

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

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This report is a project of the Jobs and Environment Initiative, a pilot program of research, policy analysis and public education. The Michigan 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 are available on the above websites.

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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 Michigan, 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 Michigan 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 Michigan in 2003
- Estimates the jobs created in Michigan 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 Michigan, 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 Michigan
- Discusses how encouraging environmental and related industries in Michigan 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 Michigan, and MISI estimates that in 2003:

- Sales due to environmental industries in Michigan totaled \$12.9 billion
- The number of environment-related jobs in the state totaled nearly 217,000
- The environmental industry in Michigan generated 3.9 percent of gross state product
- Environment-related jobs comprised 4.9 percent of total Michigan employment

- Michigan environmental industries generated 4.3 percent of the sales of the U.S. environmental industry
- With 3.4 percent of the nation's population, employment earnings in the Michigan manufacturing sector account for six percent of manufacturing earnings nationally.
- Environment-related jobs in Michigan comprised 4.4 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 Michigan 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 Michigan

Environmental jobs in Michigan are widely distributed through all occupations and skill levels, and requirements for virtually all occupations are generated by environmental expenditures. Thus, in Michigan 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 Michigan, 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 Michigan 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 Michigan comprises only 4.9 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 Michigan 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 25 employees to large firms employing thousands; 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 Michigan has been consistently losing jobs, especially in manufacturing.

Salience of the Jobs-Environment Link in Michigan 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 Michigan -- 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 Michigan are concentrated within a number of sectors, including manufacturing and professional, scientific, and technical services. This is significant because Michigan is one of the most manufacturing-intensive states 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 Michigan’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 Michigan – 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 Michigan -- 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 Michigan based on attracting and retaining professional, scientific, technical, high-skilled, well paying jobs, including manufacturing jobs. There is no inherent institutional impediment in Michigan 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 Michigan economy and labor market
- Chapter V -- Size, employment, and industrial and occupational composition of the environmental industry in Michigan
- Chapter VI – Profiles of typical environmental firms in the state
- Chapter VII -- Michigan 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 Michigan in 2003
- Estimate the jobs created in Michigan 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 Michigan, 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 Michigan

- Discuss how encouraging environment and related industries in Michigan 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 Michigan -- 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

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 14,000 more jobs in Michigan 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 (54,500) in Michigan. See Management 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.

eight percent per year over the period. This compares with an average annual rate of 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 Michigan that produces scrubbers for coal-fired power plants in adjacent Indiana? It seems clear that the jobs in the Michigan factory should be considered green or environmental jobs, even though the user of the scrubbers in Indiana may cause pollution in Michigan.

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).

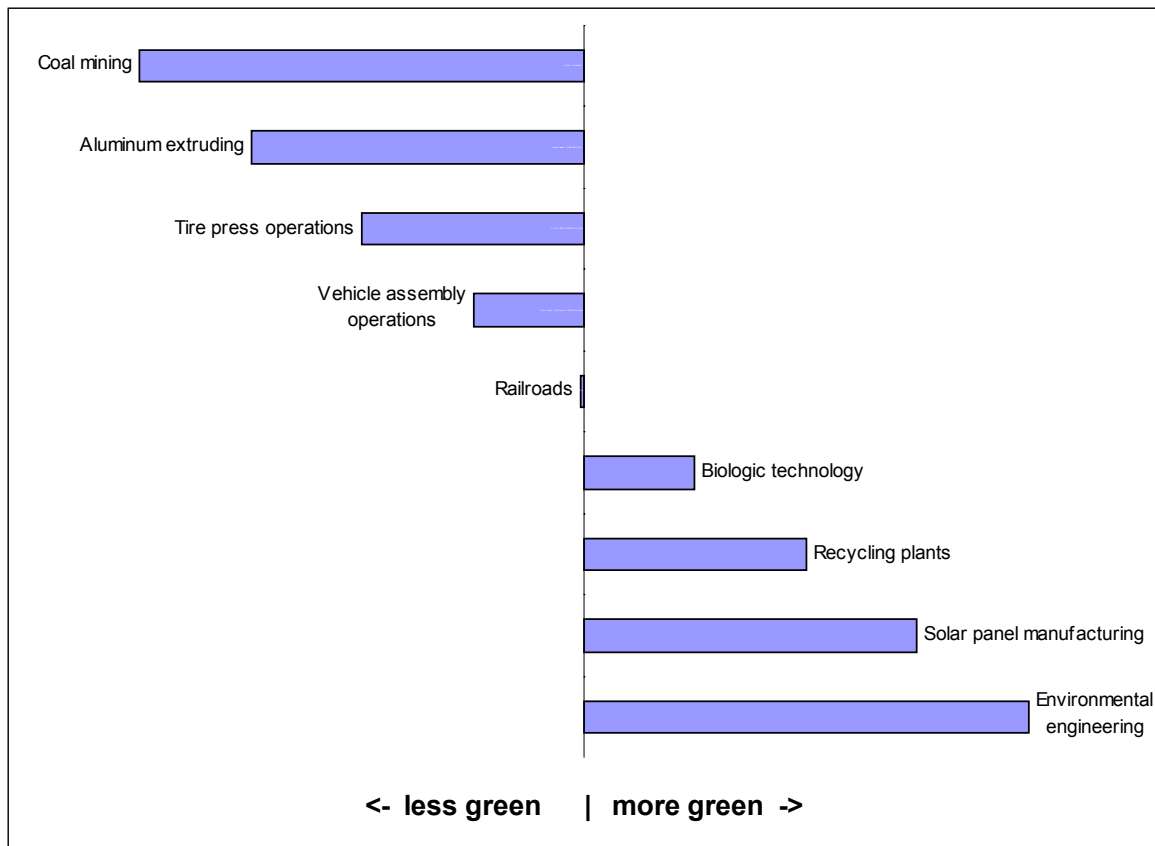
Using the spectrum concept, MISI defines environmental industries and green jobs as those which, as a result of environmental pressures and concerns, have produced the development of numerous products, processes, and services, which specifically target the reduction of environmental impact. Environment-related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

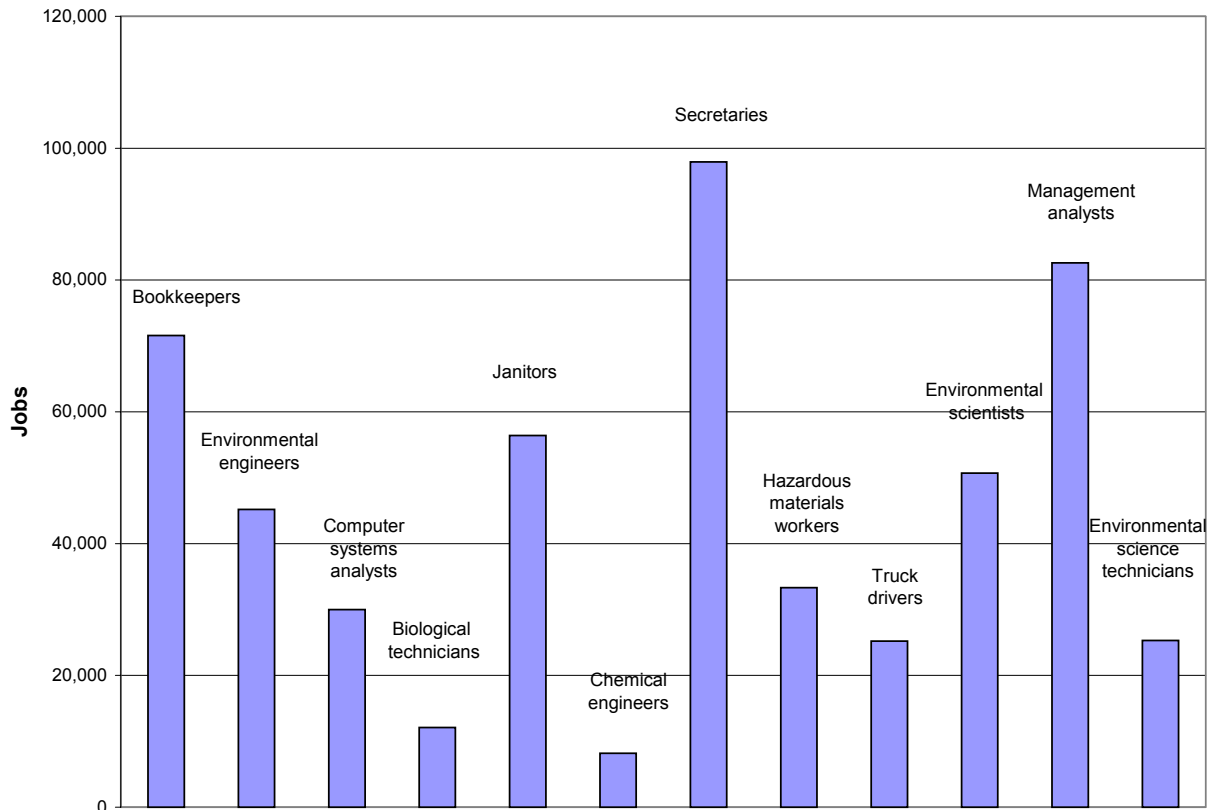


Source: Management Information Services, Inc., 2004.

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 MICHIGAN ECONOMY IN 2003

The Michigan economy continued its growth trend in 2003. Personal income rose an average of two percent annually from 2001 to 2003 and gross state product steadily increased over the period and reached an estimated \$333 billion by 2003, representing 3.8 percent of the U.S. economy. Population over the 2000 to 2003 period grew at a modest rate of just over one percent per year, slightly half of the overall U.S. rate. In 2001 the population reached and surpassed the 10 million-level and Michigan remains the 8th largest state based on population, with 3.4 percent of the total U.S. population.

