

JOBS CREATION IN THE ENVIRONMENTAL INDUSTRY IN WISCONSIN AND THE UNITED STATES

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Building Diagnostics Research Institute
Chevy Chase, Maryland
www.buildingdiagnostics.org
301-951-5951

By

Roger H. Bezdek
Robert M. Wendling
Management Information Services, Inc.
Washington, D.C.
www.misi-net.com
202-889-1324

This report is a project of the Jobs and Environment Initiative, a pilot program of research, policy analysis and public education. The Wisconsin report is part of a series of state-based and national reports on current jobs creation in the environmental industry, including in manufacturing, and further jobs potential inherent in environmental management and stewardship. Other reports completed examine jobs creation and environmental industry in Ohio and in Michigan and are available on the above websites.

Contact: Paula DiPerna, 212-688-0942
Roger Bezdek, 703-620-4120

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EXECUTIVE SUMMARY

Objective of the Report

The objective of this report is to examine and describe the environmental industry and its jobs impact and jobs creation potential in the state of Wisconsin, and to provide national context on the U.S. environmental industry as a whole.

The relationship between jobs and the environment is important to examine, in view of the size of the environmental industry and because the jobs impact of environmental management has been at times controversial. The report aims to examine the “trade-off” between jobs and environmental protection and highlight specific examples of how the environmental industry in Wisconsin and nationally has had, and could have, jobs benefits. Therefore, this report:

- Assesses the current size of the environmental industry and related jobs in the U.S. and the prospects for the future
- Analyzes the concept and definition of an “environmental job”
- Estimates the size and the industrial sector composition of the environmental industry in Wisconsin in 2003
- Estimates the jobs created in Wisconsin in 2003 by environmental protection and their importance to the state economy
- Estimates the occupation and skill levels of these jobs
- Identifies a sample of typical environmental companies in Wisconsin, the products and services they provide, their geographic location, and the number of jobs they create
- Identifies state government initiatives and policies that could facilitate further development of environmental industries in Wisconsin
- Discusses how encouraging environmental and related industries in Wisconsin could form an integral part of state economic development strategy
- Presents findings and conclusions

Findings -- The National Context

MISI has extensive experience analyzing the environmental industry. We have found that, over the past four decades, protection of the environment has grown rapidly to become a major sales-generating, profit-making, job-creating U.S. industry. Yet, we have also found that the importance of the environmental industry to the U.S. economy is still not fully understood by policy makers or the public at large.

MISI estimates that in 2003 protecting the environment generated \$301 billion in total industry sales, \$20 billion in corporate profits, 4.97 million jobs, and \$45 billion in Federal, state, and local government tax revenues. Moreover, the industry transcends traditional understanding of “green jobs,” often wrongly assumed to be jobs for people to plant trees or clean up toxic waste sites or pollution accidents. (All estimates of the size of the environmental industry and jobs impact rely upon definitions used. MISI estimates rely upon the definitions in Chapter III.)

The environmental industry will continue to grow for the foreseeable future. MISI forecasts that in the U.S. real expenditures (2003 dollars) will increase from \$301 billion in 2003 to \$357 billion in 2010, \$398 billion in 2015, and \$442 billion in 2020; environmental employment will increase from 4.97 million jobs in 2003 to 5.39 million jobs in 2010, 5.76 million jobs in 2015, and 6.38 million jobs in 2020.

Environmental protection created nearly five million jobs in the U.S. in 2003, and these were distributed widely throughout all states and regions in the U.S. The vast majority of the jobs created by environmental protection are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc., and most of the persons employed in these jobs may not even realize that they owe their livelihood to protecting the environment.

Environmental protection is a large and growing industry in Wisconsin, and MISI estimates that in 2003:

- Sales due to environmental industries in Wisconsin totaled \$5.4 billion
- The number of environment-related jobs in the state totaled nearly more than 97,000
- The environmental industry in Wisconsin generated 2.9 percent of gross state product
- Environment-related jobs comprised 3.5 percent of total Wisconsin employment

- Wisconsin environmental industries generated 1.8 percent of the sales of the U.S. environmental industry
- With 1.9 percent of the nation's population, employment earnings in the Wisconsin manufacturing sector account for 3.1 percent of manufacturing earnings nationally.
- Environment-related jobs in Wisconsin comprised two percent of the total number of environment-related jobs in the U.S.
- Environment-related employment in the state has been increasing in recent years between one and two percent annually.

Most of the environmental jobs in Wisconsin are in the private sector, and these are heavily concentrated in several sectors, including manufacturing, professional, scientific, and technical services, and educational services.

Types of Environmental Jobs in Wisconsin

Environmental jobs in Wisconsin are widely distributed through all occupations and skill levels, and requirements for virtually all occupations are generated by environmental expenditures. Thus, in Wisconsin as in the U.S. generally, the vast majority of the jobs created by environmental protection are standard jobs for all occupations.

Nevertheless, we found that, in Wisconsin, the importance of environmental expenditures for jobs in some occupations is greater than for others. For some occupations, such as environmental scientists and specialists, environmental engineers, hazardous materials workers, water and liquid waste treatment plant operators, environmental science protection technicians, refuse and recyclable material collectors, and environmental engineering technicians, virtually all of the demand in Wisconsin is created by environmental protection activities.

However, in occupations not traditionally identified as environment-related, a significant share of the jobs is also generated by environmental protection. While, on average, environment-related employment in Wisconsin comprises only 3.5 percent of total employment, in 2003 environmental protection generated jobs for a larger than average share of many professional, scientific, high-tech, and skilled workers in the state.

Our survey of existing environmental companies in Wisconsin revealed a wide range of firms, and they are located throughout the state, in major urban centers, suburbs, small towns, and rural areas; they range in size from small firms of 20 employees to large firms employing many hundreds; they are engaged in a wide variety of activities, including remediation, manufacturing, testing, monitoring, analysis, etc.; and they include some of the most sophisticated, high-tech firms in the state. A number

of these firms have created significant numbers of new jobs over the past six months, including jobs in the manufacturing sector – at a time when Wisconsin has been losing jobs, especially in manufacturing.

Salience of the Jobs-Environment Link in Wisconsin at the Policy Level

We identified a number of existing state initiatives and interventions that could be used to assist the environmental industry and create jobs.

Key Points

First, contrary to common perception, most of the jobs created by environmental protection – both nationwide and in Wisconsin -- are not for “environmental specialists.” The vast majority of the jobs created by environmental protection are standard jobs for a wide variety of occupations.

Second, as noted above, environmental jobs in Wisconsin are concentrated within a number of sectors, including manufacturing and professional, scientific, and technical services. This is significant because Wisconsin is the second most manufacturing-intensive state in the nation and is currently very concerned with preserving, modernizing, and expanding its manufacturing base. Environmental protection offers a means of doing this, and investments in the environment can greatly assist Wisconsin’s manufacturing sector.

Third, since the late 1960s, protection of the environment has grown rapidly to become a major U.S. industry. Protection of the environment and remediation of environmental problems will continue to be a growing and profitable industry in the U.S., and astute business and labor leaders, government officials, and policymakers in Wisconsin – and in other states – should be cognizant of this.

Fourth, all regions and states benefit substantially from environmental expenditures. Many of the economic and employment benefits flow directly to states – such as Wisconsin -- whose policymakers and government officials often see only costs and disadvantages from environmental protection. Yet, these policymakers and the public should welcome information that environmental protection offers substantial opportunities for economic development and job creation.

Fifth, investments in environmental protection will create large numbers of jobs for highly skilled, well-paid, technical workers, including college-educated professionals, many with advanced degrees, requiring advanced training and technical expertise, many of them in the manufacturing sector.

These are the kinds of jobs that states seek to attract and which provide the foundation for entrepreneurship and economic growth. These types of jobs are also a prerequisite for a prosperous, middle class society able to support state and local governments with tax revenues,

Sixth, but perhaps most important, this study demonstrates that environmental protection can form an important part of a strategy for Wisconsin based on attracting and retaining professional, scientific, technical, high-skilled, well paying jobs, including manufacturing jobs. There is no inherent institutional impediment in Wisconsin to using existing state economic assistance policies and incentives to facilitate and encourage development of the environmental industry in the state, especially given that industry's strong pre-existing economic traction.

Contents of the Report

- Chapter II -- History and current status of the U.S. environmental industry; provides industry and job forecasts through 2020
- Chapter III -- Definition of environmental jobs; illustrates the typical composition of occupational employment within environmental companies
- Chapter IV -- The current state of the Wisconsin economy and labor market
- Chapter V -- Size, employment, and industrial and occupational composition of the environmental industry in Wisconsin
- Chapter VI – Profiles of typical environmental firms in the state
- Chapter VII -- Wisconsin Policy Context, Opportunities and Gaps; identifies state programs that could be used to assist environmental firms
- Chapter VIII – Summary of major findings

I. INTRODUCTION

The nexus between jobs and the environment will increase in importance in the future as the U.S. and other nations strive to meet pressing need for employment and income generation, while also confronting the challenges of multi-source pollution, energy waste and inefficiency, traffic congestion, climate change, scarcity of potable and usable water, electric grid reliability, etc. The prevailing view among economic development proponents has been that environmental protection is negative for jobs and employment. However, this view is not supported by empirical evidence. In addition, it is possible to estimate and document the overlooked size of the environmental industry in the U.S. as a whole, and at the state level, and the jobs this industry has protected and created.

The challenge -- and opportunity -- is to begin to shift the debate from “trade-offs” between jobs and environmental protection to a new level of congruent and integrated environmental and economic policy. This report provides information on jobs creation among individual environmentally-related companies as recently as May 2004, and we also note the results of prior research on the environmental industry over time.

Here we:

- Assess the current size of the environmental industry and related jobs in the U.S. and the prospects for the future
- Analyze the concept of an “environmental job”
- Estimate the size and the industrial sector composition of the environmental industry in Wisconsin in 2003
- Estimate the jobs created in Wisconsin in 2003 by environmental protection and their importance to the state economy
- Estimate the occupation and skill levels of these jobs
- Identify a sample of environmental companies in Wisconsin, the products and services they provide, their geographic location, and the number of jobs created
- Identify state government programs that could be used to facilitate development of environmental industries in Wisconsin

- Discuss how encouraging environment and related industries in Wisconsin could form an integral part of state economic development strategy
- Summarize the major research findings

II. BACKGROUND: THE U.S. ENVIRONMENTAL PROTECTION INDUSTRY AND RELATED JOBS

II.A. Emergence of the Environmental Protection Industry

Contrary to general public perception and public policy understanding, since the late 1960s, protection of the environment has grown rapidly to become a major sales-generating, profit-making, job-creating industry. Expenditures in the U.S. for environmental protection (EP) have grown (in constant 2003 dollars) from \$39 billion per year in 1970 to \$301 billion per year by 2003 -- increasing more rapidly than GDP over the same period. As shown in Table 1:

- In 1970, environmental protection expenditures totaled \$39 billion (2003 dollars).
- In 1980, environmental protection expenditures totaled \$121 billion (2003 dollars).
- In 1990, environmental protection expenditures totaled \$204 billion (2003 dollars).
- In 2003, environmental protection expenditures totaled \$301 billion (2003 dollars).

Table 1
Environmental Protection Expenditures and Jobs
In the U.S. Economy, 1970 - 2020

	Expenditures (billions of 2003 dollars)	Jobs (thousands)
1970	\$39	704
1975	77	1,352
1980	121	2,117
1985	158	2,838
1990	204	3,517
1995	235	4,255
2003	301	4,974
2010	357	5,392
2015	398	5,756
2020	\$442	6,377

Source: Management Information Services, Inc., 2004.

For comparison, it is interesting to note that if "EP" were a corporation, it would rank higher than the top of the Fortune 500. Also, for comparison, MISI's estimate of 2003 EP expenditures (\$301 billion) ranks it higher than the sales of \$259 billion for Wal-Mart, the largest corporation in the U.S.

Many companies, whether they realize it or not, owe their profits -- and in some cases their existence -- to EP expenditures.¹ Many workers, whether they realize it or not, would be unemployed were it not for these expenditures: In 2003 environmental protection created nearly five million jobs distributed widely throughout the nation. To put this into perspective, the size of environment-related employment is:

- Over ten times larger than employment in the U.S. pharmaceuticals industry
- Nearly six times larger than the apparel industry
- Almost three times larger than the chemical industry
- Fifty percent greater than employment in religious organizations
- Nearly half the employment in hospitals
- Almost one-third the size of the entire construction industry

Further, while MISI forecasts that the rate of growth in expenditures for environmental protection will decline over the next decade, real expenditures will continue to increase substantially.²

Are Environmental Jobs “Productive?”

It is sometimes suggested that investments in environmental protection are "nonproductive," i.e., expenditures lots of money on anything -- for example, building pyramids in the desert -- would stimulate industry and create jobs. However, environmental protection is hardly "make work." EP investments build tangible and intangible long-term assets, not the least among them is a healthier, safer, cleaner, and more livable environment nationwide and in Wisconsin -- an important recruiting factor in attracting the new "high tech" firms strongly courted by all states, not to mention residents, tourists, high-visibility events, and investors.

Environmental protection is an exemplary public good, and according to the Harris pollsters this issue has consistently enjoyed wider and stronger public support

¹In this report, "expenditures" refers to all public and private spending in the environmental sector (EP spending) and is used interchangeably with "sales."

²The rate of growth declines because the total size of the industry continues to increase.

than virtually any other issue over the past three decades. Investments in plant and equipment which produce this strongly desired public good are as productive as those that produce automobiles, television sets, golf balls, or defense systems that we are willing to pay for directly in the prices of products or indirectly through the government.

It is also sometimes alleged that environmental standards penalize certain states and regions at the expense of others. While this can be sometimes true, the point has been overused. MISI's research does not support the contention that economic hardship in a given state or region can be blamed on "unreasonable" environmental laws. Further, MISI has found that the overall relationship between state environmental policies and economic/job growth is positive, not negative.

It is significant that many environmental economic and employment benefits flow directly to states whose policymakers and government officials often see only costs and disadvantages from environmental protection.³ Funds expended on pollution abatement and control programs are not wasted, but, rather, investments in environmental protection contribute as much to the well-being and labor markets of the nation and individual states as money spent on other goods competing for scarce private and public funds. All regions and states benefit substantially, and many states benefit at greater than proportionate rates from U.S. EP expenditures.

Over the past three decades protecting the environment has been a major public priority. The legislation enacted has significantly improved the nation's environment and has set in motion ongoing programs that will have significant effects on the nation's environment, economy, and job market well into the 21st century. Importantly, protection of the environment and remediation of environmental problems will continue to be a growing and profitable industry in the U.S. Astute businessmen, labor leaders, government officials, and policymakers should become more cognizant of opportunities inherent in the environmental industry.

II.B. Environmental Protection as a Recession Proof Industry

Expenditures to protect the environment has been one of the most rapidly and consistently growing "recession proof" industries in the economy for the past three decades, and real EP expenditures (2003 dollars) increased from \$39 billion in 1970 to \$301 billion in 2003. This represents nearly an eight-fold increase in expenditures in barely more than three decades -- a sustained real average rate of growth of about eight percent per year over the period. This compares with an average annual rate of

³For example, in 1989 MISI assessed the economic and jobs impacts of acid rain control legislation and found that, contrary to what was then widely believed, such legislation would actually create 5,100 more jobs in Wisconsin than it would imperil. See Roger H. Bezdek and Robert M. Wendling, "Acid Rain Abatement Legislation – Costs and Benefits," *International Journal of Management Science*, Vol. 17, No. 3 (1989), pp. 251-261 . More recently, in a study of vehicle fuel efficiency standards, MISI found that – contrary to the common perception -- enhanced CAFE standards would create a large number of jobs (11,000) in Wisconsin. See Roger H. Bezdek and Robert M. Wendling, "Potential Long-term Impacts of Changes in U.S. Vehicle Fuel Efficiency Standards," *Energy Policy*, Vol. 33, No. 3, pp. 407-419.

growth of GDP that averaged between two and three percent over the same period. That is, since the late 1960s, expenditures for pollution abatement and control has been increasing at a rate nearly three times as large as that of GDP.

