

**Spring 2014
Industry Study**

**Final Report
*Environment Industry***



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ENVIRONMENT 2014

Abstract: The Eisenhower School for National Security and Resource Strategy Environment Industry Seminar spent the spring of 2014 examining a complex array of social and political issues, market segments, legal frameworks, and special interests that shape and define the environmental industry within the United States. After its course of study, the seminar concluded that the environmental industry is part of a nascent yet robust industrial base that is comprised largely of human capital, intellectual property, and technologically advanced engineering and consulting services that produces both goods and services. The seminar also decided that the environmental industry is growing, and becoming more global in reach and scope.

An environmental industry is not often considered within a national security context. However, given that scarcity caused by rising global population and continued environmental degradation will likely exacerbate human conflicts, national decision makers should envision an American environmental industrial base as a source of potential mitigation for national and global environmental dilemmas that can in turn be part of the US strategic response to current and future security challenges.

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Chesapeake Bay Foundation, Washington, DC
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US Senate Committee on Environment and Public Works, Washington, DC
US Green Building Council, Washington, DC
Washington Aqueduct, Washington, DC
Mountains Watershed Partnership, Honolulu, HI
Honolulu Board of Water Supply, Honolulu, HI
US Army Garrison, Hawaii, Honolulu, HI
First Wind, Honolulu, HI
Meridian 158 LLC (management and strategy consulting), Honolulu, HI
Hunt Companies, Honolulu, HI
Hanwha Q CELLS USA Corp., Honolulu, HI
National Oceanic & Atmospheric Administration and US Department of Commerce, Honolulu, HI
Hawaiian Earth Products, Honolulu, HI
Department of Environmental Services, City & County of Honolulu, Honolulu, HI
Schnitzer Steel Industries, Inc., Honolulu, HI
Carlsmith Ball LLP (law firm), Honolulu, HI
HDR Engineering, Inc., Honolulu, HI
Center for Excellence In Disaster Management & Humanitarian Assistance, Honolulu, HI
Energy Resources and Operations, Hawaiian Electric Company, Honolulu, HI
Energy & Environmental Protection Committee, Hawaii State Legislature, Honolulu, HI
Alaska Resource Development Council, Anchorage, AK
Alaska Oil and Gas Association, Anchorage, AK
Municipality of Anchorage Solid Waste Services, Anchorage, AK
Municipal Light & Power, Anchorage, AK
North Pacific Fishery Management Council, Anchorage, AK
US Coast Guard-Sector Anchorage, AK
Alaska Department of Environmental Conservation, Anchorage, AK
Hilcorp Energy Company, Anchorage, AK
CIRI (an Alaska native corporation), Anchorage, AK
Cook Inlet Regional Citizens Advisory Council, Anchorage, AK
US Department of the Interior, Anchorage, AK
US Environmental Protection Agency, Anchorage, AK
Cook Inletkeeper, Anchorage, AK
Alaska Department of Fish and Game, Anchorage, AK
Institute of Social and Economic Research, University of Alaska Anchorage, Anchorage, AK
Alaska Miners Association, Inc., Anchorage, AK
US Coast Guard (17th Coast Guard District), Anchorage, AK
Alaska Wildlife Conservation Center, Anchorage, AK
Alaska SeaLife Center, Anchorage, AK

Methodology

Our examination of the environment industry in many ways resembled a descriptive, qualitative case study.¹ Our seminar conducted “an empirical inquiry that investigated a contemporary phenomenon [environment industry] within its real-life context.”² While traditional case studies generally employ a narrow focus on a specific element of a phenomenon, our approach was to examine the environment industry with much breadth, but little depth. Therefore, instead of a narrow approach on a specific sector of the industry, we approached the entire environment industry as one bounded system.³

While the ontologies and epistemologies of the seminar members vary greatly, our study of the environment industry generally accepted a realist ontology and employed a post-positivist epistemology.⁴ A post-positivist approach assumes that researchers take a completely neutral stance when examining a phenomenon. In layman’s terms, it can be described as a “just the facts, ma’am,” approach. Since this report provides specific recommendations for US government decision makers, we concede a bias in our assessment of the environment industry. Some bias is inevitable since we live and interact within the very environment that we studied.⁵ However, in the tradition of post-positivist research, all of us tried our best to set aside previously held ideological beliefs and pre-conceived notions in an effort to examine the environment industry. The salience of the research alignment of ontology and epistemology will become more apparent during the discussion of climate change found later in this report.

Over the course of the Spring Term, our seminar utilized three types of sources for data collection. We reviewed both scholarly and popular literature about the environment, environmentalism, and the environment industry. We also received presentations and participated in informal interviews with experts from private industry, government, and interest groups. To maintain confidentiality for subject matter experts who provided data for our study, specific facts, figures, and opinions provided by these experts are not cited or otherwise attributed. Finally, we made our own personal observations during site visits to multiple locations, including the Washington, DC region, Alaska, and Hawaii. The use of three general types of sources allowed us to take advantage of triangulation⁶ within the design of our study.

This approach was inherently etc.⁷ While our seminar did not possess personnel with extensive experience within the environment industry that could provide an emic perspective, we were able to leverage the observations and reports of the 15 different researchers that comprise our seminar. We analyzed this data collectively via formal and informal discussions, as well as individually via reflection and independent research. The analysis, amalgamation, and integration of information gleaned by 15 different researchers allowed our seminar to create a “rich and thick”⁸ description of the environment industry. In this respect, all 15 participants in our seminar directly contributed to this report. This description, coupled with the use of triangulation of data in the design of our study, enabled our seminar to develop an assessment of the environment industry that possesses high levels of both descriptive validity and trustworthiness.⁹

Definitions

One challenge of examining a social phenomenon is that popular and scholarly literature abounds with multiple (and sometimes contradictory or divergent) definitions for the same terms and concepts. For this study, there are distinct differences between the terms *environment*, *environmentalism*, and the environment *industry*. In addition to defining these terms, this section

will also provide standardized definitions for some terms commonly encountered by our industry study.