The civilian labor force grew by 78,000 during 2003, reaching a high mark of 5,076,000, but not fully recovering to the state all-time labor force size of 5,204,000 recorded in 2000. State employment did not match the growth in the labor force in 2003, staying level at around 4,670,000, so the Michigan unemployment rate rose steadily through the year, rising from 6.6 percent to 7.6 percent. Michigan mirrored the national trend of very visible and high productivity growth from 2000 to 2003 as the economy grew, but with less labor input.

Michigan holds the 4th largest high-tech employment ranking in the country. With over 900,000 people in Michigan directly employed in advanced manufacturing, over 568,000 employed in high-tech positions, and graduating over 4,000 engineering students per year, Michigan's workforce remains a leader in the country.

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

- With 3.4 percent of the nation's population, employment earnings in the Michigan manufacturing sector account for almost six percent of manufacturing earnings nationally.
- More important, almost 20 percent of every dollar earned in the state is earned by employees in the manufacturing sector – compared to 12 percent nationally.
- The Michigan/U.S. index for manufacturing is 164, much higher than for any other sector.

Manufacturing is thus the linchpin of the Michigan economy, and Michigan 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 13 percent. The third largest sector is health care and social assistance.

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

	Michigan (mill.\$)	Michigan Share of U.S.	Michigan Share of Earnings	U.S. Share of Earnings	Michigan Index
Personal Income	312,266	3.4%	-	-	-
Agriculture, Forestry, Fishing and Hunting	930	1.2%	0.4%	1.2%	33
Mining	671	1.2%	0.3%	0.8%	34
Utilities	3,080	4.4%	1.3%	1.1%	120
Construction	13,039	3.2%	5.4%	6.2%	87
Manufacturing	47,783	6.0%	19.8%	12.1%	164
Wholesale Trade	10,818	3.2%	4.5%	5.1%	87
Retail Trade	14,421	3.3%	6.0%	6.8%	88
Transportation and Warehousing	5,877	2.8%	2.4%	3.2%	77
Information	5,260	2.0%	2.2%	4.1%	54
Finance and Insurance	10,315	2.1%	4.3%	7.6%	56
Real Estate and Rental and Leasing	2,910	2.3%	1.2%	1.9%	64
Professional, Scientific, and Technical Services	20,967	3.6%	8.7%	8.9%	97
Management of Companies and Enterprises	6,391	4.7%	2.6%	2.1%	127
Administrative/Support/Waste Management/Remediation Services	9,450	3.8%	3.9%	3.8%	103
Educational Services	1,699	1.9%	0.7%	1.4%	50
Health Care and Social Assistance	21,389	3.4%	8.9%	9.7%	92
Arts, Entertainment, and Recreation	2,163	2.8%	0.9%	1.2%	75
Accommodation and Food Services	5,363	2.5%	2.2%	3.3%	68
Other Services	5,525	3.0%	2.3%	2.8%	82
Public Administration	31,353	2.8%	13.0%	16.9%	77

Source: Management Information Services, Inc., 2004.

V. THE ENVIRONMENTAL INDUSTRY AND JOBS IN MICHIGAN

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

MISI estimates that in 2003:

- Sales of the environmental industries in Michigan totaled \$12.9 billion.
- The number of environment-related jobs totaled nearly 217,000.
- The environmental industry in Michigan comprised 3.9 percent of gross state product.
- Environment-related jobs comprised 4.9 percent of Michigan employment.
- Michigan environmental industries accounted for 4.3 percent of the sales of the U.S. environmental industry.
- Environment-related jobs in Michigan comprised 4.4 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 Michigan by Industrial Sector

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

Comparison of the industrial sector distribution of environment-related jobs in Michigan 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 Michigan 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 Michigan is more manufacturing intensive than other average private sector activity in the state:

- 29 percent of private sector jobs in the environmental industry are in manufacturing, compared to 17 percent in manufacturing among all private sector industrial activities in Michigan.

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

Industry	Establishments	Total Employment	Environmental Employment	Environmental Jobs (percent)
Agriculture, Forestry, Fishing and Hunting	651	3,515	216	6.1
Mining	385	5,226	627	12.0
Utilities	426	24,136	6,914	28.6
Construction	24,590	173,244	8,633	5.0
Manufacturing	13,785	659,736	38,895	5.9
Wholesale Trade	12,814	178,545	4,021	2.3
Retail Trade	37,055	503,576	351	0.1
Transportation and Warehousing	4,965	90,412	544	0.6
Information	3,621	86,397	170	0.2
Finance and Insurance	13,641	168,065	202	0.1
Real Estate and Rental and Leasing	8,882	61,676	278	0.5
Professional, Scientific, and Technical Services	20,255	195,553	39,432	20.2
Management of Companies and Enterprises	1,472	152,641	2,188	1.4
Administrative/Support/Waste Management/Remediation Services	12,390	294,857	25,287	8.6
Educational Services	2,402	70,286	2,537	3.6
Health Care and Social Assistance	24,933	516,974	1,269	0.2
Arts, Entertainment, and Recreation	3,486	53,009	449	0.8
Accommodation and Food Services	19,092	327,545	188	0.1
Other Services	24,378	175,892	2,676	1.5
Public Administration	-	670,515	81,624	12.2
State Total	229,224	4,411,800	216,500	4.9

Source: Management Information Services, Inc., 2004.

- 29 percent of environmental jobs are in professional, scientific, and technical services, compared to 5 percent of all private sector jobs in the state.
- 19 percent of environmental jobs are in administrative, support, and waste management services, compared to 8 percent of all private sector jobs in the state.
- 2.2 percent of environmental jobs are in educational services, compared to 1.9 percent of all private sector jobs in the state.

Conversely, there are relatively few environmental jobs in other sectors of the Michigan economy:

- Less than one percent of environmental jobs are in the retail trade sector, compared to 11 percent in retail trade among all private sector jobs in the state.
- Less than one percent of environmental jobs are in the finance and insurance sector, compared to four percent among all private sector jobs in the state.
- Less than one percent of environmental jobs are in the health care and social service sector, compared to 12 percent among all private sector jobs in the state.
- Less than one percent of environmental jobs are in the transportation and warehousing sector, compared to two 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 217,000 environmental jobs account for about 4.9 percent of the total 4.4 million jobs in Michigan. However, this distribution is uneven among industry sectors:

- Nearly 29 percent of employment in the utilities sector consists of environmental jobs, primarily water, waste treatment, sanitation, and related facilities.
- More than 12 percent of public administration employment in the state consists of environmental jobs.
- More than 20 percent of Michigan jobs in the professional, scientific, and technical services are environmental jobs.
- **About six percent of the state's manufacturing employment is environment-related** – significantly higher than the 4.9 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 4.9 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 nearly 30 percent of private sector environmental jobs are in professional, scientific, and technical services, compared to only five percent of all private sector jobs in the state.

This indicates that investments in the environment will provide a greater than proportionate assist to Michigan's manufacturing sector. As noted in Chapter IV, Michigan is one of the 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, nearly six 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 Michigan – 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 Michigan by Occupation and Skill

Environmental employment in Michigan 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 Michigan 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 protection in Michigan in 2003 within selected occupations. This table shows that in 2003 environmental protection generated in Michigan generated:

- More jobs for machinists (966) than for forest and conservation technicians (190)
- More jobs for office clerks (4,118) than for environmental engineers (1,382)
- More jobs for executive secretaries (2,522) than for environmental scientists (1,523)

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

Occupation	Jobs
Accountants and Auditors	1,780
Chemical Engineers	197
Computer and Information Systems Managers	535
Construction Laborers	880
Customer Service Representative	2,425
Electricians	1,079
Engine and Other Machine Assemblers	186
Environmental Engineers	1,382
Environmental Scientists and Specialists	1,523
Employment, Recruitment, and Placement Specialists	525
Financial Analysts	353
Forest and Conservation Technicians	190
Forging Machine Setters, Operators, and Tenders	204
Geoscientists, Except Hydrologists and Geographers	272
Hazardous Material Removal Workers	1,210
Human Resource Managers	297
Industrial Engineers	739
Industrial Machinery Mechanics	464
Inspectors, Testers, and Sorters	1,161
Janitors and Cleaners	3,040
Landscaping and Grounds Workers	1,101
Machinists	966
Management Analysts	1,134
Marketing Managers	311
Mechanical Engineering Technicians	307
Medical Scientists, Except Epidemiologists	225
Office Clerks	4,118
Packers and Packagers	952
Receptionists and Information Clerks	1,512
Refuse and Recyclable Material Collectors	5,454
Sales Representatives, Technical and Scientific Products	563
Secretaries	2,522
Security Guards	1,115
Septic Tank Services and Sewer Pipe Cleaners	702
Tool and Die Makers	524
Truck Drivers, Heavy and Tractor Trailer	2,176
Water and Liquid Waste Treatment Plant Operators	5,130
Word Processors and Typists	523

Source: Management Information Services, Inc., 2004.