As might be expected, this rate of growth has not been consistent. In the early 1970s, EP expenditures were increasing nearly 15 percent per year, by the late 1980s they were increasing at about seven percent annually, and by the late 1990s were increasing at about four percent annually. This is to be anticipated as the industry grew and matured -- but even the most recent growth rates of four percent are higher than the growth rate of GDP. In 1970, EP expenditures accounted for 0.9 percent of GDP, whereas by 2003 the U.S. was devoting about three percent of GDP to pollution control and abatement and related environmental programs.

More interesting, perhaps, is the "recession-proof" nature of this industry:

- In the late 1970s the U.S. economy was reeling from inflationary shocks, record interest rates, energy crises, and anemic economic growth, but between 1975 and 1980 EP expenditures grew nearly 60 percent, from \$77 billion to \$121 billion.
- In the early 1980s the U.S. experienced the most severe economic recession in half a century, with many industries experiencing depression-level problems, but between 1980 and 1985 EP expenditures increased by \$37 billion -- 31 percent.
- During the early 1990s the U.S. experienced a relatively mild recession, with GDP declining one percent and unemployment increasing to 7.5 percent; nevertheless, between 1990 and 1995 EP expenditures increased from \$204 billion to \$235 billion -- 15 percent.
- Between 2000 and 2003, while U.S. economic and job growth was generally anemic, the EP industry expanded continuously, growing to \$301 billion.

However, MISI forecasts that the rate of growth of EP expenditures will gradually decline over the next decade, as the industry grows and matures.

II.C. The Current Size and Structure of the Environmental Industry and Jobs Created

As stated earlier, if "EP" were a corporation, it would rank higher than the top of the Fortune 500:

- MISI estimates that in 2003 EP expenditures totaled \$301 billion.
- In 2003, Wal-Mart, the largest U.S. corporation, had sales of \$259 billion.
- In 2003, the number two U.S. corporation, Exxon Mobil, had sales of \$213 billion, while the third-ranked corporation, General Motors, had sales of \$196 billion.

Clearly, providing the goods and services required for environmental protection has become a major U.S. industry with significant effects on the national economy and labor market and on those of individual states.⁴

MISI estimates that in 2003 protecting the environment generated:

- \$301 billion in total industry sales
- \$20 billion in corporate profits
- 4.97 million jobs
- \$45 billion in Federal, state, and local government tax revenues

II.D. Prospects for the Future

It is likely that the environmental industry will continue to grow for the foreseeable future:

- The environmental industry has grown and matured over the past four decades into a large, viable industry.
- Environmental processes and practices have been incorporated into most manufacturing and service industries.
- Pollution prevention is increasingly being utilized instead of “end of the pipe” pollution abatement remedies, and entire manufacturing process are being designed to limit environmental degradation from the beginning of the production process.

⁴All estimates of the size of the environmental industry rely critically on the exact definition of the industry. Since there is no official definition, estimates of the size of the environmental industry differ according to the source. In MISI's case, the definition of the industry includes human and environmental sustainability principles, and MISI's estimates thus include a broader range of environmental activities in the economy than some other definitions that have been developed.

- Over the years, a large number of environmental regulations have been enacted at the local, state, and Federal levels and will continue to generate requirements for environmental technology and services well into the future -- even in the unlikely event that no new environmental regulations are enacted.
- Environmental protection and regulation is strongly desired by the public, as verified in numerous public opinion polls conducted over the past 30 years.
- As the U.S. economy continues to grow, environmental problems resulting from urban sprawl, environmental degradation, energy consumption, increasing population, traffic congestion, mobile source pollution, and related problems will continue to increase the demand for environmental remediation.
- The public is increasingly being given the choice of purchasing environmentally benign products and “green” energy, and is responding favorably. Major corporations -- such as, for example, Ford and British Petroleum -- have noted this preference and are reorienting themselves as environmentally friendly companies.
- Problems that the U.S. and the rest of the world face in the future will likely increase the demand for environment-related technology, services, and labor. To cite the most obvious example, global warming presents a long-term challenge that is being addressed by various international and national legislative and mandatory regulatory initiatives such as the Kyoto protocol, the McCain-Lieberman bill in the U.S. Senate, and the Climate Stewardship Act in the U.S. House of Representatives. Also, individual states have begun to establish and institute climate action plans. Thus, mitigating climate change and reducing and managing greenhouse gas emissions will likely create demand for hundreds of billions of dollars of output from the environmental, energy efficiency, and renewable energy industries.

MISI anticipates that the environmental industry will continue to grow slightly faster than U.S. GDP over the coming decade, although this rate of growth will gradually diminish and will approach that of GDP. This is to be expected, since the industry has grown large and matured. Nevertheless, it will likely continue to be relatively “recession proof” because it is largely driven by statutes and regulations that must be complied with irrespective of the state of health of the nation’s economy.

Thus, Table 1 indicates that MISI forecasts EP to continue to be a growing, recession proof industry well into the 21st century, offering unique entrepreneurial, profit, and job opportunities for all types of businesses and workers. **MISI forecasts**

that in the U.S. real expenditures (2003 dollars) will increase from \$301 billion in 2003 to:

- \$357 billion in 2010
- \$398 billion in 2015
- \$442 billion in 2020

Environmental protection expenditures generate large numbers of jobs throughout all sectors of the economy and within many diverse occupations. As shown in Table 1, MISI forecasts that U.S. employment created directly and indirectly by EP expenditures will increase from 4.97 million jobs in 2003 to:

- 5.39 million jobs in 2010
- 5.76 million jobs in 2015
- 6.38 million jobs in 2020

Until the U.S. reaches a level of creating and managing a sustainable environment, the environmental protection industry will continue to outpace most other industries in the U.S. economy. Until then, the environmental industry is projected to grow at a rate 2-3 percent faster than many other industries.

These major economic opportunities have tended to go overlooked by economic development policymakers and government officials. Nevertheless, significant economic opportunities do exist and can be maximized and leveraged for broad social and environmental advantage.

III. DEFINING AND ESTIMATING ENVIRONMENTAL JOBS

III.A. What Constitutes an Environmental Job?

Ambiguities and Questions

As discussed in Chapter II, environmental protection created nearly five million jobs in the U.S. in 2003, and these were distributed widely throughout all states and regions within the U.S. But how many of these are “environmental jobs” or “green jobs?” More specifically, what constitutes an “environmental job?” While a definitive analysis of this important topic is outside the scope of this report, our review of the literature indicates that there is no rigorous, well-accepted definition of an environmental job. Rather, the definitions used are often loose and contradictory.

Clearly, an ecologist or an environmental engineer working in private industry or for an environmental advocacy organization would constitute an environmental job, as would an employee of the federal or a state environmental protection agency. However, there are ambiguities. For example, most people would agree that the positions in a firm that assembles and installs solar thermal collectors on residences and commercial office buildings for solar heating and solar hot water heating would be considered environmental jobs. But what about the jobs involved in producing those solar panels, especially if the factory involved used coal-based energy, one of the most controversial fossil fuels in terms of emissions, especially greenhouse gases? Here these manufacturing jobs are included as jobs created indirectly by environmental expenditures.

Most analysts would consider jobs in a recycling plant to be environmental jobs. But what if the recycling plant itself produces air pollution?

What about a factory in Wisconsin that produces scrubbers for coal-fired power plants in Indiana? It seems clear that the jobs in the Wisconsin factory should be considered green or environmental jobs, even though the user of the scrubbers in Indiana may cause pollution in Wisconsin.

What about environmental engineers and environmental controls specialists working in a coal-fired power plant? What about the workers who produce environmental control equipment for the plant?

There are many manufacturing establishments throughout the United States that produce products for the automotive industry. Should those that produce components for fuel-efficient vehicles be considered part of the environmental industry, but not those that produce components for gas guzzlers? If so, is there any way to accurately distinguish between these? Should all factories producing catalytic converters be considered environmental jobs, even when some of these converters are used on low miles-per-gallon vehicles?

These relevant questions have, in fact, been generated by shifts in environmental policy itself. The early stages of the environmental movement in the 1970s and 1980s focused primarily on "end-of-the pipe" solutions. That is, the remedies and controls focused on cleaning or minimizing air, water, or solid waste pollutants after they had been produced. However, more recently during the 1980s and 1990s, environmental protection has gradually evolved to include entire processes, so, rather than cleaning up at the end of the pipe, the entire manufacturing and servicing processes are being designed to minimize the production of pollutants. Therefore, it is possible that very efficient processes designed to produce relatively little waste output could actually result in a decrease in the number of environmental jobs if these are defined strictly as "end of the pipe" jobs. A widespread program of energy efficiency, energy conservation, and demand-side management could ultimately result in less need for electric power to begin with and could result in the shutting down of a coal-fired electric power plant. While some may view such a shutdown as an environmental plus, many environmental jobs in that power plant involving pollution abatement and control would be in this case lost. Is this jobs loss desirable?

There is also the issue of how to take account of indirect job creation and how broadly or narrowly to define an indirect environmental job. For example, what of ancillary jobs created across the street from a factory producing solar collectors shortly after it opens, such as a doughnut shop, fast food restaurant, dry cleaner, etc. whose customers are primarily the workers at the renewable energy factory. Are these latter jobs also considered to be "indirect" green jobs or environmental jobs? We include such indirect jobs in this report, though we also conclude they are not "as green" as the direct jobs created.

While solid waste abatement and control is a major area of environmental concern, does this imply that all persons engaged in trash collection business are performing environmental jobs?

What part of the tourism industry constitutes "ecotourism," and are all jobs associated with ecotourism green jobs? Are then all the environmental externalities and costs produced by tourists, such as water use or waste, to be forgiven if these tourists are engaged in ecotourism?

Are all land management programs and all forms of alternative energy green industries, with all jobs counting as environmental jobs?

Definitions and Concepts Used in This Report

MISI considers that jobs can be considered to be "green" relative to the way the job was performed previously, i.e., in a production process, a change in technology that reduces waste emissions or energy consumption makes the jobs in that process "greener" than before. Still, can these jobs continue to be counted as environmental

jobs when newer technology makes available ways of furthering green production, e.g., further reducing energy consumption?

Two approaches can be used to address the relativity cited. The first approach targets environmental jobs, which could be new jobs or the greening of existing jobs, and defines a green job as one that emphasizes activities that contribute to environmentally sustainable development. A second approach focuses on the economy as a whole, defining a green economy as an economy that is environmentally sustainable, and environmental jobs as those jobs required to make an economy environmentally sustainable. Similarly, the term “environmental sector” is used to collectively describe companies involved in businesses designed to limit negative environmental impacts. However, this definition of green jobs as employment opportunities arising from expenditures on activities that support environmentally sustainable development, or which reduce negative impacts on the environment, also presents ambiguities.

Therefore, based on extensive research and literature review, MISI considers that environmental jobs are perhaps best understood when viewed in a continuum across a spectrum, with jobs that generate obvious environmental resource degradation or extraction at one end; a range of greener jobs involving clean production measures and technologies to reduce environmental impacts in the center, and the other end of the spectrum where jobs have a positive environmental impact (see Figure 1).

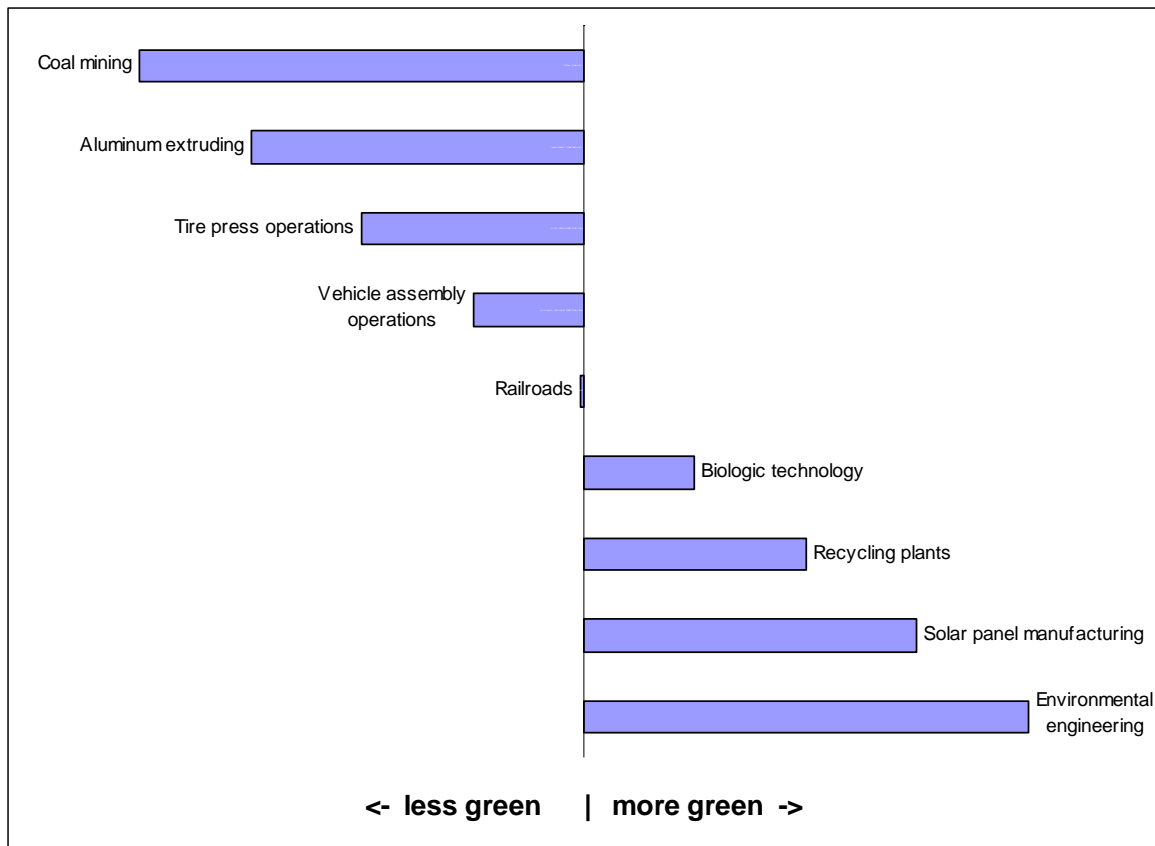
Using the spectrum concept, MISI defines environmental industries and green jobs as those which, as a result of environmental pressures and concerns, have produced the development of numerous products, processes, and services, which specifically target the reduction of environmental impact. Environment-related jobs include those created both directly and indirectly by environmental protection expenditures.

III.B. Types of Jobs Created in the Environmental Industry

There exists relatively little rigorous and comprehensive research addressing the practical relationship between environmental protection and existing jobs or future job creation. Even some research in this area sponsored by environmental organizations is off the mark, in that it has tended to emphasize jobs creation in classically green activities, such as environmental lawyers or workers in recycling plants.

However, while these jobs certainly count as jobs related to the environment, MISI’s data suggests that the classic environmental job constitutes only a small portion of the jobs created by environmental protection. The vast majority of the jobs created by environmental protection are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc. In fact, most of the persons employed in these jobs may not even realize that they owe their livelihood to protecting the environment.

