water stored in polar ice or to divert northern rivers in the largely uninhabited areas of Canada and Alaska. However, the technical, economic, legal, and environmental obstacles to transporting and using icebergs to supplement water supplies in an area such as southern California currently appear insurmountable. The enormous financial and environmental costs of proposals such as the North American Water and

Power Alliance that would transport 110 million acre-feet of water annually (about eight times the average annual flow of the Colorado River) from Alaska and northern Canada to the western United States and northern Mexico have relegated them to the realm of science fiction for the

Vulnerability of the Resource

Aquifers, which contain much of the country's usable water, are classified as confined or unconfined. Confined aquifers are overlain by impermeable materials and receive little or no recharge. The natural movement of water into and out of these aquifers is so slow that they can be treated as a stock resource that can be depleted through pumping. Unconfined aquifers, on the other hand, are more active and integral parts of the hydrologic cycle: continually recharged by the percolation of precipitation, snow melt, or water from overlying streams, canals, and reservoirs. Discharges from unconfined aquifers are the source of about 30 percent of the nation's streamflow. Recharge and discharge rates vary with seasonal and annual changes in precipitation and runoff as well as with pumping. In the long term and under natural conditions, water lost through discharge is balanced by ongoing recharge.

Pumping disrupts the equilibrium between recharge and discharge; groundwater levels decline when water is initially withdrawn. If the rate of pumping is not excessive, a new equilibrium is established (at a lowered water table) in which pumping is balanced by changes in the natural rates of discharge and recharge. Depletion can continue for decades, as it has in the portions of the Ogallala aquifer that lie under the southern High Plains and in the San Joaquin Valley of California. Eventually, however, if natural flows do not adjust first, higher costs due to increased pumping lifts and lower well yields act to reduce the rate of pumping. Higher pumping costs have already resulted in several million acres being taken out of irrigation in the High Plains. The San Joaquin Valley likely would have had a similar experience were it not for the federal Central Valley Project that provides the region with millions of acre-feet of water annually from the Sacramento and Trinity basins in northern California. In 1980, groundwater, which provides about half of our drinking water and is the source of nearly one-fourth of all freshwater withdrawals, was being depleted from six western and midwestern river basins at a rate of 20.4 million acre-feet per year. In 1983 groundwater levels declined under more than 14 million irrigated acres in eleven states in amounts ranging from 6 inches to over five feet.

Pumping from aquifers near a coastline reduces the natural discharge of freshwater toward the sea, causing saline water to shift inland and toward the surface. Saltwater will continue to intrude into the aquifer under these conditions as long as pumping exceeds the flow of freshwater to the sea. Saltwater intrusion threatens important drinking water supplies in a number of coastal areas including Long Island; Cape Cod; seven New Jersey counties; and the Florida cities of Miami, Tampa, and Jacksonville.

Water quality is an important dimension of water supply. Water is rarely pure. All ground and surface water contains minerals dissolved from soil and rock, and precipitation may contain impurities picked up in the atmosphere. The natural concentrations of contaminants in the nation's rivers, lakes, and aquifers are generally acceptable for most human uses. Anthropogenic factors, however, contribute a wide variety of substances that have reduced and in some cases destroyed the utility of specific water supplies. Despite the major progress that has been made in recent decades in reducing municipal and industrial point sources of pollution, about one-third of the assessed rivers, lakes, and estuaries in 1990 were judged to be capable of only partially supporting their designated uses.

Only a small fraction of the nation's groundwater resources is known to be contaminated such that they fail to meet drinking water standards. Communities that rely on groundwater for drinking are subject to federal monitoring requirements. In most other areas, however, groundwater monitoring is infrequent or nonexistent.

Effective monitoring is expensive, and there are millions of potential sources of groundwater contamination. For example, roughly 20 million on-site domestic waste disposal systems in the country contain nitrates, phosphates, pathogens, inorganic contaminants, or other toxins that could leak into neighboring groundwater supplies. There are 1.5 million underground tanks that store hazardous substances or petroleum products: many of them are not protected from corrosion, and a good many have been in service beyond their expected 15 to 20 year lifetime. Other potential sources of groundwater contamination include landfills, abandoned waste sites,

oil and gas brine pits, and the chemicals applied to most of the 325 to 375 million acres typically planted to crops each year.

Importance of the Resource

Water uses are separated into instream uses and those that involve withdrawing the resource from a surface or groundwater source. The former include the production of hydropower, recreation, and the provision of fish and wildlife habitat. Water is withdrawn for a variety of purposes ranging from drinking, the removal of wastes from homes and factories, irrigation of crops and golf courses, and snow making. Withdrawal uses are rarely fully consumptive; on average more than 70 percent of the water withdrawn is eventually returned to a stream or groundwater source where it can be used again. However, when water is withdrawn and subsequently returned, it affects, often adversely, the quality, location, or timing of the water available for other withdrawal or instream uses.

Freshwater withdrawals for all purposes averaged more than 1,300 gallons per person, per day in 1990 consumptive use averaged about 380 gallons. Per capita withdrawals peaked in 1975, and total withdrawals peaked in 1980. The recent decline in offstream water use is due in part to efforts to restore some of the instream values that were sacrificed in providing for the ten-fold increase in withdrawals between 1900 and 1980.

Irrigation and thermoelectric cooling accounted for 80 percent of all withdrawals in 1990. In the seventeen western states, irrigation alone accounted for five of every six gallons of water consumptively used. About 100 gallons per person per day was for domestic uses such as drinking, bathing, washing clothes and dishes, toilets, and food preparation as well as outdoor uses such as watering lawns and gardens and washing cars. Drinking and cooking represent only a small fraction of domestic water use, but in the absence of dual supply systems, all domestic supplies must meet drinking water standards.

The importance of freshwater to society is not easily measured and is commonly overlooked when it is readily available. But, as Benjamin Franklin suggested, we know the value of water when the well runs dry. A striking illustration of the importance of water is provided by the plight of the many millions of people around the world who lack ready access to clean water. The differences between developed and developing countries are many, but few have greater impact on human welfare than the availability of safe drinking water and adequate sanitation. In contrast to the situation in the United States where these basic services are taken for granted by virtually everyone, 1.3 billion people in the developing world (almost 1/4 of all who live on the Earth) lack access to safe drinking water supplies and 1.8 billion are without decent sanitation facilities. Waterrelated diseases and illnesses exact devastating impacts on mortality and morbidity; prospects for economic development are also decreased by the diminished health of the labor force and the countless hours spent transporting water for drinking and other domestic uses from distant and often contaminated sources.

We do not need to look abroad for examples of the costs associated with inadequate water supplies. Microorganisms in municipal drinking water supplies have led to several outbreaks of waterborne disease in the United States. Crytosporidium in Milwaukee's water supply resulted in some 400,000 serious illnesses and 50 deaths in the spring of 1993. Just before Christmas 1983, contaminated drinking water in Luzerne County, Pennsylvania caused an outbreak of giardiasis -- a common diarrheal disease -- that left 6,000 people ill and forced 75,000 others to obtain more expensive alternative sources of drinking water. Recent droughts in the western and southeastern regions of the United States have resulted in sizable economic and environmental losses. Even in the absence of drought, tens of millions of dollars worth of potential hydropower production was sacrificed in the Colorado, Columbia, Missouri, and Sacramento river basins when water was allocated for the preservation of fish and wildlife.

Institutional Shortcomings

The opportunities as well as the incentives to use, abuse, conserve, or protect water supplies are the result of many fragmented local, state, and federal water institutions. These institutions determine how tradeoffs among alternative water uses are made and whether highquality water is likely to be available for drinking, new development opportunities, water-based recreation, or fish and wildlife habitat. Water adequacy would be less of a concern were these institutions more effectively interlinked and more capable of efficiently protecting the quality of drinking supplies and valued aquatic ecosystems and of allocating scarce supplies to higher value uses in response to changing supply and demand conditions.

High rates of water withdrawals are a legacy of past laws and policies that historically favored offstream over instream uses. During the first two-thirds of this century water policy was dominated by the view that it is wasteful to leave resources unused that are capable of producing crops, power, or other products. Water was free for the taking, and most users enjoyed virtually unlimited supplies at low cost during all but the most extreme droughts. But the environmental costs of ignoring the impacts on instream flows were high; thousands of miles of once free-flowing streams were lost and the quality of many streams and lakes deteriorated such that they were unusable for most purposes. The engineering and diversion of the nation's rivers contributed to the sharp decline in the nation's wetlands, which store floodwater, control erosion, provide fish and wildlife habitat, improve water quality, and furnish recreational opportunities.

During the last quarter century, the policy focus has shifted almost 1800 toward protecting remaining flows and recovering some of the environmental and recreational benefits that were sacrificed in the drive to provide homes, factories, and farms with inexpensive water. This shift is evident in a number of legislative acts. The Wild and Scenic Rivers Act of 1968 precludes development activities that might significantly alter an area's natural amenities on thousands of miles of rivers and streams. The National Environmental Policy Act of 1970 requires all federal agencies to give full consideration to environmental effects in planning their programs. The Federal Water Pollution Control Amendments of 1972 (commonly known as the Clean Water Act) together with the Safe Drinking Water Act of 1974 and other legislation regulating the use and cleanup of toxic materials have made water quality rather than water supply the driving force behind the nation's water-related investments. The expenditure of more than $500 billion on water pollution control since 1972 has produced major improvements in the quality of U.S. surface water resources in the face of increasing population and economic pressures.

The Endangered Species Act (ESA) of 1973 has come to dominate water management and investment decisions in the Pacific Northwest. Since 1982 the Northwest Power Planning Council has supervised the expenditure of more than $1.7 billion for measures to rebuild salmon stocks. Despite these costly efforts, three stocks of salmon that spawn in the Snake River are listed as threatened or endangered, petitions have been filed for listing several other stocks, and as many as eighty-five salmon stocks throughout the Columbia River basin are so weakened that they could be granted protection under the ESA.