- More jobs for sales representatives (563) than for geoscientists (272)
- More jobs for truck drivers (2,176) than for hazardous material removal workers (1,210)
- More jobs for janitors (3,040) than for landscaping and grounds workers (1,101)
- More jobs for human resource managers (297) than for medical scientists (225)
- More jobs for security guards (1,115) than for septic tank and sewer cleaners (702)
- More jobs for financial analysis (353) than for chemical engineers (197)

Thus, many workers in Michigan 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 Michigan 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 Michigan comprises only 4.9 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
- Chemical engineers
- Chemists
- Civil engineers

- Computer software engineers
- Electronics engineers
- Engineering managers
- Geoscientists
- Management analysts
- Medical scientists
- Mechanical engineers
- Natural sciences managers
- Network and computer systems analysts
- 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 Michigan comprises only 4.9 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
- Chemical plant and system operators
- Chemical technicians
- Electrical and electronics engineering technicians
- Electrical and electronics repairers
- Computer systems analysts
- Construction and building inspectors
- Electrical and electronic engineering technicians

- Engine and other machine assemblers
- Employment, recruitment, and placement specialists
- Surveying and mapping technicians
- Technical writers
- Network systems and data communications analysts
- Market research analysts

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 Michigan -- 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 Michigan generated by environmental protection are close to the average of 4.9 percent of total employment; including in the following occupations:

- Bookkeeping, accounting and auditing clerks
- Carpenters
- Cashiers
- Customer service representatives
- Electricians
- Financial managers
- General and operations managers

- Human resource assistants
- Industrial engineers
- Industrial machinery mechanics
- Janitors and cleaners
- Laborers
- 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
- Training and development specialists

V.D. Jobs, The Automotive Industry and Environmental Innovation

Michigan and the automotive industry are closely linked, especially on the employment front, and America's automotive industry has at times been hard-pressed to compete with manufacturers such as Toyota and Honda, especially where fuel efficiency is concerned. Conventional wisdom has long held that investment in more fuel efficient automobiles by America's automotive companies would not be productive, since the American public is not interested in buying such vehicles or in paying higher prices for such vehicles. And, indeed, once the oil and gasoline shortages of the 1970s abated and the price of oil and gasoline fell, consumer enthusiasm in the U.S. for smaller, more fuel efficient cars also dissipated. Sports utility vehicles have become exceedingly popular, and their fuel efficiency is minimal.

However, interest in fuel efficiency is again rising. The Clinton Administration pushed heavily for advanced automotive technology and, in part because of the volatility of the Mideast region. After the events of September 11, 2001 and concern about oil supply, the Bush Administration has called for new investment in the much-anticipated hydrogen fuel cell car. In the interim, though, much progress has been made on hybrid engines to the point that demand for Toyota's Prius is high and Ford has saw fit to pioneer the "green SUV" market by manufacturing a Hybrid sports utility vehicle, hoping to overcome environmental skepticism of the popular SUV and attract more customers to Ford.

What is the impact on jobs in Michigan of increasing fuel efficiency standards? Contrary to conventional views, the jobs impact can be positive. According to the MISI/2020 vision study cited earlier, "increasing the Corporate Average Fuel Economy (CAFE) standards for automobiles, light trucks, minivans, and sports utility vehicles could result in the creation of more than 300,000 jobs distributed widely through the U.S. economy across states, industries, skills and occupations."⁶ The report examined three different technological scenarios—base case, moderate and advanced—and acknowledged that there would be regional impacts, with some job loss. However, Michigan would benefit under all scenarios, with a gain of jobs in all sectors of 54,500 jobs or 16% of the total jobs gain projected under the 2020 Advanced CAFE scenario. This scenario assumes that vehicle manufacturers are required to maximize the fuel efficiency gains possible from existing and emerging technologies and that manufacturers are required to devote most of their R&D to vehicle fuel efficiency instead of other accoutrements and improvements, such as communication, acceleration, etc.

The report also examines the question, "are CAFE standards and union jobs incompatible? This, of course, is a complicated question, inseparable from pressure on union jobs from export of work outside the U.S., increased importation of vehicles built outside the U.S., and fear that union labor will be asked to meet the costs of increased fuel efficiency by increased overtime or use of existing facilities, rather than increased hiring and jobs creation.

However, while the issue is complicated, lack of new hiring in the automotive industry cannot be attributed to increased CAFE standards. In fact, the MISI/2020 report cites evidence that, in fact, improvements in fuel efficiency tend to have a favorable effect on domestic market share and would thus, potentially, have a long-term favorable benefit for domestic vehicle manufacturers and their unionized workers.

V.E. The Environmental Industry as an Economic Driver for Michigan

This study demonstrates that environmental protection can form an important part of a strategy for Michigan based on attracting and retaining professional, scientific, technical, high-skilled, well paying jobs, including manufacturing jobs. While a

⁶The full report is entitled *Fuel Standards and Jobs* and is available from MISI. See front cover for contact details.

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 Michigan. For example:

- This study demonstrates that, at present in Michigan, environmental protection is creating 217,000 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 55,000 jobs in Michigan – more jobs than in any other state. Thus, contrary to what many believe, the production of more fuel-efficient vehicles would create substantial numbers of jobs in Michigan, not reduce them.⁷ (see discussion below for further information on this study)
- A 2002 study by the University of Illinois estimated that investments in renewable energy and energy efficiency would create nearly 30,000 jobs in Michigan.⁸
- A 2001 MISI study of environment-related jobs policies in the Midwestern states identified a number of opportunities and initiatives for job creation in Michigan.⁹
- A 1999 study sponsored by the World Wildlife Fund and the Energy Foundation estimated that an aggressive strategy to implement the

⁷Management 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.

⁸Regional Economics Applications Laboratory, *Job Jolt: The Economic Impacts of Repowering the Midwest*, University of Illinois, Chicago, 2002.

⁹Management 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.

Kyoto Climate Change Protocol in the U.S. would 31,000 jobs in Michigan.¹⁰

Finally, it is interesting to compare an environment-related economic development strategy with some of the other economic development strategies that Michigan (and other states) have traditionally relied upon. In 1996, Blue Water Fibre received \$80 million in inducements from Michigan for a paper-recycling mill that employs 34 workers – thus costing the state \$2.4 million per on-site job created. While paper recycling is a classically green enterprise, it would have been interesting to know what a concomitant investment in broader spectrum of environmental industries might have yielded in terms of jobs.

In any case, today, given the multiplier effect of environmental spending and investment, it is likely that many more jobs could be created, with the same amount of “foregone” tax revenues, through a systematic program to develop the environmental industry. Our findings show this is especially true in Michigan, which currently has a thriving, job creating environmental industry, currently generating 217,000 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.

¹⁰Tellus Institute and Stockholm Environment Institute, *America’s Global Warming Solutions*, Boston, August 1999.

VI. SUMMARY PROFILES OF SELECTED MICHIGAN ENVIRONMENTAL COMPANIES

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

- Are located throughout the state, in major urban centers, suburbs, small towns, and rural areas.
- Range in size from small firms of several employees to large firms employing thousands
- 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 these firms are given in Table 7 and are discussed below. Information presented is current as of June 2004.

VI.A. American Energy Exchange, Inc.

American Energy Exchange, Inc. (AEX) is a manufacturer of energy recovery equipment built around its patented frost free heat exchanger, and is the second largest manufacturer of this type of energy recovery equipment in the U.S. AEX is privately owned and based in Kalamazoo, and it has 50 employees in Michigan. Its customers include schools, commercial buildings, industrial facilities and institutions, and it has international sales in Canada and Mexico.

AEX manufactures air-to-air plate heat exchangers and is an experienced manufacturer of HVAC equipment, energy recovery ventilators, dehumidification, and energy recovery ventilation equipment. AEX has been manufacturing energy recovery equipment since its inception in 1981, and its Air- to-Air Plate Exchanger is the largest selling in the world. AEX markets plate exchangers as stand-alone items or in packaged systems. The packaged systems are available in three categories: energy recovery ventilators, dehumidification units, and air handling equipment.

The AEX manufactured Air-to-Air Plate Exchanger is the only exchanger of the plate type to be Certified to ASHRAE standard 84-91 for overall performance and pressure drop. In addition, most states now enforce ASHRAE standard (62-99), which requires specific minimum ventilation rates and indoor air quality to a building's occupants without adverse health effects. AEX has assisted many contractors and engineers in the design of products that easily meet these strict requirements.

Table 7
Summary of the Select Michigan Environmental Companies Profiled

Company	Location	Products/Services	Jobs
American Energy Exchange	Kalamazoo	Second largest manufacturer of heat recovery equipment in the U.S.	50
Applied Science and Technology, Inc.	Brighton, Grand Rapids	Environmental remediation, compliance, and restoration services	30
Atwell-Hicks, Inc.	Ann Arbor, Brighton, Washington, Grand Rapids	Environmental Engineering and consulting	260
Clayton Group Services	Novi	Full-service environmental and health and safety firm	450
Enerex, LLC	Harrison Township	Manufactures wind and renewable energy systems	60
Energy Conversion Devices, Inc.	Rochester Hills	A world leader in the fields of alternative energy generation and storage	340
Hubbell, Roth, & Clark	Detroit, Bloomfield Hills, Centerpoint, Howell	Environmental consulting engineering firm	260
Limno-Tech, Inc.	Ann Arbor	Environmental consulting and computer simulation	70
Malcolm Pirnie	Detroit, Lansing, Novi	One of the largest U.S. environmental engineering, science, and consulting firms.	1,400
Quantum Compliance Systems, Inc.	Ypsilanti	Environmental health and safety services	63
Tetra Tech, Inc.	Ann Arbor, Brighton, Detroit, Grand Rapids, Lansing, Port Huron, Richmond, Southfield	Water and wastewater treatment systems, watershed management, and related services	9,000
Wade-Trim	Detroit	Wastewater and water treatment	400
Weston Solutions of Michigan, Inc.	Detroit, Lansing, Houghton	Environmental remediation, redevelopment, and compliance	1,800

Source: Management Information Services, Inc., 2004.

