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Industry Study

Final Report
Environment Industry

The Industrial College of the Armed Forces
National Defense University
Fort McNair, Washington, D.C. 20319-5062

ENVIRONMENT INDUSTRY STUDY

ABSTRACT:
The Environment Industry and the broader environment sector -- which comprises the environmentally-motivated activities of other industries – are important and growing, and touch on virtually every other industry, from agriculture and manufacturing to energy and utilities. The industry will play an increasingly important role in national security, disaster risk reduction and reaction to climate change, while leading the way to energy independence and a cleaner, safer world. The industry's future is inextricably linked to environmental awareness and concern, and to government's willingness to promote "green" endeavors.

Mr. Robert Bare, Dept. of State
Col (select) Marc Berkstresser, U.S. Air Force
Ms. Katherine Brucker, Dept. of State
Ms. Winona Cason, Dept. of Homeland Security
LtCol Daryl Crane, U.S. Marine Corps
COL Marty Downie, U.S. Army
COL Ayman Elsheikh, Egypt
Mr. Charles Ford, Dept. of Homeland Security
Col Kevin Gaudette, U.S. Air Force
COL Trey Jordan, U.S. Army
Col Chuck Killion, U.S. Air Force
Mr. Brett Lambo, Dept. of Homeland Security
Ms. Brenda Lee McCullough, Dept. of the Army
COL Mohamed Mselmi, Tunisia
COL Fern Sumpter, U.S. Army

Dr. Greg Foster, Dept. of National Security Studies, Faculty
Ms. Erin Soto, U. S. Agency for International Development Chair
COL Tom Steffens, Dept. of Economics
Dr. Leanne Viera, Industry Chair, IBM

PLACES VISITED

• **Domestic**:

Bechtel Corporation, San Francisco, CA
Chesapeake Bay Foundation, Annapolis, MD
Covanta Resource Recovery Facility, Alexandria, VA
Embassy of Fiji, Washington, DC
Embassy of Japan, Washington, DC
Hamilton Army Airfield Wetlands Restoration Site, Novato, CA
Lawrence Berkeley National Laboratory, Berkeley, CA
Pacific Gas and Electric, San Francisco, CA
Packard Foundation, Los Altos, CA
San Francisco Bay Conservation and Development Commission, San Francisco, CA
SF Environment, San Francisco, CA
Silver Lake Kraftwerk, San Carlos, CA
Tioga Energy Company, San Francisco, CA
U.S. Export Assistance Center/U.S. Commercial Service, San Francisco, CA
Washington Aqueduct, Washington, DC
Webcor Consulting and Builders, San Francisco, CA
U.S. House Committee on Natural Resources, Washington, DC
U.S. Green Building Council, Washington, DC
U.S. Senate Committee on Environment and Public Works, Washington, DC

Visitors:

ARCTECH, Inc.
Booz Allen Hamilton
Center for International Environmental Law
CH2M Hill
CNA Corporation
U.S. Department of Commerce
U.S. Department of State, Bureau of Oceans and Environmental Science
Dr. Desray Reeb, Marine Mammal Researcher
Environmental Council of the States
Environmental Defense Fund
Environmental Protection Agency
Environmental Council of the States
Export-Import Bank of the United States
Federal Environmental Executive, CEQ
Global Environmental Facility
Gregori Consultants, LLC
Hogan Lovells
IBM
Mitsubishi

National Aeronautics and Space Administration
National Marine Sanctuary Foundation
National Oceanic and Atmospheric Administration
Office of Maryland Attorney General
Parsons
Resources for the Future
Rocky Mountain Institute
Smithfield Foods
Soyka & Company, LLC
Sustainable Community Development Group
The Ocean Foundation
TSN Global Consultants
UN Foundation
USAID
Veolia Energy North America
Washington Post
Waste Management
Woodrow Wilson Institute
World Business Council for Sustainable Development

• **International**:

University of the South Pacific, Suva, Fiji
U.S. Embassy, Suva, Fiji
UNDP, Suva, Fiji
International Union for Conservation of Nature, Suva, Fiji
World Wildlife Federation, Suva, Fiji
Gesellschaft für Internationale Zusammenarbeit (GIZ), Suva, Fiji
Mangrove Ecosystems for Climate Adaptation and Livelihoods, Suva, Fiji
Asian Development Bank, Suva, Fiji
Fiji Department of Environment, Suva, Fiji
Secretariat of the Pacific Community, Suva, Fiji
Fiji Electrical Authority, Suva, Fiji
AusAID, Australian High Commission, Suva, Fiji
U.S. Embassy, Tokyo, Japan
Japan Ministry of Environment, Tokyo, Japan
National Institute of Environmental Studies, Tsukuba, Japan
Tokyo University (Kashiwa Campus), Kashiwa, Japan
Smart City, Tsukuba, Japan
Mizuho Bank, Tokyo, Japan
Japan International Cooperation Agency, Tokyo, Japan
International Tropical Timber Organization, Yokohama, Japan
United Nations University, Tokyo, Japan
Greenpeace, Tokyo, Japan
Hitachi GE, Tokyo, Japan

INTRODUCTION

The environment, and hence the Environment Industry, touches on every aspect of human existence. The availability, abundance and quality of clean air and water are essential to sustain life. Where these are threatened by scarcity and pollution, remediation and regulation are required to restore balance and stem further degradation. Manufacturing, agriculture and energy support and enhance the quality of life, yet all produce significant negative externalities that threaten air and water quality. Here again, technology, innovation and regulation – coupled with a vibrant civil society – are essential to restore balance and mitigate unintended consequences. Normal human activity also has profound effects on the environment. Clearing woods for agriculture or construction destroys carbon sinks – natural protection against CO2 emissions.

To say the environment is global might be stating the obvious, but it is important nonetheless to reiterate because polluted air and water are unconstrained by national boundaries. Preventing global environmental problems requires harmonized, enforceable international standards. Even localized environmental problems, such as scarcity, can have international effects. Lack of water leads to population displacement, which puts undue pressure on limited resources elsewhere (usually cities), and can destabilize already weak states.

The Environment Industry Study considers the environment and its related industries, as well as the interlocking set of systems around it. This study was conducted through briefings, field trips and domestic and international field studies. To comprehend and deal with the environment, we must explore not only first, second and third order effects, but also first, second and third order causes. It is just as important to recognize that regulations governing fertilizer used on farms in New York affects water quality in the Chesapeake Bay, as it is to understand that obesity engenders dependence on fossil-fuel-heavy transportation, and thus is a leading contributor to CO2 emissions. The challenge in managing the environment, and the Environment Industry, is in balancing the legitimate needs of a large group of diverse stakeholders on a finite set of resources.