Environment

For the purpose of this study, the term “environment” has two separate and distinct denotations. The first denotation, and most common connotation, refers to what might be described as the *natural* environment. The natural environment is a physical construct. The US Environmental Protection Agency (EPA) defines the [natural] environment as, “the sum of all external conditions affecting the life, development, and survival of an organism.”¹⁰ This definition is somewhat vague, though it can be thought to include “air, water, land, built infrastructure, cultural resources, and the interrelationships that exist among them.”¹¹ In a sense, the natural environment is the first and most salient infrastructure for the human race. It provides and sustains all animal and human activity on the planet. Humankind is able to extract from the natural environment the resources it needs to provide and meet the basic foundation of Maslow’s Hierarchy of Human Needs.¹²

The second denotation of the term environment refers to the *political* environment. The political environment is a sociological construct. This refers to the aggregation of laws, regulations, guideline, and public opinion that shape and affect the US environment industry. For the purposes of this report, the term environment will be taken to mean the natural environment, unless specified otherwise.

Environmentalism

The term “environmentalism” is another sociological construct. Some scholars maintain that there is “no single, unambiguous, universally accepted definition of environmentalism.”¹³ In many cases, the term may carry more connotation than denotation. For the purpose of this report, our operational definition of environmentalism is simply “a concern to protect the [natural] environment through human effort and responsibility.”¹⁴ This effort may take the form of political activism, advocacy, education, awareness, and voluntarism.

Environment Industry

Just as the two terms discussed above carry different denotations and connotations, scholars, practitioners, and organizations define the environment industry in a variety of ways. In 2013, the Environmental Business Institute (EBI), a private research and publishing company founded in 1988,¹⁵ defined the environmental 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.¹⁶

Additionally, the European Organization for Economic Co-operation and Development (OECD) defines the environment industry as follows:

The environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimize pollution and resource use.¹⁷

Both definitions acknowledge that there are many factors impacting the environment industry. The six most prominent factors we encountered in our research are political, economic, socio-cultural, globalization, technological, and demographic forces. Since our research team leveraged information retrieved from the EBI, this report will use the EBI definition of the environment industry.

Industry Terms

There are common terms that appear throughout the literature and documents when conducting research on a given industry. Four terms commonly encountered in our industry study were “industry,” “market,” “sector,” and “segment.” Unfortunately, popular and scholarly literature does not offer standardized and universally accepted definitions of these terms. Therefore, for the purpose of this report, we derived our own operational definitions based on our literature review.

The term *industry* denotes a group of businesses and/or organizations that provide and/or promote a given good and/or service. The technical definition of a market is “a group of buyers and sellers of a good or service and the institution or arrangement by which they come together.”¹⁸ In the global market place for environmental goods and services, the term *market* may also mean the geographic area or region that has a demand for, or is a supplier of, environmental goods and services.

The terms *sector* and *segment* are often used interchangeably in books and articles concerning the environment industry. A sector is a specific market within a given industry. A segment is a specific good or service that is provided to that sector. For example, *clean energy systems and power* is a sector of the environment industry. *Solar power* is a specific segment within the clean energy systems and power sector.

Climate

In common vernacular, the terms *weather* and *climate* are often used interchangeably. In fact, the two concepts are quite different. Weather constitutes readily measurable atmospheric conditions such as precipitation, wind, temperature, humidity, and barometric pressure. Climate is a scientific construct. It is not experienced directly by a human the same way the feel of wind in the face and rain in the hair are experienced.¹⁹ Climate can be defined as the summation of “statistical data of measurable and measured weather over a given period of time (typically 30 years) at a given place or series of places.”²⁰ The predominant means of capturing the climate of a given place or region has been through meteorological observation and measurement conducted and recorded over long periods of time. Systematic and standardized empirical observation of weather phenomenon began in the 1800s.²¹

What is the US Environment Industry?

We have covered the definition of industry in general and the environment industry in particular. However, words have connotation as well as denotation. One of the first hurdles for any student of the environment industry is to reset or set aside pre-conceived connotations about the word *industry*. To many people, the connotation of industry is strictly an organization or series of organizations that manufacture products. It may be difficult to see the term industry as meaning anything other than a manufacturing plant operated by a vertical and rigid personnel structure. This connotation has little to do with the modern environment industry. The US environment industry contains myriads of different types of organizations that are arrayed in different sizes and with different internal structures.

Based on the definition of industry previously discussed, one can categorically aver that there is a group of businesses and organizations that produce and/or promote goods and services related to the environment. Ergo, there is an environment industry. However, the most salient question is not whether there is an environment industry. Instead, we should consider how to bound the environment industry into measurable sectors and segments.

We know from the preceding definition of the environment industry that it consists of “all revenue generation associated with environment protection...and delivery of environmental resources.” This definition helps frame the industry, but it does not fully delineate the diverse facets that make up the environment industry. We found it challenging to delimit the environmental industry because it produces a heterogeneous mix of goods and services instead of a group of homogeneous goods. It is more diverse than, for example, the aerospace industry that produces air and spacecraft, or the shipbuilding industry that produces ships. The purchases of goods and services from the environment industry are also diverse, and include domestic and international public and private organizations. In order to richly describe the environment industry, it is necessary to explore both its explicit and implicit boundaries.

Explicit Boundaries

Explicit boundaries of an industry are important because they allow the aspects of an industry to be quantified and analyzed. This in turn allows researchers and analysts to draw conclusions about an industry, such as its size, scope, and economic health. For the purpose of this report, our seminar accepted two concepts for bounding the industry.