Figure 1
The Environmental Job Spectrum

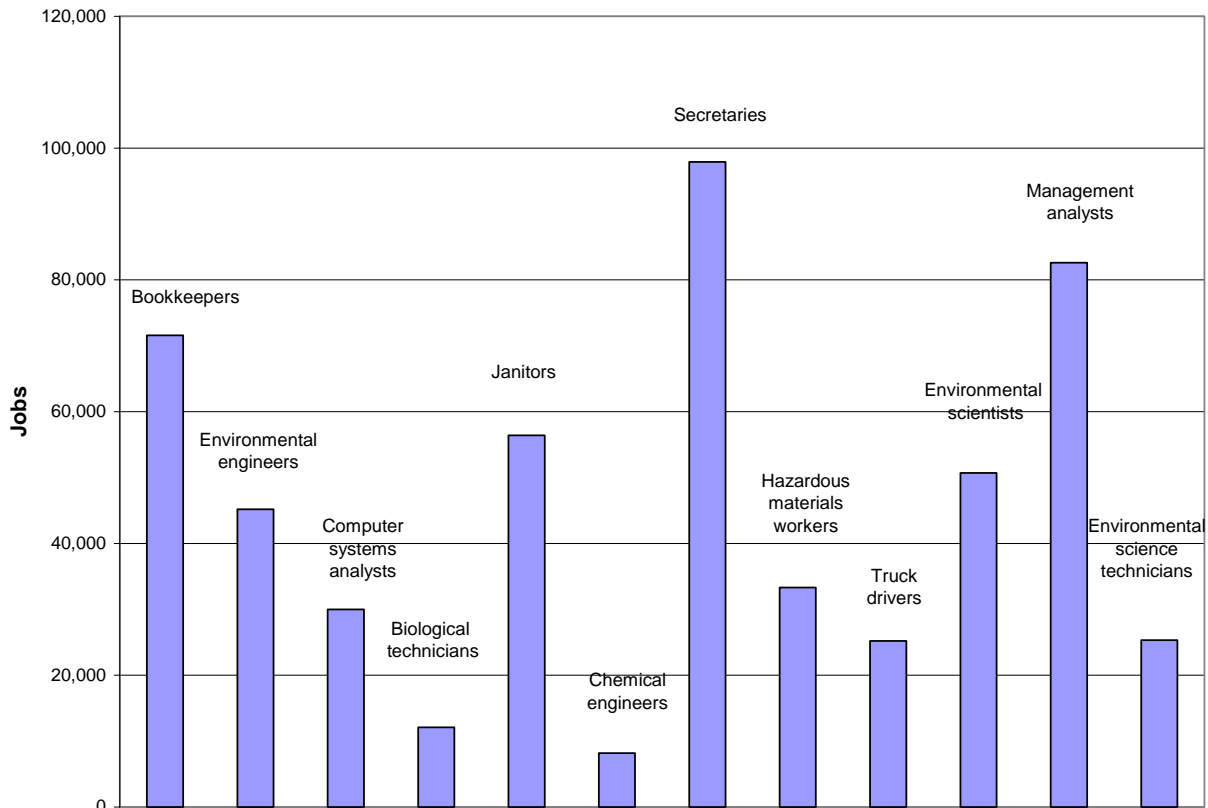


Source: Management Information Services, Inc., 2004.

For example, as illustrated in Figure 2, in the U.S. in 2003, environmental protection created:

- More jobs for secretaries (97,900) than for environmental scientists (50,700).
- More jobs for management analysts (82,600) than for environmental engineers (45,200).
- More jobs for bookkeepers (71,600) than for hazardous materials workers (33,300).
- More jobs for janitors (56,400) than for environmental science technicians (25,000).

Figure 2
Selected U.S. Jobs Created in 2003 by Environmental Expenditures



Source: Management Information Services, Inc., 2004.

- More jobs for computer systems analysts (30,000) than for chemical engineers (8,200)
- More jobs for truck drivers (25,200) than for biological technicians (12,100)

More generally, arguments stressing the economic benefits and job creation resulting from environmental protection and clean energy initiatives are not currently being made in a rigorous manner which disaggregates these benefits to a level of detail that is meaningful to policymakers. The level of detail required is at the sector, industry, state, city, and county level, and the jobs created have to be identified by industry, category, skill, and specific occupation at the state and local level. This report provides data at such levels of detail.

III.C. The Jobs Distribution in Typical Environmental Companies

There are many thousands of environmental companies located throughout the United States and they generate jobs for nearly five million workers in virtually every community. These firms:

- Range from the very small one or two person “mom and pop” shops to very large firms employment thousands of workers.
- Employ workers at all levels of skills, from the most basic and rudimentary to the very high skilled technical and professional
- Include environmental service firms and manufacturing firms
- Include those whose market is local, those whose market is state and regional, those who market is national, and those whose market is international.
- Face the same problems, challenges, and opportunities as other companies

Given the wide diversity in the size, function, and technologies of environmental companies, it is impossible to estimate the job profile of the “average” environmental firm. However, it is possible to identify the jobs and earnings profiles of typical types of firms involved in environment-related areas of work. Tables 2 and 3 illustrate this:

- Table 2 shows the 2003 occupational job distribution and employee earnings of a typical environmental remediation services company.
- Table 3 shows the 2003 occupational job distribution and employee earnings of a typical wind turbine manufacturing company.

These tables illustrate the points made above.

First, firms working in the environmental and related areas employ a wide range of workers at all educational and skills levels and at widely differing earnings levels.

Second, in environmental companies, many of the employees are not classified as “environmental specialists.” For example, even in the environmental remediation services firm profiled in Table 2, most of the workers are in occupations such as laborers, clerks, bookkeepers, accountants, maintenance workers, cost estimators, etc. All of these employees owe their jobs and livelihoods to environmental protection, but, in general, they perform the same types of activities at work as employees in firms that have little or nothing to do with the environment.

This is illustrated even more forcefully in Table 3. The occupational job distribution of a typical wind turbine manufacturing company differs relatively little from that of a company that manufactures other products. Thus, the production of wind turbines and wind turbine components requires large numbers of engine assemblers, machinists, machine tool operators, mechanical and industrial engineers, welders, tool and die makers, mechanics, managers, purchasing agents, etc. These are “environmental” workers only because the company they work for is manufacturing a renewable energy product. Importantly, with the current national angst concerning the erosion of the U.S. manufacturing sector and the loss of U.S. manufacturing jobs, it is relevant to note that many environmental and renewable energy technologies are growing rapidly.⁵ In at least some states, these types of firms can help revitalize the manufacturing sector and provide the types of diversified, high-wage jobs that all states seek to attract.

⁵For example, windpower is the most rapidly growing source of electrical power in the world.

Table 2
Typical Employee Profile of a 100-person
Environmental Remediation Services Company, 2003

Occupation	Employees	Earnings
Hazardous Materials Removal Workers	22	\$36,204
Septic Tank Servicers and Sewer Pipe Cleaners	8	30,419
Construction Laborers	7	32,382
First-Line Supervisors/Managers of Construction/Extraction	5	50,673
Truck Drivers, Heavy and Tractor-Trailer	5	33,044
General and Operations Managers	3	86,258
Laborers and Freight, Stock, and Material Movers	2	21,620
Truck Drivers, Light Or Delivery Services	2	27,437
Office Clerks	2	23,384
Refuse and Recyclable Material Collectors	2	26,796
Insulation Workers	2	32,256
Secretaries (except Legal, Medical, and Executive)	2	25,998
Bookkeeping, Accounting, and Auditing Clerks	2	31,217
Plumbers, Pipefitters, and Steamfitters	1	41,202
Executive Secretaries and Administrative Assistants	1	36,729
Maintenance and Repair Workers	1	30,849
Environmental Engineering Technicians	1	36,939
Operating Engineers and Other Const. Equip. Operators	1	40,520
First-Line Supervisors/Managers of Office/Administrative	1	47,576
Chief Executives	1	116,435
Construction Managers	1	73,994
Cleaners of Vehicles and Equipment	1	21,704
Cost Estimators	1	56,753
Janitors and Cleaners	1	25,746
Environmental Engineers	1	69,930
Industrial Truck and Tractor Operators	1	27,741
Carpenters	1	38,588
Construction and Maintenance Painters	1	33,296
Accountants and Auditors	1	53,865
Dispatchers (except Police, Fire, and Ambulance)	1	29,537
Water and Liquid Waste Treatment Plant and System Operators	1	31,049
First-Line Supervisors/Managers of Transportation Operators	1	46,914
Sales Representatives, Wholesale and Manufacturing	1	42,683
Customer Service Representatives	1	30,366
First-Line Supervisors/Managers of Mechanics and Repairers	1	49,088
Environmental Scientists and Specialists	1	62,003
Receptionists and Information Clerks	1	22,775
Environmental Science and Protection Technicians	1	44,867
Other employees	12	47,422
Employee Total	100	\$39,621

Source: Management Information Services, Inc., 2004.

Table 3
Typical Employee Profile of a 250-person
Wind Turbine Manufacturing Company, 2003

Occupation	Employees	Earnings
Engine and Other Machine Assemblers	31	\$33,359
Machinists	27	37,191
Team Assemblers	16	27,668
Computer-Controlled Machine Tool Operators	12	37,254
Mechanical Engineers	10	65,772
First-Line Supervisors/Managers of Production/Operating	10	54,705
Inspectors, Testers, Sorters, Samplers, and Weighers	8	37,202
Lathe and Turning Machine Tool Setters/Operators/Tenders	6	36,729
Drilling and Boring Machine Tool Setters/Operators/Tenders	4	36,509
Welders, Cutters, Solderers, and Brazers	4	36,530
Laborers and Freight, Stock, and Material Movers	4	28,466
Maintenance and Repair Workers	4	41,318
Tool and Die Makers	4	40,047
Grinding/Lapping/Polishing/Buffing Machine Tool Operators	4	31,899
Multiple Machine Tool Setters/Operators/Tenders	4	37,517
Industrial Engineers	3	64,659
Industrial Machinery Mechanics	3	42,315
Engineering Managers	3	99,404
Shipping, Receiving, and Traffic Clerks	3	29,516
General and Operations Managers	3	110,702
Industrial Production Managers	3	85,512
Industrial Truck and Tractor Operators	3	31,416
Purchasing Agents	3	51,702
Cutting/Punching/Press Machine Setters/Operators/Tenders	3	28,907
Production, Planning, and Expediting Clerks	3	41,601
Milling and Planing Machine Setters/Operators/Tenders	3	37,380
Mechanical Drafters	2	44,090
Customer Service Representatives	2	36,036
Bookkeeping, Accounting, and Auditing Clerks	2	32,760
Office Clerks, General	2	27,227
Sales Representatives, Wholesale and Manufacturing	2	50,757
Janitors and Cleaners	2	28,476
Sales Engineers	2	66,591
Accountants and Auditors	2	54,873
Tool Grinders, Filers, and Sharpeners	2	40,520
Executive Secretaries and Administrative Assistants	2	39,638
Mechanical Engineering Technicians	2	46,767
Electricians	2	45,570
Other employees	48	45,969
Employee Total	250	\$42,726

Source: Management Information Services, Inc., 2004.

IV. THE WISCONSIN ECONOMY IN 2003

The economy in Wisconsin continued its strong growth trend in 2003. Personal income rose over three percent annually from 2001 to 2003, exceeding the U.S. average in each year. Gross state product increased steadily over the period and reached an estimated \$189 billion in 2003, representing 1.8 percent of the total U.S. economy. Population is estimated to have grown steadily every year since the 2000 census, increasing 1.8 percent over the period, which is, however, lower than the 3.0 percent national increase. Wisconsin is now the 20th largest state based on population and at the current rate of growth should reach a population of 5.5 million in 2004.

The civilian labor force grew by around 40,000 from 2002 to 2003, reaching an all-time monthly high of 3,092,000. State employment more than kept pace with the increase in the labor force, leading to a constantly declining unemployment rate during the year dropping from 5.8 percent in January to 5.4 percent in December. This is in contrast to the national unemployment rate that rose to a monthly high of 6.3 percent during the summer of 2003.

The Wisconsin economy is strongly grounded in manufacturing and knowledge-based high-tech industries; for example:

- Wisconsin is second only to Indiana in terms of the percent of its workers employed in the manufacturing sector – 22.6 percent compared to 23.4 percent.
- Wisconsin's exports increased 7.7 percent in 2003, compared to the 4.4 percent U.S. average. The state's leading exports were industrial machinery, medical instruments, transportation equipment, electrical machinery, and plastics. The leading export markets are Canada, Japan, Mexico, China, and the United Kingdom.
- Pollution control equipment is granted a complete property tax exemption, and tax credits are available for R&D and for energy used in manufacturing.
- The University of Wisconsin at Madison ranked first among U.S. public universities in R&D spending and sixth among all universities in receiving the most patents annually.
- In 2004, Wisconsin high school seniors topped the nation in ACT scores for the 12th straight year. Wisconsin has the nation's third lowest dropout rate, and leads the nation with highly qualified teachers in 99 percent of high school classes.

- Wisconsin is the eighth highest state in terms of average educational degree levels achieved by its residents.

Table 4 shows the earnings by industry of employment in Wisconsin and how these compare to the U.S. averages. This table shows that Wisconsin ranks relatively low with respect to sectors such as mining, information, finance, insurance, and real estate. However, the salient feature illustrated in this table is the continuing importance in Wisconsin of manufacturing, and, as noted, it is the second most manufacturing intensive state in the nation. Specifically:

- With 1.9 percent of the nation's population, employment earnings in the Wisconsin manufacturing sector account for 3.1 percent of manufacturing earnings nationally.
- More important, more than 22 percent of every dollar earned in the state is earned by employees in the manufacturing sector – compared to 12.7 percent nationally.
- The Wisconsin/U.S. index for manufacturing is 175, much higher than for any other sector.

Manufacturing is thus the linchpin of the Wisconsin economy, and Wisconsin has one of the world's largest manufacturing economies.

The second-largest sector based on employment earnings is the public administration sector comprised of state, local and federal government employees, accounting for 15 percent. The third largest sector is health care and social assistance.

Table 4
Earnings by Industry of Employment in Wisconsin and the U.S. in 2003

	Wisconsin (mill.\$)	Wisconsin Share of U.S.	Wisconsin Share of Earnings	U.S. Share of Earnings	Wisconsin Index
Personal Income	168,984	1.8%	-	-	-
Agriculture, Forestry, Fishing and Hunting	1,514	1.9%	1.2%	1.1%	105
Mining	217	0.4%	0.2%	0.8%	21
Utilities	1,028	1.4%	0.8%	1.0%	80
Construction	7,968	1.9%	6.3%	6.1%	104
Manufacturing	28,205	3.1%	22.3%	12.7%	175
Wholesale Trade	6,440	1.8%	5.1%	5.2%	98
Retail Trade	8,514	1.8%	6.7%	6.8%	99
Transportation and Warehousing	4,655	2.0%	3.7%	3.3%	112
Information	2,553	1.0%	2.0%	3.6%	56
Finance and Insurance	8,357	1.6%	6.6%	7.6%	87
Real Estate and Rental and Leasing	2,072	1.1%	1.6%	2.7%	60
Professional, Scientific, and Technical Services	6,851	1.1%	5.4%	9.2%	59
Management of Companies and Enterprises	3,165	2.1%	2.5%	2.1%	120
Administrative/Support/Waste Management/Remediation Services	3,321	1.3%	2.6%	3.5%	74
Educational Services	1,409	1.5%	1.1%	1.3%	85
Health Care and Social Assistance	13,953	2.1%	11.0%	9.4%	117
Arts, Entertainment, and Recreation	1,042	1.4%	0.8%	1.1%	77
Accommodation and Food Services	2,825	1.5%	2.2%	2.7%	82
Other Services	3,664	1.7%	2.9%	3.0%	95
Public Administration	18,715	1.6%	14.8%	16.5%	90

Source: Management Information Services, Inc., 2004.

V. THE ENVIRONMENTAL INDUSTRY AND JOBS IN Wisconsin

V.A. Summary of the Environmental Industry and Jobs in Wisconsin

MISI estimates that in 2003:

- Sales of the environmental industries in Wisconsin totaled \$5.4 billion.
- The number of environment-related jobs totaled more than 97,000.
- The environmental industry in Wisconsin comprised 2.9 percent of gross state product.
- Wisconsin environmental industries accounted for 1.8 percent of the sales of the U.S. environmental industry.
- Environment-related jobs comprised 3.5 percent of Wisconsin employment.
- Environment-related jobs in Wisconsin comprised two percent of the total number of environment-related jobs in the U.S.
- Environment-related employment in the state has been increasing in recent years between one and two percent annually.

V.B. Environmental Jobs in Wisconsin by Industrial Sector

Table 5 shows the industrial distribution of total employment and of environmental employment in Wisconsin in 2003.