Seen in this light, the Environment Industry -- if not at the center of other industries – at least touches them all.

Industries compete for limited natural resources.
The EI is the key for managing diminishing resources.

THE ENVIRONMENT INDUSTRY DEFINED

The Environment Industry is not easily defined. Attempts to do so are imperfect because environmental activity cuts across industries. What is classified as the Environment Industry doesn't begin to capture the scope of environmentally-motivated commercial activity. A much larger environmental sector includes a broad range of "green" products and services, and the research and development behind them. This report considers the broader environment sector.

To the extent that it has been recognized and defined, we can say that the Environment Industry, born out of the necessity to protect and manage natural resources, comply with new laws and regulations, and respond to emerging public awareness, has grown into a multi-billion dollar industry. It has contributed to the gross domestic products of nations worldwide, bringing new and innovative solutions to global environmental challenges. The industry's viability is evident in over two decades of market data detailing its growth and longevity in revenue generation.

The Environment Industry is a monopolistic competitive, multibillion dollar, diverse economic contributor to the world economy. It is an industry in every sense of the word, consisting of environment and environment-related goods and services, classified by the Office of Management and Budget's North American Industry Classification System (NAICS). The Environmental Business International, Inc. (EBI), EB Journal (EBJ) defines the Environment Industry as "all revenue generation associated with environmental protection, assessment, compliance with environmental regulations, pollution control, waste management, remediation of contaminated property and the provision and delivery of environmental resources."[1] This runs the gamut from solid waste management and air pollution control equipment to resource recovery and clean energy systems and power. The chart below from EBJ provides a snapshot of the public and private Environment Industry companies by sector.[2]

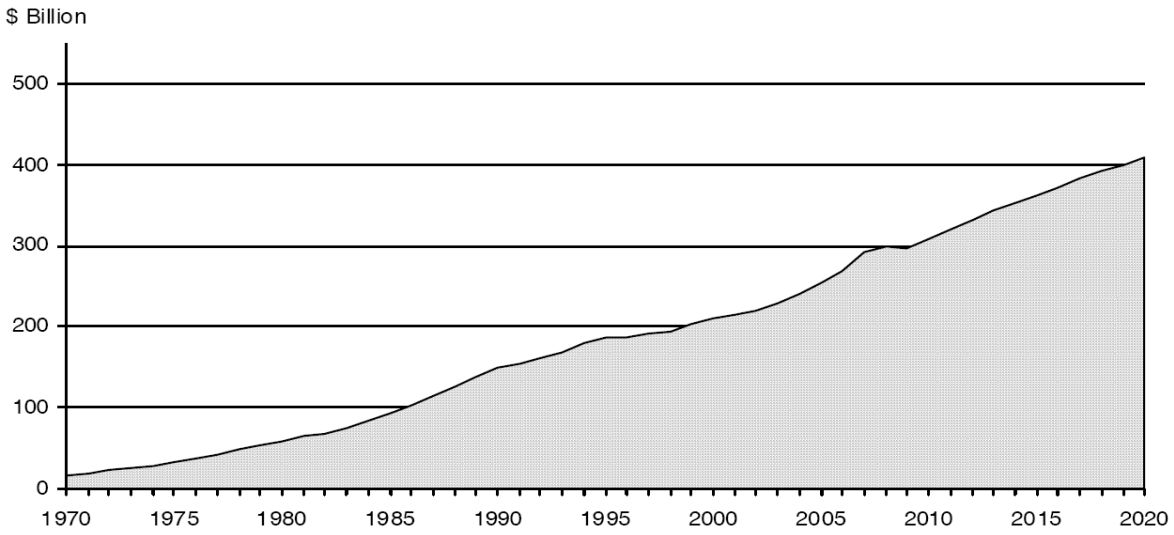
Segment	Description	Examples of Clients
Environmental Services		
Environmental Testing & Analytical Services	Provide testing of "environmental samples" (soil, water, air and some biological tissues)	Regulated industries, Gov't, Environmental consultants Hazardous waste and remediation contractors
Wastewater Treatment Works	Collection and treatment of residential, commercial and industrial wastewaters. These facilities are commonly know as POTWs or publicly owned treatment works.	Municipalities, Commercial Establishments & All industries
Solid Waste Management	Collection, processing and disposal of solid waste	Municipalities & All industries
Hazardous Waste Management	Manage on-going hazardous waste streams, medical waste, nuclear waste handling	Chemical companies Petroleum companies Government agencies
Remediation/Industrial Services	Physical cleanup of contaminated sites, buildings and environmental cleaning of operating facilities	Government agencies Property owners Industry
Environmental Consulting & Engineering (C&E)	Engineering, consulting, design, assessment, permitting, project management, O&M, monitoring, etc.	Industry, Government Municipalities Waste Mgmt. companies, POTWs
Environmental Equipment		
Water Equipment & Chemicals	Provide equipment, supplies and maintenance in the delivery and treatment of water and wastewater.	Municipalities & All industries
Instruments & Information Systems	Produce instrumentation for the analysis of environmental samples. Includes info systems and software.	Analytical services, Gov't Regulated companies
Air Pollution Control Equipment	Produce equipment and tech. to control air pollution. Includes vehicle controls.	Utilities, Waste-to-energy Industries, Auto industry
Waste Management Equipment	Equipment for handling, storing or transporting solid, liquid or haz. waste. Includes recycling and remediation eqmnt.	Municipalities Generating industries Solid waste companies
Process & Prevention Technology	Equipment and technology for in-process (rather than end-of-pipe) pollution prevention and waste treatment and recovery	All industries
Environmental Resources		
Water Utilities	Selling water to end users	Consumers, Municipalities & All industries
Resource Recovery	Selling materials recovered and converted from industrial by-products or post-consumer waste	Municipalities Generating industries Solid waste companies
Clean Energy Systems & Power	Selling power and systems in solar, wind, geothermal, small scale hydro, energy efficiency and DSM	Utilities All industries and consumers

ENVIRONMENTAL INDUSTRY SEGMENT	COMPANIES/ENTITIES
Services	
Analytical Services	1,050
Wastewater Treatment Works (mostly public sector)	***26,400***
Solid Waste Management (private companies only, not including public sector)	9,950
Hazardous Waste Management	580
Remediation & Industrial Services	2,140
Environmental Consulting & Engineering	3,570
Equipment	
Water & Wastewater Equipment & Chemicals	2,110
Instrumentation & Information Systems	780
Air Pollution Control Equipment	1,850
Waste Management Equipment	890
Process & Prevention Technology Equipment	380
Resources	
Water Utilities (mostly public sector)	***61,900***
Resource Recovery	5,090
Clean Energy Systems & Power	1,930
Total	118,620

Yet, capturing the scope of the industry is complicated by its multi-faceted nature. Some 74% of firms in the Environment Industry are publically traded, but the Securities and Exchange Commission has no all-encompassing category for environment industry securities. Instead, except for waste management shares, publicly traded companies providing environmental goods and services are traded in broadly defined categories. For instance, a company providing remediation services (cleanup, disposal, restoration and consulting) will likely trade under the heavy construction industry in the exchange market. This non-environment specific categorization is also used to group firms working complex remediation such as nuclear cleanup and restoration projects involving large and/or specialized construction equipment.