The first concept for bounding is geographical. Despite the increased effects of globalization, mergers, and acquisitions in the global environment industry, we still assert that there is a US environment industry that is separate and distinct from its largest competitors in Europe and elsewhere around the world. The second concept of bounding has to do with taxonomy, the dividing of the environment industry into identifiable and measurable parts. EBI further defines the explicit boundaries of the environment industry by dividing up the US environment industry into 14 distinct sectors. A table that depicts these sectors is provided on the next page:

Figure 1 – Sectors of US Environment Industry

| Equipment | 2012 | 2012 USA Market | USA Market % |
|------------------------------|--------------|----------------------------|-------------------------|
| Water Equipment & Chemicals | 72.4 | 25.2 | 35% |
| Air Pollution Control | 51.5 | 18.1 | 35% |
| Instruments & Info Systems | 9.8 | 3.3 | 34% |
| Waste Mgmt Equipment | 36.9 | 9.2 | 25% |
| Process & Prevention Tech | 4.3 | 2.1 | 48% |
| Services | | | |
| Solid Waste Management | 145.9 | 59.1 | 41% |
| Haz Waste Management | 22.0 | 10.0 | 45% |
| Consulting & Engineering | 56.8 | 26.0 | 46% |
| Remediation/Ind'l Services | 41.3 | 11.8 | 29% |
| Analytical Services | 5.5 | 1.9 | 35% |
| Water Treatment Works | 118.1 | 50.6 | 43% |
| Resources | | | |
| Water Utilities | 135.0 | 46.8 | 35% |
| Resource Recovery | 56.6 | 12.2 | 22% |
| Clean Energy Systems & Power | 133.6 | 65.6 | 49% |
| Total | 889.6 | 342.0 | 38% |

Source: December 2013 EBI Journal Report

In the preceding table, the leftmost column lists the 14 sectors of the environment industry. The next column shows the global value of that sector in billions of dollars (USD) for 2012. The next column then depicts the market share for the US environment industry in that sector in terms of billions of USD. The last column shows this value in terms of a percentage market share.

According to the EBI Journal Report of December 2013, the total valuation of all 14 sectors of the global environment industry is just under 900 billion USD. The US environment industry is comprised of 30,000 private firms of various sizes and 88,000 public entities (i.e. utilities and water treatment plants) that participate in one or more of the 14 sectors listed above. These organizations in turn employ upwards of 1.6 million Americans.²²

Implicit Boundaries

One could stop at the explicit boundaries when trying to define the environment industry. However, to delimit the industry and its importance based solely on 14 sectors would not provide a complete description of the industry. The environment industry is not just about recycling and waste management. It touches every other US industry, and the every day life of millions of Americans. It is complex and difficult to define; hence traditional tools, such as Porter's Five

Forces Model,²³ do not work well when examining the US environment industry. Since the environment industry is not a traditional monolithic industry, we also examined its implicit boundaries to reach a more holistic understanding of the industry.

Implicit boundaries assist researchers and analysts grasp the full scope of an industry and assess with how many other industries it interacts. This, in turn, can help determine if a given industry is strategic in the sense that it is vital for national security. In many ways, the environment industry operates in sectors outside the 14 explicit sectors listed above. For example, engineering for “green buildings” that are energy efficient may fall within the construction industry, but the technology and human capital to implement “green technology” is a direct contribution of the environment industry. Goods and services from the environment industry are diffuse, and have worked their way into many other industries such as energy, mining, transportation, retail sales, and manufacturing. Naturally, some sectors of the environment industry, such as consulting and engineering services and analytical services, lend themselves to this type of diffusion into other industries.

The environment industry creates many positive externalities that directly benefit other industries and enterprises. For example, recycling and renewable energy technologies help US companies save money and thereby improve operating profits and business value. Eco-tourism is a segment of the tourism industry that has directly benefited from the positive externalities provided by the environment industry. New technologies driven by the environment industry also have the potential of creating new businesses and markets within the United States.

Moreover, the emergence of Environmental Management Systems (EMS) has introduced concepts and practices of the environment industry into all types of public and private organizations. As defined by the US Environmental Protection Agency (EPA), EMS are, “sets of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency.”²⁴ A number of internationally accepted standards frameworks exist to effectively develop, implement, and certify an EMS. The two most prominent frameworks are the International Organization for Standardization’s family of standards, which include the 14000 and 26000 series, and the European Eco-Management and Audit Scheme.

Conceptual Framework

A further means to examine the environment industry is to explore the social and political environment in which it operates. The natural environment provides classic cases of traditional market failures.²⁵ Without state intervention, behavioral economics predict that firms and households will pollute too much. Another negative externality is often referred to as the “tragedy of the commons.”²⁶ This implies that if a common resource is left unregulated, people will over-exploit the resource, as in over-fishing fisheries. Unregulated, people will also undersupply public goods like clean air and clean water.²⁷

Therefore, government (federal, state, and local) plays a large role in shaping the political environment in which the environment industry operates. Government, particularly the federal government, influences the political environment via laws, regulations, programs, and presidential executive orders,²⁸ though state and local governments often invoke stricter regulations. These governmental actions impact the markets for environment industry goods and services. Lieutenant Colonel Charles Schoening, US Army National Guard (2014), outlines the important role of government in an essay that appears at the end of this report.

More aggressive US government involvement in environmental issues began in the 1970’s

when a bipartisan Congress passed a slew of “command and control” compliance-related regulations based on public awareness and concern about the impact of human activities on the environment. To date, over 72 US environmental-related laws and amendments have been passed. Marquee laws include the Clean Water Act (1972), the Endangered Species Act (1973), and the Clean Air Act (1970, 1977, 1990).²⁹