Comparison of the industrial sector distribution of environment-related jobs in Wisconsin with that of total employment in the state is instructive. A significant portion of the environmental jobs is in the public administration sector which, given the public nature of environmental protection, is to be expected. However, most of the environmental jobs in Wisconsin are in the private sector, and focusing on these reveals that they are heavily concentrated in several sectors. Of particular note is that the private sector environmental industry in Wisconsin is more manufacturing intensive than other average private sector activity in the state:

Table 5
Environmental-Related Jobs in Wisconsin in 2003, by Industry

Industry	Establishments	Total Employment	Environmental Employment	Environmental Jobs (percent)
Agriculture, Forestry, Fishing and Hunting	605	2,500	208	8.3
Mining	164	1,300	145	11.1
Utilities	257	11,600	2,782	24.0
Construction	15,972	123,500	4,295	3.5
Manufacturing	8,989	506,500	17,400	3.4
Wholesale Trade	7,718	113,000	1,752	1.6
Retail Trade	21,363	319,000	1,962	0.6
Transportation and Warehousing	5,170	94,600	555	0.6
Information	1,987	49,700	1,382	2.8
Finance and Insurance	8,872	129,800	861	0.7
Real Estate and Rental and Leasing	4,843	27,900	416	1.5
Professional, Scientific, and Technical Services	10,919	89,000	9,341	10.5
Management of Companies and Enterprises	1,056	37,600	861	2.3
Administrative/Support/Waste Management/Remediation Services	6,563	118,200	7,586	6.4
Educational Services	1,341	46,100	1,807	3.9
Health Care and Social Assistance	13,484	320,500	2,330	0.7
Arts, Entertainment, and Recreation	2,647	35,500	229	0.6
Accommodation and Food Services	13,283	209,500	1,641	0.8
Other Services	15,173	131,300	1,310	1.0
Public Administration	-	411,800	40,337	9.8
State Total	140,404	2,778,900	97,200	3.5

Source: Management Information Services, Inc., 2004.

- 31 percent of private sector jobs in the environmental industry are in manufacturing, compared to 21 percent in manufacturing among all private sector industrial activities in Wisconsin.
- 16 percent of private sector environmental jobs are in professional, scientific, and technical services, compared to four percent of all private sector jobs in the state.
- 13 percent of private sector environmental jobs are in administrative, support, and waste management services, compared to five percent of all private sector jobs in the state.

- 3.2 percent of private sector environmental jobs are in educational services, compared to 1.9 percent of all private sector jobs in the state.

Conversely, there are relatively few private sector environmental jobs in other parts of the Wisconsin economy:

- 3.5 percent of private sector environmental jobs are in the retail trade sector, compared to 13.4 percent in retail trade among all private sector jobs in the state.
- 1.5 percent of environmental jobs are in the finance and insurance sector, compared to 5.5 percent among all private sector jobs in the state.
- Four percent of environmental jobs are in the health care and social service sector, compared to 14 percent among all private sector jobs in the state.
- One percent of environmental jobs are in the transportation and warehousing sector, compared to four percent among all private sector jobs in the state.

Assessing the portion of total state employment in each industrial sector accounted for by environmental jobs indicates that the 97,000 environmental jobs account for about 3.5 percent of the total 2.8 million jobs in Wisconsin. However, this distribution is uneven among industry sectors:

- 24 percent of employment in the utilities sector consists of environmental jobs, primarily water, waste treatment, sanitation, and related facilities.
- Nearly ten percent of public administration employment in the state consists of environmental jobs.
- More than ten percent of Wisconsin jobs in the professional, scientific, and technical services are environmental jobs.
- **About 3.5 percent of the state's manufacturing employment is environment-related** – equal to the 3.5 percent average for environmental jobs of total state employment.

- Only very small portions of total state employment in sectors such as food services, entertainment, real estate, finance, insurance, and retail trade are comprised of environmental jobs.

Key Observations on Jobs Distribution

The concentration of environmental jobs within certain industrial sectors is instructive and interesting.

While accounting for 3.5 percent of total state employment, the industrial sector composition of environmental employment is highly skewed in favor of certain sectors. For example, nearly one-third of private sector environmental jobs are in manufacturing, compared to less than 18 percent of all private sector employment, and more than 16 percent of private sector environmental jobs are in professional, scientific, and technical services, compared to only four percent of all private sector jobs in the state.

This indicates that investments in the environment will provide a greater than proportionate assist to Wisconsin's manufacturing sector. As noted in Chapter IV, Wisconsin is second-most manufacturing-intensive states in the nation and is currently very concerned with preserving, modernizing, and expanding its manufacturing base. Table 5 indicates that the environmental industry can aid in this objective.

Similarly, **environmental investments generate, proportionately, more than four times as many jobs professional, scientific, and technical services as the state average.** Jobs in this sector are the high-skilled, high-wage, technical and professional jobs that Wisconsin – and other states – seeks to attract and retain. Table 5 indicates that investments in environmental protection can be of considerable assistance here.

V.C. Environmental Jobs in Wisconsin by Occupation and Skill

Environmental employment in Wisconsin can be disaggregated by specific occupations and skills, and this information for 2003 for selected occupations is given in Table 6. This table illustrates that environmental jobs in Wisconsin are widely distributed through all occupations and skill levels and, while the number of jobs created in different occupations differs substantially, employment in virtually all occupations is generated by environmental spending.

As noted in Chapter III, the vast majority of the jobs created by environmental protection are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc. and most of the persons employed in these jobs may not even realize that they owe their livelihood to protecting the environment. This is borne out in Table 6, which lists the jobs created by environmental

Table 6
Environmental Jobs Generated in Wisconsin in 2003, by Selected Occupations

Occupation	Jobs
Accountants and Auditors	688
Biological Technicians	261
Chemists	287
Computer and Information Systems Managers	264
Construction Laborers	436
Customer Service Representative	1,297
Electricians	435
Engine and Other Machine Assemblers	229
Environmental Engineers	1,030
Environmental Scientists and Specialists	960
File Clerks	152
Financial Analysts	117
Forest and Conservation Technicians	262
Graphic Designers	170
Hazardous Material Removal Workers	510
Human Resource Managers	175
Industrial Engineers	158
Industrial Machinery Mechanics	241
Inspectors, Testers, and Sorters	459
Janitors and Cleaners	1,478
Landscaping and Grounds Workers	488
Machinists	441
Management Analysts	453
Marketing Managers	173
Mechanical Engineering Technicians	120
Medical Scientists, Except Epidemiologists	479
Office Clerks	2,072
Packers and Packagers	593
Receptionists and Information Clerks	777
Refuse and Recyclable Material Collectors	2,540
Sales Representatives, Technical and Scientific Products	229
Secretaries	1,100
Security Guards	354
Septic Tank Services and Sewer Pipe Cleaners	620
Tool and Die Makers	114
Truck Drivers	2,328
Water and Liquid Waste Treatment Plant Operators	2,375
Welders and Solderers	392

Source: Management Information Services, Inc., 2004.

protection in Wisconsin in 2003 within selected occupations. This table shows that in 2003 environmental protection generated in Wisconsin generated:

- More jobs for machinists (441) than for forest and conservation technicians (262)
- More jobs for office clerks (2,072) than for environmental engineers (1,030)
- More jobs for secretaries (1,100) than for environmental scientists (960)
- More jobs for welders (392) than for biological technicians (261)
- More jobs for truck drivers (2,328) than for hazardous material removal workers (510)
- More jobs for janitors (1,478) than for landscaping and grounds workers (488)
- More jobs for receptionists (777) than for medical scientists (479)
- More jobs for security guards (354) than for chemists (287)
- More jobs for service representatives (1,297) than for septic tank cleaners (620)

Thus, many workers in Wisconsin are dependent on environmental protection for their employment, although they often would have no way of recognizing that connection unless it is brought to their attention.

The importance of environmental spending for jobs in some occupations is much greater than in others. For some occupations, such as environmental scientists and specialists, environmental engineers, hazardous materials workers, water and liquid waste treatment plant operators, environmental science protection technicians, refuse and recyclable material collectors, and environmental engineering technicians, virtually all of the demand in Wisconsin is created by environmental protection activities. This is hardly surprising, for most of these jobs are clearly identifiable as “environmental” jobs.

However, in many occupations not traditionally identified as environment-related, a greater than proportionate share of the jobs is also generated by environmental protection. Recalling that, on average, environment-related employment in Wisconsin comprises only 3.5 percent of total employment, in 2003 environmental protection expenditures generated jobs for a greater than proportionate share – as much as ten percent or more -- of many professional occupations in the state, including:

- Architects
- Chemists
- Civil engineers
- Computer software engineers
- Electronics engineers
- Management analysts
- Mechanical engineers
- Medical scientists
- Natural sciences managers
- Surveyors

For many other occupations, also not traditionally identified as environment-related, a greater than proportionate share of the jobs is also generated by environmental protection. Again recalling that, on average, environment-related employment in Wisconsin comprises only 3.5 percent of total employment, in 2003 environmental protection generated jobs for as much as ten percent or more of many highly skilled, technical occupations in the state, including:

- Architectural and civil drafters
- Biological technicians
- Chemical equipment operators
- Chemical technicians
- Civil engineering technicians
- Electrical and electronics engineering technicians
- Electrical and electronics equipment assemblers
- Electrical and electronics drafters

- Industrial engineering technicians
- Network systems and data communications analysts
- Surveying and mapping technicians

The above findings are significant for they indicate that state investments in environmental protection will create jobs in greater than proportionate share in two categories that Wisconsin -- and other states -- are eager to attract:

- College-educated professional workers, many with advanced degrees
- Highly skilled, technical workers, with advanced training and technical expertise, many of them in the manufacturing sector

Environmental protection thus generates jobs that are disproportionately for highly skilled, well-paid, technical and professional workers, who in turn underpin and provide foundation for entrepreneurship and economic growth.

Finally, there are many occupations for which requirements in Wisconsin generated by environmental protection are close to the average of 3.5 percent of total employment; including in the following occupations:

- Bookkeeping, accounting and auditing clerks
- Carpenters
- Cashiers
- Construction laborers
- Customer service representatives
- Electricians
- Financial managers
- General and operations managers
- Human resource assistants
- Industrial engineers

- Industrial production managers
- Janitors and cleaners
- Machinists
- Maintenance and repair workers
- Medical and clinical laboratory technicians
- Operating engineers
- Payroll clerks
- Secretaries, except legal, medical, and executive
- Shipping and receiving clerks
- Stock clerks
- Team assemblers
- Welders

V.D. The Environmental Industry as an Economic Driver for Wisconsin

This study demonstrates that environmental protection can form an important part of a strategy for Wisconsin based on attracting and retaining professional, scientific, technical, high-skilled, well paying jobs, including manufacturing jobs. While a successful strategy must have other components as well, rarely has any state recognized the economic and jobs benefits that could flow from specifically encouraging the development of environmental and environment-related industries as an economic development initiative. Indeed, usually the opposite is the case: States tend to view environmental economic costs as economically negative.

While designing such a development strategy is outside the scope of this report, there are concrete examples of environment-related initiatives that could create substantial numbers of jobs in Wisconsin. For example:

- This study demonstrates that, at present in Wisconsin, environmental protection is creating more than 97,000 jobs in the state, and these are disproportionately high-skilled, professional,

scientific, technical, well paying jobs – many of them in manufacturing.

- A 2002 joint study by MISI and 20/20 Vision for the Energy Foundation estimated that an aggressive strengthening of U.S. Federal Corporate Average Fuel Economy (CAFE) standards would create nearly 11,000 jobs in Wisconsin. Thus, contrary to what many believe, the production of more fuel-efficient vehicles would create substantial numbers of jobs in Wisconsin, not reduce them.⁶
- A 2002 study by the University of Illinois estimated that investments in renewable energy and energy efficiency would create nearly 7,400 jobs in Wisconsin.⁷
- A 2001 MISI study of environment-related jobs policies in the Midwestern states identified a number of opportunities and initiatives for job creation in Wisconsin.⁸
- A 1999 study sponsored by the World Wildlife Fund and the Energy Foundation estimated that a strategy to address global warming in the U.S. would create 15,000 jobs in Wisconsin.⁹

Given the multiplier effect of environmental spending and investment, it is likely that substantial numbers of jobs could be created through a systematic program to develop the environmental industry. Our findings show this is especially true in Wisconsin, which currently has a thriving, job creating environmental industry, currently generating more than 97,000 jobs in the state, to a large extent unbeknownst to most state residents and probably to most policymakers. Such a systematic program of investment could have significant positive and potentially transformational impact. It is a matter of more fully linking classic economic development approaches with a better understanding of the role and reach of environmental programs and expenditures as a factor contributing to that development.

⁶Management Information Services, Inc. and 20/20 Vision Education Fund, *Fuel Standards and Jobs: Economic, Employment, Energy, and Environmental Impacts of Revised CAFE Standards Through 2030*, Washington, D.C., 2002. See also Bezdek and Wendling "Potential Long-term Impacts of Changes in U.S. Vehicle Fuel Efficiency Standards," op. cit.

⁷Regional Economics Applications Laboratory, *Job Jolt: The Economic Impacts of Repowering the Midwest*, University of Illinois, Chicago, 2002.

⁸Management Information Services, Inc., *Survey of Jobs and the Environment Issues in Six Midwestern States: Identifying Policy Challenges and Opportunities*, report prepared for the Joyce Foundation, Chicago, July 2001.

⁹Tellus Institute and Stockholm Environment Institute, *America's Global Warming Solutions*, Boston, August 1999.

VI. SUMMARY PROFILES OF SELECTED WISCONSIN ENVIRONMENTAL COMPANIES

We conducted a survey of existing environmental companies in Wisconsin, examining a functional, technological and geographic mix of companies. Our research revealed many firms, and they:

- Are located throughout the state, in major urban centers, suburbs, small towns, and rural areas.
- Range in size from small firms of 20 employees to large firms employing many hundreds
- Are engaged a wide variety of activities, including remediation, manufacturing, testing, monitoring, analysis, etc.
- Include some of the most sophisticated, high-tech firms in the state

Summary descriptions of a representative sample of firms are given in Table 7 and are discussed below. Information presented is current as of July 2004.

VI.A. ANGI International, Inc.

ANGI International was founded in 1986 and is one of the world's leaders in manufacturing and distributing Compressed Natural Gas (CNG) refueling equipment for natural gas vehicles and other applications in the CNG Industry. Based in Milton, ANGI manufactures and distributes a complete CNG fueling product line including compressor units, storage, dispensing, installation and service products. The firm has 60 employees -- primarily manufacturing, engineering and clerical, and approximately half of its sales are international.

ANGI was founded in response to industry requirements for a single source natural gas vehicle (NGV) equipment supplier. It is a driving force in the development and implementation of improved refueling technology which serves to make natural gas the preferred alternative vehicle fuel, and is one of the few companies in the industry exclusively dedicated to providing highly integrated turnkey NGV refueling solutions. The company is involved in CNG programs in the United States and many other countries, including Egypt, Venezuela, China, Brazil, Malaysia, Mexico, Thailand, Pakistan, Japan, Czech Republic, Korea, Canada, and Indonesia. ANGI has provided over 600 CNG stations worldwide, and thousands of clean burning natural gas powered cars, buses and trucks around the world are refueling at NGV refueling stations designed, packaged, and serviced by ANGI.

Table 7
Summary of the Select Wisconsin Environmental Companies Profiled

Company	Location	Products/Services	Jobs
ANGI International	Milton	A world leader in manufacturing Compressed Natural Gas refueling equipment for natural gas vehicles	US: 60 WI: 60
Cardinal Environmental	Sheboygan	A full service environmental laboratory, testing, and consulting firm	US: 20 WI: 16
Liquid Waste Technology, LLC	Somerset	Manufacturing and engineering services for automated and remote controlled robotic waste water treatment equipment	US: 70 WI: 20
MEGTEC Systems	De Pere	A leading manufacturer of thermal management and emission control systems	US: 800 WI: 400
Natural Resources Technology, Inc.	Pewaukee	Environmental consulting and natural resource restoration, management, exploration, development, and utilization	US: 45 WI: 41
Nedland Industries, Inc.	Ridgeland	Designs, manufactures, and markets solid waste pollution control equipment	US: 65 WI: 65
North American Hydro	Schofield, Neshkoro	Owns and operates hydroelectric facilities and manufactures hydroelectric equipment	US: 100 WI: 70
Quest Technologies	Oconomowoc	A world leader in the design and manufacturing of environmental, health, and safety instrumentation	US: 110 WI: 90
STS Consultants	Green Bay, Madison, Milwaukee, Oshkosh, Schofield	Environmental, engineering, and geo-environmental consulting, and design, and construction of landfills, lagoons, and impoundments	US: 500 WI: 165
Triad Engineering	Milwaukee	Full service environmental engineering, investigation, remediation, and consulting	US: 65 WI: 60

Source: Management Information Services, Inc., 2004.