Perhaps reflecting its newness, the Environment Industry, as defined by those who categorize businesses, includes only those activities that respond to environmental problems. This misses the economic activity generated by positive concern for the environment. Whether it is neatly categorized and captured or not, there is no question that the Environment Industry and the larger environmental sector are important and growing. Concerns about CO2 emissions, fossil fuel dependence, energy efficiency, waste disposal and sustainability are driving business and employing more and more people.

Historical and Projected Size of the U.S. Environmental Industry[3]



CURRENT CONDITION

With its far-reaching activities and diverse nature of its firms, the Environment Industry defies easy analysis. Whether work is "environmental" has more to do with the aim of the project than the work itself. Creating or restoring wetlands is clearly an environmental activity, but the bulldozing and planting activities are categorized as construction and landscaping. Moreover, it would be impossible to derive a competent analysis of the industry by combining the financial performance of waste management, renewable energy, construction and water treatment firms. Even so, we can assess various aspects of this sector.

What's Behind the Industry?

Both in the United States and abroad, the Environment Industry is driven by environmental awareness, concern and legislation. Climate change concerns also play an important role. Core "environmental" functions such as remediation and clean-up, stem from the environmental movement in the 1970s and the introduction of standard-setting legislation. This is the purest proof that the environment is a business, hard though it may be for the green-minded to accept. Quite simply, prior to the sweeping environmental legislation of the 1970s, pollution paid. Trash and toxic effluent were externalities and not part of any firm's cost structure. When federal environmental legislation began to force firms to pay for these externalities, it created business opportunities not only for clean-up but also for prevention. Moving from "pollution pays" to "polluter pays" created the "recognized" Environment Industry, while sowing the seeds for a vast market of environmentally-motivated commercial activity. Today, myriad industries and sectors, including construction, landscaping, engineering, energy-generation and packaging are spurred by environmental consciousness.

The Economic State of the Industry

In its 2011 report, the EBJ said the U.S. environment industry generated total revenues in excess of $317 billion, contributing to an $803 billion dollar global market. The credit for generating these revenues goes to the approximately 30,000 private sector and more than 80,000 public sector entities that employed over 1.6 million Americans.[4] Although the market is lucrative, U.S. companies operating in this industry have been vulnerable to economic fluctuations caused by regulatory and policy implementation, volatile market conditions and threats to national security. The market potential, however, is considerable. The clean energy market alone is projected to reach $500 billion annually by 2020, two and a half times the size of the current $200 billion global personal computer market.[5]

The U.S. Environmental Industry, 1980-2010 ($ billions)[6]

ENVIRONMENTAL INDUSTRY SEGMENT	1980	70-80 Growth	1990	80-90 Growth	2000	90-00 Growth	2010	00-10 Growth
SERVICES								
Analytical Services	0.3	300%	2.1	523%	1.8	-14%	1.84	4%
Wastewater Treatment Works	8.4	213%	18.4	119%	28.7	56%	46.91	63%
Solid Waste Management	10.6	236%	26.1	145%	39.4	51%	52.42	33%
Hazardous Waste Management	0.6	315%	6.7	1081%	8.2	21%	8.73	7%
Remediation/Industrial Services	1.6	401%	9.9	534%	10.1	3%	12.18	20%
Consulting & Engineering	1.3	1492%	12.5	856%	17.4	39%	27.02	55%
EQUIPMENT								
Water Equipment & Chemicals	6.9	306%	13.4	93%	19.8	48%	27.15	37%
Instruments & Information Sys.	0.4	265%	2.0	404%	3.8	88%	5.48	46%
Air Pollution Control Equipment	4.5	1122%	11.1	144%	19.0	72%	15.17	-20%
Waste Management Equipment	4.5	134%	8.7	92%	10.0	15%	11.12	12%
Process & Prevention Tech.	0.1	259%	0.4	418%	1.2	183%	1.87	61%
RESOURCES								
Water Utilities	9.3	181%	19.8	112%	29.9	51%	42.13	41%
Resource Recovery	6.1	161%	13.1	114%	16.0	22%	25.25	58%
Clean Energy Systems & Power	4.1	467%	4.8	18%	5.9	22%	40.14	581%
Totals:	**59**	**246%**	**149**	**153%**	**211**	**42%**	**317.41**	**50%**

Factors Affecting the Industry

One of the greatest determinants of the health of the Environment Industry is the extent to which environmental goals, such as emission reduction targets, recycling rates, energy efficiency standards and renewable energy use are backed by **policy**. Codifying emissions standards, subsidizing renewable energy (through producer and/or consumer incentives), and mandating recycling and/or banning non-recyclable products stimulate the industry. Many of these factors are driven by engaged citizens, NGOs and activist states and municipalities. California, for example, has changed industry standards for the entire United States by establishing bold emission limits and energy efficiency requirements. A municipality that prohibits additional landfills, for example, could create a market for waste-to-energy power plants.

Just as the Environment Industry treats **externalities**, it is also affected by other externalities. The advent of **hydraulic fracturing** (fracking) to extract natural gas has opened heretofore inaccessible reserves, driving natural gas prices to record lows. This is likely to have a deleterious effect on renewable energy development in the United States as the impetus to move away from petroleum is more economic than environmental. The recent emergence of vast natural gas reserves offers relief from the economic and foreign-dependence issues surrounding petroleum, as well as cleaner fuel. The near-euphoria surrounding this "solution" is, at this writing, overriding important, unresolved problems, such as: gas escaping during extraction, ground water pollution, and – in some areas – insufficient supporting infrastructure (storage and transmission). Renewables are likely cleaner still, but are not even close to being price competitive when compared to natural gas. If the U.S. government wants to promote renewable energy in the face of falling natural gas prices, even greater incentives might be required.