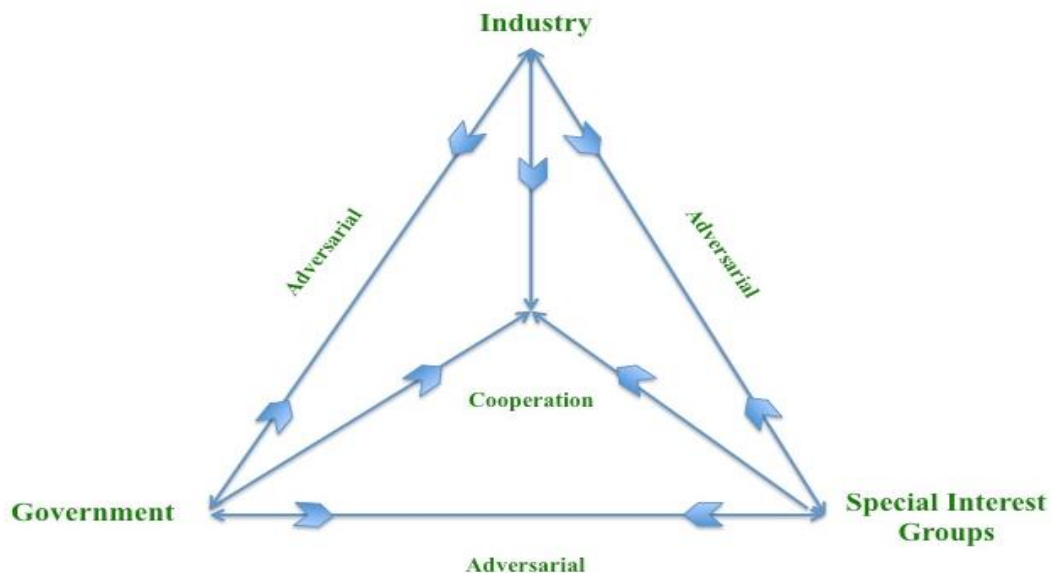
Furthermore, international agencies are vital to forging agreements on global environmental issues, even though enforcement can be difficult. More than 1,100 multilateral and 1,500 bilateral agreements that address the environment are in force throughout the world. The United States is a signatory to 475 multilateral agreements.

A success story about multilateral agreements is the Montreal Protocol on Substances that Deplete the Ozone Layer (1989). This protocol is probably the best example of substantial and positive environmental change brought about through multilateral action. Almost overnight, people, nations, and industries around the world developed alternatives to chlorofluorocarbon refrigerants. Today, the once feared ozone hole over Antarctica is shrinking. The United States is one of 197 countries that ratified the Montreal Protocol.³⁰

An additional factor that affects the political environment of the environment industry is the role of Non-Governmental Organizations (NGOs). When it comes to the natural environment, NGOs often take the form of special interest advocacy groups (i.e. Greenpeace), research institutions (i.e. Wrigley Institute for Environmental Studies), and legal firms (i.e. Earth Justice). Through advocacy, public outreach, research, and education, these groups seek to influence the way governments and industry approach and interact with the natural environment. The influence on the environment industry of government and NGO interaction cannot be overstated.

The below schematic is a conceptual framework of the political environment in which the US environment industry operates:

Figure 2 – US Environment Industry Conceptual Framework



The Defense Industrial Base is sometimes described as operating within an “Iron Triangle,” defined by Congress, the Defense Industry, and the Department of Defense.³¹ In a sense, the US

environment industry operates within a “Green Triangle.” In the graphic on the preceding page, the three corners of the triangle (industry, government, and special interest groups) have relationships that are simultaneously cooperative and adversarial. While each entity has different objectives in the relationship, they generally cannot act independently if they are to achieve their goals. For example, the government may support specific goals of a “clean air” interest group by passing a law limiting carbon dioxide emissions if it is in the public good (since addressing a negative externality may be in the interest of the government). However, if the environment industry has not developed such technology, then neither group can meet their goals. As a result, the special interest group may petition the government to provide subsidies for clean air technology, thus expanding the market for the firms within environment industry.

While this example is overly simplistic, it serves to illustrate that the three entities must pool their resources, expertise, and sometimes funding, in order to cooperate to craft sound policies and promote and execute sustainable development and infrastructure. However, they must also, and inevitably will, have a concurrent adversarial relationship in that each must act as a monitor and enforcer via the other groups when it comes to laws, regulations, and political and social rights. Both cooperative and adversarial relationships must be balanced. Too much cooperation with one another can lead to charges of collusion, selling-out, or “being in one another’s pocket.” Too little cooperation can lead to open hostility and gridlock.

Common Themes

There are a couple of common themes that are readily apparent when one examines the environment industry. First, profits are modest in all sectors, even when markets are growing very quickly, such as the clean energy systems and power sector. A second common theme is the nearly universal acceptance of a stakeholder theory of management as opposed to a shareholder theory of management. According to the more traditional shareholder approach to management, the only social and fiduciary responsibility of a business is to the owners (shareholders) of that business.³² Stakeholder theory, first championed by R. Edward Freeman (1984), argues that the social responsibility of business managers is to balance the needs of the shareholders with those of stakeholders (customers, suppliers, employees, communities, unions, and so on).