ANGI recently moved to a larger, completely renovated manufacturing facility in Milton. The complex was built specifically for ANGI occupancy through substantial investment by ANGI and the property owners, and with aid made available by the State of Wisconsin Brownfield Grant Program.

The new facility expands ANGI's manufacturing capacity by an estimated 40 percent and resulted in a much improved work environment. It provides ANGI 60,000 square feet of manufacturing and material handling floor space with dedicated shop areas for dispenser and panel assembly, compressor assembly, weld and fabrication, machining, control panel assembly, and hydrostatic testing. This new testing facility will support extended testing of the largest compressors ANGI packages on natural gas at the customer's specified suction and discharge conditions. Scheduled expansions to the testing facility include the addition of high power digital drives to provide up to 500 kW of programmable electric power and a nitrogen compression loop for functional dispenser testing and leak testing.

VI.B. Cardinal Environmental

Cardinal Environmental (CE) is a full service environmental laboratory and consulting firm based in Sheboygan that has been in business over 20 years. It provides environmental site assessments, asbestos inspection and management planning, occupational safety and health, toxic and hazardous waste management, wastewater sampling and analysis, and air emissions management. The firm has 16 employees in Wisconsin consisting primarily of chemists, biologists, and environmental scientists, and has hired two new staff in the past six months. Most of CE's clients are commercial and industrial and all of its sales are domestic.

CE staff has the expertise for complete project organization, including initial problem diagnosis and study design, project implementation, data interpretation and development of recommendations for cost-effective control measures. The firm provides a wide variety of services including air emissions compliance, asbestos management services, safe drinking water services, regulatory compliance reporting, indoor air quality, lead consulting and testing services, laboratory services, industrial hygiene, occupational health and safety, consulting services, training programs, storage tank removal and wastewater/groundwater management services. In addition to its core services, CE also routinely samples and analyzes water, wastewater, air, soil, and waste for various contaminants. CE staff also provide assistance with environmental reports and permits and can also provide health and safety related training or exposure monitoring.

VI.C. Liquid Waste Technology, Inc.

Liquid Waste Technology, Inc. (LWT) provides manufacturing and engineering services for automated and remote controlled robotic dredging equipment for waste water treatment and sludges. Based out of Somerset, LWT clientele include private and public sector organizations and municipal wastewater treatment facilities. The firm has 20 employees in Wisconsin, its clients are primarily municipalities, and about half of its sales are international.

LWT:

- Designs and provides complete systems for land application of sludges, bio solids and liquid livestock manure by direct sub-surface injection, including tool bars, hose reels, and agitators.
- Designs and builds electronically controlled, hydraulically powered systems for remote operation with specific remedial needs (including Super Fund). This includes rail tank car agitators, submersible robotic crawlers, and submersible chopper pumps for digester cleaning systems. In addition to these custom applications, LWT also designs a number of control systems, including hand held, automated, electronic, and radio remote controlled interfaces.
- Provides specialized sub-contract dredging and land application services for municipal waste water treatment plant sludges, water plant lime, food processing bio solids, industrial process residuals, silt and sand, and other types of lagoon slurries.

LWT's products are used for cleaning up polluted water, whether for a sewer system, waste water treatment plant, or an old working harbor. A trend seen around the U.S. today is to take an existing polluted harbor and revitalize that area into a thriving waterfront where hotels, condominiums, restaurants, and bars can be placed, thus turning once undesirable real estate into a revenue generation center for both small businesses and the municipality. LWT helps this become a reality with its offerings to ensure the waterways are clean and pollutant free, and are thus enticing to home buyers, businesses, tourists, and visitors.

VI.D. MEGTEC Systems

MEGTEC designs, manufactures, sells, installs, and services web handling, air flotation drying, process thermal management, and emission control systems, and provides energy and engineering services designed to maximize productivity and performance. MEGTEC's U.S. headquarters is located in De Pere, the firm has 800 employees worldwide, including 400 manufacturing employees in Wisconsin, and has

hired ten new staff in the past six months. Most of its clients are in the industrial sector and about 40 percent of its sales are international.

MEGTEC's three regional headquarters are located in the Wisconsin, France, and Singapore, and its manufacturing facilities are located in De Pere. The company also has offices in Germany, Sweden, the United Kingdom, Australia, Japan, Sweden, and Shanghai. Around the world, companies rely on MEGTEC for expertise and technologies in web handling, air flotation drying, process thermal management, and emission control systems. With over 20,000 installations of dryers, splicers and oxidizers throughout the world and over 100 patents, MEGTEC has earned a reputation from its innovation and experience.

The MEGTEC companies, including MEGTEC Systems Inc. and its previous companies, affiliates, subsidiaries, and divisions, bring together a strong history of innovation. Their single-source solutions have been enhanced initially through Sequa Corporation's acquisition of TEC Systems and operationally combining it with its MEG-France business. The MEGTEC family expanded further through the acquisitions of Thermo Wisconsin, the air emission control division of Wolverine Corporation, AMAL/Enkel, and the licensing of zero-speed splicer technology from Butler Automatic. The companies that comprise MEGTEC bring unique specialties and advanced technologies to MEGTEC's product and service offerings. MEGTEC is owned and supported by Sequa Corporation, a diversified industrial company listed on the New York Stock Exchange.

VI.E. Natural Resource Technology, Inc.

Natural Resource Technology, Inc. (NRT) is an environmental consulting firm providing technical assistance on natural resource restoration, management, exploration, development, and utilization matters. NRT is an employee owned company located in Pewaukee, and its staff consists of engineers, geologists, hydrogeologists, and scientists. The firm was founded in 1993, has 41 employees in Wisconsin, and has hired six new staff in the past six months. NRT primarily services domestic clients including industry, commercial establishments, electric utilities, oil companies, railroads, financial institutions, insurance companies, developers, law firms, state and local government agencies, and industry research associations.

NRT staffers are routinely invited to participate on significant agency rule-making advisory committees, such as Chapter NR 700 series (Investigation and Remediation of Environmental Contamination) and ILHR 47 (Petroleum Environmental Cleanup Fund Act Emergency Rules). NRT staffers attend numerous other policy committee meetings, and knowing the direction of new agency policies in advance enables NRT to develop compliance strategies, often resulting in significant cost savings to clients. Active participation on these committees also greatly enhances NRT's credibility during negotiations with regulatory agencies involving difficult site management decisions.

Environmental Health and Safety regulations and natural resource management represent some of the most difficult challenges currently faced by businesses and communities. NRT assists in meeting these challenges with practical solutions, based on sound technical approaches, proven methods, and innovative technologies. Specifically, NRT specializes in environmental health and safety services, hazardous waste, hydrocarbon site management, remediation, economic development, business risk management, solid waste, water resources, legal support services, and utility services.

VI.F. Nedland Industries

Nedland Industries designs, manufactures and markets dumpsters and compactors, and is located in Ridgeland. The firm was founded in 1945, has 65 employees in Wisconsin – primarily manufacturing workers, and has hired 18 new staff over the past six months. Its clientele are municipalities and industrial and commercial companies.

Nedland has manufactured top quality refuse and recycling products for a half century, and all of its products are made of prime high quality steel plate, channel, and tubing. The firm's product line includes Roll-Offs, Receivers, Compactors, Front Load, Rear Load, Poly Dura Kan, and Recycling Containers. Nedland services both the public and private sectors and its products are marketed to office buildings, motels, hotels, department stores, chain stores, and manufacturing facilities, as well as to many other commercial and industrial facilities.

VI.G. North American Hydro, Inc.

North American Hydro, Inc. (NAH) is a Wisconsin-based engineering and independent power producing company specializing in the hydroelectric field worldwide. NAH was incorporated in 1978 to service the needs of both the new and rehabilitation markets and it has facilities in Schofield and Neshkoro. Its employees are primarily engineers and dam operations personnel, it has 96 staff (70 in Wisconsin) and has hired six new staff in the past six months.

The company's experience is demonstrated in the successful implementation of projects ranging from large multi 100-megawatt interconnected facilities to isolated micro-hydro stations. NAH specializes in the development of hydroelectric resources and is growing: In 2002 the company opened its new Engineering and Manufacturing facility in Schofield. NAH currently owns, operates, and manages 29 hydroelectric sites and, by contract with a major utility and municipality, operates and maintains four other hydroelectric sites. NAH is also involved in the development of numerous hydro-projects throughout the U.S.A.

NAH manufactures a variety of products for the hydro electric field, and its product line includes hydroelectric generating systems, instrumentation and control products, materials and components, on-site generation products, operations and maintenance equipment and supplies, power conditioning products, and power plant equipment. One of the firms most requested products is electric gate control for vertical or horizontal gateshaft applications in older, manually controlled hydro plants.

VI.H. Quest Technologies Inc.

Quest Technologies Inc. (QTI) is a world leader in the design and manufacturing of occupational health, safety, and environmental instruments, and is headquartered in Oconomowoc. It was founded in 1946, has 110 employees (including 90 in Wisconsin), and has hired one new employee in the past six months. About one-third of QTI staff are manufacturing workers and the remainder are primarily engineers, technicians, and sales representatives. The firm's clientele are dealers who market QTI products to industrial, commercial, and government customers, and about 35 percent of the sales are international.

QTI offers *Quest* brand products as the worldwide Systems Solution for Occupational Health, Safety and Environmental measurement applications. QTI's *Metrosonics* brand is positioned to become the champion of easy-to-use and affordable instruments in these applications. QTI produces a large product line including the following:

- *Noise Dosimeter.* A noise dosimeter is the most accurate method for measuring an employee's noise exposures. An employee wears a noise dosimeter during a work-shift and it measures noise levels at all the locations the employee visits. QTI offers a full line of noise dosimeters and the software and technical support to handle all of a client's noise measurement needs.
- *Sound Level Meters.* QTI offers a variety of Sound Level Meters for all sound/noise measuring needs.
- *Gas Detection Monitors.* QTI offers several types of rugged, lightweight and simple to operate gas monitors designed for demanding work environments. QTI monitors permit users to easily and reliably confirm proper calibration and/or perform recalibration in the field. Its advanced monitors can also indicate when calibration is due.

- *Vibration Monitors.* The international community has recently drawn considerable attention to occupational vibration and its detrimental effects on the human body. In response to these developments, QTI has released the HAVPro personal human vibration monitor, which provides tri-axial vibration measurements for calculating hand-arm and whole body vibration exposures.
- *Indoor Air Quality Monitors.* QTI monitors provide industrial hygiene and safety professionals with a single monitoring device for recording, reporting, charting, and analyzing many hazards contributing to poor indoor air quality. QTI monitors can be used to address IAQ complaint investigation and mitigation, air exchange rate measurement, HVAC system performance monitoring, HVAC system balancing, and mold investigation and remediation
- *Heat Stress and Thermal Environment Monitors.* Heat Stress and Thermal Environment Monitors are used to indicate possible stress or other related issues caused by excessive heat. These monitors can be used to measure the heat of an individual or their surrounding area while Thermal Environment Monitors use a variety of sensors to measure ambient temperature, evaporative cooling, and radiant heat exposure. QTI Thermal Environment Monitors can convert measurements to a simplified, single-number Indoor and Outdoor WBGT Index. This index can then be used in conjunction with guidelines developed by ACGIH, U.S. Navy, EPRI, ISO and others.

VI.I. STS Consultants

STS Consultants is an environmental engineering consulting firm providing science and engineering solutions for the constructed environment. STS has 14 offices located throughout the Midwest, including offices in Green Bay, Madison, Milwaukee, Oshkosh, and Scofield. The firm has 500 employees, including 165 in Wisconsin, and most of the staff are scientists, engineers, surveyors, and planners. STS has hired ten new employees over the past six months. About 70 percent of its clients are commercial and residential developers and 30 percent are public agencies; virtually all of its business is domestic.

STS was founded in 1948 as Soil Testing Services, Inc. Since its inception, STS has transformed itself from a two-person testing service to a globally-recognized environmental engineering and consulting firm. Growth for the company has been built on a foundation of solid clients and industry leading talent.

Since 1948, STS has continued to grow and expand its service offerings. In the 1960s, STS made a name for itself in the waste management and environmental services arena. The company's thorough understanding of soil dynamics, groundwater characteristics, and subsurface exploration capabilities made for a natural transition into broader geo-environmental consulting. Siting, permitting, design, and construction of earthen structures such as landfills, lagoons, and impoundments became an area of special expertise for STS.

In the 1970s, STS continued to mature and adjust to clients' new requirements relating to stronger environmental regulations, rapid suburban development, and incorporation of technological advances. STS focused on providing its clients with the expertise necessary to successfully address these issues.

A highlight in the development of STS occurred in the 1980s when it capitalized on an opportunity to combine its engineering and scientific expertise with the strong entrepreneurial spirit that had come to define the firm. STS took an abandoned dam and powerhouse in Michigan that was scheduled to be dismantled and redeveloped the site under the management of its new subsidiary, STS HydroPower, Ltd. The effort successfully reconnected the plant to the grid, and before being sold in the mid-1990s, STS HydroPower, Ltd. grew to include a portfolio of 11 hydroelectric plants in Michigan, Virginia, Colorado, California, and Oregon.

STS focuses on the following markets: Commercial, Federal, Forest Products, Manufacturing, Mining, Municipal Solid Waste, Power, Transportation, and State and Local Government. The firm has completed over 100,000 projects in the United States and abroad and currently provides a comprehensive package of services to a broad client base. STS continues to support its clients' interests at home and abroad, to invest in technology, client support systems and its staff, and to plan a future of high-profile projects.

VI.J. Triad Engineering Incorporated

Triad Engineering Incorporated (TEI) is a full-service engineering and consulting firm headquartered in Milwaukee that provides engineering and environmental services to a broad range of clients. Triad provides planning and design services and services during construction to clients in the private and public sectors. TEI currently employs 65 personnel (60 in Wisconsin), including civil, mechanical, environmental, chemical, electrical, structural, and transportation engineers, geologists, hydrogeologists, chemists, technicians, and support staff. Its clients are 40 percent municipal and 60 percent industrial, and 95 percent of its business is domestic.

Since its inception in 1981, TEI has steadily grown in size and capabilities. The company specializes in the custom design and implementation of wastewater treatment plants, and its experience includes projects throughout the United States, Canada, Dominican Republic, Mexico, Jordan, and Saudi Arabia. Triad has won awards of

recognition from clients for design and implementation of services related to soil and groundwater remediation, industrial waste and wastewater treatment, and infrastructure improvements.

TEI provides engineering design services, investigation, remediation, and site closure services, and environmental management and technical services. Triad also provides design/build, turnkey, and construction management services through its wholly owned subsidiary, TEI Corporation.

VII. OPPORTUNITIES IN WISCONSIN STATE GOVERNMENT PROGRAMS FOR ENCOURAGING ENVIRONMENT-RELATED JOBS

There are a number of state government programs and initiatives that could be used to stimulate environment-related industries and jobs in Wisconsin. Some of the more important ones are summarized below. All of the initiatives and programs discussed could be maximized to strengthen the environmental industry and tap inherent leverage and multiplier effect benefits, building upon the existing robust industry.

VII.A. Governor's Initiatives

VII.A.1. The Green Tier Program

The Wisconsin Green Tier Program is a voluntary program for regulated organizations that want to be exemplary stewards and unregulated organizations that want to cooperate on environmental tasks. Green Tier seeks the best environmental outcome and uses a contract to make a legal commitment to achieve that outcome. The law is prospective, not retrospective, and contains incentives that encourage parties to go beyond compliance and address priority local, regional, or state environmental issues, especially those outside of regulatory law.