The ESA could have a similar impact on water management in California where the Delta smelt, whose prime habitat is the Sacramento-San Joaquin Delta, has been granted protection. Protecting the habitat of the smelt or other Delta species that are under consideration for protection would limit the ability to export water from the Delta to the millions of people in central and southern California who depend on its supply for domestic, industrial, and agricultural uses. The ESA has been invoked to alter water investment and management decisions in other areas, including putting a hold on the $590 million Animas-La Plata project in the Colorado River Basin.

The Electric Consumers Protection Act of 1986 (ECPA), which requires the Federal Energy Regulatory Commission to give power and non-power benefits equal consideration in its licensing and relicensing decisions, has made hydropower relicensing another battleground in the struggle over alternative water uses. The United States has more than 2,300 hydroelectric power plants with a total capacity of 73,500 megawatts; annual production in 1993 of 265 billion kilowatt hours accounted for about 9% of U.S. electrical power generation. Most of these plants operate under federal licenses that were issued as many as fifty years ago, when fewer questions were raised about the effects of hydropower on fish and wildlife habitat. As the licenses expire, the utilities are faced with a complex, costly, and time-consuming relicensing process under ECPA that is likely to require a detailed environmental assessment of a plant's impacts on fish and wildlife habitat, water quality, recreation, land use, local communities, and cultural resources. If a new license is eventually granted, it is apt to be encumbered with restrictions that diminish the value of the plant's power output.

Concluding Thoughts

There is justifiable cause for concern over the adequacy of our water supplies. We have limited control over the resource, most opportunities for increasing supplies are financially and environmentally costly, and current uses are depleting or contaminating some valued supplies. While demands for the many services provided by water are growing, institutions have been slow to adapt to the challenges of growing scarcity, supply vulnerability, and rising instream values.

On the other hand, there is reason for optimism as to the long-term adequacy of water supplies. Although the costs of freshwater are likely to rise in the future, we are in a position today to influence the magnitude and even the nature of those costs. Critical determinants of future water costs will be the efficiency with which existing supplies are managed, how supplies are allocated among competing uses, and the effectiveness and costs of efforts to protect aquatic environments and drinking water quality.

As the competition for water increases, all users within a hydrologic unit or watershed become increasingly interdependent; each water use can affect the quantity or quality available to all the others. Moreover, ground and surface water supplies are often naturally connected such that what is done to one affects the other. Today the interdependencies among water users and the interchangeability of supplies are all too often ignored in management decisions because natural hydrologic regions are split into multiple political and administrative units; water supply facilities are under separate ownership; and ground and surface waters are subject to quite different laws. Integrated management of existing supplies and infrastructure, ideally at the river basin level (Figure 4) but also within smaller watersheds, is a cost-effective means of increasing reliable water supplies and resolving water conflicts in many regions.

With demand growing faster than supply in many areas, we need to provide appropriate incentives to conserve and protect the resource, and opportunities to allocate supplies efficiently among competing uses. When water is under priced and its allocation is restricted by law and tradition, the inevitable results are inefficient water use, lost development opportunities, interruptions in service, and higher costs for new water users. On the other hand, when the real costs are borne by users of the resource and there are opportunities to transfer water voluntarily among alternative uses, then the resource is used more efficiently, there are increased incentives to develop and adopt water-conserving technologies, the highest-value uses are assured of an adequate supply, and society derives greater net benefits from its scarce supplies. Efficient, voluntary water transfers must include provisions to incorporate third-party effects into trade decisions (since parties other than the buyer and seller are likely to be impacted by a water transfer), without imposing high transactions costs. The nature and magnitude of future water costs will depend importantly on our success in developing such market institutions.

The provision of instream benefits such as fish and wildlife habitat, water-based recreation, and the amenities of natural waterways pose special problems because they are not marketed. Moreover, while the adoption of water-conserving technologies can slow or even reverse the growth in demand for domestic, industrial, and agricultural water, technology is not likely to offer suitable substitutes for instream uses such as fish and wildlife habitat, water-based recreation, and the amenities of natural waterways. Another challenge for improving water management and allocation decisions is to develop procedures that expeditiously strike an appropriate balance among environmental, social, and developmental values. In some instances, environmental values continue to be slighted by institutions rooted in a bygone era when water left in a stream was assumed to have no value. In other cases, environmental values are introduced preemptively through legislation such as the Endangered Species Act or through long and costly judicial or administrative proceedings. The public interest is likely to be better served if instream uses are considered within a basin-wide context rather than on a project by project basis.

The United States has made impressive gains over the last two decades in restoring and protecting its water resources. But resistance is growing to the enormous investments that continue to be made in treating industrial and municipal wastes because of high costs and diminishing returns. More cost-effective approaches to water-quality goals are needed. These might include effluent fees that provide incentives to develop and adopt least-cost technologies, and tradable permits to pollute that establish an allowable quantity of pollution in a watershed and provide incentives to meet this level at the lowest cost. Non-point-source pollutants such as runoff from farms, urban areas, and construction sites and seepage from landfills and septic systems are now the principal sources of pollutants reaching the nation's waters. Since these pollutants lack specific points of discharge where they can be collected and treated, watershed management with particular emphasis on the use of riparian (riverside) lands must be employed to achieve significant further improvements in the quality of the nation's waters.

Concerns regarding the safety of drinking water are still growing in spite of the billions of dollars that are spent annually monitoring and treating supplies. Legislative reforms are needed that would (1) allow local communities to target their resources to the most pressing problems; (2) provide the Environmental Protection Agency more flexibility to focus on the contaminants that pose the greatest health risks; and (3) give greater emphasis to protecting drinking water supplies from contamination in the first place.

In summary, with improved basin-wide management of supplies, institutions that enable water to be transferred efficiently and expeditiously among uses in response to changing supply and demand conditions, and cost-effective approaches to protecting aquatic ecosystems and drinking water supplies, reliable supplies of freshwater will be available at readily affordable prices for the foreseeable future.

For Further Reading

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Technology Development Programs

Technology Development

DOE/EM-0184P
August 1994
The Office of Environmental Management (EM) faces technical challenges in meeting its cleanup and waste management goals and complying with environmental regulations. In some cases, proven technology is not yet available for cleaning up contamination. In other cases existing technology can be applied but doesn't comply with laws and regulations or doesn't satisfy public requirements for safety and risk management. To address these needs EM has a technology development program. Its goals are to develop technologies that make cleanup better, faster, cheaper, and safer, and make it possible to comply with existing regulatory requirements. In many cases, development of new technologies presents the best hope for ensuring a substantive reduction in risk to workers and the environment.
Technology development programs are designed to make new, innovative, and more effective technologies available for transfer to users through progressive development. Projects are demonstrated, tested, and evaluated to produce solutions to current problems. The transition of technologies into more advanced stages of development is based on technological, regulatory, economic, and institutional criteria. New technologies are made available for use in eliminating radioactive, hazardous, and other wastes in compliance with regulatory mandates. The primary goal is to protect human health and prevent further contamination.

Technology development programs are conducted to address five major remediation and waste management problem areas that have been identified to date within the U.S. Department of Energy (DOE) weapons complex. These problems have been targeted for action on the basis of risk, prevalence, or need for technology development to meet environmental requirements and regulations. In the future, additional areas may be added (or currently identified areas further partitioned) to ensure that research and technology development programs remain focused on EM's most pressing remediation and waste management needs. These major problem areas are termed focus areas:

Contaminant Plume Containment and Remediation

Uncontained hazardous and radioactive contaminants in soil and groundwater exist throughout the DOE weapons complex. There is insufficient information at most sites on the contaminants' distribution and concentration. The migration of some contaminants threatens water resources and, in some cases, has already had an adverse impact on the offsite environment. Many of the current characterization, containment, and treatment technologies are ineffective or too costly. Improvements are needed in characterization and data interpretation methods, containment systems, and in situ treatment.

Mixed Waste Characterization, Treatment, and Disposal

DOE faces major technical challenges in the management of low-level radioactively contaminated mixed waste. Several conflicting regulations and lack of definitive mixed waste treatment standards hamper mixed waste activities. Disposal capacity for mixed waste is also expensive and severely limited. DOE now spends millions of dollars annually to store mixed waste because of the lack of accepted treatment technology and disposal capacity. Currently available waste management practices require extensive, and hence expensive, waste characterization before disposal. Therefore, DOE must pursue technology that leads to better and less expensive characterization, retrieval, handling, treatment, and disposal of mixed waste.

High-Level Waste Tank Remediation

Across the complex, hundreds of large storage tanks containing hundreds of thousands of cubic meters of high-level mixed waste present a problem that has received much attention from both the public and DOE. Primary areas of concern are deteriorating tank structures and consequent leakage of their contents. Research and technology development activities must focus on the development of safe, reliable, cost-effective methods for characterization, retrieval, treatment, and final disposal of the wastes.

Landfill Stabilization

Numerous DOE landfills pose significant remediation challenges. Some existing landfills have contaminants that are migrating, requiring interim containment prior to final remediation. Materials buried in "retrievable" storage pose another problem--the development of retrieval systems that reduce worker exposure and reduce the quantity of secondary waste. Development of in situ methods for both containment and treatment is also a high priority.

Facility Transitioning, Decommissioning, and Final Disposition

The aging of DOE's weapons complex facilities, along with the reduction in nuclear weapons production, had resulted in a need to transition, decommission, deactivate, and dispose of numerous facilities contaminated with radionuclides and hazardous materials. While the building and scrap materials at the sites are a potential resource with a significant economic value, current regulations lack clear release standards, and thus indirectly discourage the recovery, recycling, and/or reuse of these resources. Development of enhanced technologies for the decontamination of these materials and effective communication of the low relative risks involved are promising avenues toward the recovery, recycle, and/or reuse of these resources. In addition, material removal, handling, and processing technologies must be improved to enhance worker safety and reduce cost.