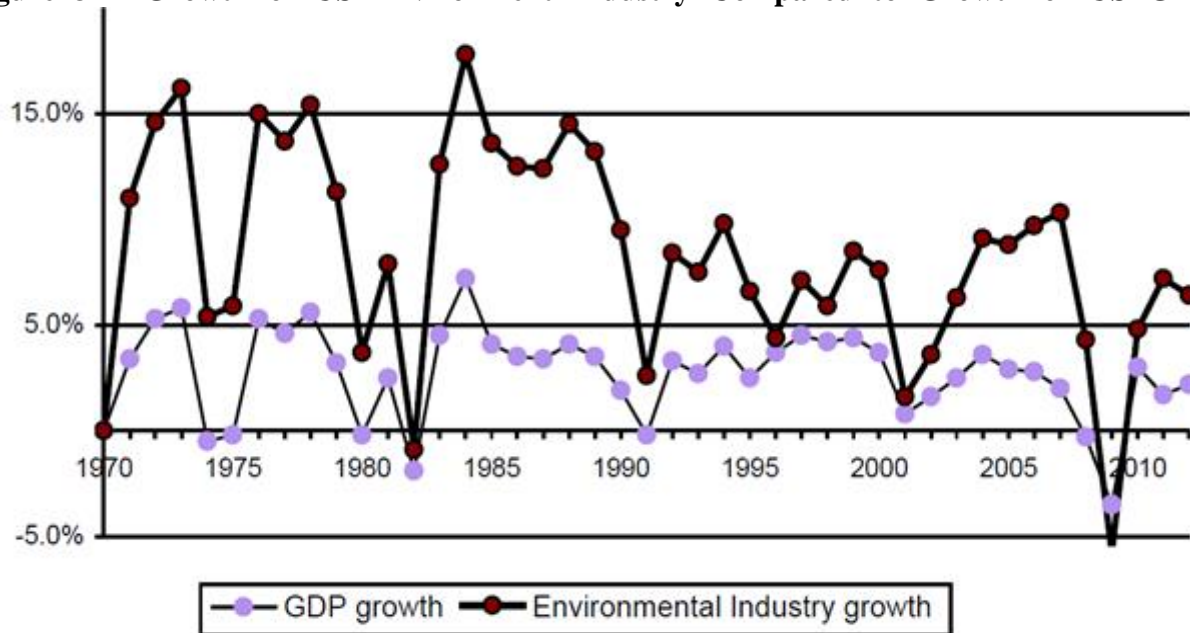
There are two approaches to stakeholder theory that are prevalent and exist concurrently in the environment industry. First, some managers support corporate environmental sustainability “out of a sense of a fundamental normative objective where protecting the environment is seen as the right thing to do.”³³ The second approach to stakeholder theory is an acknowledgement that since most investors focus on the health of a firm's revenue stream and earnings, managers must implement greater corporate sustainability practices to improve returns on investment. This, in turn, serves as leverage to justify corporate operations that improve the natural environment.

Health of the US Environment Industry

The overall health of the US environment industry is very good. Currently, the US environment industry owns a 38% market share of the global environment industry. The next closest competitor is the European environment industry, which owns a 26% share of the global market.³⁴ Of the 14 sectors listed by EBI, the four largest in terms of annual revenue are clean energy systems and power (66 billion USD), solid waste management (59 billion USD), water treatment works (51 billion USD), and water utilities (47 billion USD). The global environment

industry grew 44% from 2000 through 2010. The projected growth rate for the US environment industry through 2017 is 4.1% per year.³⁵ To date, the environment industry has outperformed the US Gross Domestic Product in terms of rate of growth in nearly every year since 1970. It is important to note, however, that when the US economy has performed poorly, the US environment industry has performed as poorly, or even worse, than the overall economy. This may indicate that when economic times are bad, firms are less willing to pursue sustainability measures due to slipping profits. This, in turn, has an even greater effect on the US environment industry.

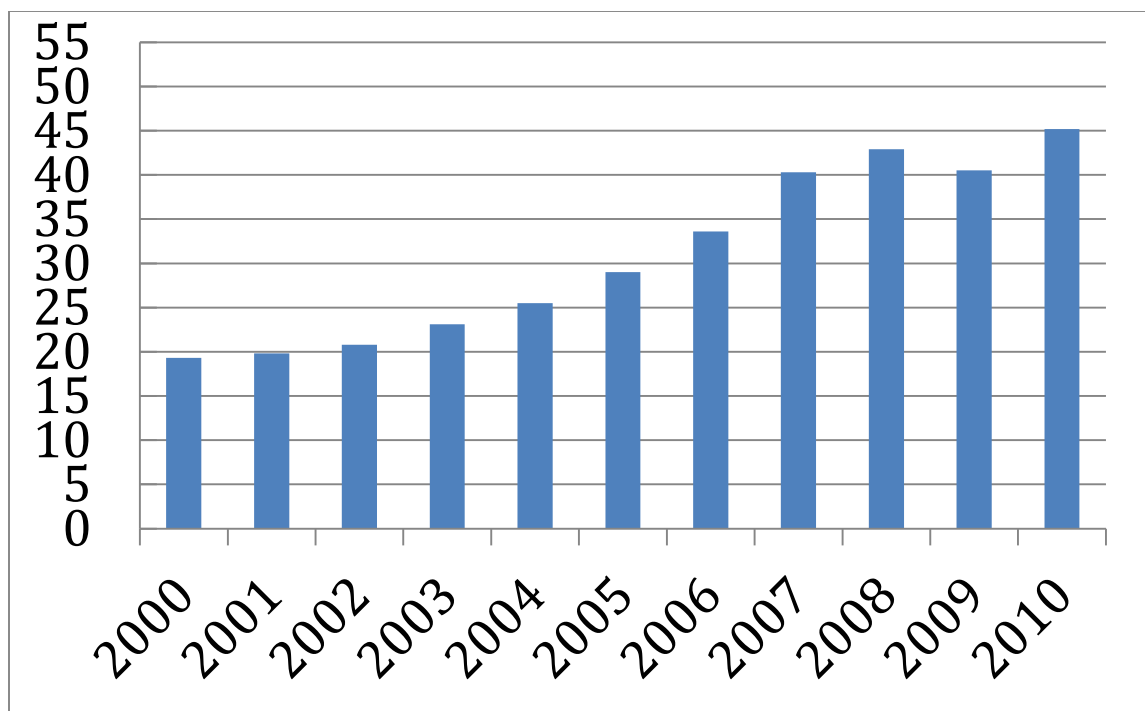
Figure 3 – Growth of US Environment Industry Compared to Growth of US GDP



Source: December 2013 EBI Journal Report

As depicted in the table on the next page, US exports of environmental goods and services are growing. This trend of predictable growth is likely to continue, driven by the demands for mitigation of, and adaptation to, global environmental degradation issues.