Green Tier uses contract law principles, building on the Habitat Conservation Program, brownfield cleanups, enforcement settlements, and Europe's covenants and compacts. State government staff visited Bavaria and The Netherlands to understand Dutch Covenants and Bavaria Compacts, and the Governor signed a regulatory reform working partnership with Bavaria and a stewardship agreement with the Dutch.

This program offers unique potential for addressing jobs and the environment issues and the jobs/environment nexus:

- It is an experimental, evolving program that is "pushing the envelope" with respect to environmental policy.
- The utilization of European approaches may encourage incorporation of jobs priorities in the program, since these are given much higher priority in Europe than in the U.S.

VII.A.2. Grow Wisconsin

The Grow Wisconsin initiative is designed to help increase productivity, expand exports, add value, increase skills, and employ technology to maximize the value of Wisconsin's current economic base and to create and utilize knowledge to build

emerging industries. Recognizing that Wisconsin is producing valuable knowledge and intellectual property in its universities, laboratories, and companies and that some of the fastest growing, highest paying, and emerging industries depend on commercializing this knowledge, the initiative's objectives are to:

- *Tap Urban Potential.* Wisconsin needs at least one dense, vibrant urban economic and cultural center to attract the full range of people, industries, and opportunities that characterize a high growth, high wage economy. The initiative will help tap the full potential of the Milwaukee area to ensure that finance, culture, entertainment, and urban amenities are fully developed and benefit the entire state.
- *Implement Strategies Regionally.* Wisconsin is a diverse state with differing economic needs and dominant industries across the state, and the initiative is designed to work with regional groups and officials to tailor strategies across the state.
- *Lower Regulatory Burdens, Keep Standards High.* Wisconsin can gain a dual economic advantage by having a business friendly regulatory climate and being a good steward of the environment. This high end approach to regulatory reform involves keeping standards high, but lowering regulatory burdens.
- *Build a World Class Infrastructure.* The initiative seeks to secure the energy, transportation, and communication infrastructure Wisconsin needs to be fully engaged in the national and world economy.

There may be potential here to have this initiative focus on renewable energy, energy efficiency, environment, and jobs issues, even though it has not thus far. Grow Wisconsin funds can be used to help create environment-related industries and jobs, and this effort could be greatly expanded. The initiative could also sponsor conferences on jobs and the environment issues.

VII.A.3. Governor's Task Force on Energy Efficiency and Renewables

Governor Doyle created the Governor's Task Force on Energy Efficiency and Renewables in September 2003 in response to the increasing demand for energy in the state and needed improvements in Wisconsin's energy infrastructure. The 25-member Task Force included representatives from business, labor, consumer, and environmental groups, members from the state's investor-owned utilities, public-power communities, and rural electric cooperatives, and a bipartisan group of four legislators. It was given the mission of advising the governor on creative, consensus policy options and practical business initiatives to restore Wisconsin as a leader in energy efficiency

and renewable energy sources, relying upon cooperation among the stakeholders in the energy industry with the goal of reducing Wisconsin's dependence on out-of state energy and helping to save ratepayers money. In July 2004, the Task Force unanimously approved every recommendation presented by its four subcommittees to increase energy efficiency and use of renewable resources in Wisconsin. Key recommendations from the Task Force include:

- Increase the statewide use of renewable energy by all customers to 10 percent by 2015
- Increase the State of Wisconsin's purchases of renewable energy to 20 percent by 2010
- Improve the state's focus on energy efficiency programs by increasing the role of the Public Service Commission in setting targets and funding levels for energy efficiency
- Update and improve the state's energy building codes
- Create rural energy initiatives, such as increased use of locally developed anaerobic digestors and wind generators

The Task Force is a "classically green"-oriented entity. It's recommendations will obviously create jobs, but have no component that maximizes, publicizes, or further develops the current jobs creation benefits or potential. However, the goals are broad enough to include environment-related jobs programs. Thus, the jobs component of these programs could be readily optimized. Ultimately, promotion of renewable energy at significant scale would support diverse businesses and create diverse jobs across Wisconsin's industrial sector.

VII.A.4. The Technology Zone Program

The Technology Zone program is a new economic development initiative that offers stimulus to the growth of businesses in Wisconsin's high-technology sector. Specifically:

- Eight zones have been designated
- Zones are effective for ten years
- \$5 million in income tax credits have been allocated to each zone
- Tax credits will be made available to high-technology businesses locating or expanding in a designated Technology Zone

The new program is based on the state's successful Community Development Zone Program, which provides income tax credits to companies that start, expand, and locate in 20 designated areas of economic distress around the state. Since the program's inception in 1989, the Department of Commerce has certified 489 businesses for projects creating 9,600 jobs, retaining 4,000 jobs, and generating \$517 million in private investment.

The program represents another step along a continuum that includes an increased commitment by the Department of Commerce to funding technology projects, the creation of more than \$130 million in new venture capital resources, venture capital missions to the east and west coasts, and the establishment of the Wisconsin Technology Council to coordinate statewide technology development. All these initiatives are the result of a broad consensus that seeks to capitalize on Wisconsin's potential as a New Economy leader.

The Technology Zone program offers significant potential: It is a new program and it may thus be possible to include the environmental industry as a major target and environment-related jobs considerations as goals. The program can be used to help create high-tech environment-related industries and jobs, and this effort could be greatly expanded, with significant jobs benefits throughout the state.

VII.B. Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources Environmental Protection Division has several relevant programs, including:

- Air Pollution Control -- air quality monitoring, industrial emissions, air pollutants, permits, regulations, and partnerships.
- Business Assistance -- cooperative environmental assistance including pollution prevention, business sectors, partnerships, ISO 14000, publications and innovative environmental initiatives.
- Environmental Clean-up -- brownfields and spills, financial tools, an outline for cleaning up contaminated property, regulations, UST/LUST information, requirements of the Spill Law, and liability exemptions from the Spill Law.
- Financial Assistance -- environmental, recreational, and conservation-related grant and loan programs.
- Waste -- solid waste, hazardous waste, mining, and recycling programs.

- Water -- surface water, contaminated sediment, drinking water, groundwater, Lakes Partnership/grants, Lower Fox River, Great Lakes, nonpoint source pollution, and wastewater permits.

The DNR also has an environmental intern program for college students that places about 30 interns per year in various state agencies.

VII.C. The Bureau of Community Financial Assistance

The Bureau of Community Financial Assistance administers grant and loan programs. Financial program staff works closely with local governments and interest groups to develop and support projects that protect public health and the environment and provide recreational opportunities. Relevant programs include:

- Environmental Loans Section -- loan programs for drinking water, wastewater, and brownfield projects, and a grant program for brownfield site assessments.
- Environmental Financial Assistance Section -- grant programs for nonpoint source runoff pollution, recycling, lakes, rivers, municipal flood control and well compensation.
- Land & Recreation Financial Assistance Section -- grant programs for conservation, restoration, parks, stewardship, recreational facilities and trails, hunter education, forestry, forest fire protection, gypsy moth, household hazardous waste collection, dam rehabilitation/abandonment, dry cleaner remediation, and urban wildlife damage.

The types of programs supported include Urban Forestry, Urban Green Space, Waste Reduction and Recycling Demonstration Grants, Recycling Grants to Responsible Units Site Assessment Grant Program, Stewardship Grants for Nonprofit Conservation Organizations, and others.

CFA funds can be used to help create environment-related industries and jobs, and this effort could be greatly expanded.

VII.D. Cooperative Environmental Assistance

CEA was created as part of Wisconsin Department of Natural Resources' 1996 reorganization. The bureau is housed in the Customer Assistance and External Relations Division and it:

- Coordinates and integrates pollution prevention, waste reduction, business recycling, small business clean air assistance, hazardous waste minimization, and other voluntary approaches to environmental protection within DNR.
- Houses business sector specialists who focus on developing relationships between businesses and environmental organizations utilizing partnerships and recognition programs.
- Investigates and supports innovative, non-regulatory incentives to promote environmental protection.
- Publishes a quarterly newsletter for businesses, *Waste•Less•News*.

Thus far, CEA has not had a jobs/environment focus, but the potential exists.

VII.E. The Wisconsin Conservation Corps

The Wisconsin Conservation Corps was created in 1983 by the Legislature as a means to simultaneously provide employment for struggling young people and help address the state's conservation, natural resource, and environmental priorities. The statutes gave the agency four equally important objectives:

- The employment of young adults, ages 18 through 25, throughout the state.
- Conserving, developing, enhancing, or maintaining Wisconsin's natural resources through conservation and community development projects of long-lasting benefit.
- Encouraging and developing job skills, cooperation and discipline through meaningful work experience, training, and educational opportunities.
- Promoting the well-being of children, the elderly, persons with disabilities and persons with low incomes through the implementation of projects that include human services activities.

The Corps initially consisted of four work crews, each of which spent most of its time in the woods, either planting new trees or cutting down old ones. At present, the WCC has grown to 50 crews, located in both rural and urban areas. The WCC's mission has also expanded to include weatherization work, wildlife habitat preservation and improvement, historical preservation, and other tasks.

WCC participants are paid the minimum wage and, as part of the program, are provided four hours per week in instruction in a variety of educational courses relating to basic and remedial skills, college preparation, vocational and technical skills, natural resources and the environment, computer literacy, career planning, etc. They also earn a \$2,800 tuition voucher after a year of service.

The WCC represents a useful and interesting type of jobs and environment program. Unfortunately, the WCC was terminated on June 30, 2003. At some point in time, the state may wish to revisit this decision.

VII.F. Wisconsin Department of Commerce

The Wisconsin Department of Commerce is the state's primary agency for delivery of integrated services to businesses. The department's goals are to:

- Foster the retention and creation of new jobs and investment opportunities in Wisconsin.
- Foster and promote economic business, export, and community development.
- Promote the public health, safety and welfare through effective and efficient regulations, education and enforcement.

The WDOC's economic development agency offers financial assistance for a wide variety of purposes, including employee training, high-technology research and development, business incubators, product development, community planning and business assistance, community loans to business, community public facilities improvements, community infrastructure for a business expansion, rural business expansions and start-ups, and business investment in economically distressed areas.

Thus far, there appears to be little focus on the environmental industry in this department, but such a focus could strategically leverage the benefits of environmental protection for economic development on an interdepartmental intergovernmental basis.

VII.G. Brownfields Development Program

The Brownfields Initiative Grant Program is administered by the Department of Commerce, and funding is available for Brownfields projects that promote economic development and have a positive effect on the environment. Since 1998, the program has awarded \$379 million in grants to 89 projects across Wisconsin. These projects are having a significant impact on communities, both economically and environmentally and have thus far resulted in:

- The return of 1,100 acres of abandoned or under-used environmentally contaminated sites into clean, viable properties
- An increase of over \$607 million in taxable property values
- The creation of over 4,000 new jobs

Brownfields grants may be used for brownfields redevelopment or associated environmental remediation activities. Eligible applicants include individuals, corporations, partnerships, non-profit organizations, and local units of government. The program requires that the grant funds be used for brownfields redevelopment or associated environmental remediation activities and that the grant recipient contributes to the cost of the project.

This program can be used to create environment-related jobs in Wisconsin and, indeed, already has. For example, as discussed in Section VI.A, ANGI recently moved to a larger, completely renovated manufacturing facility in Milton that was built specifically for ANGI occupancy with aid made available by the Brownfields Grant Program.

VII.H. Business Employees' Skills Training Program

The Business Employees' Skills Training (BEST) program was established by the Wisconsin Legislature to help small businesses in industries that are facing severe labor shortages upgrade the skills of their workforce. Under the BEST program, the department provides applicants with a tuition reimbursement grant to help cover a portion of the costs associated with training employees.

Eligible applicants include small businesses that have fewer than 25 full time employees or annual sales of less than \$2.5 million, and eligible project costs are limited to tuition expenses for courses that are directly related to the employee's work requirements. The maximum funding available is 75 percent of eligible project costs, not to exceed \$1,000 per full-time employee trained and \$10,000 per business. Given the limited funds available, projects are awarded on a competitive basis.

The BEST program could be used to assist Wisconsin firms in environmental industries upgrade the skills of their workers.

VIII. SUMMARY OF MAJOR FINDINGS

This report presents information about jobs creation and the potential of the environmental industry in the state of Wisconsin, as well as background information on the jobs impact of the environmental industry in the nation as a whole. The report finds that the environmental industry is a major player in both the state and national economy, and that the direct and indirect jobs creation potential of the environmental industry is significant, multi-sectoral, under-appreciated, and could be maximized for broad socio-economic and environmental benefit.

Jobs and the National Environmental Industry

The report summarizes MISI findings on the national environmental industry. MISI research has found that over the past four decades, protection of the environment has grown rapidly to become a major sales-generating, profit-making, job-creating U.S. industry. This “industry” ranks well above those in the top of the Fortune 500, and MISI estimates that in 2003 protecting the environment generated:

- \$301 billion in total industry sales
- \$20 billion in corporate profits
- 4.97 million jobs
- \$45 billion in Federal, state, and local government tax revenues

It is likely that the environmental industry will continue to grow significantly for the foreseeable future, and MISI forecasts that in the U.S. real expenditures (2003 dollars) will increase from \$301 billion in 2003 to:

- \$357 billion in 2010
- \$398 billion in 2015
- \$442 billion in 2020

Environmental protection generates large numbers of jobs throughout all sectors of the economy and within many diverse occupations, and MISI forecasts that U.S. employment created directly and indirectly by environmental protection will increase from 4.97 million jobs in 2003 to:

- 5.39 million jobs in 2010
- 5.76 million jobs in 2015

- 6.38 million jobs in 2020

Environmental protection created nearly five million jobs in the U.S. in 2003, and these were distributed widely throughout all states and regions within the U.S. The vast majority of the jobs created by environmental protection are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc. In fact, most of the persons employed in these jobs may not even realize that they owe their livelihood to protecting the environment.

Firms working in the environmental and related areas employ a wide range of workers at all educational and skill levels and at widely differing earnings levels. Even in environmental companies, most of the employees are not classified as “environmental specialists.” Rather, most of the workers are in occupations such as laborers, clerks, bookkeepers, accountants, maintenance workers, cost estimators, engine assemblers, machinists, machine tool operators, mechanical and industrial engineers, welders, tool and die makers, mechanics, managers, purchasing agents, etc.

Jobs in Wisconsin and Wisconsin’s Environmental Industry

We found that environmental protection is a large and growing industry in Wisconsin. MISI estimates that in 2003:

- Sales of the environmental industries in Wisconsin totaled \$5.4 billion.
- The number of environment-related jobs totaled more than 97,000.
- The environmental industry in Wisconsin comprised 2.9 percent of gross state product.
- Environment-related jobs comprised 3.5 percent of Wisconsin employment.
- Wisconsin environmental industries accounted for 1.8 percent of the sales of the U.S. environmental industry.
- Environment-related jobs in Wisconsin comprised two percent of the total number of environment-related jobs in the U.S.
- Environment-related employment in the state has been increasing in recent years between one and two percent annually.

Most of the environment-related jobs in Wisconsin are in the private sector, and these are heavily concentrated in several sectors, including manufacturing, professional, scientific, and technical services, and educational services.

Environmental jobs in Wisconsin are widely distributed through all occupations and skill levels and, while the number of jobs created in different occupations varies substantially, requirements for virtually all occupations are generated by environmental spending. Thus, in Wisconsin as in the U.S. generally, the vast majority of the jobs created by environmental protection are standard jobs for all occupations.

Nevertheless, we found that, in Wisconsin, the importance of environmental protection for jobs in some occupations is much greater than for others. For some occupations, such as environmental scientists and specialists, environmental engineers, hazardous materials workers, water and liquid waste treatment plant operators, environmental science protection technicians, refuse and recyclable material collectors, and environmental engineering technicians, virtually all of the demand in Wisconsin is created by environmental protection activities. This is hardly surprising, for most of these jobs are clearly identifiable as “environmental” jobs.

However, for many occupations not traditionally identified as environment-related, a greater than proportionate share of the jobs are also generated by environmental protection. While, on average, environment-related employment in Wisconsin comprises only 3.5 percent of total employment, in 2003 environmental protection generated jobs for a greater than proportionate share of many professional, scientific, high-tech, and skilled workers in the state.