Foreign competition is a function of the nature of an environmental business. Waste management, construction and other on-site activities are best handled by local firms, even if the firm is a subsidiary of a foreign company. Foreign competition becomes a problem when there is a large manufacturing component and production takes place in countries with much lower labor costs. This has been an enormous problem for the solar industry. U.S. and other western firms continue to try to differentiate on solar panel features (efficiency, durability), but low-cost suppliers in Asia and India have essentially made solar panels commodities.

Consumer-led demand is having a considerable effect on all industries. Growing consumer awareness – often led by NGOs or engaged stockholders -- about climate change, non-recyclable packaging, unsustainable agricultural practices, over-fishing (to name but a few) is pushing companies to change the way they do business. Whether it is McDonald's giving up Styrofoam packaging, Wal-Mart deciding to sell only sustainably caught fish or San Francisco banning plastic bags and Styrofoam, consumers are increasingly driving the environmental agenda. Investor interest in corporate environmental behavior extends beyond ethical issues like recyclable packaging and sustainable fishing. Investors are sharply focussed on profits – recognizing that "green is good" – and avoiding future financial hits, such as from having to clean up or remediate a polluted site, and as a result are pressuring firms to implement appropriate management controls.

The Changing Energy Landscape

Concerns about the safety of nuclear energy – especially in active seismic zones – is leading countries to reassess their energy mix. Following the March 3, 2011 earthquake, tsunami and Fukushima nuclear disaster, Japan shut down all remaining nuclear plants, losing 30% of its power supply. The government's poor handling of the disaster caused popular support for nuclear power to plummet: some 60-70% of Japanese now oppose nuclear energy. Slow initially to embrace renewable energy, Japan could now make a huge investment in this sector – and might well have to if public opinion makes returning to nuclear energy impossible.

CHALLENGES

One of the biggest challenges affecting the Environment Industry is the **climate change debate**. While most scientists don't dispute climate change, or, that in addition to natural global warming anthropogenic (human caused) climate change is occurring, politicians – particularly in the United States – have opened this issue to debate. While public perceptions about anthropogenic climate change might be inaccurate, most industry associations accept the veracity of global warming science, and are working to mitigate its effects by reducing greenhouse gas emissions and/or encouraging adaptation strategies to live with climate change. The few industry associations resisting greenhouse gas emission regulations tend to have a financial stake in selling products that produce CO_2. Still, individual companies are hedging their bets with corporations like BP taking controlling interests in solar energy firms. (See amplification below in Essays on Major Issues.)

Complicating the climate change discussion is the fact that forecasters use multiple models, making it difficult to offer policy makers certainty about what will happen and, therefore, what mitigation and adaptation measures are appropriate. Will storms increase in frequency, severity, or both? At what rate? The generally admonition that wet places will get wetter and dry places drier, does not point to a clear policy path, making it easier for government to postpone action.

Some argue, however, that we don't have to be convinced climate change is a problem; we must only consider the risk we are willing to take. (If the weather man says there is a 60% chance of rain, do you carry an umbrella?)[7] Scientists are convinced that global warming is occurring now, and will cause significant temperature increase and sea level rise for the foreseeable future. Those who deny climate change for financial or other reasons are likely to persist until evidence of larger sea level rises, higher average temperatures, and severe weather is incontrovertible. Overall, industries responding to climate change will probably be more successful than those clinging to the ideas and business practices of the old fossil fuel economy.

An off-shoot of the debate over climate change is the lack of urgency in responding to its effects. Some of this must be attributable to the conceptual difficulty most people face of seeing an immediate threat in a 10 cm sea level rise over the course of 20 years. A possible bright spot (discussed below in the Outlook section) is the growing sense of urgency about, and readiness to address, disaster risk reduction, whose measures mirror those to mitigate climate change effects.

Diverse Policies, Aims and Capabilities Across the Globe

International environmental treaties, protocols and agreements notwithstanding, differing standards, concerns and enforcement undermine the effectiveness of these regimes.

Developing nations, with generally poor waste removal and water treatment systems and low-tech power generation, would, at first glance, be prime targets to jump from rudimentary power generation, for example, to renewable energy (or, waste to energy). This would mirror what so many of them did with telecommunications: from no phones to cell phones (skipping land lines entirely). In a perfect world, they could avoid fossil-fuel based power altogether. This is not unprecedented. A similar energy leapfrog took place in Germany's eastern states which, during the German Democratic Republic era, never got into nuclear power. After reunification in 1990 the eastern states began an aggressive transition from dirty coal fired plants to solar and wind energy. Yet, the expense of renewable energy plants and the imperative to industrialize rapidly are overriding environmental concerns in many developing nations. This is unfortunate given that the industrial revolution showed what unbridled industry could do to the environment, and technology today would allow emerging economies to escape this degradation.

Lack of Economies of Scale in Smaller Nations

Another sign that environmentally sound behavior must be underpinned either by policy or commercial viability is the fact that many small countries lack either the population or the population concentration to make refuse removal, recycling and/or waste water treatment cost-effective. Suva, the capital and largest city of Fiji, has a population of about 80,000. A U.S. waste management firm, sensing an opportunity to collect and dispose of solid waste, lost all interest in the idea upon learning that Suva did not generate enough refuse to make a waste-to-energy plant profitable. In the meantime, waste in Fiji is either burned or sent to landfills.

Waste water disposal is even a bigger problem, especially for small island states where the sea supports local fisherman and often serves as a tourist draw. Here again, the case of Fiji is instructive. The largest island has a total population of 150,000, dispersed among hundreds of small villages and a few larger cities. Resorts are often nestled in under-populated areas where no central water treatment exists. The villages and resorts are left to their own devices to dispose of waste water, and absent means (villages) or willingness (resorts) the waste often flows directly into the sea. Lack of enforcement capability and susceptibility to corruption prevent the Government of Fiji from going after the resorts while lack of political responsiveness keeps it from helping the villages. This is especially unfortunate given the relatively low cost of installing a low-tech, environmentally-friendly water treatment system – a village of 300 in western Fiji having done so for about $200,000.

Supporting Environmental Goals with Policy

Altruism and the profit motive will only go so far in spurring environmentally-friendly business. At some point stated goals to reduce dependence on foreign oil, promote renewable energy use, or improve energy efficiency must be backed by policy. Whether such policy cuts through red tape (as in efforts to reduce the fixed costs of installing residential solar panels) or creates incentives, it can boost usage to the point where companies can achieve economies of scale, making the product or service affordable to all. Moreover, government intervention might be necessary to get firms make environmentally sound decisions now – effectively forcing them to pay for the externalities from the beginning instead of later, when legislation is finally enacted to change their

behavior. However necessary such policy actions might be, they are likely to be controversial, either for their content, expense, or attack on vested interests.