Figure 4 – US Environment Industry Exports in Billions of USD per Year



Source: December 2013 EBI Journal Report

Domestic Challenges/Opportunities

Despite this positive outlook, the US environment industry faces challenges. Industry Value-Added,³⁶ which measures a sector's contribution to GDP, is growing by just 2.0% in the water-related sectors on the industry. This is less than the overall US economy, and somewhat behind the waste disposal (3.7%) and remediation (4.2%) sectors.³⁷ These numbers suggests while there is money to be made in environmental goods and services in general, regulation poses a special barrier in the water sector. Regulated pricing keeps profits below the level needed to attract investment and induce conservation. As a result, even the world leader in water technology, Veolia of France, has not made a healthy profit in years.

In waste treatment, a big problem is nationally segmented markets. Our seminar met with a representative from a leading US company that has spent decades trying to gain a foothold in Europe and Asia. For its part, Europe has excellent technology for waste-to-energy which has barely made it to American shores due to two factors. First, the idea of burning trash, which is a key technology in the waste-to-energy segment of the clean energy and power systems sector, is often met with popular opposition in the United States. Second, the financials for waste-to-energy do not work in most US localities. It costs more to produce energy by burning trash than can be made selling that energy, especially when compared to the cheaper cost of fossil fuel energy production. However, the technology itself is proven. A waste-to-energy plant our seminar toured on the Hawaiian island of Oahu is a success story. While it required significant public funding to construct the plant, the trash incinerated to create energy significantly reduces the amount of waste going to landfills on the island as well as decreases reliance on fossil fuels, both of which are key goals of the local government.

Global Challenges/Opportunities

Climate Change

As mentioned in the Methodology section, our seminar employed a post-positivist approach to the issue of climate change. This means we set aside feelings, intuition, ideologies, and previously held beliefs; and that we examined the issue solely through the empirical, quantitative science that is available on the subject. Lieutenant Colonel L. Karl Paulsen, US Air Force (2014), makes the case that the evidence for anthropogenic causes for climate change is clear and convincing. Furthermore, Mr. Daniel Froats, US Department of State (2014), makes a strong economic argument why the US government should use stronger command-and-control regulations to combat climate change. These essays appear at the end of this report.

Regional Challenge/Opportunities

Several members of our seminar conducted in-depth literature reviews about environmental issues in different regions of the world. While each region presents its own challenges and opportunities as potential markets for the US environment industry, one common theme emerged. Nations with poor governance and economic performance suffer from greater degrees of environmental degradation, while nations that are stronger in those areas are generally more effective in addressing environmental issues.

Europe

The European Union has the world's highest environmental standards.³⁸ An essay by Colonel K. Hooper, United States Army (2014) illustrates an example of a strong environmental industry within Central Europe. This essay appears at the end of this report. As a result, a flourishing environment industry has emerged in Europe (particularly in Western Europe). In 2012, an estimated 3.4 million people worked in the European eco-industry, which represents around 1% of the total European workforce. These numbers are expected to continue to increase as the number of "green jobs" continues to grow. The strength of the European environment industry means it is both a collaborator and a competitor with the US environment industry.

Asia

Asia, which accounts for as much as 60% of the world's population,³⁹ has two major challenges when it comes to environmental degradation. First, many countries in this region have rising populations, which places a strain on resources such as food, water, and energy. For example, the UN estimates 1.4 billion people in China, India, and Pakistan currently face severe water scarcity. This problem is projected to get worse.⁴⁰

Moreover, many people in China and India are rising from poverty into the middle class. With this new affluence comes even greater demand for goods and services, which will further strain demands on the environment. Asia's environmental industry is still in its early development stages. Many countries are only beginning to establish national environmental policies, some 40 years after the United States. There are many market segments available for growth for the US environmental industrial base, but many challenges ahead for Asia.

Middle East/North Africa

The most pressing environmental concern for the Middle East and North Africa is the increasing scarcity of fresh water for agriculture, energy, sanitation, and drinking needs. Traditionally, most populations in the region rely on untreated groundwater to meet drinking and agricultural needs. Groundwater supplies in this region are under duress from over-use and increasing rates of salinization. The situation in this region with regard to water is dire for several nations that have strategic alliances with the US. For example, Nafeez Mosaddeq Ahmed (2013) posits that Egypt is "...on the brink of a protracted state-collapse process driven by intensifying resource scarcity," with water being a primary driver.⁴¹ This region provides a potentially profitable market for the US environment industry. However, security threats to industry interests and personnel will likely remain high in the coming years.

Sub Saharan Africa

The environment in Sub-Saharan Africa is in a precarious state. Deforestation, desertification, climate change, high rates of urbanization, and lack of access to sanitation and potable water are among the chief environmental menaces in the region. In general, African governments, sometimes buttressed by indigenous environmental organizations, have adopted laws and regulations intended to protect the environment. However, most of the region's 47 countries lack both good environmental governance and the capacity to address their domestic environmental problems.

International and regional organizations have done the lion's share of the work to diagnose Africa's environmental perils, recommend policies to prevent and combat environmental degradation, and offer technical assistance to African governments. Mr. Joel Maybury, U.S. Department of State (2014), makes the case that the US government can ill afford to ignore the environmental plight of sub-Saharan Africa. His essay on this topic appears at the end of this report.

Russia and the Former Soviet Union

Environmental degradation is a serious issue throughout most of the former Soviet Union. Former Soviet (now mostly Russian) heavy industry and oil and gas exploration have significantly degraded landscapes throughout the region. This has negatively impacted its ecosystems, caused massive air pollution, adversely affected biodiversity, infringed upon the rights of indigenous groups, and increased human health risks. In fact, "Russia's air still rates among the most polluted in the world."⁴² Moreover, government and industry officials from this region do not place as much value on environmentalism or environmental governance as do their counterparts in the West.⁴³ This region is in dire need of environmental assistance from both the US government and the global environment industry. However, improvements in security and diplomatic ties with the West will need to be made before this market becomes more accessible to the US environment industry.