U.S. Department of Energy
Office of Environmental Management

METC - EWM Project: Chemical Decontamination of Process Equipment Using Recyclable Chelating Solvent

EWM Project Data Sheet

Chemical Decontamination of Process Equipment Using Recyclable Chelating Solvent

Focus Area: Decontamination & Decommissioning

Developer: Babcock & Wilcox

Problem: The DOE's Decontaminating and Decommissioning (D&D) programs require cleanup of a tremendous volume of equipment and material. Existing technologies are not adequate for meeting the cleanup goals with current and projected resources in a timely manner. Technologies are needed to decontaminate equipment to levels which would allow for reuse and/or recycle and to reduce the high costs associated with cleanup and disposition of contaminated equipment and material.

Solution: Development and demonstration of an effective and efficient chemical process, utilizing chelate-based solvent systems, for removal of uranium and other actinides from contaminated process equipment. After decontamination the chemical solvent is treated to remove the active materials and to regenerate the chelate so that it can be reused in the decontamination of additional process equipment.

Applications & Benefits:

- Potential significant reduction in equipment cleanup costs
- Cleaning of surface contamination on process equipment to a level allowing for reuse of the process equipment components or materials
- Limits the amount of metal removal during decontamination so that the process equipment components or materials can be more readily reused or recycled
- Reduce the overall volume of contaminated material and, hence, reduce disposition costs
- Regeneration and reuse of solvent to minimize secondary waste generation

Technology: The proposed technology is similar to that used in the chemical cleaning of steam generating equipment. Chelating agents form extremely stable complexes with certain metallic species; stabilization of the metal in solution allows the chelate to continually enhance the dissolution of the species of interest into the solvent.

A number of readily available chelates, such as EDTA, DTPA, and HEDTA are known to form very strong and stable complexes with uranium. The purpose of this program is to optimize the chemical conditions needed to selectively dissolve the actinide based contaminants from the process equipment. To encompass the entire technology, commercially available proprietary chelate systems and specially synthesized actinide selective chelates will be included in the screening test program. An example of a synthesized actinide chelate is the tetrahydroxamate ligand synthesized by New Mexico State University under separate DOE sponsorship.

After application of the chelating solvent to the process equipment for an appropriate time period, the spent solvent is removed to a waste processing facility, and the dissolved radioactive contaminants are precipitated out of solution. The precipitated contaminants are then filtered and dried for subsequent disposal. The regenerated chelating solvent is then available for reuse in the cleaning system, thereby minimizing the amount of secondary waste generated by the process. In related steam generator chemical cleaning technology, iron has been reduced from over 7000 ppm in a chelate solution to less than 1 ppm thus demonstrating the feasibility of this approach.

Another area of investigation in this program is the potential use of foam in the process application. In this concept, foam is used as the transport media to deliver the solvent to the process equipment surfaces. The benefits of foam cleaning are that it minimizes waste volumes and has the potential to improve solvent contact with the equipment surfaces. The application testing will include variations in the gas flow rate and surfactant concentration with the final selected chelate system.

Schedule: Development and demonstration of the recyclable chelate system is planned to occur in a two phase program. The first phase of the program covers 16 months with the objective being to develop and qualify the process on a pilot scale. Work will begin with bench-scale tests in the laboratory to select the appropriate chelate and to optimize application conditions. The process developed will be qualified in a pilot facility on an actual piece of contaminated equipment. If proven successful, the second phase of the project is planned. During Phase II, if authorized, the technology will be demonstrated on actual process equipment at a DOE site. An Allis Chalmers centrifugal compressor from the Oak Ridge K-25 site is currently being considered for the demonstration.

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DOE's Morgantown Energy Technology Center (METC) supports the Environmental Management (EM) - Office of Technology Development by contracting research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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Executive Branch Initiatives

Moving Manufacturing Technologies to the Global Marketplace

As we shift from a defense-oriented to a civilian-oriented technology base and prepare for the 21st century, America has a window of opportunity to develop and apply advanced manufacturing technologies to improve the competitiveness of our manufacturing industries. By properly focusing and coordinating our national research and development effort, we can enhance the ability of U.S. manufacturers to compete in domestic and international markets.

The Clinton Administration's technology policy reflects the reality that both American industry and government have underinvested in manufacturing technology, even though a strong manufacturing capability, like a highly skilled national workforce, is a critical determinant of the Nation's global economic competitiveness. In 1992, the Federal investment in commercially-oriented relevant manufacturing R&D represented less than 2 percent of the Federal R&D budget, significantly less than the shares allocated by other industrialized nations

Advanced Manufacturing Tecnologies

The Administration is crafting a government-wide strategy to speed the development and application of advanced manufacturing technologies. The Committee on Civilian Industrial Technologies, chaired by the Under Secretary of Commerce for Technology, is completing plans for a coordinated interagency effort to promote:

- partnerships to support manufacturing R&D in government laboratories, universities, and industrial consortia;
- rapid adoption of advanced technologies through a nationwide network of industrial outreach services;
- development and diffusion of environmentally benign manufacturing practices; and
- strengthening and expansion of manufacturing and engineering education and worker training programs.

Within Federal science and technology agencies, manufacturing research will receive greater attention. The Administration championed, and Congress approved, a sizable FY1994 budget increase to deepen and broaden the laboratory, competitive-grants, and manufacturing extension programs of the Commerce Department's National Institute of Standards and Technology.

A portion of the 21-percent increase in funding for NIST's intramural research (to $226 million) will be used to increase the agency's advanced manufacturing research. At NIST and other Federal laboratories, information technology and its applications will be a major focus of manufacturing research. Plans call for transforming NIST's Automated Manufacturing Research Facility, a factory-like laboratory for developing the technology for flexible computer-integrated manufacturing, into a national testbed for the network technologies and protocols needed for virtual manufacturing enterprises. The facility will become a node in an experimental, electronic manufacturing network linked to counter- part research facilities in companies, government laboratories, and universities.

In March, an industry-led, federally facilitated effort achieved initial international acceptance of a universal standardized system for electronic exchanges of technical information on products and manufacturing processes. The digital format, called Standard for the Exchange of Product (STEP) model data, was approved as a draft standard by the International Organization for Standardization; after a 6-month comment period, it will become an international standard. Wide-scale adoption of a standardized, digital format for describing part information would eliminate many of the barriers that prevent units within companies and groups of companies from working as teams on design and manufacturing projects. In September, Ford Motor Co.'s Powertrain Operations in Dearborn, MI, and the Department of Energy's Allied/Signal Kansas City Plant jointly designed and built an engine part using the STEP standard. The Departments of Commerce and Defense now are playing key supporting roles in the drive to develop standards that enable agile manufacturing.

DOE has taken several actions to make extensive in-house manufacturing facilities available to U.S. industry. Much of the advanced equipment that once was restricted to classified personnel can now be used by industry,university, and other government researchers. For example, the Oak Ridge National Laboratory's once highly secretive Y-12 plant made components for nuclear warheads and optical components for the former Strategic Defense Initiative. Now, outside researchers have access to one Y-12 plant's concurrent engineering center, prototyping facility, and ultraprecision manufacturing equipment that were formerly reserved for military work. Additional efforts to enhance industrial competitiveness are being planned as the Y-12 plant is fully converted into a Center for Defense and Manufacturing Technology.

DOE is pursuing a wide range of initiatives to make its manufacturing technologies, capabilities, and know-how available to U.S. industry. In addition to contracted R&D work in support of the Department's defense and energy missions, DOE is stressing cooperative work with individual firms and with teams of companies, making available to industry its specialized centers of manufacturing expertise, and collaborating with Federal and State agencies in efforts to enhance the capabilities and competitive performance of small and medium-sized manufacturers. Currently, DOE has under way or in negotiation more than 115 advanced manufacturing cooperative projects involving more than 60 companies. Over the life of the projects, the level of effort is expected to exceed $270 million.

Over the past 9 months, the Defense Department's shift to foster a dual-use manufacturing capability has gained momentum, propelled by the Administration's Technology Reinvestment Project and planned reform of an acquisition process that discouraged integration of defense and commercial technology-development efforts. For example, the Advanced Research Projects Agency (formerly the Defense Advanced Research Projects Agency), long successful in nurturing progress in the development of technologies that have enabled the Nation to maintain a superior military, is undertaking an ambitious program to speed the development of dual-use technologies in strategically important areas. Research on dual-use technology accounts for a substantial portion of the agency's $2.2 billion budget. ARPA allocated about $600 million for manufacturing-related research during FY 1994. It is investing its resources to drive advances in materials and materials processing, production technology, design-process integration, agile manufacturing, and enterprise integration. The National Science Foundation and ARPA are running a joint program to support agile manufacturing projects led by industry and hosted by a university or not-for-profit institute. Award announcements are expected early in 1994.

Manufacturing Extension Partnership

Working with a growing roster of Federal agencies and laboratories and State and local organizations, the Commerce Department's National Institute of Standards and Technology is moving ahead in its plans to build a nationwide network of electronically linked manufacturing extension centers. As envisioned in the Administration's Technology for America's Economic Growth, A New Direction to Build Economic Strength, this Manufacturing Extension Partnership, or MEP, will provide a coordinated mechanism for delivering technical and business support services to the nation's 350,000 small and medium-sized manufacturers.

These firms employ some 6 million Americans, supply components to U.S. makers of higher-value-added products such as computers and automobiles and are essential to the health of regional, State, and local economies.

Yet, a sizable fraction of these critically important elements of the manufacturing "food chain" have been slow to adopt modern, performance-enhancing equipment, production methods, and organizational techniques, leaving them ill-prepared to meet the challenges posed by foreign competitors that are exploiting the advantages of modern technology. Through the MEP, the Administration is following through on its pledge to establish a nationwide network of 100 manufacturing extension centers by 1997 to assist manufacturers to modernize their production capabilities. Concrete steps taken thus far to build this vital component of the Nation's manufacturing infrastructure are described below.