Measuring and Quantifying the Intangibles
Where it is easy for firms and entities to embrace environmentally-friendly practices when cost savings can be quantified, it is more difficult to win support with the promise that a LEED (Leadership in Energy and Environmental Design) certified building, for example, will create a better work environment, making for happier, more productive workers. Until there is a body of evidence documenting and quantifying the increased productivity, reduced absenteeism and lower employee turnover of firms implementing "soft" environmental measures, the rate at which businesses adopt such practices is likely to remain low.

OUTLOOK

The challenges just described notwithstanding the outlook for the Environment Industry is promising. In the first instance, there is growing public interest and consumer demand for environmentally responsible products and environmentally sustainable business practices. This coincides with flourishing technological advances that make "going green" not just possible but also profitable. Moreover, the military is demanding more in clean and efficient energy, both to reduce enormous fuel costs for the Department of Defense and to obviate the need for frequent fuel deliveries to troops in the field, convoys being popular targets for insurgent and IED attacks.

National Security Requirements
The Environment Industry can play a significant role in helping the United States meet its national security requirements. Boosting **renewable energy** use reduces our dependence on foreign energy suppliers and the concomitant need to employ military resources to protect these energy supplies and shipment routes. By one estimate, a 30% reduction in U.S. petroleum use would significantly enhance national security.[8] Similarly, widespread use of solar panels on DoD buildings (including base housing) could cut energy costs dramatically and conserve more of the DoD's shrinking budget for activities tied directly to national defense.[9]

Reducing fossil fuel dependence is a national economic security issue for many countries. According to the Asian Development Bank, fossil fuels constitute the single largest import bill for Pacific nations.[10] Indeed, 9.3% of Fiji's national diesel imports support the power industry. If the Fiji Electrical Authority achieves its goal of going from 60% renewable energy in 2012 to 90% by 2015, its share of national diesel imports will drop to 2.8%.[11]

Short term (1-5 year) outlook is good, but cautious. Waste management and recycling should continue to be strong. Renewable energy will be volatile as U.S. and European firms struggle to compete with low-cost producers. We can expect more municipalities to sharpen recycling requirements, limit landfill expansion, and enact other pollution control measures, increasing the market for environmental goods and services. The outcome of the 2012 U.S. presidential elections will affect the activist nature of national environmental policy.

With or without a change in the White House we should see increased focus on energy efficiency and energy conservation. Greater strides in fuel and energy efficiency will reduce the need for behavior changes. Indeed, efficiency is the most effective energy saver. With businesses increasingly seeing the value in adopting sustainable practices and the vast profits to be made in the move toward sustainability and otherwise "going green," we can anticipate strong growth in the related consulting, construction and engineering services sectors.

In the long term (10-15 years) we are likely to see more urgency in the environmental sector. Any political and administrative dallying in the short term will present policy makers with unavoidable decisions later on as the effects of climate change become undeniable. Sea level rise in the San Francisco Bay, for example, will convert the new baseball stadium into a potential Sea World venue by 2030.[12] If mitigation measures are not put in place beforehand, cities will have to take urgent action to shore-up low-lying areas or to relocate residential and commercial activities. In a more positive sense, advancements in the short-term will have synergistic effects that will accelerate environmental business in the longer term. Solar energy and hybrid and electric cars, just to mention two, have not yet reached the level of saturation to achieve economies of scale. When installing residential solar panels becomes truly affordable, for instance, more and more households will add them.

Political, economic and social factors affecting outlook

Big growth in the environmental sector will depend of the convergence of public pressure and political will to incentivize green activity. This includes, but is not limited to: tax credits for green energy and possibly lifting subsidies to oil companies and/or raising taxes on gasoline. Indeed, lack of a carbon tax has been cited as the single biggest impediment to renewable energy development.[13] Lifestyle choices will also play a role, such as individuals giving more weight to access to public transportation when deciding where to live and work.

Closely related to this is the network effect. Bio-fuels, electric cars and residential roof-top solar are in their infancy and thus lack adequate infrastructure. At some point, the number of electric or hybrid cars will make it profitable to have a large network of charging stations. Some of this can be accomplished with incentives. Once an electric vehicle can be charged easily almost anywhere, more and more people will be willing to purchase them.

Is industry positioned to respond to challenges?

Industry is perhaps more technically than politically prepared to respond to environmental challenges. On balance, willingness and alacrity of response are a function of a firm's or industry's perception of the environmental threat and any penalties for non-compliance. Not unexpectedly, industries involved in the production of petroleum products or dependent on the same for their operations tend to be slow to adopt greener technologies, proving, perhaps, that not all the fossils are in the fuel.

Nevertheless, there are promising signs that firms find it both profitable and desirable to be green. Reporting requirements are prompting some companies to make voluntary emission reductions, avoiding the negative publicity on how much they pollute. In the same vein, a strong incentive for ISO 14001 compliance is not the annual savings but rather the aim of avoiding the multi-million dollar clean-up when incremental emissions combine to result in a major disaster.[14]

The National Defense Industrial Association (NDIA) takes a pragmatic view of global warming and fossil fuel use, quoting Marine Gen James N. Mattis: "release me from the tether of fuel."[15] The president of the NDIA writes that America "needs to further exploit solar, geothermal and wind power," and that the "military is interested in more efficient and renewable forms of energy on the battlefield."[16] Indeed, the military's insistence on renewable energy and more efficient fuels could be a driving force in pushing industry. As a member of a recent advisory board titled "National Security and the Threat of Climate Change" the NDIA president and board "decided to accept the fact of global warming" and to "determine how these effects could drive human conditions that would result in situations requiring a military response."[17]

Perhaps the greatest promise for spurring sweeping change lies with the **insurance industry**. While others are debating the danger and rate of climate change and sea level rise, insurers (and re-insurers) are already reacting. A collaborative report by the 300 year-old Lloyd's Insurance company and Risk Management Solutions predicts that with a 30 cm sea level rise and no adaptation "insurance losses from coastal flooding for high-risk properties could double by 2030."[18] The risk will be exacerbated by the growth of coastal mega-cities, with greater than half the world's population projected to live within 100km of the coast in 25 years' time.[19] The report states that without serious greenhouse gas mitigation action, an aggressive program of adaptation can help keep premiums affordable -- for a while. Eventually, however, "risk-informed development planning" must be combined with adaptation to reduce total risk.[20] The report sagely concludes that "the world cannot insure its way out of climate change."[21] As if to reinforce this point, the insurance industry is raising rates for properties in some low-lying coastal areas and even refusing to write policies in others.