AEX also holds patents in the U.S. and Canada for the discontinuous air flow design of the aluminum plate profile in its plate exchanger. The AEX Exchanger can maintain its stated performance even under the worst of installation and operation conditions. Contractors and engineers consider this to be an important advantage since, unlike the wheel and heat pipe, the AEX Exchanger has no moving parts to fail or require periodic greasing, adjustment, or replacement. In addition, the system has no Freon or coatings to check, recharge, or renew. The plate design, unlike the heat wheel applications, virtually eliminates any need for cleaning or filtering, even in extremely dirty or oily situations. Therefore, by design, the AEX Plate Exchanger eliminates maintenance costs and operational failures.

VI.B. Applied Science & Technology, Inc.

Applied Science & Technology, Inc. (ASTI) provides environmental and training services, compliance, and ISO14001 assistance, resource management, development assistance, remediation, and related services, and has offices in Brighton and Grand Rapids. The firm has 30 employees in Michigan, and has hired two employees – both scientists – in the past six months. Most of ASTI's employees are engineers, scientists, and technicians.

For industry and business, ASTI provides investigation, permitting, and remediation services to assist in achieving compliance with federal, state, and local environmental regulations. For property acquisition and management, ASTI provides assessment, inspection, and restoration services to evaluate site impacts, provide documentation for liability protection, remediate soils and groundwater contamination, and manage natural features. ASTI's understanding of environmental regulations, agency procedures, and client business needs enables it to provide cost-effective solutions to resolve environmental issues associated with development, operations, releases to the environment, and site closure.

ASTI has provided environmental and training services to industry and government since 1985. Its service groups are staffed by engineers and scientists certified as hazardous materials managers, regulatory compliance managers, professional geologists, environmental professionals, underground storage tank professionals, wetland scientists, asbestos inspectors, environmental property assessors, building inspectors, and management planners. Although ASTI routinely provides services in the Great Lakes region, it has also completed projects throughout the United States, Canada, and in Eastern Europe.

VI.C. Atwell-Hicks

Atwell-Hicks, Inc. (AHI) is a developmental consulting firm specializing in environmental services, civil engineering, surveying, and land planning. AHI has four offices in Michigan, in Ann Arbor, Brighton, Washington, and Grand Rapids, and one

office in Illinois. The firm has 260 employees and has added 37 new staff in the past six months. AHI employees include engineers, scientists, surveyors, and planners, and the firms clients are in the public, private, and institutional sectors; it has no international sales.

AHI began in 1905 when Harry Atwell, a University of Michigan civil engineering professor, began a land surveying company in Ann Arbor. Civil engineer and surveyor Herbert Hicks joined him in 1949, bought the firm a year later, and incorporated it as Atwell-Hicks, Inc. The firm grew along with the Michigan economy, and over the years, AHI added services and changed ownership several times. When the construction industry ground to a halt in the early 1980s, AHI worked to provide additional value-added environmental services to its offerings. The firm has been breaking new ground ever since, providing development and environmental services for its clients.

AHI currently offers technical expertise in civil engineering, land surveying, land planning, environmental services, brownfield redevelopment, landscape architecture, development analysis, and other areas. It delivers greater efficiencies, expanded operations, and improved profitability to its clients by utilizing government incentive programs, working with local municipalities to rezone land, and providing innovative engineering planning and environmental services. Clients from the country's largest homebuilders to local developers utilize AHI to maximize profitable, environmentally sound use of a finite piece of land, and Fortune 100 firms use AHI to capitalize on their underutilized land and buildings throughout the Midwest.

AHI continues to expand, and opened a new office in Grand Rapids in January 2004 to keep pace with increased demand, better serve clients, and expand its capabilities statewide. AHI strives for excellence and has been repeatedly ranked as one of the nation's top 500 Design Firms by the *Engineering News Record*.

VI.D. Clayton Group Services, Inc.

Clayton Group Services, Inc. (CGS) is a full-service environmental and health and safety firm with its corporate offices and laboratory in Novi, and 20 offices nationwide. It provides a wide range of services, including multi-disciplinary laboratory and consulting services and industrial hygiene, environmental, and microscopy analyses to address a broad range of environmental concerns. CGS has 450 employees including engineers, scientists, industrial hygienists, chemists, and field personnel. CGS services a variety of industries including government, aerospace, real estate, telecommunications, law firms, and retail property.

CGS has been a stable presence in the environmental services industry since 1954. To support local projects, as well as those of national and international scope, CGS has organized its services into three broad disciplines:

- *Environmental Services.* Services offered under this discipline include environmental assessments, remediation services, management systems/ISO 14001, litigation support (environmental), air quality services, regulatory compliance, and subsurface investigations.
- *Occupational Health and Safety.* Services under this discipline include industrial hygiene, asbestos and lead management, indoor air quality and mold remediation, ergonomics, training, safety, risk control, litigation support (occupational health and safety), and facilities water management.
- *Laboratory Services.* Laboratory services available include environmental analyses, microscopy and materials characterization, industrial hygiene analyses, air quality, electronic data deliverables, method development and validation, and lab related litigation support.

VI.E. Enerex L.L.C.

Enerex L.L.C. manufactures, designs, markets, distributes, and installs a wide range of wind generators, photovoltaic, solar, and control systems that are engineered for ease of installation and automated control. The firm's products and solutions are designed for residential, commercial, and industrial applications for remote and grid-connected systems. Enerex is based in Harrison Township and employees over 60 staff.

Enerex has over 50 years of electrical engineering experience and adheres to the vision of environmental leadership, and it works out of a 60,000 sq. ft. "smart" building. The high-tech smart building uses alternative energy, including wind generators and photovoltaic solar systems. Enerex is committed to the challenge of developing cleaner energy, and its core purpose is to provide the energy that makes it possible for people all across the globe to have more choices, more opportunity, and a better way of life.

Enerex is a recognized leader in protecting the environment and believes that alternative green power is a key element in reducing the threat of global climate change and improving air quality. The firm also believes that alternative green power is a significant and growing source of electricity that can provide consumers with a wide choice of environmentally friendly energy options.

VI.F. Energy Conversion Devices

Energy Conversion Devices Inc. (ECD) is a world leader in the fields of alternative energy generation and storage and advanced information technologies. The firm is based in Rochester Hills and specializes in materials research and advanced product development. Including its subsidiaries, ECD has 11 offices located throughout Michigan. The firm currently holds more than 350 U.S. patents and more than 800 foreign patents covering basic material compositions, product applications, and manufacturing processes. ECD conducts extensive research and development of new products and technology designed to benefit its commercial partners, and its staff consists of 340 scientists, engineers, technicians, and manufacturing employees. The firm's clients are primarily industrial and commercial, and it has substantial international sales.

ECD's president is Stanford Ovshinsky, who pioneered the fundamentally new science of amorphous and disordered materials, and its Chairman and Chief Executive Officer is Robert Stempel, the retired Chairman and Chief Executive Officer of the General Motors Corporation. Mr. Ovshinsky has been honored as one of *Time Magazine's* Heroes for the Planet and with the American Chemical Society's Heroes of Chemistry 2000 Award.

ECD's major products and services include thin-film photovoltaics, regenerative fuel cells, solid hydrogen storage, NiMH batteries, optical memory, electronic memory, solar solutions, fuel cell solutions, hydrogen solutions, battery solutions, information solutions, media solutions, machine and manufacturing services, and central analytical lab services. ECD's vision is based on the twin pillars of energy and information, and the pillars are composed of ECD's atomically engineered materials. As a result, ECD is able to invent the materials, the product, and the production technology.

Since its inception in 1960, ECD has offered fundamental scientific and technological solutions providing the ability to tap into the energy of the sun and of hydrogen, the basic element of our universe and the ultimate fuel. ECD is able to achieve this by creating a complete system of products for the generation, storage and transportation of non-polluting, non-climate-changing energy. In addition, ECD is able to efficiently tap into solutions for information technology through its phase-change and Ovonic Unified Memory technology.

ECD's products are widely used. For example, ECD makes the photovoltaic cells used on the Mir space station to generate electricity from sunlight, in the 1980s the Japanese licensed ECD patents to produce digital video discs, ECD's battery technology is currently making "Green" cars a reality, and ECD battery technology is used in both electric and hybrid vehicles.

VI.G. Hubbell, Roth & Clark, Inc.

Hubbell, Roth & Clark, Inc. (HRC) is a full service professional firm, providing a wide range of environmental engineering and consulting services to municipal, industrial, and private clients, primarily in southeastern Michigan. Headquartered in Bloomfield Hills, HRC also maintains branch offices in Detroit, Centerpoint, and Howell and has 260 employees. Its clientele is 90 percent municipal and 10 percent industrial

Founded in 1915, HRC began its service and found the source of its growth from Detroit's transformation into a major metropolitan area and center of manufacturing and commerce. From the earliest plans for wastewater treatment to the construction of an interceptor network that currently serves over three million people in the city of Detroit as well as Wayne, Oakland, and Macomb Counties, HRC participated in many of the environmental and public works projects that have enhanced the quality of life in communities across Michigan.