- NIST designed scale-up plans that allow the MEP to expand smoothly and to maintain both high-quality standards and close regional and local linkages.

- The deployment portion of the Administration's Technology Reinvestment Project includes $87 million for manufacturing extension programs. Aimed at improving the quality, productivity, and performance of small manufacturing firms, the industrial outreach programs approved by the Defense Department-managed TRP will speed development of the nationwide MEP network.
- As requested by the President, Congress has approved a two-thirds increase in the MEP budget, raising it to $30.2 million in FY 1994.
- Linkages have been formed recently between the MEP and Federal agencies with roles to play in the delivery of technical assistance and workforce training and small business support services. Alliances with the:
  - Environmental Protection Agency will help U.S. manufacturers adopt technologies and practices that can reduce sources of pollution.
  - Small Business Administration will link NIST's seven existing regional Manufacturing Technology Centers with SBA's Small Business Development Centers. SBDC subcenterswill be set up in each MTC to provide business-planning and financial services geared to the needs of manufacturers.
  - Navy and University of Maryland will promote adoption of"best manufacturing practices" identified in a long-standingNavy benchmarking program.
  - Department of Energy's Lawrence Livermore Laboratory willprovide industrial clients of the California MTC with access to laboratory scientists and engineers and to its research and testing facilities.
  - Department of Labor will focus on workforce training needsand will provide MEP personnel with tools to assess the training needs of client firms.
  - The Labor Department also will assist the MEP in helping businesses to integrate new technology with innovativeworkplace practices and human resource policies
- Implementation of TECNET, an electronic dissemination and access system, has begun, initially linking the NIST MTCs and client firms. TECNET will be the backbone of the MEP electronic network, which will provide manufacturers with easily accessible technology and business-support services.

The Departments of Commerce and Energy now are expanding and diversifying already-existing collaborative efforts to strengthen industrial outreach efforts, including a toll-free number that provides U.S. machine-tool manufacturers with access to NIST and DOE manufacturing experts. The Oak Ridge National Laboratory's Y-12 plant provides technical assistance to the Southeast MTC, and it has a field staff that works with Southeast manufacturers and responds to telephone inquiries. This year alone, Y-12 plant personnel have responded to about 500 requests for help. At Sandia National Laboratories, an electronic technical- assistance system will soon go on line. Called the Technology Information Environment for Industry, or TiE-In, the system will contain technical databases. technology tutorials, analytical tools, and other resources. It also will provide industrial users with access to high-performance computers.

Manufacturing Competitiveness Initiative

The Department of Commerce plans to begin an annual strategic assessment of the health of the U.S. manufacturing base. This assessment will characterize the comparative strength of U.S. manufacturing, measuring the extent to which U.S. industry has adopted modern manufacturing technologies and modern workforce and organizational practices. An understanding of the strengths and weaknesses of U.S. manufacturing will help to direct government resources and guide the development of legal and regulatory policies.

U.S.-Japan Manufacturing Technology Fellowship Program

With Japan's Ministry of International Trade and Industry, the Commerce Department initiated, in January, an innovative program to place U.S. engineers in Japanese manufacturing firms for up to 1 year. The goal of the Manufacturing Technology Fellowship Program is to help U.S. engineers to learn Japanese manufacturing practices firsthand and to promote long-term professional exchanges with the Japanese. More than 60 Japanese firms have signed on as host organizations. Numbering 30, the first fellows will begin working for their host companies in February 1994 after a thorough orientation and training session. An agreement reached with the Society of ManufacturingEngineers provides additional private-sector involvement.

Electronics

Electronic devices, components, and systems are vital "building-block" technologies of modern industry and commerce. The public and private sectors must devote increased effort to maintaining U.S. leadership in those areas of electronics where it remains strong. They also must strive to recover lost ground in established and emerging technology areas dominated by foreign industry.

Comparative competitive assessments indicate that the United States lags well behind the competition in 13 critical electronic technologies, including optical information storage, multichip packaging systems, and display technology. Two key thrusts of the Defense Department's dual-use technology strategy information technology and advanced manufacturing focus directly on issues critical to the health of the U.S. electronics sector. The ability to perform massive amounts of computing equivalent to that done on today's supercomputers on machines scaled for use by individuals or by individual enterprises will revolutionize information processing. Over the next 5 years, new scalable computer architectures will make extremely powerful software applications available to users over a broad range of computers. Computers with this common software will enable a wide range of users to analyze problems that now require the most specialized of systems. A new Defense Department initiative will help to establish a new computing paradigm based on scalable, affordable systems, from workstations to supercomputers with 200 times the capabilities of today's machines.

A second major R&D activity will establish an all-optical network testbed operating at 100 gigabit (billion bits) per second by 1995 or 10 times faster than the commercial networks that will then be available. The network testbed will be the foundation of an information superhighway that can provide new commercial opportunities to U.S. manufacturing and service firms.

The dual-use thrust in advanced manufacturing will emphasizemultichip modules, a technology offering the potential to interconnect dozens of "bare" silicon chips in a single package no larger than the packages that now hold individual integrated circuits. At the system level, the benefits of this technology could translate into a 70-percent reduction in volume and weight, a doubling of performance capabilities, and a tenfold increase in reliability. The Defense Department's Advanced Research Projects Agency is investing more than $75 million annually to help develop a viable domestic merchant multichip module infrastructure, enabling the United States to compete strongly in a new industry anticipated to have a multibillion dollar global market by the end of this decade. Other actions in the electronics R&D area taken during the Administration's first 9 months include:

- ARPA provided $20 million in July to a consortium of display manufacturers working with government to create an infrastructure supporting the development and growth of a U.S. display industry. Modeled after SEMATECH, the effort is one element of ARPA's High Definition Systems program, which aims to rebuild U.S. strength in this militarily and commercially important technology area now dominated by foreign competition.
- ARPA is investing $8 million annually to support R&D work on microelectromechanical systems, or MEMS. A revolutionary enabling technology with applications in many commercial industries and in "smart" defense systems, MEMS are fabricated from the same materials and with the same processes used to make today's integrated circuits. Goals of the program include: demonstrating processes and prototyping systems; merging sensors, actuators, and computing devices; and lowering the barriers to access and commercialization by developing an infrastructure to support multiuser design, fabrication, and testing of new MEMS.
- ARPA's support for SEMATECH in FY 1994 will focus on the manufacturing tools and methodologies needed for low-cost, flexible, scalable manufacturing to meet defense and commercial needs. Currently, the industry is optimized to produce single part types in large volumes. Emphasis will be on combining advances in manufacturing

equipment with software innovations to enable state-of-the-art microelectronics manufacturing facilities capable of producing many part types in rapid turnaround time and with reduced cost sensitivity to manufacturing volume.

- ARPA's Advanced Materials Synthesis and Processing Partnerships Program began negotiations with several consortia to advance dual-use technology objectives in strategically important areas of electronics and photonics:
  - Smart materials and structures ($4.5 million);
  - Advanced molecular beam epitaxy technology ($4.7 million);
  - Organic thin-film materials for optoelectronic technologies($2.5 million):and
  - Visible vertical cavity surface emitting laser ($4.6million).
- The Commerce Department's National Institute of Standards and Technology and the Department of Energy's Sandia National Laboratories are coordinating their R&D efforts and assigning 40 researchers to address priority technology needs and issues identified by the Semiconductor Industry Association. In March, Sandia and NIST announced that they will align their efforts with the trade association's technological road map, which details the technological milestones that U.S. integrated circuit manufacturers must achieve to remain internationally competitive.
- NIST issued in April a comprehensive summary specifying the broad range of measurement needs that must be addressed to strengthen U.S. competitiveness in electronics. The publication, Measurements for Competitiveness, was developed in consultation with industry, and it has been favorably reviewed by some 20 industry periodicals. A portion of the FY 1994 increases sought and received by the Administration will support expanded NIST laboratory research and services for industry in this area.

Realizing the Opportunities of the Information Age

Information is a critical resource, for service industries as well as manufacturing, for economic as well as national security. By one estimate, two-thirds of U.S. workers are in information-related jobs, and the rest are in industries that rely heavily on information.

The Clinton Administration has taken a leadership role in putting information technology and resources to better use in promoting U.S. economic growth. The Administration recognizes clearly that Americans have a stake in the construction of an advanced National Information Infrastructure (NII), a web of communications networks, computers, databases, and consumer electronics that will put vast amounts of information at users' fingertips. The information infrastructure can be used by all Americans, not just by scientists and engineers. As entrepreneurs, factory workers, doctors, teachers, school children, users of public libraries, Federal employees, and citizens, Americans can harness this technology to:

- create jobs, spur growth, and foster U.S. technological leadership;
- reduce health care costs while increasing the quality of service in underserved areas;
- deliver higher-quality, lower-cost government services;
- prepare our children for the fast-paced workplace of the 21st century; support lifelong learning; and
- build a more open and participatory democracy at all levels of government.

The NII: A High Priority for the Clinton Administration

Promoting rapid, equitable, and smooth development and use of the NII is one of the Administration's highest priorities. In September, Vice President Gore and Commerce Secretary Brown released a policy statement and action agenda for speeding up full development and utilization of the NII. The policy statement clearly recognizes that private-sector firms are already developing and deploying that infrastructure today. It is the private sector that will build and own the NII of tomorrow. Nevertheless, there remain essential roles for government in complementing the efforts of the private sector and assuring the growth of an information infrastructure available to all Americans at reasonable cost.

In developing our initiatives in this area, the Administration is working in close partnerships with business, labor, academia, the public, Congress, and State and local government.

To ensure effective coordination of government activities and full involvement of the private sector, the President:

- Established an interagency Information Infrastructure Task Force (IITF) to work with Congress and the private sector to develop initiatives needed to accelerate deployment of a National Information Infrastructure. Chaired by Commerce Secretary Brown and composed of high-level Federal agency representatives, the IITF's three committees are now focusing on telecommunications policy, information policy, and applications.
- Established a private-sector Advisory Council on the National Information Infrastructure. The Council will consist of 25 members, who will be named by Secretary Brown by December 1993.