Disaster Risk Management – Circumventing Climate Change Mitigation Lethargy

Where the slow pace of climate change fails to excite urgency in implementing adaptation and mitigation measures, the palpable danger of more frequent and intense storms, flooding and erosion is spurring action, both by governments and individuals. The threat of natural disasters is far more acute to individuals, making it easier to win support to shore up wetlands areas, construct, reinforce or raise levees, or move people out of flood plains.

GOVERNMENT GOALS AND ROLE

The environment is a dynamic system of overlapping and complimentary concepts, issues, missions, activities, laws, and other driving forces. Government is almost an ecosystem of its own. Some organizations and functions drive conservation, protection, sustainability, and enforcement, while others rely upon the health and vitality of the environment to further their strategic or operational ends. Still others exist to leverage the environment for strategic, economic, or social priorities.

Generally speaking, government's role in the environment revolves around conservation, protection, sustainability, strategy, economy, and society. Government's functional approach to these themes, however, does not make for a simple organizational chart. Government is first and foremost a legal and regulatory enforcer of environmental prescripts. It is also responsible for the health and welfare of its people, to include air, water, land, food, agriculture, and social conditions.

While safeguarding the future by encouraging, incentivizing, or requiring sustainable practices, government must also promote environmental science and technology and ensure a robust economy. It must support our security and strategic interests in the world, and consider energy security, sustainable development, and potential strategic and security shifts related to the environment or secondary/tertiary impacts of climate change and the environment. When environmental issues become policy goals, as in the drive for greater use of renewable energy, the government takes on an activist role with incentives, subsidies and other efforts to encourage the development and use of new technologies.

Reflecting the wide variety of environmental issues and the fact that the environment touches every aspect of human existence, there are numerous U.S. government agencies with specific roles and responsibilities for protecting and managing the environment. The **Environmental Protection Agency** (EPA)'s mission is succinct, but not simple. "The EPA protects human health and safeguards the environment."[22] Organized along four core functional areas: air and radiation; solid waste and emergency response; chemical safety and pollution protection; and research and development, the EPA develops national environmental policies, regulations, standards, and enforcement regimes to safeguard air, water, land, and ecosystems from harmful pollution, emissions, and contamination. The EPA works closely with state regulators and industry stakeholders to coordinate development, implementation, and enforcement of new and existing environmental standards. Despite its leading role, the EPA is not a Cabinet agency, which affects its authority and the primacy of the environment in U.S. policy.

The **Department of Agriculture**'s (USDA) mission is "to provide leadership on food, agricultural, and environmental issues by developing agricultural markets, fighting hunger and malnutrition, conserving natural resources, and ensuring standards of food quality through safeguards and inspections."[23] Its thematic focus is on sustainability, conservation, science, technology, and incentivizing environmentally sustainable activities. Agriculture at its very core has everything to do with the environment. The health and vitality of the agricultural sector depends on clean water, air and soil, and environmentally sound practices. The USDA also manages the Forest Service and through its Natural Resources and Environment Division "…is responsible for fostering sound stewardship of 75 percent of the Nation's total land area."[24]

The National Oceanic and Atmospheric Administration (NOAA) resides within the **Department of Commerce.** A unique blend of science, research, operations, and oversight, NOAA operates the National Marine Fisheries Service, the National Ocean Service, and the Office of Oceanic and Atmospheric Research. These units work to balance our need to use coastal resources with the long-term health and sustainability of the natural resources contained within them.

Energy and the environment are inextricably linked. Most environmental issues are tied to energy production and consumption. Energy, however, is not wholly about the environment. Is clean energy an economic pursuit or an environmental one, or both? Would clean technology and clean energy be necessary or desirable without environmental concerns? Energy security has emerged as a driving force in strategic, political, social, and economic activities. With its broad energy mission, the **Department of Energy** (DOE) is in the middle of this conversation. DOE's environmentally-related portfolio covers Infrastructure and Environment, Environmental Management, Civilian Radioactive Waste Management, Science Program, and hydro-electric

power. DOE is also responsible for our national nuclear arms complex, including ensuring the environmentally sound management and disposition of those assets.

The **Department of the Interior** (DOI) manages the Nation's public lands and all things that exist within or on top of those lands, as well as all things that pass through them. DOI deals heavily in conservation of natural resources through its Fish, Wildlife, and Parks organization, as well as ecological and environmental protection related to this conservation mission. The DOI also operates the Bureau of Land Management that is principally concerned with striking a balance between use and productive exploit of public lands, and the environmental, ecological, economic, and social imperatives that relate to them.

Beyond agencies with obvious environmental responsibilities are many where the environment can have a profound effect on their activities. The **Department of Defense** (DOD) sees the environment as a macro-level global security concern, but it also deals with environmental issues as they touch on operations. DOD is a large operator of facilities and equipment that not only could harm the environment, but also are also prime targets for cost and operational efficiencies. Renewable energy, recycling and waste management are leading areas for significant benefits to supply chain, logistics, and sustainment.

Environmental standards and enforcement regimes are bound by international agreements, treaties, and accords which the **Department of State** negotiates. Through our Embassies and Consulates overseas the Department reports on economic, social and political issues that cause, contribute to or exacerbate environmental stress, as well as resulting threats to security.

The **United States Agency for International Development** (USAID) promotes development activities in parts of the world with the highest risk and opportunity for environmental action. "The Agency's environmental programs support two strategic goals: reducing long-term threats to the global environment, particularly loss of biodiversity and climate change; and promoting sustainable economic growth locally, nationally, and regionally by addressing environmental, economic, and developmental practices that impede development and are unsustainable."[25]

The **White House Council on Environmental Quality** (CEQ) provides a chapeau of sorts in its effort to ensure that U.S. environmental policy is underpinned by a strong science and policy basis. It aims "to move the nation to greater reliance on clean energy, and increase energy security, to combat global warming while growing the green economy, to protect public health and the environment, especially in vulnerable communities, and to protect and restore … ecosystems."[26] The inclusion of environmental justice in the CEQ's mandate is important as environmental problems -- both in the United States and elsewhere -- were historically "solved" by foisting them off on communities and populations ill-prepared to resist. Barges of toxic waste being dumped on unsuspecting developing countries is a contemporary example of this problem, but soil, water, air and noise pollution are still more commonly found adjacent to disadvantaged populations.