Our survey of existing environmental companies in Wisconsin revealed a wide range of firms, located throughout the state and across sectors, including manufacturing. These firms:

- Are located throughout the state, in major urban centers, suburbs, small towns, and rural areas.
- Range in size from small firms of 20 employees to large firms employing many hundreds
- Are engaged a wide variety of activities, including remediation, manufacturing, testing, monitoring, analysis, etc.
- Include some of the most sophisticated, high-tech firms in the state; for example:
 - ANGI International (Milton) is a world leader in manufacturing and distributing Compressed Natural Gas (CNG) refueling equipment for natural gas vehicles and other applications in the CNG Industry.
 - MEGTEC Systems (De Pere) is a world leader in the design, manufacture, and sales of services web handling, air flotation drying, process thermal management, and emission control systems.

- Quest Technologies Inc. (Oconomowoc) is a world leader in the design and manufacturing of occupational health, safety, and environmental instruments.
- STS Consultants (Green Bay, Madison, Milwaukee, Oshkosh, and Scofield) is one of the Midwest's major environmental engineering consulting firms providing science and engineering solutions for the constructed environment.
- North American Hydro, Inc. (Schofield and Neshkoro) is a pioneering company specializing in the hydroelectric field worldwide.

A number of these firms, including Cardinal Environmental (Sheboygan), MEGTEC Systems, Natural Resources Technology, Inc. (Pewaukee), Needland Industries (Ridgeland), North American Hydro, and STS Consultants have created significant numbers of new jobs over the past six months.

We identified a number of existing state initiatives that could be used to maximize the jobs creation benefit and potential of the environmental industry. These include the Green Tier Program, Grow Wisconsin, the Technology Zone Program, Cooperative Environmental Assistance, the Brownfields Development Program, and the Business Employees' Skills Training Program

We suggest policy options that could maximize the jobs benefits of the environmental industry in Wisconsin, with no institutional impediment. Such initiatives should be encouraged and expanded. This study demonstrates that environment-related initiatives can create substantial numbers of jobs in Wisconsin, a state that remains manufacturing oriented and seeks new ideas for employment generation, stable good jobs, and workforce development.

BIBLIOGRAPHY

"A Changing Great Lakes Economy: Economic and Environmental Linkages, State of the Lakes Ecosystem Conference. August 1995, www.epa.gov.

Allison, G. *Are Jobs Really the Price of a Clean Environment?* Washington, D.C., League of Women Voters, 1977.

American Council for an Energy Efficient Economy. *Energy Innovations: A Prosperous Path to a Clean Environment*, July 1997.

American Federation of State, County, and Municipal Employees. *Thinking Creatively About Welfare-To-Work Job Creation*. Washington, DC, July 1998.

American Petroleum Institute. *A Reconstruction and Reconciliation of Administration Estimates*, July 1998.

Arnold, Frank S. *Environmental Protection: Is it Bad for the Economy? A Non-Technical Summary of the Literature*. EPA Economy and Environment, July 10, 1999.

Australian Conservation Foundation, Australian Council of Trade Unions, and the Commonwealth Department of Employment, Education, and Training. *Green Jobs in Industry -- Research Report*. Melbourne, May 1994.

Baily, Wallace K. "Local Area Personal Income, 1982-97." *Survey of Current Business*, May 1999, pp. 50-67.

Banzhaf, Spencer. "Accounting for the Environment," *Resources*, Issue 151 (Summer 2003), pp. 6-10.

Barnow, Burt. *The U.S. Experience with Public Service Employment Programs*. Johns Hopkins University Institute for Policy Studies, Baltimore, MD, September 1994.

Bartch, Charlie and Christine Anderson. *Matrix of Brownfield Programs by State*. Northeast-Midwest Institute, September 1998.

Berman, Eli and Linda Bui. *Clearing the Air: The Impact of Air Quality Regulations on Jobs*. Economic Policy Institute Study, 1997.

Bezdek, Roger H. "The Environmental Protection Industry and Environmental Jobs in the U.S.A.," in Leal Filho and Kate Crowley, eds., *Environmental Careers, Environmental Employment, and Environmental Training: International Approaches and Contexts*. Frankfurt am Main: Peter Lang Publishers, pp. 161-179, 2001.

_____. "State of the Industry: Jobs and Sales Created by Environmental Protection." *New England's Environment*. Vol. 1, No. 8 (August 1999), pp. 12-16.

_____. "The Net Impact of Environmental Protection on Jobs and the Economy." Chapter 7 in Bunyan Bryant, editor., *Environmental Justice: Issues, Policies, and Solutions*, Washington, D.C.: Island Press, 1995, pp. 86-105.

_____. "The Economy, Jobs, and the Environment." *Proceedings of GEMI '95: Environment and Sustainable Development*, Arlington, Virginia, March 1995, pp. 65-79.

_____. "Environmental Protection: A Recession-Proof Industry?" *Virginia's Environment*, February 1994, pp. 10-16.

_____. "Environment and Economy: What's the Bottom Line?" *Environment*, Vol. 35, No. 7 (September 1993), pp. 7-32.

_____. "The Economic and Employment Effects of Investments in Pollution Abatement and Control Technologies." *Ambio*, Vol. XVIII, no.3, (1989), pp. 274-279.

_____, and Robert M. Wendling. "Potential Long-term Impacts of Changes in U.S. Vehicle Fuel Efficiency Standards." *Energy Policy*, Vol. 33, No. 3, pp. 407-419.

_____, "Acid Rain Abatement: Costs and Benefits." *International Journal of Management Science*, Vol. 17, No. 3 (1989), pp. 251-261.

Blodgett, John E. "Environmental Protection: How Much It Costs and Who Pays," *Congressional Research Service Report for Congress*, No. 97-459 ENR, April 1997.

Blanchard, Brenda J. *Department of Commerce, Energy and Economic Development*, 2004, www.commerce.state.wi.us.

"Brownfields Redevelopment Provisions in the State Budget: WEDA & Commerce Working to Enhance Grant Program." Wisconsin Economic Development Association *WEDAWIRE*, Fall 1999.

The Bryson Interdisciplinary Climate, People and Environment Program. www.ccr.aos.wisc.edu.

California State Department of Conservation. *Green Business: Growing Jobs and Profits*. Sacramento, CA, July 1995.

Campbell, M. and W. Glenn. *Profit From Pollution Prevention*. Toronto: Pollution Probe, 1982.

Clark, Lyman. *The Environmental Industry in the United States*. Report to the Economic Analysis and Research Branch, Office of Regulatory Management and Evaluation, Environmental Protection Agency, Washington, D.C., January 1991.

Cropper, Maureen L. and Wallace E. Oates,. "Environmental Economics: A Survey." *Journal of Economic Literature*, Vol. 30, No. 2 (June 1992), pp. 12-36.

Current Developments, State Conservationist Message, February, 2001, www.info.usda.gov.

Darmstadter, Joel. "Greening the GDP: Is It Desirable? Is It Feasible?," *Resources*, Issue 135 (Spring 2000), pp.11-15.

Department of Workforce Development, Individual Training Accounts. www.dwd.state.wi.us.

DiPerna, Paula. *Creating Jobs and Sustainable Livelihoods Through Agenda 21 and Other Environmental Policies: A Critical Catalyst for Implementation*. Report Prepared for UNDP, October 1997.

DRI. "Potential Benefits of Integration of Environmental and Economic Policies: An Incentive-Based Approach to Policy Integration." Report prepared for the Commission of the European Communities, Luxembourg, 1994.

Duff, Marc. "New Federal Air Pollution Proposals Troubling," www.legis.state.wi.us.

ECOTEC. "The Employment Impact of Environmental Policies." Discussion Paper No. 2 in the series "Sustainability, Employment, and Growth," ECOTEC, Birmingham, England, 1993.

Electronic Industries Alliance, International Cooperative for Environmental Leadership, and World Resources Institute. *Taking a Byte Out of Carbon: Electronics Innovation for Climate Protection*, July 1998.

Employment Research Associates. *Biomass Resources: Generating Jobs and Energy*. Great Lakes Regional Biomass Energy Program, September 30, 1999.

Environmental Activism Conference at Northwestern University, January 11, 1999. www.great-lakes.net.

Environmental Education Works for Wisconsin. *Welcome to the EE Works for Wisconsin Web Site*, www.uwsp.edu.

Environmental Law & Policy Center. *About the Environmental Law & Policy Center*, www.elpc.org.

Environmental Law Institute. *Barriers to Environmental Technology Innovation and Use*. ELI Research Report, February 2000.

_____. *Innovation, Cost, and Environmental Regulation: Perspectives on Business, Policy and Legal Factors Affecting the Cost of Compliance*. Environmental Law Institute, May 1999.

Great Lakes Information Network. *Economy of the Great Lakes Region*. February 22, 2001, www.great-lakes.net.

Greenwald, Judith M. *Labor and Climate Change: Getting the Best Deal for American Workers*. Progressive Policy Institute, October 1998.

Green Jobs Project. *Environment and Employment in Spain*. Spanish Report, April 1998.

Goodstein, E.B. "Jobs or the Environment? No Trade-off." *Challenge* (January-February 1995), pp. 41-45.

_____. *Jobs and the Environment: The Myth of a National Trade-Off*. Economic Policy Institute, Washington, D.C., 1994.

Governor's Task Force on energy Efficiency and Renewables. "Work Group Recommendations for Energy Efficiency Framework." Madison, Wisconsin, July 9, 2004.

Hass, Joanne M. "Green Tier on Fast Track." WisPolitics.com. March 18, 2003.

Hoerner, J. Andrew, Alan Miller, and Frank Muller. "Promoting Growth and Job Creation through Emerging Environmental Technologies." *Global Change* (Electronic Edition), April 1995.

Interlaboratory Working Group on Energy-Efficient and Low-Carbon Technologies. *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond*. Washington, D.C.: U.S. Department of Energy, 1997.

International Institute for Sustainable Development. *Making Budgets Green: Leading Practices in Taxation and Subsidy Reform*. Winnipeg, 1994.

International Labour Office. *Employment and Training Implications of Environmental Policies in Europe*. ETIEPE, Geneva, 1989.

Jacobs, M. *Green Jobs? The Employment Implications of Environmental Policy*. WWF Report, Lancaster/Brussels, 1994.

Jaffe, A.B., Peterson, S.R., Portney, P.R., and R.N. Stavins. "Environmental Regulation and the Competitiveness of US Manufacturing." *Journal of Economic Literature*. Vol. XXXIII (March 1995), pp. 132-163.

Jorgenson, Dale, Richard Goettle, Daniel Gaynor, Peter Wilcoxon, and Daniel Slesnick. *The Clean Air Act and the U.S. Economy: Final Report of Results and Findings*. Environmental Economics Report Inventory, August 27, 1993.

_____, and Peter Wilcoxon, "Environmental Regulation and U.S.. Economic Growth." *RAND Journal of Economics*, Vol. 21, No. 2, Summer 1990, pp. 153-167.

Laitner, Skip, John DeCicco, Neal Elliott, Howarfd Geller, Marshall Goldberg, Robert Morris, and Steven Nadel. *Energy Efficiency and Economic Development in the Midwest*. American Council for an Energy-Efficient Economy, April 1995.

Management Information Services, Inc. *Jobs in the Environmental Industry in Michigan and the United States*. Report prepared for the Building Diagnostics Research Institute, July 2004.

_____. *Jobs in the Environmental Industry in Ohio and the United States*. Report prepared for the Building Diagnostics Research Institute, May 2004.

Survey of Jobs and the Environment Issues in Six Midwestern States: Identifying Policy Challenges and Opportunities. Report prepared for the Joyce Foundation, Chicago, Illinois, July 2001.

_____. *Assessing The Impact Of Environmental Protection On Job Creation, Protection, And Enhancement, And On Workforce Development And Training For The Poor, Underemployed, And Unemployed In Indiana*. Report prepared for the Joyce Foundation, July 2000.

_____. *Federal Subsidies and Incentives for the Energy Industries*. September 1998.

_____. *Costs Incurred by Electric Utility Companies Due to Federal Air Pollution Control Requirements*. Report prepared for the Edison Electric Institute, 1996.

_____. *Anticipating the Labor Markets of the 21st Century*. Report prepared for the American Management Association, 1994.

_____. *Potential Economic and Employment Impact on the U.S. Economy of Increased Exports of Environmental and Energy Efficiency Technologies Under NAFTA*. Report prepared for the White House, 1993.

_____. *Environment and Employment in Canada: Final Report of the Symposium*. Prepared for the Canada Employment and Immigration Advisory Council, 1992.

_____. *The Net Costs and Benefits to Each State and to the Nation of Acid Rain Abatement Legislation*. 1987.

_____. *Simulation of the Economic Impact of Pollution Abatement and Control Investments: Methodology, Data Base, and Detailed Estimates*. 1986.

_____. *Economic and Employment Benefits of Investments in Environmental Protection*. 1986.

_____, and 20/20 Vision. *Fuel Standards and Jobs: Economic, Employment, Energy, and Environmental Impacts of Increased CAFE Standards Through 2020*. Report prepared for the Energy Foundation, San Francisco, California, July 2002.

Morgenstern, Richard D., William A. Pizer, and Jih-Shyang Shih. *Are We Overestimating the Real Economic Costs of Environmental Protection?* Resources for the Future Discussion Paper 97-36-REV, June 1997.

"Nine Wisconsin Counties Receive Failing Grades for Air Pollution." May 23, 2000, www.jsonline.com.

Office of the Governor. "Executive Order #25, Relating to the Creation of The Governor's Task Force on Energy Efficiency and Renewables." September 30, 2003.

_____. "Governor Doyle Says Unanimous Task Force Recommendations Will Provide Balance to State's Energy Policy." July 20, 2004

_____. *Grow Wisconsin*. September 10, 2003.

Organization for Economic Cooperation and Development. *Environmental Policies and Employment*. Paris, 1997

Priorities for State Funding. www.taxpayfedil.org.

Proceedings of the Conference on Cost, Innovation, and Environmental Regulation: A Research and Policy Update. Environmental Economics Report Inventory, June 1, 1999.

Regional Economics Applications Laboratory. *Job Jolt: The Economic Impacts of Repowering the Midwest*. University of Illinois, Chicago, 2002.

Renner, M. *Jobs in a Sustainable Economy*. Worldwatch Paper 104. Washington, D.C.: Worldwatch Institute, 1991.

Repowering the Midwest: The Clean Energy Development Plan for the Heartland. Environmental Law and Policy Center, Chicago, February 2001.

Resource Data International. *The Economic Risks of Reducing the U.S. Electricity Supply*, November 1997.

_____. *Energy Choices in a Competitive Era: The Role of Renewable and Traditional Energy Resources in America's Electric Generation Mix*. April 1995.

The Scout Report for Business Economics. Volume 4, Number 14, March 22, 2001, www.scouts.cs.wisc.edu.

Tellus Institute. *America's Global Warming Solutions*, August 1999.

Thompson, John D. *A Study Evaluating the Impacts of Increasing Wisconsin's Renewable Portfolio Standard*. Final report prepared by the University of Wisconsin – Madison for the Wisconsin Department of Administration, Division of Energy, 2004.

Torinus, John. "Freeing Companies From Bureaucracy Would Spur Growth." *Milwaukee Journal Sentinel*. February, 23, 2003.

United Nations, European Commission, International Monetary Fund, Organization for Economic Co-operation and Development, and World Bank. *Integrated Environmental and Economic Accounting 2003, A Handbook of National Accounting*, 2003.

Unofficial Text from Update Database of 1999-2000 Wisconsin Statutes and Annotations. www.legis.state.wi.us.

U.S. Congressional Budget Office. *Environmental Regulation and Economic Efficiency*. Washington, D.C., 1985.

U.S. Department of Commerce, Bureau of the Census. *Statistical Abstract of the United States*. 2004.

_____. *County Business Patterns*. Annual Series, 2004.

_____. *Survey of Environmental Products and Services*. February 1998.

_____. *Population Projections: States: 1995 – 2025*. 1998.

_____. *Current Population Reports*. Various issues.

_____. *Current Population Survey, Annual Demographic Study*. Annually.

_____. *Pollution Abatement Cost and Expenditures: 1999*. MA200(99), November 2002.

U.S. Department of Commerce, Bureau of Economic Analysis. *State Personal Income, Quarterly Series*. 2004.