Action Plan and Accomplishments

The Information Infrastructure Task Force is undertaking work in nine major areas where government action is warranted.

1. Promoting private-sector investment, through tax and regulatory policies that encourage innovation and promote long-term investment, as well as wise procurement of services. The Administration is working with Congress to pass legislation by the end of 1994 that will increase competition and ensure universal access in communications markets particularly those, such as the cable television and local telephone markets, that have been dominated by monopolies. Such legislation will explicitly promote private-sector infrastructure investment both by companies already in the market and those seeking entry. The President has signed into law tax incentives for private-sector investment in R&D and new business formation, including a 3-year extension of the R&D credit and a targeted capital gains reduction for investments that will help spur the private-sector investment needed to develop the NII.
2. Extending the "universal service" concept to ensure that information resources are available to all at affordable prices. The Commerce Department's National Telecommunications and Information Administration (NTIA) will hold a series of public hearings on universal service and the NII, beginning by December 1993. Building on the knowledge gained from these activities, the IITF will work with the NII Advisory Council and with State regulatory commissions to determine how the universal service concept should be applied in the 21st century.
3. Promoting technological innovation and new applications. The Administration will commit government research programs and grants to help the private sector develop technologies needed for the NII. These government programs will focus on the development of public applications in such fields as education and health care. The Administration will continue the High-Performance Computing and Communications (HPCC) Program. This program funds R&D designed to create more powerful computers, faster computer networks, and more sophisticated software. It is also intended to enable scientists and engineers to tackle "Grand Challenges," such as forecasting the weather, building more energy efficient cars, designing life-saving drugs, and designing and simulating next-generation aircraft. The Administration requested $1 billion for the HPCC Program in FY 1994 and is in the process of forming a "High-Performance Computing Advisory Committee" to provide private-sector input on the Program. The Administration requested an additional $96 million in the FY 1994 budget to create a new component of the HPCC Program Information Infrastructure Technologies and Applications (IITA). This program will develop and apply high-performance computing and high-speed networking technologies for use in the fields of health care, education, libraries, manufacturing, and provision of government information. The Administration won FY 1994 funding from the Congress for NII networking pilot and demonstration projects. Under NTIA's direction, this $26 million pilot program will provide matching grants to State and local governments, health care providers, school districts,

libraries, universities, and other non-profit entities. The grants will be awarded on a competitive basis and will fund projects to connect institutions to existing networks, enhance communications networks that are currently operational, and permit users to interconnect among different networks. Another $40 million was requested for research by the Department of Energy's national laboratories on technologies and applications related to the information infrastructure. By the end of January 1994, the IITF will complete an inventory of current and planned government activities and will widely disseminate the results through electronic and printed means. The IITF applications committee is establishing an electronic forum to encourage government and private-sector contributions and comments about government applications projects. NASA recently launched the Advanced Communications Technology Satellite (ACTS), an experimental testbed bringing together industry, government, and academia to test pioneering concepts and technologies that advance on-demand, flexible communications services. Over 50 experiments are scheduled in areas such as business communications and supercomputer networking, as well as technology verification and scientific research. To date, over 21 industrial partners and 25 universities have developed experiments for ACTS and have agreed to contribute $8 million over the life of the program.

4. Promoting interactive, user-driven operation of the NII. As the NII evolves into a "network of networks," government will ensure that users can transfer information across networks easily and efficiently. To assure interoperability and openness of the many components of an efficient, high-capacity NII, standards for voice, video, data, and multimedia services must be developed. Those standards also must be compatible with the large installed base of communications technologies and be flexible and adaptable enough to meet user needs at affordable costs. The National Institute of Standards and Technology has named an interagency panel to review open systems network requirements and recommend policies on the use of networking standards by the Federal Government. The panel will consider issues related to the Internet Protocol Suite and Open Systems Interconnection specifications, as well as proprietary networking protocols. The Administration also will work closely with the private sector, as well as State and local governments, to identify government policies and regulations that may hinder the growth of interactive services and applications. The IITF will determine how those regulations should be changed.
5. Ensuring information security and network reliability. The NII must be trustworthy and secure, protecting the privacy of its users. Government action also will aim to ensure that the overall system remains reliable, quickly repairable in the event of failure, and, perhaps most important, easy to use. The Administration is completing a Presidentially directed review of Federal policies on encryption technology. In addition, Federal

agencies are seeking to work more closely with industry to develop new technologies that protect the privacy of citizens, while enabling law enforcement agencies to continue to use court-authorized wiretaps to fight terrorism, drug rings, organized crime, and corruption. The National Communications System (NCS) brings together 23 Federal agencies with industry to reduce the vulnerability of the Nation's telecommunications systems to accident, sabotage, natural disaster, or military attack. And the Federal Communications Commission (FCC) has an industry and user Network Reliability Council to advise it on ensuring the reliability of the Nation's commercial telecommunications networks. These efforts are increasingly important as the threat posed by terrorism and computing hacking grows.

6. Improving management of the radio frequency spectrum, an increasingly critical resource. Many of the dramatic changes expected from the development of the information infrastructure will grow out of advances in wireless technologies. The ability to access the resources of the NII at any time, from any-where in the country, will be constrained, however, if there is inadequate spectrum available. The President in August 1993 signed the Emerging Telecommunications Technology Act, which directs the Secretary of Commerce to transfer, over a 10-year period, at least 200 MHz of spectrum now used by Federal agencies to the FCC for subsequent licensing to the private sector. It allows the FCC to use competitive bidding to grant new license assignments for spectrum. This will accelerate the development of new wireless industries such as Personal Communications Services and will help to create good jobs. The entire cellular industry, which has generated 100,000 jobs, was created by licensing only 50 MHz of spectrum. The Commerce Department is currently determining what frequencies should be transferred to the FCC. The Administration has pledged support for greater reliance on market principles in distributing spectrum among the widely differing wireless services that will be a part of the NII. At the same time, the Administration will promote policies to ensure that entrepreneurs and small, rural, and minority and women-owned businesses are able to participate in spectrum auctions. The FCC is currently conducting proceedings to implement these policies.
7. Protecting intellectual property rights. The Administration will recommend ways to strengthen domestic copyright laws and international intellectual property treaties to prevent piracy and to protect the integrity of intellectual property. To ensure broad access to information via the NII, the IITF will study how traditional concepts of fair use should apply with respect to new media and new works. The IITF will explore the need for standards for the identification of copyright ownership of information products in electronic systems (e.g , electronic headers, labels, or signature techniques).
8. Coordinating with other levels of government and with other nations. Because information crosses State, regional, and national boundaries,

coordination is important to avoid unnecessary obstacles and to prevent unfair policies that handicap U.S. industry. The IITF is planning to meet later this month with State and local officials, the private sector, and non-Federal agencies as it devises proposals for regulatory reform and other NII policy issues. The Administration will work directly on behalf of U.S. firms to open overseas markets for telecommunications-related goods and services to potential overseas customers. This includes elimination of trade barriers raised by incompatible U.S. and foreign standards or more subtly between the methods used to test conformance to standards. The Administration also is working to lift export controls that handicap U.S. manufacturers of computers and telecommunications equipment. The IITF will coordinate the Administration's examination of policy issues related to the delivery of telecommunications services to and from the United States, including claims by some U.S. companies that regulatory practices in foreign countries deny market access for U.S. carriers and impose excessive charges for completing calls from the United States, thus harming the competitiveness of U.S. industry.

9. Providing access to government information and improving government procurement. As described in the National Performance Review, Federal agencies, in concert with State and local governments, will use the NII to open the immense reservoir of government information to easy public access. Additionally, Federal procurement policies for telecommunications and information services and equipment will promote important technical developments for the NII and provide attractive incentives for the private sector to contribute to NII development. IITF working groups will carefully consider the problems associated with making government information broadly accessible to the public electronically. Additionally, several interagency efforts have begun to ensure that the right information is stored and available. Finally, to help the public find government information, an interagency project will develop a virtual card catalog to indicate the availability of government information in whatever form it takes. The Federal Government has taken a number of steps to promote wider distribution of its public reports. A number of Federal agencies are converting their public information into electronic form and disseminating it over the Internet. In September, "FedWorld," an electronic locator and gateway to government information operated by the Department of Commerce's National Technical Information Service (NTIS), was made accessible via Internet. FedWorld links the public with more than 100 Federal bulletin boards and information centers. In June 1993, OMB prescribed new policies that will lower the cost to the public of acquiring information from Federal agencies. Among other things, the policies mandate that, in distributing information to the public, Federal agencies should recoup only those costs associated with the dissemination of that information, not with its creation or collection. Other efforts are also under way to afford greater public access to the government. One project would

turn thousands of local and field offices of various Federal agencies into Interactive Citizen Participation Centers, at which citizens can communicate with the public affairs departments of all Federal agencies. The President and Vice President have made White House documents accessible to the public via electronic mail. The Administration is using on-line information services and the Internet to make available speeches, press briefings, executive orders, and a summary of the budget.

Defense Technology: The Payoffs for Economic and Military Security

Historically, this Nation's policies to support the development of advanced industrial technology were motivated primarily by national security concerns. This linkage traces back to post-Revolutionary times, when the government spurred the development of an interchangeable parts approach to manufacturing to meet a pressing need for rifles. The government's impact on manufacturing was significant then and it remained so, at least until recently.

During and after World War II, new high-technology industries were driven and assisted by the government's push to strengthen national security. Defense programs dominated the Federal Government's R&D portfolio. The payoffs were substantial, with U.S. industry benefiting from defense-driven investments. But an increasingly inflexible defen acquisition process lengthened production cycles and increased costs at the same time that commercial enterprises began the drive to reduce costs and time to market. Defense systems' development needs and benefits diverged from the industrial mainstream, which was spurred by stiff overseas competition and dramatic technology advances. Today, though defense continues to blaze the trail in key areas of leading-edge research, the rate at which that innovation is actually moved into production often lags well behind that of commercial industry in important sectors such as computers and microelectronics.