Complementing and complicating this dizzying array of federal offices are the environmental policy and enforcement arms (and, in some places, natural resource agencies as well) of state, county and municipal governments that mightily affect the landscape of environmental governance because although environmental standards might be federal, implementation is up to the states.

On top of this are international regimes, including treaty secretariats, the United Nations Environmental Program and the UN Commission on Sustainable Development.

ESSAYS ON MAJOR ISSUES

The Climate Change/Global Warming Debate

The National Oceanographic and Atmospheric Administration clearly states that "there is no scientific debate" on the rise of greenhouse gasses caused by human activity.[27] Similarly a recent study conducted at the University of Illinois concluded that the "debate on the authenticity of global warming and the role played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term climate processes."[28] The challenge is "how to effectively communicate this fact to policy makers and to a public that continues to mistakenly perceive debate among scientists."[29] Interestingly, the few scientists skeptical of climate change have less expertise and experience than those convinced of global warming veracity, measured by the number of publications each group has written.[30]

The reasons for the debate are varied, but many with ties to the oil and gas industry see global warming as a threat to their business.[31] Strategies to mitigate climate change invariably center around reducing carbon dioxide emissions, which means burning (and selling) less fossil fuel. Business interests opposed to these changes strive to discredit climate change science, and create doubt about the need for mitigation among the general public.[32] Even the term "global warming" has become politicized and is often replaced with the more innocuous "climate change" idiom, which is now giving way to calls for "clean energy" and "energy independence."[33] The term "greenhouse gas" is also being modified to "carbon pollution" and "heat-trapping emissions," allegedly to make global warming understandable to the public.[34]

There is cultural resistance to the idea of global warming. In the industrial world several generations have prospered in a fossil fuel economy. Many such individuals don't see viable alternatives to oil and gas, and feel threatened by a movement that encourages less reliance on oil. Hence, the subject has become contentious and as "toxic"[35] as topics such as abortion and gun control. Climate change mitigation affects the cost and easy access to American mobility (which many see as a right), and the methods used to heat and cool U.S. homes. Cultural behaviors are some of the most difficult and entrenched types of actions to change.[36] Even though there is "overwhelming scientific consensus that global warming is indeed happening and humans are causing it,"[37] additional proof will probably be required before the general public widely supports more effective climate change mitigation strategies. Unfortunately additional proof will probably take the form of temperature and sea level rise, and extreme weather events. These planetary changes could prompt world leaders to pursue unproven geo-engineering projects, which many experts view as ineffective.[38]

Marc Berkstresser

Sustainability

Economics has long been an enemy of environmentally sound behavior. As long as pollution costs were not assigned to polluters, and firms saw an inexhaustible supply of resources, there was no incentive to behave in a sustainable manner. This is changing. Increasingly firms are opting for sustainable practices and operations. ISO 14000 or other environmental management systems (EMS) work to make sure every employee, section or division incorporates sustainability into every business decision. Evidence is mounting that such systems not only improve business profitability, they also improve employee morale. PNC bank decided to increase its number of LEED certified buildings (a component of an EMS strategy) to just over half its 931 branches. In those branches annual revenue is more than $3 million higher, loan balances are almost $1 million higher and the per capita cost of utilities was almost $700 less on average. One of the main factors in the increased profitability was a more engaged and satisfied workforce that was consequently more productive.[39]

Another decision businesses can make to improve sustainability is to view compliance with government environmental regulations as a competitive advantage and not a cost. Since its founding in 1970 the U.S. Environmental Protection Agency (EPA) has been both championed as a saver of the planet, and vilified (by big business) as a profit killer. Yet its enforcement of the Clean Water and Clean Air Acts as well as various other environmental regulations has made the air and water in 2012 much cleaner than in 1970. It has forced businesses pay the external cost of environmental pollution (the "polluter pays" principle) and made consumers aware of the true costs of any product or service. Indeed, several studies of the Clean Water Act alone have shown that compliance benefits society to the annual tune of $32 to $142 billion. [40]

A truly forward-looking business should not fight the EPA but rather embrace compliance as a competitive advantage. An instructive example is a green building retrofitting program in Chicago. One of the big challenges to retrofitting buildings to achieve LEED certification is the upfront cost. While it is easy to calculate the ten or twenty year reduction in energy costs that such retrofits will bring, it is difficult for small landlords to afford the initial costs. The Energy Savers project of Chicago stepped in to solve this nettlesome problem by helping small landlords put together a plan to retrofit a building and then finding funding via grants, loans or tax credits.[41] As with the PNC bank case, these new green buildings have attracted more tenants than traditional buildings. Retrofitting thus increased rental income and decreased energy usage, which are both a boon to the small landlord's bottom line.

The last way in which sustainability can improve a company's bottom line is financial performance and value creation. If a company adopts sound EMS practices and makes regulatory compliance a corporate mission, do investors believe that such practices increase the company's value? Both the PNC bank and Chicago landlord examples show that green buildings increase employee productivity, reduce costs, and attract new clients, all of which are positive attributes when investors analyze companies for value creation. In addition, several analyses have shown that a portfolio of investments focused on sustainability have outperformed non-sustainable portfolios over medium-term periods (15-20 years).[42] While there is some variability in the data and more analysis is needed, this research shows that when companies incorporate sustainability into their business philosophy by making investments in things like green buildings, waste reduction, and energy efficiency, profits and employee productivity increase, leading to more profits and better

investor value. Not all investments in sustainability increase profits and so companies need to constantly assess the efficacy of such initiatives. But what is very clear is that businesses that seek only to reduce cost and discount negative externalities in business plans will be punished both in profitability and in the markets.[43]

Robert Bare

The Legal Environment of the Environmental Industry

The global environmental industry was born from society's recognition of the need to conserve finite resources, preserve quality of life and achieve sustainability at the local, regional, national and international level. The rule of law is consistently applied to achieve these ends. Regulations, statutes, and international treaties drove the evolution of the industry that grew out of the environmental movement and will continue to drive its growth in the future.