_____. *Gross State Product*, Annual Series. 2004.

U.S. Department of Commerce, Office of Technology Policy. *Meeting The Challenge: U.S. Industry Faces the 21st Century - The U.S. Environmental Industry*. September 1998.

U.S. Department of Energy. *The Jobs Connection: Energy Use and Local Economic Development*, www.eren.doe.gov.

U.S. Department of Energy. *U.S. Carbon Reductions by 2010 and Beyond: The Potential Impact of Energy-Efficient and Low-Carbon Technologies*. September 1997.

U.S. Department of Labor, Bureau of Labor Statistics. *Employment and Wages, Annual Series, 2004*.

_____. *Local Area Unemployment Statistics. Monthly Series, 2004*.

_____. *Occupational Employment and Wage Estimates. Annual Series, 2004*.

_____. *State and Area Employment, Hours, and Earnings. Monthly Series, 2004*.

U.S. Environmental Protection Agency. *The Benefits and Costs of the Clean Air Act, 1970 to 1990*. Report prepared for the U.S. Congress, October 1997.

U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation. *Environmental Investments: The Cost of a Clean Environment*. EPA-230-11-90-083, November 1990.

U.S. Office of Technology Assessment. *Industry, Technology, and the Environment: Competitive Challenges and Business Opportunities*. OTA-ITE-586, U.S.GPO, Washington, DC, 1994.

Wagner, Gernot. "The Political Economy of Greening the National Income Accounts," *AERE Newsletter*, Association of Environmental and Resource Economists, Vol. 21, No. 1 (May 2001), pp.14-18.

WEFA, Inc. *Global Warming: The High Cost of the Kyoto Protocol*, June 1998.

Wisconsin Department of Commerce. www.commerce.state.wi.us.

_____. "Brownfields Grant Program." 2004

_____. "Brownfields Grant Program: Wisconsin, the Land, Its People." 2004

_____. *Business Employees' Skills Training (BEST) Program*. 2004.

_____. "Frequently Asked Questions About Wisconsin's Technology Zones." 2004.

_____. "Wisconsin Technology Zone Program." 2004

Wisconsin Department of Employment Relations. *Employment Opportunities*. www.jobs.der.state.wi.us.

Wisconsin Department of Natural Resources. www.dnr.state.wi.us.

_____. *Community Financial Assistance*. <http://dnr.wi.gov>.

_____. *The Environmental Cooperation Pilot Program: 2003 Progress Report*. October 31, 2003

_____. "Green Tier: Frequently Asked Questions." 2004.

_____. *Pollution Prevention Success Stories*, www.dnr.state.wi.us.

_____. *Pollution Prevention Week, February 28, 2001*, www.dnr.state.wi.us.

_____. "Wisconsin-Bavaria Regulatory Reform Working Partnership." 2003.

Wisconsin Department of Workforce Development. *WI Labor Market Information*. www.dwd.state.wi.us.

_____. "Wisconsin Conservation Corps." August 13, 2003.

Wisconsin Housing and Economic Development Authority. www.wheda.com

Wisconsin Labor and Industry Review Commission. www.dwd.state.wi.us.

Wisconsin Wildlife Federation. "WWF Dates for 2001 to Remember," www.execpc.com. *Workforce Development*. www.dted.state.mn.us.

World Resources Institute. *U.S. Competitiveness is Not at Risk in the Climate Negotiations*. October 1997.

APPENDIX: U.S. COMMERCE DEPARTMENT ESTIMATES OF THE ENVIRONMENTAL INDUSTRY IN WISCONSIN

There are two historical sources of information about the environmental industry in Wisconsin. Unfortunately, they only address certain segments of the industry, do not focus on jobs, and were conducted for 1999. These are briefly summarized below.

International Trade Administration

One estimate of the size of the environmental industry is available through the U.S. Department of Commerce.¹⁰ The Department's International Trade Administration (ITA), Office of Environmental Technologies Industries estimated, for 1999, the world market for environmental products and services and the size of the U.S. market, including estimates at the state and metropolitan statistical area levels. In this example of environmental accounting, the environmental industry is defined to include:

- Environmental-related services
 - Environmental testing and analytical services
 - Wastewater treatment works
 - Solid waste management
 - Hazardous waste management
 - Remediation/Industrial services
 - Consulting and engineering

- Environmental equipment
 - Water equipment and chemicals
 - Water equipment and chemicals
 - Instruments and information systems
 - Air pollution control equipment
 - Waste management equipment
 - Process and prevention technology;

- Environmental resources:
 - Water utilities
 - Resource recovery
 - Environmental energy sources.

ITA estimated that the 1999 U.S. environmental market totaled \$189 billion, almost 38 percent of the global \$499 billion market. In meeting the demands of those markets, the U.S. environmental industry was estimated to have generated \$196 billion

¹⁰See U.S. Department of Commerce, International Trade Administration, Office of Environmental Technologies Industries, *Environmental Industry of the United States*, a USDOC/ITA web-accessible briefing generated by Environmental Business International, Inc. for 1999.

of revenues. ITA also estimated the U.S environmental trade balance for 1999. It estimated that the U.S. exported \$21 billion worth of environmental products and services and imported \$14 billion, thus generating a positive net U.S. exports balance of just over \$7 billion in environmental-related goods and services.

The ITA U.S. industry estimates were disaggregated by state, and Table A.1 lists the estimated industry revenues, jobs, the number of companies, and the exports of the industry in Wisconsin. The ITA estimated that, in 1999, Wisconsin accounted for about 2.1 percent of the U.S. industry, and that the number of environmental jobs in the state totaled more than 29,000.

Table A.1
U.S. Department of Commerce Estimates
of the U.S. and Wisconsin Environmental Industries, 1999

		Wisconsin	U.S.	Wisconsin Share of U.S.
Revenues	(millions)	\$4,116	\$196,465	2.1%
Jobs	(number)	29,405	1,389,638	2.1%
Companies	(number)	2,888	115,030	2.5%
Exports	(millions)	\$605	\$21,310	2.8%

Source: U.S. Department of Commerce (ITA) and Environmental Business International; 1999.

The ITA report disaggregated the Wisconsin industry by metropolitan statistical area (MSA) – see Table A.2. In Wisconsin, this consisted of the Milwaukee-Waukesha MSA. Milwaukee-Waukesha accounted for about 28 percent of the industry in the state and almost 8,200 environmental-related jobs.

Table A.2
U.S. Department of Commerce Estimates of the Wisconsin
Environmental Industry by Metropolitan Statistical Areas, 1999

		Milwaukee- Waukesha WI
Revenues	(millions)	\$1,146.6
Jobs	(number)	8,190
Companies	(number)	804
Exports	(millions)	\$169
MSA Average Share of Wisconsin		28%

Source: U.S. Department of Commerce (ITA) and Environmental Business International; 1999.

Census Bureau -- Pollution Abatement Costs and Expenditures (PACE)

The Census MA200 survey has been one of the more respected sources for information on the U.S. environmental industry.¹¹ This report was not available for a number of years after 1994, but was revived for the year 1999. The results of the survey are not consistent with previous reports for a number of reasons, but they do present a snapshot of major portions of the environmental industry with information available by detailed North American Industry Classification System (NAICS) industry and geographically, by state. However, the survey's biggest weakness is that it only covers the mining (NAICS 21), manufacturing (NAICS 31-33), and electric power generation industries (NAICS 22111). Clearly, the U.S. agricultural, services, transportation, and government sectors have pollution abatement costs and expenditures that contribute to and help define the U.S. environmental industry, but they are not included in the PACE survey. Therefore, while the survey estimates are of sufficient quality, they lack comprehensiveness and describe only a small fraction of the environmentally-related business activities in the U.S.

Table A.3. lists the pertinent information for Wisconsin and the United States from the most recent survey, for 1999. Pollution abatement costs in these selected Wisconsin industries included over \$163 million of capital expenditures and nearly \$200 million for operating costs. Together with \$109 million in operating costs for disposal and recycling activities and other categories of economic activity, the PACE estimates for Wisconsin in 1999 totaled nearly \$600 million. This represented two percent of the overall PACE estimates in the United States.

¹¹See U.S. Department of Commerce, Economic and Statistics Administration, Census Bureau, *Pollution Abatement Cost and Expenditures: 1999, MA200(99)*, November 2002.

Table A.3
Pollution Abatement Costs and Expenditures Estimates for Wisconsin
and the U.S. From the Census MA200 Survey, 1999
(million dollars, except where noted)

	Wisconsin		U.S.		Wisconsin Share of U.S.	
Pollution abatement						
Capital expenditures	163.1		5,809.9		2.8%	
Non-hazardous		154.1		4,497.8		3.4%
Hazardous		9.0		1,312.0		0.7%
Air	30.0		3,463.7		0.9%	
Non-hazardous		23.1		2,644.7		0.9%
Hazardous		6.9		819.0		0.8%
Water	85.4		1,801.9		4.7%	
Non-hazardous		83.8		1,488.2		5.6%
Hazardous		1.6		313.7		0.5%
Solid Waste	2.7		361.9		0.7%	
Non-hazardous		2.3		245.5		0.9%
Hazardous		0.4		116.4		0.3%
Multimedia	45.0		182.3		24.7%	
Non-hazardous		45.0		119.4		37.7%
Hazardous		-		62.9		-
Operating Costs	196.0		11,864.4		1.7%	
Non-hazardous		166.0		8,924.9		1.9%
Hazardous		30.0		2,939.5		1.0%
Air	36.8		5,069.1		0.7%	
Non-hazardous		30.2		3,941.2		0.8%
Hazardous		6.6		1,127.9		0.6%
Water	83.6		4,586.5		1.8%	
Non-hazardous		75.3		3,511.8		2.1%
Hazardous		8.2		1,074.6		0.8%
Solid Waste	49.2		2,013.3		2.4%	
Non-hazardous		39.6		1,320.4		3.0%
Hazardous		9.6		692.9		1.4%
Multimedia	26.4		195.5		13.5%	
Non-hazardous		20.8		151.5		13.7%
Hazardous		5.6		44.0		12.7%
Disposal and recycling						
Capital expenditures	13.5		398.7		3.4%	
Disposal	3.6		267.2		1.3%	
Non-hazardous		3.0		218.0		1.4%
Hazardous		0.7		49.2		1.4%
Recycling	9.8		131.5		7.5%	
Operating costs	109.0		4,923.6		2.2%	
Disposal	88.3		3,680.9		2.4%	
Non-hazardous		64.5		2,466.2		2.6%
Hazardous		23.8		1,214.7		2.0%
Recycling	20.7		1,242.7		1.7%	

(continued)

Table A.3 (Continued)
Pollution Abatement Costs and Expenditures Estimates for Wisconsin
and the U.S. From the Census MA200 Survey, 1999
(million dollars, except where noted)

	Wisconsin	U.S.	Wisconsin Share of U.S.
Pollution prevention	25.5	2,767.9	0.9%
Other expenditures	71.1	3,154.5	2.3%
Site cleanup	40.2	1,039.3	3.9%
Remediation	22.1	827.3	2.7%
Replacement	12.5	83.1	15.0%
Other	5.6	128.8	4.3%
Habitat protection	0.2	155.2	0.1%
Monitoring/testing	9.6	599.5	1.6%
Administration	21.0	1,360.4	1.5%
Other payments			
Payments to government	20.6	959.1	2.1%
Permits/fees	19.8	816.6	2.4%
Fines/penalties/charges	0.4	116.3	0.3%
Other	0.4	26.2	1.5%
Tradeable permits - bought	-	20.2	-
Tradeable permits - sold	-	23.7	-
Tradeable permits - other	-	12.6	-
Total	598.8	29,934.6	2.0%

Source: U.S. Department of Commerce (ESA/Census Bureau), 2002.

ABOUT THE JOBS AND ENVIRONMENT INITIATIVE

The Jobs and Environment Initiative, founded in 2004 by Paula DiPerna, is a pilot program of research, policy analysis and public education. The objective of the Initiative is to examine and demonstrate the links between jobs creation in all sectors of economic activity, including manufacturing, and all aspects of environmental management. The Initiative seeks to describe and analyze current jobs benefits of environmental investment and stewardship; bring further public and policy attention to the strength and scope of the environmental industry; examine potential for further jobs creation; highlight policy opportunities, and improve understanding of the positive contributions of environmental management to economic growth and employment generation, at the local, state, regional, national and international levels. The Initiative conducts state-based and national reports and other inquiries, and is a collaboration between Management Information Services, Inc. (www.misi-net.com) and the Building Diagnostics Research Institute (www.buildingdiagnostics.org). For information contact Paula DiPerna at 607-547-8356

ABOUT MANAGEMENT INFORMATION SERVICES, INC.

Management Information Services, Inc. (MISI) is an economic research firm with expertise on a wide range of complex issues, including energy, electricity, and the environment. The MISI staff offers expertise in economics, information technology, engineering, and finance, and includes former senior officials from private industry, federal and state government, and academia. Over the past two decades MISI has conducted extensive proprietary research, and since 1985 has assisted hundreds of clients, including Fortune 500 companies, nonprofit organizations and foundations, academic and research institutions, and state and federal government agencies including the National Academy of Sciences, the U.S. Department of Energy, the U.S. Environmental Protection Agency, the Department of Defense, and the Energy Information Administration.

For more information, please visit the MISI web site at www.misi-net.com.

ABOUT THE BUILDING DIAGNOSTICS RESEARCH INSTITUTE

The Building Diagnostics Research Institute, Inc. (BDRI) is a Section 501(c)(3) not-for-profit organization dedicated to providing the highest level of research, education and training, and public outreach on issues related to the effects of building performance on health, safety, security, and productivity. The Institute's mission is to leverage more than 25 years of building diagnostics experience in order to enhance health, safety, security, and productivity, and it is implemented by conducting basic and applied research, providing education and training for health and building professionals, disseminating knowledge, and serving as an advocate for the general public. BDRI's

basic and applied research, its education and training, and its public outreach are carried out by an interdisciplinary team of staff and external scientists and professionals representing a variety of disciplines, including chemistry, industrial hygiene, engineering, microbiology, and law and public policy.

For more information, please visit the BDRI web site at www.buildingdiagnostics.org.

BIOGRAPHICAL INFORMATION

Paula DiPerna, founder of the Jobs and Environment Initiative, served formerly as President of the Joyce Foundation, and Vice-President for International Affairs for the Cousteau Society and is a widely published author and public policy analyst.

Roger H. Bezdek, Ph.D., is President of Management Information Services, Inc. He has 30 years experience in consulting and management in the environmental, energy, economic forecasting, and regulatory areas, serving in private industry, academia, and the Federal government. He has served as a consultant to the White House, Federal and state government agencies, environmental organizations, and various corporations and research organizations. Dr. Bezdek, is an internationally recognized expert in economic forecasting and environmental analysis, and is the author of four books and of 200 articles in scientific and technical journals. He received his Ph.D. in Economics from the University of Illinois (Urbana).

Robert M. Wendling is Vice President of Management Information Services, Inc. He has 28 years experience in consulting and management in the energy, environmental, statistical/econometric modeling, and regulatory areas. He has served in industry as corporate CEO and president and as corporate vice president and in senior positions in the U.S. Department of Commerce and the Department of Energy. He is the author of 75 reports and professional publications on energy and environmental topics and lectures frequently on various energy, forecasting, regulatory, and economic modeling topics. He received an M.A. in Economics from George Washington University.

James E. Woods, Ph.D. is CEO of the Building Diagnostics Research Institute. He has 35 years experience in management and consulting in the environmental industry, serving in academia, industry, and as an advisor to DOE, EPA, NIST, and the National Academy of Sciences. He has extensive experience in end-use demand in the residential, commercial, and industrial sectors, environmental factors, and energy modeling, has managed 20 large scale energy and environmental research projects, and is the founder of the Building Diagnostics Research Institute. He received a Ph.D. in Mechanical Engineering from Kansas State University.