Latin America and the Caribbean

Latin America has the largest income inequality gaps in the world. 111 million Latin Americans live in shantytowns.⁴⁴ Despite the pressure this poverty places on the natural environments in Latin American countries, there has been progress towards better environmental governance in the region. The EPA has lent technical assistance to nations such as Brazil and Mexico to improve water safety, waste management, and to arrest the rate of deforestation.⁴⁵ Continued emphasis on environmental policies by nations in this region will provide market opportunities for US environment industry businesses.

Link of US Environment Industry to National Security

For most people, the term “national security” conjures up images of military might and war.⁴⁶ A traditional definition of security might be “the absence of a military threat, or the protection of the nation from external overthrow or attack.”⁴⁷ Framed this way, force (primarily military force) is the only true threat to the power of a nation. Therefore, military force is the only instrument by which a state can preserve and defend itself.⁴⁸

However, since the latter half of the 20th Century, this connotation of national security began to change. Elizabeth L. Chalecki (2013) notes that beginning in the 1960’s, some thinkers began to “view threats to national security through a larger lens and consider environmental issues as drivers of national security threats.”⁴⁹ Certain scholars, such as Paul Ehrlich (1968), posited that scarce resources in an over-populated world cause wars.⁵⁰ In 1977, Lester Brown, founder of the Worldwatch Institute, argued that, “systemic environmental issues such as climate change, deforestation, and a loss of arable land could be nonmilitary drivers of insecurity, and that military forces would be would be ineffective against these new threats.”⁵¹

The current paradigm that military strength equals security is largely blinding the US government to the fact that people rely on the environment to survive.⁵² Food, water, and clean air are fundamental to security because humans cannot live without them. Water scarcity has already led to direct conflict, and there are more challenges on the horizon. Environmental degradation may also be a contributing factor to conflict when it is combined with political instability, population growth, chronic economic deprivation, and societal stress. To effectively address these security concerns, the US must broaden its conception of national security and include the underlying factors that contribute to conflict as opposed to focusing only on the conflict itself.⁵³ This broadened understanding of conflict would lead the US government to consider environmental issues in all phases of national security planning, and bring to bear an array of capabilities to address these concerns prior to conflict.

In doing so, the US government must recognize that the US environment industry can play a key role in promoting and maintaining global security. Through the sale and export of its goods and services, the US environment industry can increase global security by helping nations mitigate and adapt to the effects of environmental degradation due to climate change and other factors. In fact, one could make a strong argument that the US environment industry will be critical for meeting US global security concerns in the 21st Century.

Is the US Environment Industry a Strategic Industry?

Is the environment industry as previously defined a strategic industry for the United States? The answer is clearly yes. As previously discussed, national security is broader than merely protecting the American people from outside attack or inside insurrection. National security must protect the American people from an entire range of threats. Just as the US Centers for Disease Control and Prevention protects Americans from pathogens and other vectors of pandemic disease, the EPA and other federal and state agencies protect Americans from hazardous pollutants in the air, water, and soil. In order to fulfill their mandates, organizations such as the EPA must be able to turn to the US environment industry for the goods and services that can provide clean air and safe water.

The environment industry plays a key role in adaptation to increasing rates of climate change and mitigation of environmental degradation that is inevitable as the global population continues to increase. As more people are lifted from poverty to the middle class (particularly in India and China), the global demand for goods and services will accordingly increase. Greater numbers of people and greater affluence among people will lead to even more competition for scarce and finite goods and services. This will exacerbate conflicts that already exist across the globe, and may even form the basis of new conflicts not yet imagined.

By including environmental issues in its national security planning, the US government has the opportunity to use these scarcity issues as vehicles for global and regional cooperation. The US government, in a public-private partnership with the environment industry and NGO's, will be well served by helping all nations use scarce resources (i.e. energy, water) more effectively and efficiently (i.e. recycling, renewable) to adapt to greater scarcity and mitigate its effects. Effective resource use can ameliorate the affects of scarcity, thereby lessening the chances of violent conflict and potentially providing opportunities for collaboration. Moreover, environmental adaptation and mitigation efforts will be cheaper for the United States in the long term, as opposed to the US allowing conflicts to fester and possibly being forced to intervene militarily and at significant human and financial cost.

Finally, in a qualitative sense, no other industry contributes as much to maintaining the clean air and water that so many Americans expect and demand. As the world becomes more polluted (by sources inside and outside the United States), the environment industry can help adapt and mitigate degraded air and water quality domestically and internationally. Only the environment industry has the collective and organizational knowledge, skills, and resources to mitigate degraded air and water quality. As other countries recognize the implications of environmental degradation, they will increasingly seek solutions. This in turn will provide a robust market for environmental products and services. The US government can take advantage of the US environment industry as a vehicle for economic growth and national security by working now to create a sustainable world for tomorrow.

Summation

This report began with an explanation of the methodology the environment industry study used to examine the US environment industry. After a discussion of definitions, this report delineated the explicit and implicit boundaries of the US environment industry. Despite some significant challenges, the health of the US environment industry is very good, and will likely continue to grow over the next several years. The United States remains a global leader in the global environment industry, for which there are a wide range of domestic, regional, and global issues and opportunities. Finally, this report advocates that US policy makers adopt a broader view of

what constitutes national security; and that within this broader view, recognize that the US environment industry is a strategic industry that can directly contribute to global security and the quality of life for all of humanity.

Recommendations

The United States must play a leading role on environmental issues and within the environment industry. While the United States already has many of the capabilities necessary to address today's environmental issues, the challenges facing the world will require significant financial and human capital resources. We believe the United States should commit itself to bolstering cooperation with other countries as well as international and multilateral organizations. Collectively, sharing our best practices can only improve our chances of reversing, or at least stalling, some of the threats to our environment.

The United States enjoys international credibility with respect to the environment and responses to environmental degradation. For instance, the EPA has led in technical assistance to African countries with weak environmental governance. Were it not for budget constraints, the United States might play a larger role in boosting the economies of developing countries without sacrificing their indigenous natural resources. Unfortunately, American unwillingness to ratify important instruments like the Basel Convention, the Kyoto Protocol, and the United Nations Convention on the Law of the Sea hurts our credibility as well as our ability to shape international solutions. Addressing this credibility issue is difficult because America lacks a strong domestic constituency to support US involvement and cooperation in multilateral organizations. However, the United States cannot expect to improve international cooperation if its own environmental policies and practices are not in order.