Three Pillars of a 21st-Century Defense Technology Strategy The Clinton Administration intends to reverse this trend and will pursue more efficient and effective strategies for defense investments in technology. The three pillars that will serve as the foundation for a 21st-century defense technology strategy are:

- Reform the current Department of Defense (DOD) acquisition process, now biased against the use of commercial processes and products within defense systems.
- Focus more R&D within DOD on dual-use products and processes, emphasizing the need to achieve advances in high-tech defense systems that are affordable.
- Reach out globally to our allies, to benefit from international cooperation on a technology-by-technology basis.

These strategic thrusts are beginning to redirect this Nation's massive defense investment so that it is both more effective and more supportive of our broader industrial base. Reform the current DOD acquisition process to encourage the use of commercial processes and products within defense systems. By using components. technologies, and subsystems developed by commercial industry whenever possible, defense should be able to attain three compatible objectives:

- Shorten development times, increasing the pace at which innovation is incorporated into new defense systems in critical areas. Introduce the commercial high-tech sector's continuous stream of improvements and updates during both the development and deployment phase.
- Reduce costs for procuring leading technology to satisfy military needs. Commercial components, technologies, and subsystems in many instances can meet functional needs at lower costs than technology that is military-driven and customized. Eliminate unnecessary military specifications, testing requirements, and procurement procedures.
- Prepare for building back military capabilities. Close integration with the private sector is imperative if the Nation is to be equipped to quickly gear up its capabilities.

Focus more R&D within DOD on dual-use products and processes, emphasizing affordable advances in high-tech defense systems. Investments in technologies that are both critical to defense systems and vital to commercial industries serve a dual use.

Dual-use technologies include manufacturing processes as well as products. For example, the Microelectronics Manufacturing Science and Technology (MMST) Program supported by DOD was designed to develop fast, flexible, cost-effective techniques for manufacturing semiconductors. The primary goal was to meet military needs for relatively small batches of semiconductors at affordable cost, but the technology is valuable to commercial production as well. In fact, it was developed in partnership with the commercial division of Texas Instruments. Reach out globally to our allies, to benefit from international cooperation on a technology-by-technology basis. Technology today is global, flowing with relative freedom across national boundaries. We need to ensure that the flow of defense technology-related knowledge is not just one way. In the recent past, we have shared considerable expertise and technology with our allies. A part of our strategy now must be to strengthen our relationships with allies and explore how they may be helpful to us in solving technology-based problems.

Progress to Date

The Administration has taken concrete steps to implement its new vision for a defense strategy, which makes the most of our national investment in technology by supporting both military and economic strength:

- DOD is explicitly emphasizing dual-use R&D to better integrate defense technology development with commercial industry. This is a break from past Administrations' unwillingness to address defense technology's dual-use needs and opportunities. Application of critical technologies will be accelerated in four focused "thrust areas": information technology, manufacturing, materials, and advanced simulation and training.

- President Clinton has changed the name of the Advanced Research Projects Agency (ARPA) to reflect its new focus on dual-use technologies. ARPA is rebalancing its advanced research portfolio while continuing its emphasis on electronics and information processing; it is also strongly supporting the High Performance Computing and Communications Initiative and the National Information Infrastructure, two notable dual-use efforts. ARPA also is seeking to transform manufacturing production processes through advances in materials, equipment, design-process integration, agile manufacturing, and enterprise integration. A key to ARPA's strategy is its emphasis on partnerships and cost sharing.
- The Administration successfully launched the Technology Reinvestment Project (TRP), the largest multiagency technology program ever conducted by the Federal Government. President Clinton introduced this top-priority dual-use effort in March 1993 as a cornerstone of his $1.7 billion Defense Reinvestment and Conversion Initiative. The TRP stresses partnering among industry, government, and universities; it has drawn a powerful show of interest, especially from industry.

TRP funds are available for three key areas: technology development, to create new technologies with the potential for commercialization within 5 years; technology deployment, to disseminate existing technology for near term commercial and defense products and to support improved use of technologies in small businesses; and manufacturing education and training, to strengthen engineering and workforce capabilities necessary for a competitive industrial base.

Six Federal agencies jointly manage and implement the TRP. Led by the Defense Department's ARPA, the other participating agencies are the Commerce Department's National Institute of Standards and Technology, the Departments of Energy and Transportation, the National Aeronautics and Space Administration, and the National Science Foundation. Project managers sought broad participation through an "800" hotline and a series of regional briefings sponsored by the White House. The hotline received 35,000 calls and 55,000 information packages were distributed, reflecting an extraordinary level of interest. More than 2,800 proposals, requesting $8.5 billion, were submitted in response to the offer of $472 million in merit-based, matching Federal grants from the TRP. Proposals were received from organizations in all 50 states and the District of Columbia.

The President on October 22 announced the first successful applicants: 41

projects accounting for $140 million in requested Federal matching funds.

The remainder of the awards will be announced in November. Planning is under way for an expected follow-up round of competitions for the TRP.

- Technology application efforts and acquisition are beginning to reflect the new strategy for integrating defense and commercial technologies. Advanced Technology Demonstrations (ATD) in DoD are increasing the focus on manufacturing and speeding the rate at which new technology is fielded by our military. For example, the Technology for Affordability "thrust" is now seeking major advances in design tools, process integration and control, and production management.
- DOD is emphasizing technology in the acquisition process to improve efficiency. An example is a greatly enhanced Continuous Acquisition Life-Cycle Support (CALS) program, which aims to automate much of the routine work associated with logistics support. Another element is automation of the procurement process, with pilot programs being launched to electronically advertise and respond to procurement requests. DOD intends to take an active part in the expected large-scale movement of business information into the National Information Infrastructure.
- To encourage defense firms to participate in dual-use cooperative R&D, the Administration has clarified regulations regarding the use of independent research and development (IR&D) funding as part of a firm's contribution to a cost-sharing proposal. Use of IR&D monies as part of industry matching funds is permitted in certain kinds of cooperative arrangements involving contractors working jointly with others (e.g., joint ventures, teaming arrangements, and consortia).
- DOD has launched a major new initiative with Japan to gain access to its commercial technologies, manufacturing know-how, components, and subsystems. This effort seeks to better balance the significant amounts of U.S. defense technology that flow to Japan, with a compensating flow of dual-use technologies obtained from commercial firms in Japan for use in defense applications. The emphasis is on fostering company-to-company linkages that gain access for our defense industrial base to Japanese expertise and information.
- DOD has proposed significant new initiatives in jointly developing military systems with our NATO allies. Joint development programs can lead to additional expense since language, cultural, and institutional differences typically must be overcome. But this Administration is firmly convinced that gains from splitting development costs with partners and from interoperability of systems can greatly exceed the incremental costs of taking the trouble to work with allies.

A dual-use strategy as discussed above offers clear advantages to the military. Defense planners know that the way to get the most out of shrinking dollars is to buy as much as possible from commercial manufacturers who, under the discipline of the market, must give their customers good value high quality, reliable products embodying the latest and best technologies at competitive prices. While the dual-use approach is not as central to the interests of commercial companies, they too will benefit. Defense spending for dual-use R&D and procurement has a more than proportionate effect on advancement of technology, because investments will be heavily weighted to leading-edge technologies with potentially broad application.

Nevertheless, defense spending makes up a small and declining share of a $5.5 trillion to $6 trillion economy. Civil-military integration is just one part, though an important part, of successful conversion to a post-Cold War economy. The best and broadest conversion strategy must also include govern- ment investments that lift the performance of the whole economy. This means:

- investing in first-class education and training of all our workers;
- forming R&D partnerships with industry on promising technologies that are primarily commercial as well as dual use; and
- developing new national initiatives that meet widely agreed public needs while also fostering the advance of technology, the growth of knowledge-intensive, wealth-generating industries, and the creation of high-quality jobs.

Other sections of this progress report deal with these broader strategies for transition to a post-Cold War world.

Energy and Environment: New Technologies for Growth

In his February 22, 1993, statement on Technology for America's Economic Growth, President Clinton's foremost goal is "long-term economic growth that creates jobs and protects the environment." In establishing this goal, the President rejected the conventional view that economic growth and environmental quality are inversely related that is, that gains in one produce setbacks in the other.

Today's high fuel and waste-disposal costs, stiff business competition,and high levels of national and international environmental awareness have fundamentally changed the economic growth/environment equation. Inefficient industrial practices that were economically and environmentally practical just 10 years ago are no longer viable. Today, such waste is too costly to business competitiveness and to our environment, especially with growing concern over urban air quality and global warming. The Clinton Administration is working with the U.S. business and research communities to promote the development and deployment of new technologies that simultaneously prevent pollution, increase energy efficiency, and promote economic growth. Clean technologies such as energy-efficient light bulbs and motors, alternative fuel cars, and advanced steel making reduce air pollutants and other pollutants. Such technologies also reduce the energy needs of U.S. companies, trimming costs, improving international competitiveness, freeing up money for capital investments, and reducing the Nation's energy trade deficit. The result is improved environmental quality and long-term economic growth.

Adding to these positive effects are the tremendous opportunities for increasing U.S. exports of environmental technologies. Over the next decade, developing nations will be expanding their economies fivefold, while the global population doubles. Limited capital and rising world demands for environmen- tally responsible production will make traditional resource-inefficient development impractical. Sustainable development, based on energy efficient, environmentally benign processes, is the necessity of the future.

The United States is the world's leading producer of environmental technologies with 35 percent of the current market. The Clinton Administration is working to ensure that America maintains and improves its leadership position in this growing global market.

Since release of the February policy statement, the Administration has launched new initiatives and strengthened existing programs to accomplish its national energy and environmental objectives. Together, these programs represent a coordinated, government-wide effort to:

- create high-wage, secure U.S. jobs through production of new and existing environmental technologies;
- promote environmental technology exports;
- improve energy efficiency and conservation;
- improve environmental quality;
- minimize industrial wastes;
- maximize industrial competitiveness;
- diversify energy supply and demand; and
- reduce energy trade deficits.