HRC continued to grow and expand its offerings. It added capabilities of road improvements, subdivision design, utilities, bridges, and industrial facilities to its expertise in wastewater treatment, drainage, and sewerage projects. More recently, HRC has added traffic engineering, geographic information systems (GIS), a materials testing laboratory, watershed management, and right-of-way services to its portfolio of capabilities. HRC is committed to continual improvements in the professional environmental and engineering services it provides to its clients.

HRC projects currently range from the design of roads and bridges to the intricacies of water supply treatment and distribution and the challenge of providing innovative wastewater collection and treatment solutions. Ranked by *Engineering News-Record* as one of the top 500 design firms, HRC has received several awards. Most recently, HRC was awarded the Project of the Year Award by the American Public Works Association.

VI.H. Limno-Tech, Inc.

Limno-Tech, Inc. (LTI) is an environmental consulting and engineering firm based in Ann Arbor. LTI focuses on environmental assessment, management, remediation, and regulatory compliance and provides environmental assessment and management, environmental permitting assistance, environmental economic analysis, and environmental monitoring and data analysis. It has 70 employees, including 55 in Michigan, and has hired five new staff in the past six months. About half of its business is in the public sector, and, while LTI focuses on the domestic market, about five percent of the firm's revenue is derived from international sales.

LTI was founded in 1975 as an outgrowth of research efforts at the University of Michigan. There, Paul Freedman, co-founder and president of LTI, and his colleagues were researching advances in lake science and computer simulation applied to lake

restoration and Great Lakes management. They recognized an opportunity to provide consulting services using these advances to assist clients in meeting the new mandates and goals of the Federal Water Pollution Control (Clean Water) Act, and they formed LTI to provide these services.

Since its inception, LTI has developed and applied the latest advances in environmental science and computer simulation to more effectively solve client problems and better protect the water environment. The scope of services was initially limited to lake and river eutrophication issues, but has expanded over the years to include services related to oceans, estuaries, and groundwater, as well as a full spectrum of concerns from toxics and sediment contamination to ecological restoration and water resource management.

LTI continues to develop advanced problem-solving skills for issues that range from permit issuance to watershed management, remediation, and restoration projects. In addition to its headquarters in Ann Arbor, LTI has opened a regional office in Washington, D.C. to better serve its clients. LTI also created LTI Environmental Engineering, a subdivision of LTI, to provide services related to groundwater, hazardous waste, and facility/site assessment, management, and remediation.

VI.I. Malcolm Pirnie

Malcolm Pirnie is one of the largest firms in the U.S. focused on environmental issues, and for over a century has provided environmental engineering, science, and consulting services to 3,000 public and private clients. Of its 1,400 employees, 70 work out of its offices in Detroit, Lansing, and Novi, and it has added five new jobs in Michigan over the past six months. The firm's employees are primarily engineering/technical, and its business in Michigan is about 50 percent government/public sector and 40 percent private – commercial and industrial. It has some international sales activities, primarily in Canada.

Malcolm Pirnie has built its practice and reputation on technical excellence and innovation, and its staff of engineers, scientists, consultants, designers, architects, and technical support personnel are located in more than 40 offices nationwide. More than 100 Pirnie projects over the last ten years have been recognized for engineering excellence in competitions nationwide, and the firm is a recognized source in developing environmental policy, management, and technology.

Malcolm Pirnie was founded in 1895 as consulting practice in Boston to solve "problems in water supply, sewerage and sewage disposal." The firm's reputation grew as early projects helped define where the emerging environmental profession was headed. New technologies such as rapid sand filtration and disinfection were perfected as the firm developed drinking water supplies for new Florida resorts and engineered water treatment plants and reservoirs along the Eastern seaboard. After various transitions in partners and management, the firm evolved to become Malcolm Pirnie

Civil Engineer in 1930. By 1940, the firm had a staff of 25 devoted almost exclusively to Army and Navy work and defense projects across the country and in Puerto Rico, developing the high-purity oxygen concept to heighten effectiveness of aerobic wastewater treatment.

Spurred by the first federal environmental law passed in 1948, Malcolm Pirnie's water process experts continued to engineer drinking water facilities for America's cities. They expanded their focus from producing biologically safe water using filtration to concern about its chemical constituents, and revolutionized large-plant design by applying new high-rate technologies.

During the 1960s and 1970s, having developed expertise in large sewage treatment facilities, the firm designed innovative nitrification plants for New York State's Capital District that initiated the cleanup of the badly polluted Hudson River. Malcolm Pirnie engineered challenging environmental facilities overseas and designed improved processes to treat complex industrial wastes. With the 1970s, the first Earth Day signaled a new environmental era, and Pirnie's services were in demand for major projects in cities all across the country, including Cleveland and Cincinnati. New technologies and disciplines were added, expanding the firm's capabilities from engineering to environmental sciences and planning. In the 1980s, Superfund hazardous waste investigations and cleanups from Love Canal to Marathon Battery were a major focus for the firm, while a new array of drinking water quality issues related to organic contamination drove innovative project designs. The firm expanded into environmentally sound, state-of-the-art solid waste management and air quality solutions, and into new issues such as odor control and air toxics. Pirnie's engineers and scientists continue to evaluate and apply new technologies designed to safeguard public health and the environment.

Malcolm Pirnie is a closely-held "S" corporation with headquarters in White Plains New York. All shares are owned by full-time employees who are also officers or senior managers of the firm. The firm's annual revenues exceed \$200 million and it is ranked by the *Engineering News Record* among the top 25 U.S. firms in many environmental areas, including environmental science, water treatment and desalination, sewerage and solid waste, wastewater treatment, hazardous waste, chemical and soil remediation, and site assessment and compliance.

VI.J. Quantum Compliance Systems

Quantum Compliance Systems, Inc. (QCSI) is an environmental health and safety (EH&S) firm located in Ypsilanti. Its major activities are developing commercial information management tools for environmental health and safety and providing support services including data entry, software maintenance, and training. It has 63 employees and has added six new staff within the past six months. Its employees include environmental engineers, computer scientists, technicians, and data entry

personnel. Its clients are 90 percent private industry and ten percent government, and about ten percent of its sales are international.

Quantum was founded in 1986 by a team of environmental engineering and computer science professionals who knew “there had to be a better way” based on their direct experience in EH&S. Since 1986, QCSI has been helping corporations increase productivity and profits using information technology to comply with EH&S regulations. QCSI delivered the first EH&S Reporting System database system in 1987, which was designed to analyze and produce information that would inform employees of the hazardous materials in their environment. In 1989, Quantum released the first version of its flagship product platform, which was named the Facility Tracking System (FacTS™).

The firm focuses on developing commercial information management tools for EH&S and it provides extensive professional support services, including training, data entry, software maintenance, implementation consulting, and software customization. The extensive industry experience of Quantum’s employees is a key to its success, and FacTS™ results directly from that experience and from the firm’s commitment to produce the highest quality application on the market. The firm is privately held and has over 100 separately licensed installations.

Quantum’s products are installed facilities-wide in many Fortune 500 companies in the United States, in the international facilities of U.S.-based companies, and in worldwide facilities of internationally-based companies. QCSI offers a comprehensive set of EH&S capabilities that allow the client to control the entire compliance process across its enterprise with a single vendor relationship.

Quantum’s customer organizations range across a wide spectrum of industries, including aerospace, automotive, pulp and paper, pharmaceuticals, chemicals, electric utilities, oil and gas, primary metals, and high technology manufacturing. The firm offers expertise in environmental, health and safety, systems engineering, product support, project management, database management and programming, and other specialized skill areas.

VI.K. Tetra Tech, Inc.

Tetra Tech, Inc. (TTI) is a leading U.S. provider of environmental consulting, engineering and technical services with 11 offices in Michigan, including Ann Arbor, Brighton, Detroit, Grand Rapids, Lansing, Richmond, Southfield, and Williamston. With over 9,000 employees located in the United States and internationally, including 260 in Michigan, the company supports commercial and government clients in the areas of resource management, environmental services, water/wastewater management, and infrastructure. TTI services include research and development, applied science and technology, engineering design, construction management, and operations and

maintenance, and the firm has 350 offices worldwide and had total revenue of \$1.1 billion in 2003.

TTI was founded in 1966 to provide engineering services related to waterways, harbors, and coastal areas. Over the past 38 years, the company has substantially increased the size and scope of its business and expanded its service offerings through a series of strategic acquisitions and internal growth. Tetra Tech currently provides environmental services, water/wastewater management, infrastructure services, communications support, and outsourcing services.

TTI provides services to protect and improve the quality of life through responsible resource management and sustainable infrastructure. The company continuously adapts its services to provide for society's changing needs and to meet customer expectations. The two business areas in which TTI provides capabilities to its customers are critical to sustain the quality of life: Infrastructure services and resource management services.

Infrastructure Services. TTI provides growing communities with facilities and systems to improve the quality of life and protect public health and safety. It designs and engineers facilities for water supply, water treatment, wastewater treatment, storm water management, transportation networks, communications networks, commercial and public facilities, educational facilities, and leisure facilities. As one of the largest design firms in the U.S., TTI provides full service architectural and engineering capabilities for all types of buildings. The company also incorporates the latest technologies to enhance communications.

Resource Management Services. TTI has a leadership position in water resource and environmental management, emphasizing solving critical problems in watershed management, groundwater cleanup, and environmental restoration to ensure clean water supply, productive reuse of economic assets, and sustainable development of natural resources. This business area emphasizes solutions to complex resource management problems which encompass broad geographic areas.

In addition to its service offerings, TTI encourages its professionals to participate in outreach programs, and its employees participate in many non-profit agencies and projects within their local communities. For example, TTI employees have worked with local watershed councils, such as the Huron River Watershed Adopt-A Stream, and the Clinton River Watershed Council, and TTI employees are frequent participants in Earth Day teaching programs to audiences from kindergartens to universities.