In the United States, there was early recognition of the need to conserve shared natural resources. A 1671 law passed by the South Carolina Colonial Assembly—and still in effect—made it a punishable offense to pollute any "creeks, streams or inland waters" with pollution harmful to fish or their spawn.[44] Rachel Carson's *Silent Spring* (1962), an exposition of the dangers of unregulated pesticide use, is widely recognized as one of the galvanizing forces that led to the establishment of the Environmental Protection Agency (EPA) in 1970 and a concomitant explosion of federal environmental legislation and regulations in the 1970s and 1980s, during which time international environmental law also saw a surge of development. Before 1974, there were fewer than 36 international environmental agreements, there are now "nearly nine hundred international legal instruments that are either primarily directed to international environmental issues or contain important provisions on them."[45]

Environmental laws generally fall into two categories: those imposing specific, substantive regulatory environmental controls and those focused on environmental planning and information transfer. Within water, air, or soil pollution, the statutes generally provide for protective standards based on either health or technology standards, or both, usually allocating costs on the polluter pays principle.

Garrett Hardin's 1968 article, "The Tragedy of the Commons," accurately noted the need for "coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated," and presaged the passage of the pollution prevention statutes of the 1970s and 1980s as well as the necessity for the creation of the EPA to administer the complexities of those statutes.[46] The need for legal regimes to protect the commons has increased as globalization, industrialization of developing nations, and populations have all increased. We are also seeing a greater demand for hard scientific evidence of compelling need (as with climate change and renewable energy), rather than universal adoption of the precautionary principle as in some of the pollution prevention statutes and the United Nations Framework Convention on Climate Change.

Still, the tensions evidenced by Rachel Carson's demand for more information from the pesticide industry are echoed today by the demands of Non-Governmental Organizations (NGOs) like the

Environmental Defense Fund (EDF) for more information regarding the chemicals used by the gas industry in hydro-fracturing. Where the federal government fails to step in, NGOs and state and local governments are more likely to engage—and with strategic effect. California and the Environmental Defense Fund (EDF) partnered in 2002 to pass a precedential law for automobile fuel economy. After fourteen other states followed, EDF successfully fended off legal challenges from the automotive industry and established State authority to individually regulate. This success compelled the industry to accept a single, stricter federal standard rather than face 50 separate State standards.[47]

Finally there is growing emphasis on the intersection between environmentalism and economics. Sustainability as an ideal is increasingly used economic efficiency as well as environmental protection as seen in its use by corporations like Bechtel as a differentiation from their competitors and by local agencies like the San Francisco Department of Environment to promote pollution reduction. With revenues nearing one billion dollars, there is reason for optimism that the environment industry will continue to be a critical part of the global economy.

Chuck Killion

Environment and Security: Threats and Opportunities

The environment has seldom, if ever, caused armed conflict. It has, however, contributed to tensions that erupted in violence. In addition, according to the United Nations Environmental Program, "since 1990, at least eighteen violent conflicts have been fuelled by the exploitation of natural resources."[48] Thus the environment figures prominently in conflict. But, because the environment is so fundamental to human existence and activity, cooperation on environmental issues can be an important confidence and security-building measure between states that might otherwise be unwilling to meet.

Some of the most fragile states and regions of the world are beset with environmental problems, notably water scarcity, desertification and pollution. These problems beget others. Population displacement puts more stress on the same scare resources elsewhere, and often prompts other friction, as between farmers and herders. If different clans are associated with different livelihoods another complicated dimension as added to the mix. In addition, sweeping political changes in the early 1990s converted domestic environmental assets into trans-boundary assets, notably in the former Soviet Union and the former Yugoslavia. Where conflicting claims by legitimate stakeholders was once handled internally, they now require international negotiations.

Possible Avenues of Cooperation on Environmental Issues

While environmental issues are often part of the problem, they can also be part of the solution. Technical cooperation can provide an avenue for dialogue where none other exists and has led – as with Israel and the Palestinians – to higher level, political contacts. Similarly, under the auspices of the International Tropical Timber Organization, a forest management program with Ecuador and Peru helped resolved a long-standing border dispute.

Useful steps for all countries, but especially those with environmental issues with their neighbors include:

- Collaboration to strengthen regional cooperation to confront environmental degradation, water scarcity, desertification, and water and air pollution. Scientific and technical cooperation has the advantage of being apolitical and thus better for collecting and exchanging information, sharing experiences and coordinating actions needed to tackle environmental issues;
- Raising awareness among the public and decision-makers on the dangers and the consequences of environmental degradation;
- Preventing and mitigating environmental degradation through improved regulatory frameworks and enforcement activities;
- Integrating environmental degradation and climate change in the national and sectors planning and dedicating more resources for research and developing appropriate technology;
- Creating positive economic incentives for good environmental practices and for the development and utilization of clean technologies;
- Encouraging foreign firms to invest in the sectors of interest such as sea water desalinization, waste water recycling, and renewable energy.

Mohamed Mselmi

CONCLUSION

National security broadly defined includes not only physical security from adversaries, but also food, water and energy security, physical security from environmental threats such as natural disasters, freedom from want and deprivation, economic well-being and basic individual freedoms, such as defined in our Bill of Rights. The Environment Industry, touching as it does on every other industry, is critical to the security requirements of the United States.

Moreover, a nation such as ours -- often called on or motivated to intervene on behalf of others -- must be concerned about environmental conditions around the world. Environmental scarcity or abundance contributes to conflict, and climate change is a threat multiplier for instability in fragile regions of the world. At the same time, environmentally sound behavior -- supported by industries and technology that maximize efficiency and conservation -- reduces stress on limited resources, and increases a nation's self-reliance, thus contributing positively to national security.

Because of the symbiotic relationship between government, the environment and the Environment Industry, recommendations for the industry must also be directed at the government. This is especially true with infant industry segments where producer or consumer support might be necessary to get an environmentally-desirable industry off the ground, or where national goals require policy support.

Successes, failures and unrealized opportunities in the Environment Industry thus far lead to the following **recommendations**:

1) Industry should continue its commitment to sustainable practices to conserve resources, increase productivity and cut costs.

2) Government should lead by example by requiring sustainable practices in government agencies at all levels.

3) Government should invest in infant segments by supporting basic research and stimulating demand (tax incentives, consumer/producer credits).

4) Industry should consider investments in high-growth environmental segments as an integral part of a diversified portfolio.

5) Government, NGOs, industry and the public should increase cooperation to advance environmental goals.

There is growing recognition world-wide that humans are putting undue stress on the environment, though there is considerable difference of opinion about the severity of the problem and the appropriate response. Still, we need not get to the precipice before taking action to make sure the planet can continue to support healthy existence. The modern world enjoys the means to ensure that the present generation can meet its needs without compromising the ability of future generations to meet their needs. Sustainability is within our technical and financial reach. The Environment Industry -- supported by government, NGOs, academic and research institutions and ordinary citizens – will be at the center of efforts to secure a safe, healthy, prosperous and sustainable existence.

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