Actions Taken to Date - Clinton Administration Initiatives

Climate Change Action Plan.

This plan, released in October, presents the Administration's strategy for reducing the growth of greenhouse gases linked to global warming. The plan will reduce U.S. greenhouse gas emissions in the year 2000 to 1990 levels. It includes more than 50 new or expanded initiatives, relying primarily on increased energy efficiency. It will stimulate investments in technologies of the future, strengthening America's position in the global environmental technology marketplace. The Administration proposes to support the program with $1.9 billion largely through redirected Federal funding between 1994 and 2000. This funding will leverage an additional $60 billion in private-sector investments in environmental technology. Projected energy savings from these investments total more than $60 billion between 1994 and 2000, with continued benefits of over $200 billion in energy savings between 2001 and 2010. By the year 2000, the program should reduce total annual carbon emissions by the equivalent of 109 million metric tons of carbon.

Clean Car Initiative.

On September 29, 1993, President Clinton and Vice President Gore joined with General Motors, Ford, and Chrysler to an nounce an historic new partnership. The Clean Car Initiative aims to strengthen U.S. competitiveness by developing technologies for a new generation of vehicles that are both safer and up to three times more fuel efficient (80 miles per gallon or better) than today's cars. Major collaborations with the Big Three U.S. automakers are under development. On the government side, a high-level coordinating committee chaired by Under Secretary of Commerce for Technology Mary Good is directing R&D in a strategic plan to avoid duplication, focus on priority areas, and make the most of existing resources. The first stage of the plan is in fast-track development, to be completed before the end of the year.

Environmental Technologies Initiative.

The Environmental Protection Agency in April launched its Environmental Technologies Initiative, designed to stimulate technological innovation to meet the Nation's environmental objectives. The initiative aims to create a more productive environmental technology marketplace and works toward incorporating environmental considerations into the design of new technologies and into upgrades of existing technologies. Projected funding for this initiative is $36 million for FY 1994. Funding is expected to increase over the next decade.

Environmental Technology Export Strategy.

Following President Clinton's Earth Day charge, an interagency committee has been working with the environmental technology industry to develop a national environmental export strategy that will help coordinate public and private activities and help U.S. companies to take advantage of a world market estimated at $275 billion to $300 billion. The group has been focusing on trade development and technical assistance to increase exports of U.S. environmental technologies.

Chaired by the Commerce Department with the participation of the Environmental Protection Agency, Department of Energy, and 10 other agencies, the Interagency Environmental Technologies Exports Working Group will soon release a report including specific recommendations to increase these exports.

The National Environmental Trade Technology Initiative demonstrates how better coordination can provide industry with critical assistance. This initiative combines the Commerce Department's export-promotion expertise with the financial capabilities of the Export-Import Bank to introduce practical solutions to environmental problems in developing countries like Mexico, which need environmentally responsible technologies. The EnviroMex '93 conference held in Mexico last month, for instance, brought together over 200 American and Mexican industry representatives interested in exploring opportunities for increased trade.

Environmental Technologies and NAFTA.

President Clinton has pushed for ratification of the North American Free Trade Agreement (NAFTA), knowing that this agreement and the supplemental agreement on environmental cooperation will enhance opportunities to export U.S. environmental technologies and create jobs at home. Many of the goods and services provided by the U.S. domestic environmental technology industry are being marketed and sold throughout Mexico. These exports are valued at about $1 billion each year and support about 27,000 jobs in the United States. As exports to Mexico grow, so will the number of jobs here and export-related jobs on average pay almost one-fifth more than other jobs. The NAFTA initiative clearly ties together the Clinton Administration's goals of American international economic competitiveness and global environmental security.

Budget Priorities.

The Department of Energy has revamped its science and technology budget priorities. Dramatic increases will be seen in funding for research programs related to energy efficiency, renewable energy, natural gas, alternative fuels, and technology transfer.

The Environmental Protection Agency (EPA) has reallocated substantial funding to global warming and the environmental technology initiatives described above. Similar changes are under way at other science and technology agencies, such as the Commerce Department's National Institute of Standards and Technology (NIST). Expansion of NIST's Manufacturing Extension Partnership to meet the President's goal of 100 manufacturing extension centers across the country to help small and medium-sized companies adopt updated technologies will include an emphasis on environmentally sound manufacturing. In September, EPA and NIST announced a pilot, collaborative effort to help companies adopt pollution-prevention technologies that also reduce operating costs.

The Technology Reinvestment Project (TRP)

designed to assist in the transition to an integrated industrial base that can meet both defense and commercial needs, also will provide support to environmentally sound manufacturing. Several of the initial projects selected for funding have the goal of assisting smaller companies to increase their competitiveness by matching energy, environmental, and manufacturing technology needs.

Clean Cities.

Clean Cities is a market-driven initiative developed by the Department of Energy to promote the use of alternative fuels and assist in the implementation of the Energy Policy Act. Since its September national kickoff, Denver, Philadelphia, Wilmington, Las Vegas, and Washington, DC, have been formally designated Clean Cities. The program works by establishing partnerships between Federal, State, and local governments and the private sector, including utilities, fuel suppliers, fuel distributors, auto manufacturers, and organizations committed to acquiring alternative-fueled vehicles for their fleets. Together, these groups create a fleet large enough to support an emerging refueling and maintenance infrastructure and operate on American-produced fuels, which will improve the U.S. trade deficit and decrease reliance on insecure energy sources, create jobs, and improve air quality.

Natural Gas Strategic Plan.

The Administration has put in place, and funded at $200 million per year, the first, credible, long-term Federal R&D effort for natural gas. It focuses on strategic opportunities in end-use markets, such as ultra-high efficiency utility gas turbines, fuel cells for both industrial and automotive applications, and natural gas vehicles.

Motor Challenge.

In October, the Administration launched the Motor Challenge program to provide industry leaders an opportunity to demonstrate how improved efficiency of electric motor systems can enhance industrial productivity and profitability while preventing pollution. The program is a collaboration between the Federal Government, motor manufacturers, electric utilities, and industrial motor systems users. By promoting a systems approach to electric motor system design and implementation, the program seeks the largest and most profitable opportunities for increasing industrial motor efficiency.

Small Business Innovation Research (SBIR).

In FY 1993, the Department of Energy devoted $49.7 million in grants under this competitive grants program that supports phased research and development on advanced concepts and technologies related to energy and the environment. The Department hosted a Commercialization Opportunity Forum in late September. After receiving extensive training in development of a business plan for a successful SBIR project, 24 companies made presentations to 56 representatives from venture capital firms and large corporations at the forum. These contacts are expected to produce significant investment in the SBIR projects, which will result in the creation of new jobs. Growing interest in the SBIR program among U.S. businesses was evident at the program's national conference in October 1993.

The meeting attracted 1,100 attendees, the largest of any such meeting in the program's history.

"Golden Carrot" Market-Pull Consortia.

The Environmental Protection Agency (EPA), Department of Energy (DOE), and utilities issued a challenge and an opportunity to manufacturers of refrigerators: the company that could build a chlorofluorocarbon-free refrigerator that also exceeded energy performance standards would receive a guaranteed market, with the consortium making up the difference in price between the new super-efficient refrigerator and more conventional units. President Clinton has directed DOE and EPA to expand this program to additional industries to accelerate the commercialization of advanced, energy-efficient technologies through partnerships with key market players. These partnerships may include contests for new technology introductions, working with government procurement agencies to leverage their purchasing power of certain qualifying products, and working with utilities to create market incentives for new technologies.

"Green Lights" Program.

EPA is expanding this voluntary program aimed at improving lighting efficiency. The program enlists participants who agree to survey all of their domestic facilities and upgrade their lighting wherever profitable over a period of 5 years. The program now has over 1,000 participants.

Energy Analysis and Diagnostic Centers.

This program involves local colleges and universities in performing audits of small businesses and manufacturing plants to identify opportunities for energy-efficiency improvements and waste minimization. The Administration plans to expand this program, which currently funds about 700 audits per year. This will increase to about 2,000 per year by the year 2000. Federal Fleet Conversion Task Force. This task force is working on a plan to convert the Federal automotive fleet to alternative fuels that are cleaner burning and less expensive. The Administration plans to use the Federal Government's purchasing power to stimulate the domestic alternative fuels market and to develop a refueling infrastructure for alternative fuel vehicles.

Intermodal Surface Transportation Efficiency Act of 1991

This law offers increased flexibility in how states spend their resources, thus allowing for greater flexibility and innovation. The Clinton Administration has further increased state options by expanding opportunities for states to use Intelligent Vehicle Highway Systems and telecommunications strategies to meet their Clean Air goals.

Climate-Wise Recognition Program.

EPA and DOE have proposed a new program dubbed "Climate-Wise" to encourage and recognize voluntary efforts to reduce greenhouse gas emissions. Climate-Wise will reinforce statutory provisions under the Energy Policy Act of 1992 and contribute to U.S. environmental objectives by allowing organizations to receive public recognition for their voluntary greenhouse gas mitigation efforts. They would be eligible by initiating actions that reduce or offset greenhouse gases, such as energy conservation and efficiency measures, switching to lower-carbon content fuels, establishing programs to encourage employees to use mass transit or carpools, or implementing carbon sequestration activities, such as urban and rural tree planting.

Long-Range Environmental Export Strategy Clean Production.

As a follow-on initiative to the Environmental Technology Export Strategy, the Department of Energy has proposed to develop a long-range environmental market strategy focused on the strategic market growth potential of clean production technologies.

Transportation and the Economy

As noted in the President's Technology for America's Economic Growth, A New Direction to Build Economic Strength, a competitive, growing economy requires a transportation system that can move people, goods, and services quickly and efficiently. To meet this challenge, each transport sector must work effectively both by itself and as part of a larger, interconnected whole. Technologies that increase the speed, reliability, and cost-effectiveness of the transportation sector also will increase the economy's competitiveness and ability to create jobs.