VI.L. Wade-Trim

Wade-Trim is an environmental consulting firm with offices in Detroit, Bay City, Cadillac, Flint, Gaylord, Grand Rapids, Taylor, and Troy. Its major activities include wastewater and water treatment, engineering, planning, surveying, landscape architecture, environmental science services, maintenance and management services, and turnkey electrical services for water resource projects. The firm has over 400 employees, including 380 in Michigan, and has added 20 new staff in the past six months. Wade-Trim is employee-owned, and its employees are primarily engineers, technicians, planners, surveyors, landscape architects, and administrative workers. It is a Michigan-based company and it also has three satellite offices in Florida, Ohio, and Pennsylvania. The firm services a large number of clients, 90 percent of whom are municipalities and ten percent of whom are commercial developers.

Wade-Trim started in 1926 as a small firm whose purpose was to provide professional engineering services to local municipalities in and around Dearborn. Through expansions and buyouts of two small firms, Wade-Trim had grown by 1970 to a staff of 22 employees and had moved to Taylor, Michigan. Wade-Trim continued to grow to meet changing client needs and opened more offices to maintain local service across the state. In addition to expanding geographically, Wade-trim also further expanded its expertise to offer a full range of professional engineering services to meet the infrastructure needs of government and industry.

Wade-Trim has created two subsidiary companies with specialized services: Facilities Management and Municipal Systems Consulting

Facilities Management helps municipal governments and private corporations optimize their operation through a variety of services. It was formed in 1996 to meet the growing demands of Wade-Trim clients and other municipalities requiring contract management and management assistance of their water, wastewater, recreational, transportation, and other public facilities. Turnkey electrical services were later added for water resource projects.

Municipal Systems Consulting (MSC) was recently created to help clients with information processing, decision-making and service delivery. MSC offers a wide variety of services including conference facilitation, strategic planning and visioning, change and transformation management, and program evaluation and design, among others.

Wade-Trim was recently awarded a 2004 Eminent Conceptor Award for engineering, the highest award given, from the American Council of Engineering Companies of Michigan and the Michigan Society of Professional Engineers. Before construction began on the Michigan Department of Transportation's \$39 million US-131 Freeway extension, Wade-Trim was consulted and recognized an opportunity to reduce \$10 million of earthwork as originally designed by two separate consulting firms. A Value Engineering Change Proposal (VECP) was submitted to MDOT. It was the

largest VECP ever submitted to MDOT and one of the largest earthwork projects performed in Michigan. The VECP resulted in contract savings of \$2.3 million that was used for other northern Michigan transportation improvements. The total volume of earthwork was reduced by 45 percent and the project was completed a year ahead of schedule.

VI.M. Weston Solutions of Michigan, Inc.

Weston Solutions of Michigan, Inc. (WSMI) is a leading environment and redevelopment firm that provides comprehensive solutions to complex problems for industry and government worldwide. WSMI has three offices located in Detroit, Okemos, and Houghton, employs 50 people in the state, and has hired 10 new staff over the past year. WSMI employees are primarily scientists, engineers, and technicians. About 80 percent of its business is with the state government and about 20 percent is with industry, and about five percent of its sales is international.

WSMI is a subsidiary of the larger entity Weston Solutions, Inc. (WSI). WSI has 60 offices located in the U.S. and abroad. In total, WSI employs over 1,800 people worldwide and is the second largest U.S. all-environmental firm. WSI services encompass environmental remediation, redevelopment, and management and compliance.

Founded in 1957, WSI places emphasis on restoring resource efficiency to clients' operations -- including land, air, water, facilities, and staff -- to ensure that clients derive maximum value from their resources. For environmental remediation, WSI develops and implements solutions that safely and cost-effectively address complex remediation challenges, provide economic and environmental benefits, and address public concerns. Redevelopment by WSI entails revitalizing aging infrastructure and turning contaminated areas into valuable assets. Management and compliance services offered by WSI help reduce costs, reduce risk, improve health and safety, enhance public image, and improve financial decisions for WSI clients.

Since becoming a private company in 2001, WSI has seen continued improvement in profitability, growth, and financial stability. In 2003, WSI became a 100 percent employee owned company. In 2001, WSI received the top "gold" award in the large firms division from the *Environmental Business Journal* for "its dramatic change in structure and performance to become a successful employee-owned company."

VII. OPPORTUNITIES IN MICHIGAN 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 Michigan. 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. Michigan Manufacturing Summit

On December 8, 2003 Governor Jennifer Granholm met with Michigan's business and labor leaders at the Michigan Manufacturing Matters Summit to discuss issues related to the state of manufacturing in Michigan and develop a consensus agenda to take to Washington, D.C. Participants in the summit represented large and small manufacturers and labor organizations and conducted an open discussion about issues ranging from health care to foreign currency. The consensus agenda contains specific action steps designed to improve the state of manufacturing in Michigan and the nation. The Governor noted that "Manufacturing is the backbone of our state's economy. We are committed to finding ways to make it easier to retain, expand, and grow manufacturing here. When this important sector of our economy is growing, we are able to invest more in education, health care, and the environment – the key quality of life issues that make Michigan a great place to raise a family and grow a business."

During the Summit, consensus was reached on actions that can be taken at the federal and state levels to create a better business environment to improve the competitiveness of manufacturing. The only action relating to the environment jobs nexus stated that, with respect to energy policy, the U.S. needs diversified, affordable, reliable, new domestic and competitive sources of energy, such as clean coal, oil, natural gas, hydro, solar, wind, alternative feed stocks and biomass, and investment in infrastructure, as well as a national focus on conservation. The Summit recommended "a thoughtful approach to energy policy that supports manufacturing, is reliable and promotes the use of diverse energy sources." Other dimensions and strengths of the Michigan environmental industry-manufacturing jobs leakage were not addressed.

VII.B. Governor's Initiatives

VII.B.1. Clean Michigan Initiative

The CMI is a multi-year, \$570 million program for environmental clean-up, pollution prevention, and redevelopment projects. The only projects for which job creation is a criteria for approval are those involving Brownfields remediation.

VII.B.2. The Clean Michigan Fund

The Clean Michigan Fund is a \$100 million bond program that provides \$50 million in grants to local governments for the development and renovation of public recreation facilities, and \$50 million for extensive state park renovations. As the highest priority of the Department of Natural Resources, CMI will be supplemented with another \$50 million from other funding sources, including state park user fees, to expand the scope of work and the number of parks that will receive major renovations. A majority of bond dollars will be spent in five areas: Replacement of toilet/shower buildings, water, sewage, and electrical systems, and road repairs. In southeast Michigan, projects that have been funded include rehabilitation of state park facilities, dam repairs, and improved playgrounds.

The Clean Michigan Initiative and the Clean Michigan Fund are “classically green”-oriented entities. They obviously create jobs, but have no component that maximizes, publicizes, or further develops the current jobs creation benefits or potential. However, they do have substantial resources, and their goals are broad enough to include environment-related jobs programs. Thus, the jobs component of these programs could be readily optimized.

VII.C. State Commissions: The Environmental Science Board

The Michigan Environmental Science Board is an independent autonomous state agency established in 1992 to provide sound scientific and technical advice to the Governor and to state departments, as requested by the Governor, on matters affecting the protection and management of Michigan's environment and natural resources. It consists of an executive director and nine individuals appointed by the Governor who have expertise in the relevant scientific and technical disciplines. Upon receipt of a request from the Governor to investigate a given topic or issue, a panel is convened of MESB members with appropriate expertise and outside experts as needed.

In its ten year history, the MSEB has never conducted a study of the importance of the environmental industry in providing jobs in Michigan or of any other related jobs and environment issue. However, the state Governor could request such an analysis that would receive maximum publicity throughout the state and at the highest levels of state government, and generate benefits for the state's environmental industry in terms of exposure, profile, and ultimately perhaps new business and jobs creation.

VII.D. Michigan Retired Engineer Technical Assistance Program

Retired professionals are available through the state RETAP to assist Michigan businesses and institutions with pollution prevention. Individually, the analysts have thirty to forty years of experience with Michigan industries. RETAP offers free,

confidential, and non-regulatory on-site pollution prevention assessments for Michigan businesses and institutions. Teams of RETAP professionals review operations for potential waste reduction strategies and opportunities, including source reduction, reuse, recycling, and energy efficiency. Written, confidential reports identify pollution prevention options and contain specific recommendations to save money, increase efficiency, reduce need for costly waste disposal and treatment, reduce liability, and promote a positive public image.

There is no obligation to implement the recommendations, however, significant cost savings can be achieved from employing pollution prevention techniques. Follow-up by RETAP with companies assisted through the program has shown thousands of dollars of annual cost savings. Michigan businesses with fewer than 500 employees and Michigan institutions of any size are eligible to participate in the program.

RETAP is one of the few specific environment-related jobs programs sponsored by the state government.

VII.E. Michigan Energy Office

The Michigan Energy Office promotes energy efficiency and renewable energy resource development to Michigan's residents, businesses, and public institutions. Program activities are designed to encourage the use of new technologies and alternative energy sources. Program activities are designed to encourage the use of new technologies and alternative fuels in buildings, industrial processes, vehicles and in power generation. Program objectives are advanced through a variety of services, including information dissemination, technical assistance, financial assistance and demonstration projects. The grant, contract, and incentive opportunities offered include:

- Home Energy Rating Rebates -- financial incentives are available to encourage homeowners to implement recommendations made in the improvement analysis report provided with a home energy rating.
- Statewide Energy Conferences and/or Fairs -- the Office funds statewide energy conferences and fairs.
- Energy Star Promotion Grants -- the Office funds public and non-profit organizations to conduct Energy Star Promotion projects to promote the Energy Star concept and products and to assist consumers in identifying and selecting energy efficiency options.
- Energy Education projects -- public and non-profit organizations are eligible for funds to provide energy education

- Wind Turbine and Solar Photovoltaic Incentive Program -- this program promotes the use of wind turbine and solar photovoltaic systems to produce electricity from renewable energy resources, and the incentives help reduce the costs of these systems.

The Office sponsors solar energy demonstrations to demonstrate that solar energy works in Michigan, and has been providing two types of grants to public and non-profit organizations:

- Community Energy Project Grants -- up to \$6,000 have been used for a variety of smaller demonstrations, and grants have included solar fountains, solar lawn mowers, solar schools, and solar hot water systems.
- Photovoltaic systems -- 10 kW and larger systems have been eligible for grants up to \$60,000. Michigan State University, Oakland University, Calvin College, City of Troy, and Western Michigan University have received grants for these larger projects.

There may be potential here to have the Office focus on renewable energy, energy efficiency, environment, and jobs issues, even though it has not thus far. It could also sponsor conferences on jobs and the environment issues.

VII.F. Department of Environmental Quality

The Michigan Department of Environmental Quality uses performance targets, means, and measurements as planning tools in order to achieve its mission. These targets include implementing a comprehensive system to establish environmental baselines and measure environmental improvements and making a significant contribution to the redevelopment of urban areas without having an adverse impact on the environment.

DEQ currently has no jobs and environment focus in its programs, however, the potential for changing this exists. For example:

- Its performance targets could be modified to include J&E issues and goals.
- Its program of redeveloping the state's urban areas in an environmentally benign manner could be modified to include the creation of employment opportunities for the unemployed in urban areas.

DEQ sponsors no conferences related to jobs and environment issues; the nearest thing to these are its education and outreach customized workshops. These could be used to focus on environment-related jobs issues in the state.

VII.G. Department of Labor and Economic Growth

In December 2003 the Michigan Department of Labor and Economic Growth (DLEG) was created to “promote job creation and economic growth in Michigan by centralizing and streamlining the state’s job, workforce, and economic development functions under one department.” The reorganization will permit the Governor to move forward on an aggressive, streamlined job creation and economic development program. According to the Governor "This is about creating jobs and promoting economic development. We want a streamlined department that is flexible, saves taxpayer dollars, and will allow us to compete for the jobs of the future."

The new department is a one-stop shop for business creation and development, and Executive Order 2003-18 renamed the Department of Consumer and Industry Services as DLEG and transferred programs of the Department of Career Development aimed at matching employers and workers to DLEG to help create one of best trained workforces in the nation. Key programs from other departments focusing on economic development issues were also transferred to DLEG, including two of interest here: Michigan Next Energy Authority and the Michigan Strategic Fund. Thus far, there appears to be no 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.H. Michigan Biomass Energy Program

The goal of the Michigan Biomass Energy Program (MBEP) is to encourage increased production and use of energy derived from biomass resources through program reports, partnerships, technical assistance, and education. MBEP has partnered with state agencies and other organizations to coordinate workshops, facilitate an ethanol working group, and to increase the biofuel infrastructure in Michigan. MBEP is located in the Department of Labor and Economic Growth.

MBEP provides funding for state bioenergy/biofuel projects on a regular basis and focuses on the development of renewable energy derived from biomass resources. The types of energy obtained from biomass include heat, electricity, and liquid fuels. Although MBEP attempts to provide information on all types of biomass, much of its research and project funding focuses on three main areas: Anaerobic Digestion, Energy Crops, and Ethanol.

MBEP is also a “classically green”-oriented entity, and obviously creates jobs. But it has no component that maximizes, publicizes, or further develops the current jobs creation benefits or potential. However, the program does have substantial resources,

and its goals are broad enough to include environment-related jobs programs. Thus, the jobs component of this program could be readily optimized.

VII.I. Michigan Economic Growth Authority

Michigan Economic Growth Authority (MEGA) was created to promote high quality economic growth and job creation. MEGA offers refundable job creation tax credits against the Michigan Single Business Tax that are designed to attract new, innovative and cutting-edge companies that specialize in new technologies. The tax credits are available to firms doing advanced computing, biotechnology, electronic device technology, engineering, and laboratory testing related to product development, medical device technology, product research and development, advanced vehicle technology or technology that assists in the assessment or prevention of threats or damage to human health or the environment. MEGA tax credits are also available to companies creating good-paying jobs in manufacturing, R&D, wholesale trade and office operations that meet the criteria. Each credit may be awarded for up to 20 years and up to 100 percent of the amount of the project. Since their inception in 1995, MEGA tax credits have spurred an estimated \$5.1 billion in private investment, creating 29,000 jobs and spinning off another 35,000. MEGA funds can be used to help create environment-related industries and jobs, and this effort could be greatly expanded.

VII.J. SmartZones

Michigan SmartZones are collaborations between universities, industry, research organizations, government, and other community institutions intended to stimulate the growth of technology-based businesses and jobs by aiding in the creation of recognized clusters of new and emerging businesses, those primarily focused on commercializing ideas, patents, and other opportunities surrounding corporate, university or private research institute R&D efforts. SmartZones provide distinct geographic locations where technology-based firms, entrepreneurs, and researchers can locate in close proximity to all of the community assets that will assist in their endeavors. The locations of the Michigan SmartZones represent areas that comprise a critical mass of technology development assets including commitment to supporting technology development, leadership and commitment of research institutions to support technology development, coordinated access to capital, business development networks, established technology infrastructure, educated and talented workforce, proximity to R&D partners, and education and training opportunities.

The SmartZones program coordinates all of the community assets and services necessary to support technology development in the knowledge based economy. SmartZone communities are designed to challenge high-tech "hot spots" such as California's Silicon Valley, Route 128 in Massachusetts, and the North Carolina Research Triangle. SmartZones have thus far been established in Battle Creek, Houghton, Lansing, Mount Pleasant, Kalamazoo, Grand Rapids, Muskegon, Oakland County, Ann Arbor/Ypsilanti, Detroit, and Wayne County. The SmartZones 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.K. Michigan Renewables Energy Program

The Michigan Renewables Energy Program (MREP) was established by the legislature and implemented by the Public Service Commission to promote the use of renewable energy in the state. A diverse group of individuals and organizations with knowledge and experience in energy production, technology, education, and policy development have been assembled to identify and address barriers to the advancement of renewables and recommend initiatives to increase renewable use in Michigan. MREP was established "to inform customers of the availability and value of using renewable energy generation and the potential for reduced pollution." It will "promote the use of existing renewable energy sources and encourage the development of new facilities."

Some MREP Collaborative participants have been renewable energy advocates for 20 years or more, and some of the policy ideas and initiatives considered by the Collaborative have been deliberated since the energy crises of the 1970s and 1980s, but few programs to support renewable energy for Michigan have been enacted, and some that were enacted were short lived. The crux of the difficulty in forming consensus through the MREP Collaborative, however, has been fundamental disagreements about acceptable approaches to renewable energy policy formulation. Recent changes in the structure of Michigan's electric utility markets have created a situation characterized by:

- Modest public resources to support renewable energy research and development or demonstration projects
- Utilities hesitating to expend resources or increase customer rates to support renewable energy, in part because of a fear that any additional costs might jeopardize their competitive position
- Alternative electric suppliers (AESs) not yet indicating interest in bringing renewable energy products to market.

Ultimately promotion of renewable energy at significant scale would support diverse businesses and create diverse jobs across Michigan's industrial sector.

VII.L. NextEnergy

The Michigan Next Energy Authority (MNEA) promotes the development of alternative energy technologies and provides tax incentives for business activities and property related to the research, development, and manufacturing of those

technologies. MNEA was created to promote the development of alternative energy technologies and to provide tax incentives for business activities and property related to the research, development, and manufacturing of those technologies. The MNEA board is comprised of the State Treasurer, the directors of the state departments of Management and Budget and Transportation, and four private-sector members appointed by the Governor. MNEA is responsible for certifying taxpayers and property as eligible for tax credits against the Michigan Single Business Tax or exemptions from the General Property Tax. The goals of the NextEnergy program are to:

- Make Michigan a world center of excellence for alternative energy technology (AET) education, research, development, and manufacturing.
- Make Michigan a world center of excellence for the demonstration and understanding of the future infrastructure required by AET.
- Make Michigan a world center of excellence for the advancement of power electronics and enabling technologies required by AET.
- Demonstrate the use of AET, pushing public and consumer understanding toward a demand market.
- Advocate and assist in developing basic and advanced AET education curriculum, ensuring long-term leadership in engineering, research and technical support.
- Advocate industry concerns to policy makers, creating a vibrant environment in which the AET industry can grow and advance.
- Help fill critical knowledge gaps by assisting collaborative research efforts between industry and institutions.
- Assist Michigan governmental and economic development leaders in the retention and attraction of AET related development.