Today, one of the greatest challenges we face is to rehabilitate and properly maintain the huge stock of infrastructure facilities already in place. Providing a world-class transportation sector will require the Nation to meet the challenges posed both by increased congestion in many parts of the transportation system and by the need to rebuild and maintain a public capital stock valued at more than $2.4 trillion.

The Federal Government is committed to leading an effort to realize the vision of "sustainable" transportation, with the goal of balancing different modes of transportation while taking into account performance, cost, resource use, and social impact.

Partnership for a New Generation of Vehicles

President Clinton and Vice President Gore have joined with the Big Three American automakers General Motors, Ford, and Chrysler in an historic new partnership to strengthen U.S. competitiveness by developing technologies for a new generation of vehicles up to three times more fuel efficient than today's. It is a technological venture as ambitious as any America has ever attempted and is a model for the new partnership between government and industry envisioned by President Clinton. It is an all-out effort to ensure that the U.S. auto industry leads the world in technology. It will expand economic opportunity, preserve jobs, protect the environment, and strengthen our economic competitiveness. The long-term goal of the partnership is the development of affordable, safe, attractive, and dramatically more efficient automobiles. Groundbreaking research and development goals for industry and government engineering teams will be launched in three categories:

- Advanced manufacturing techniques to make it easier to get new product ideas into the marketplace quickly. Such techniques would include rapid, computer-based design and testing systems and new automation and control systems that can lower production costs.
- Technologies that can lead to near-term improvements in automobile efficiency, safety, and emissions, such as lightweight, recyclable materials and catalysts for reducing exhaust pollution.
- Research that could lead to production prototypes of vehicles capable of up to three times greater fuel efficiency.

Radical new concepts, such as fuel cells and advanced energy storage systems like ultracapacitors, will be developed to produce more fuel-efficient cars that are affordable, meet or exceed current safety standards, and retain the performance and comfort available today. Led by Under Secretary of Commerce for Technology Mary Good, the project will be managed by an interagency team consisting of representatives from the Departments of Commerce, Defense, Energy, and Transportation; the Environmental Protection Agency; National Aeronautics and Space Administration; and the National Science Foundation. This interagency team is preparing an inventory of government programs that can help meet the partnership goals, as a first step in rapid development of a coordinated R&D strategy.

Electric and Hybrid Electric Vehicles

The Defense Department's Advanced Research Projects Agency has selected six regional coalitions in Hawaii, Sacramento, Los Angeles, Indianapolis, Atlanta, and Boston to work on electric and hybrid electric vehicle technology and infrastructure. The projects will focus on conversion or replacement to electric or hybrid of small pickup trucks and medium-sized buses on military bases and installation of the vehicle support infrastructure; conversion or purchase of electric or hybrid vehicles for commercial use in the community, including infrastructure; research to advance the state-of-the-art on one or more components or systems for electric or electric hybrid vehicles or for their support infrastructure; and support activities.

Research and Technology Outreach Seminars

DOT also has begun a series of outreach seminars entitled "Promoting Transportation Applications in Defense Conversion and Other Advanced Technologies." Held in Ann Arbor, MI; Davis, CA; Cambridge, MA; and Austin, TX, the seminars are bringing together representatives of academia, State, and local governments, and private industry to discuss transportation and the environment, infrastructure rehabilitation and maintenance, and new vehicle technology. DOT will use the information gathered in these meetings to shape its Transportation Research and Technology Strategic Plan.

Intelligent Vehicle/Highway Systems (IVHS)

DOT has initiated studies aimed at having a prototype demonstration of an automated highway system by 1997. To foster improvements in IVHS user services, DOT has begun a 3-year process to establish the overall IVHS system architecture. DOT plans to make maximum use of defense-oriented firms' developments in sensor technologies, high-speed computing, communications, human factors, display technologies, and autonomous vehicle control systems. Working with Montgomery County, MD, which is installing 200 video cameras along its roads, the Commerce Department's National Institute of Standards and Technology is evaluating automatic vision-based surveillance to determine the types of useful traffic information the system can obtain and how to quickly extract, analyze, and translate the information into traffic management decisions that ease congestion and avert safety hazards.

Global Positioning System (GPS)

GPS is a space-based positioning, navigation, and time distribution system designed for worldwide military use. In May 1993, the Secretaries of Transportation and Defense established a joint task force to examine the possibilities for expanded civil participation in the implementation, operation, and support of the GPS. A DOD-DOT team is working to identify and resolve issues related to augmentation of the current system and funding to provide civilian users with the necessary accuracy and integrity. The Federal Aviation Administration (FAA) defined the technical standards for GPS receivers to be used in civilian aviation and approved supplemental use of the GPS for all phases of flight. NASA and the FAA are testing the GPS system to investigate ways to improve navigation and collision avoidance. Full operation of GPS is expected in FY 1995.

Climate Change Action Plan

As part of the climate change action plan released in October, the Administration is conducting a year-long process to identify and implement policies in the transportation sector to reduce the projected growth of greenhouse gases. This process will involve all relevant stakeholders and will consider, among other issues, policies to increase the fuel efficiency of new personal vehicles.

Magnetic Levitation (MagLev)

High-speed magnetically levitated ground transportation is a new mode of surface transportation in which vehicles glide above their guideways, suspended, guided, and propelled by magnetic forces at speeds of 250 to 300 miles per hour or higher. The Administration is publishing the results of the 3-year national MagLev initiative, a cooperative interagency effort of the Department of Transportation and its Federal Railroad Administration, the Army Corps of Engineers, and the Department of Energy. While questions remain about the commercial viability of MagLev, the Administration should proceed with the development of a program. In FY 1994, $20 million was provided to continue research and analysis of MagLev.

Intermodal Surface Transportation Efficiency Act of 1991

The Intermodal Surface Transportation Act offers increased flexibility in how states spend their resources, thus allowing for greater flexibility and innovation. The Clinton Administration has further increased state options by expanding opportunities for states to use Intelligent Vehicle Highway Systems and telecommunications strategies to meet their Clean Air goals. In July 1993, DOT published the Surface Transportation Research and Development Plan to develop a range of technologies needed to produce convenient, safe, and affordable modes of surface transportation by the mid-1990s and to maintain a long-term advanced R&D program for next-generation systems. DOT published Intermodal Technical Assistance Activities for Transportation Planners in August 1993 and is actively seeking feedback to improve the quality of its assistance programs. Aeronautics For decades, the United States led the aviation revolution every step of the way, and America ruled the skies. Today, the aeronautics industry is one of the largest in the country employing nearly 1 million people in high-quality jobs, generating almost $100 billion in annual sales, and producing tens of billions of dollars in exports.

Today's aeronautics environment, however, is extremely dynamic foreign competition, economic deregulation of the airline industry, the end of the Cold War, and the growing concern for the global environment have all changed the aviation industry. The Administration is committed to making the changes required to strengthen civil aviation in the United States. NASA is addressing the technology needs of civil aviation by expanding its investments in high-speed research, advanced subsonic technologies, and high-performance computing and communications. The plans for these programs have been developed and will be refined. By working closely with industry and government agencies, NASA aims to ensure that design, manufacturing, and operations issues are addressed early in the technology development process and to maximize its investments through effective and timely technology transfer.

High-Speed Research (HSR)

NASA is developing the technologies that industry needs to design and build an environmentally compatible and economically competitive high-speed civil transport (HSCT) for the 21st century. As currently envisioned, an HSCT aircraft would carry 300 passengers at Mach 2.4 on transoceanic routes over distances up to 6,000 nautical miles at fares comparable to subsonic transports.

An HSCT would reduce flight times from California to Japan to about 4 hours, and from California to Australia to about 7 hours. Such an aircraft will be essential for capturing the valuable long-haul Pacific Rim market. Market studies indicate that the successful development of a domestic HSCT will result in $200 billion in sales and 140,000 jobs for U.S. industry. Before industry can develop this type of aircraft, environmental concerns, such as aircraft noise, sonic boom, and atmospheric contaminants, must be addressed. An HSCT must meet not only the current regulatory standards but also those anticipated for the early part of the next century. NASA is sponsoring an independent, international scientific assessment to determine globally acceptable levels of engine emissions and noise.

In FY 1994, NASA will focus on technologies required to make an HSCT economically feasible and competitive. In close cooperation with U.S. industry and the university research community, NASA plans to develop and validate technologies for an HSCT, including advanced propulsion systems, new structural materials, improved aerodynamic designs, and state-of-the-art flight control and display systems. While NASA is concentrating its investments in the early, high-risk stages of development, the aircraft manufacturing industry has indicated that it is willing to make a substantial investment in this program as the technological risk decreases. The High-Speed Research program aims to produce an industry HSCT prototype around the year 2000.

Advanced Subsonic Technology

Subsonic airliners will continue to be a vital element of both long-haul and domestic air travel for the foreseeable future, and the Administration and

NASA are accelerating investments in this key area through the Advanced Subsonic Technology Program. In partnership with U.S. industry, NASA is developing lightweight, highly reliable optical systems; lightweight, low-cost composite structures; highly efficient turbofan engines; and integrated wing design techniques. These R&D efforts are intended to increase airline profitability through increased aircraft productivity, lower ownership costs, and reduced direct operating costs, resulting in increased economic valuation of the aircraft relative to foreign competitors.In a collaborative effort to increase safety, FAA and NASA have successfully flight tested three types of sensors that increase warning times to airline pilots. They also are evaluating a four-dimensional Aircraft Traffic Management System known as the CENTER/TRACON Automation System, or CTAS, that will enable more on-time arrivals and departures and cut fuel consumption. By early in the next century, the combination of CTAS, GPS, and other navigation and display technologies could provide a significant improvement in the efficiency of our national airspace system and create a market for new products.