The NextEnergy program includes the NextEnergy Center, a Tax-Free Zone, Incentives, Steps to Spur Demand, and Demonstration Microgrids. The program is designed to make Michigan a world leader in the research, development, commercialization and manufacture of alternative energy technologies such as hydrogen fuel cells. These technologies include mobile applications to power cars and trucks, stationary uses for homes and factories, and portable needs such as laptop computers, cell phones and PDAs. The program is creating a 700-acre, tax-free NextEnergy Zone in York Township near Ann Arbor, building the NextEnergy Center there, and attracting alternative energy companies from around the world to the zone,

making it a cluster of energy innovation. NextEnergy is designed to reduce America's dependence on foreign oil, improve the environment, and strengthen the economy.

The NextEnergy program could be key in developing environment-related industries and jobs in Michigan, and its potential for doing so should be explored.

VII.M. Michigan Strategic Fund

The Michigan Strategic Fund is the agency responsible for overseeing the state's economic development strategies. The appropriation to the Michigan Strategic Fund is used to support global and statewide business development and job creation and retention activities, promote statewide tourism, and administer federal community development block grants. The Michigan Strategic Fund is empowered to enter into partnerships with local governments to create the Michigan Economic Development Corporation (MEDC). Total recommended funding for the Michigan Strategic Fund is \$100 million, and the funds are used for Community and Economic Development Job Creation Services, Community Infrastructure Development, and Job Training Programs. The Fund's priorities include placing Michigan among the top five states for new business expansions and locations, begin the development of the Technology Corridor, develop strategies for improving the relationship between higher education and economic development in order to grow the economy by moving research ideas into the marketplace, and promote smart economic growth by helping communities revitalize their urban cores. The Michigan Strategic Fund could be a significant force in supporting the state's environment-related industries with concomitant potential for jobs creation. This link should be greatly expanded through the Fund.

VIII. SUMMARY OF MAJOR FINDINGS

This report presents information about jobs creation and the potential of the environmental industry in the state of Michigan, 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 Michigan and Michigan’s Environmental Industry

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

- Sales of the environmental industries in Michigan totaled \$12.9 billion.
- The number of environment-related jobs totaled nearly 217,000.
- The environmental industry in Michigan comprised 3.9 percent of gross state product.
- Environment-related jobs comprised 4.9 percent of Michigan employment.
- Michigan environmental industries accounted for 4.3 percent of the sales of the U.S. environmental industry.
- Environment-related jobs in Michigan comprised 4.4 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 Michigan 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 Michigan 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 Michigan 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 Michigan, 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 Michigan 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 Michigan comprises only 4.9 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 Michigan 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 30 employees to large firms employing thousands
- 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:
 - American Energy Exchange (Kalamazoo) is the second largest manufacturer of heat recovery equipment in the U.S.
 - Enerex (Harrison Township) manufactures, designs, markets, distributes, and installs wind generators, photovoltaic, solar, and control systems.
 - Energy Conversion Devices (Rochester Hills) is a world leader in the fields of alternative energy generation and storage and advanced information technologies.

- Limno-Tech (Ann Arbor) is a leader in lake science and computer simulation applied to lake restoration and Great Lakes management.
- Quantum Compliance Systems (Ypsilanti) is an innovator in using information technology in assisting companies to comply with environmental, health, and safety regulations.
- Tetra Tech (11 offices in Michigan) is a leading U.S. provider of environmental consulting, engineering, and technical services.

A number of these firms, including Limno-Tech, Quantum, Atwell-Hicks (Ann Arbor, Brighton, Washington, and Grand Rapids)), Wade-Trim (Detroit), and Weston Solutions of Michigan (Detroit, Lansing, and Novi) 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 Clean Michigan Initiative, the Clean Michigan Fund, the Michigan Biomass Energy Program, the Michigan Economic Growth Authority, SmartZones, NextEnergy, and the Michigan Strategic Fund.

We suggest policy options that could maximize the jobs benefits of the environmental industry in Michigan, 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 Michigan, a state that remains manufacturing oriented and seeks new ideas for employment generation, stable good jobs, and workforce development.

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

There are two historical sources of information about the environmental industry in Michigan. 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.¹¹ 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

¹¹See 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 Michigan. The ITA estimated that, in 1999, Michigan accounted for about 4.4 percent of the U.S. industry, and that the number of environmental jobs in the state totaled more than 54,000.

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

		Michigan	U.S.	Michigan Share of U.S.
Revenues	(millions)	\$7,532	\$196,465	4.4%
Jobs	(number)	54,094	1,389,638	3.9%
Companies	(number)	4,025	115,030	3.5%
Exports	(millions)	\$536	\$21,310	2.5%

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

The ITA report disaggregated the Michigan industry by metropolitan statistical area (MSA) – see Table A.2. In Michigan, these areas include the Detroit and the Grand Rapids-Muskegon-Holland MSA. Detroit accounted for nearly half of the industry in the state and almost 25,000 environmental-related jobs. Grand Rapids-Muskegon-Holland MSA accounted for about 11 percent of the state's environmental industry and nearly 6,000 jobs.

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

		Detroit MI	Grand Rapids-Muskegon -Holland MI
Revenues	(millions)	\$3,417	\$803
Jobs	(number)	24,539	5,770
Companies	(number)	1,826	429
Exports	(millions)	\$243	\$57
MSA Average Share of Michigan		45%	11%

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.¹² 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 Michigan and the United States from the most recent survey, for 1999. Pollution abatement costs in these selected Michigan industries included over \$200 million of capital expenditures and more than \$600 million for operating costs. Together with \$400 million in operating costs for disposal and recycling activities and other categories of economic activity, total PACE estimates for Michigan in 1999 totaled just over \$1.0 billion. This represented 3.7 percent of the overall PACE estimates in the United States.

¹²See 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 Michigan
and the U.S. From the Census MA200 Survey, 1999
(million dollars, except where noted)

	Michigan		U.S.		Michigan Share of U.S.	
Pollution abatement						
Capital expenditures	160.1		5,809.9		2.8%	
Non-hazardous		122.9		4,497.8		2.7%
Hazardous		37.2		1,312.0		2.8%
Air	99.8		3,463.7		2.9%	
Non-hazardous		79.8		2,644.7		3.0%
Hazardous		20.0		819.0		2.4%
Water	37.8		1,801.9		2.1%	
Non-hazardous		28.2		1,488.2		1.9%
Hazardous		9.5		313.7		3.0%
Solid Waste	21.0		361.9		5.8%	
Non-hazardous		13.4		245.5		5.5%
Hazardous		7.7		116.4		6.6%
Multimedia	1.5		182.3		0.8%	
Non-hazardous		1.5		119.4		1.3%
Hazardous		-		62.9		-
Operating Costs	394.0		11,864.4		3.3%	
Non-hazardous		306.8		8,924.9		3.4%
Hazardous		87.1		2,939.5		3.0%
Air	138.0		5,069.1		2.7%	
Non-hazardous		109.3		3,941.2		2.8%
Hazardous		28.8		1,127.9		2.6%
Water	182.8		4,586.5		4.0%	
Non-hazardous		143.8		3,511.8		4.1%
Hazardous		39.1		1,074.6		3.6%
Solid Waste	68.3		2,013.3		3.4%	
Non-hazardous		50.3		1,320.4		3.8%
Hazardous		18.0		692.9		2.6%
Multimedia	4.7		195.5		2.4%	
Non-hazardous		3.5		151.5		2.3%
Hazardous		1.3		44.0		3.0%
Disposal and recycling						
Capital expenditures	42.1		398.7		10.6%	
Disposal	8.1		267.2		3.0%	
Non-hazardous		7.5		218.0		3.4%
Hazardous		0.7		49.2		1.4%
Recycling	34.0		131.5		25.9%	
Operating costs	210.1		4,923.6		4.3%	
Disposal	186.7		3,680.9		5.1%	
Non-hazardous		106.7		2,466.2		4.3%
Hazardous		80.0		1,214.7		6.6%
Recycling	23.3		1,242.7		1.9%	

(continued)

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

	Michigan		U.S.		Michigan Share of U.S.	
Pollution prevention	140.9		2,767.9		5.1%	
Other expenditures	115.2		3,154.5		3.7%	
Site cleanup	51.6		1,039.3		5.0%	
Remediation		48.0		827.3		5.8%
Replacement		0.6		83.1		0.7%
Other		3.1		128.8		2.4%
Habitat protection	6.9		155.2		4.4%	
Monitoring/testing	14.3		599.5		2.4%	
Administration	42.4		1,360.4		3.1%	
Other payments						
Payments to government	30.8		959.1		3.2%	
Permits/fees	27.8		816.6		3.4%	
Fines/penalties/charges	1.5		116.3		1.3%	
Other	1.5		26.2		5.7%	
Tradeable permits - bought	-		20.2		-	
Tradeable permits - sold	-		23.7		-	
Tradeable permits - other	-		12.6		-	
Total	1,093.2		29,934.6		3.7%	

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

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THE JOBS AND ENVIRONMENT INITIATIVE

The Jobs and Environment Initiative was founded in 2004 by Paula DiPerna, former President of the Joyce Foundation, Vice-President for International Affairs for the Cousteau Society and a widely published policy analyst and author. The objective of the Initiative is to highlight that many good, stable jobs for people in all walks of life are created by environmental management. The Initiative seeks to describe and analyze current jobs benefits of environmental management, bring further public and policy attention to the strength and scope of the environmental industry, examine potential for

further jobs creation, and improve understanding of the positive contributions of environmental management to economic growth and employment generation, at local, state, regional, national and international level. The Initiative is a collaboration between Management Information Services, Inc. (www.misi-net.com) and the Building Diagnostics Research Institute (www.buildingdiagnostics.org). For further information contact Paula DiPerna at 607-547-8356

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