Additionally, our current capability to respond to international disasters and humanitarian crises that will occur as a result of climate change would be more effective if our military and civilian agencies were better synchronized. The US government should develop processes to better integrate military and civilian responses within the government as well as reach out to the private sector, particularly to those firms and entities with a proven track record of international experience. The US government should forge meaningful public-private partnerships, and should also engage these private sector stakeholders for creative funding, policy, and technical solutions to domestic and international environmental challenges.

As discussed earlier in this report, the US environment industry relies on good environmental governance and regulation in order to thrive. Such governance and regulation is critical to the market structure in which the industry operates. Examples of further government regulation that can help the US environment industry include: a national renewable portfolio standard; taxes and export duties on dirty fuels; and incentives for utilities to introduce smart grid technology. Moreover, a carbon-trading program will drive innovation and investment in new technology, similar to the hydrogen sulfide cap and trade program of the 1990s that was effective in reducing acid rain. Extension of production tax credits will also drive continued innovation in the renewable energy market, including much-needed improvements to battery technology.

The US government can also support the US environment industry with demand-side initiatives. The provision of individual tax credits will increase demand for energy efficiency improvements and the installation of small-scale renewable energy technology. Additionally, enhanced Export-Import Bank policies (such as modification of risk ratios) provide opportunity for greater exports of US environment industry goods and services.

Our nation's policy makers must broaden their concept of national security from a traditional military-centric point of view to one that incorporates the environmental causes of insecurity. With water, energy, and food being a potential nexus of future scarcity and conflict, policymakers must include sustainability in national security dialogue. The President should expand the National Security Council and staff to elevate environmental considerations and integrate sustainment solutions. Industry has seen success elevating a sustainment-focused leader to its equivalent of a cabinet-level position within corporate governance frameworks; it is time for the US federal government to do the same.

Finally, US policy makers should broaden their view of the environment industry and recognize it for what it is – an Environmental Industrial Base (EIB). This idea is similar to the concept of the Defense Industrial Base (DIB). Policy makers need to nurture and develop the EIB just as it does the DIB in order to respond, mitigate, and adapt to environmental challenges that threaten US and global security in the 21st Century.

Essays

The following essays represent individual works by selected members of our seminar. These essays were chosen among many excellent works in order to bring greater focus on one or more of the many topics covered in this report.

The Role of Government

It takes government at all levels of society to ensure the protection of the environment and sustainment of natural resources. At each level, there is a structure in place that ensures environmental regulations are enacted, promulgated, and enforced. This includes elected officials who create environmental laws and agencies that put them into effect. Federal, state, and local agencies must be nested and work collaboratively to achieve the most effective results. This structure ensures that individuals have a mechanism to voice their environmental concerns. At the other end of the spectrum, international organizations exist to bring the world community together to resolve global environmental issues.

Regulation is key to protecting the environment and resources for the common good and future generations. The US Environmental Protection Agency is the principal executive branch organization that promulgates and enforces legislation. States often implement stricter requirements, but must, at a minimum, enforce federal regulations. Local jurisdictions may also opt to implement tighter controls and locally, specific standards. Local oversight and enforcement are critical to the success of environmental regulation since local agencies have the knowledge and resources to monitor compliance.

International agencies, such as the United Nations Environment Programme, are vital to forging agreements on global environmental issues. Enforcement is difficult at the international level; however, nations must work together to solve these global environmental problems.

Lieutenant Colonel Charles Schoening, Army National Guard

The Scientific Case for Climate Change

Scientists have studied the climate dating back hundreds of thousands of years by analyzing historical ice cores, tree rings, glacier lengths, pollen remains, ocean sediments and the earth's orbit around the sun.⁵⁴ The Intergovernmental Panel on Climate Change proclaims, "Scientific evidence for warming of the climate system is unequivocal,"⁵⁵ and 97% of climate scientists agree that weather-warming trends over the past century are very likely due to human activities. The majority of leading scientific organizations worldwide have also issued public statements endorsing this position.⁵⁶

The warming trend caused by humans, which has advanced at an unprecedented rate in the past 1,300 years, is a global security concern.⁵⁷ In the last 100 years, the earth's surface temperature has been warming, with the 20 warmest years on record since 1981.⁵⁸ Even a small change in average planetary temperature can cause significant climate and weather events, including more frequent floods and droughts, intense rain, and severe heat waves. As the earth's oceans are warming and becoming more acidic, ice caps are melting and sea levels are rising. In fact, the sea level has risen by almost 7 inches in the last century - nearly double the rate of increase compared to the previous 100 years.⁵⁹

Since the early 1900s, industrialization has released excess carbon dioxide and other greenhouse gases (GHG) into the air and additional atmospheric damage has occurred from the effects of deforestation, industrial processes, and some agricultural practices.⁶⁰ Excessive GHGs change the global climate and affect our water supplies, agriculture, power and transportation systems, the natural environment as well as health and safety. To study and report this harmful ecological development, the Environmental Protection Agency, in conjunction with many government agencies, academic institutions, and partner organizations, compiles over 25 indicators to monitor the signs of US climate change and track global trends for scientific comparison.

These organizations have found that atmospheric CO₂ concentrations alone have increased by almost 40% since pre-industrial times. Today, over 30 billion tons of CO₂ are released each year.⁶¹ Oceans cover over 70% of the globe, store massive amounts of energy from the sun, and transfer this energy around the world through their currents. As a result of GHGs, oceans absorb more heat, which causes surface temperatures and sea levels to rise, high levels of dissolved carbon is changing the chemistry of seawater, and our coastal bodies of water are becoming more acidic.⁶² Warmer waters are believed to foster stronger tropical storms, which is especially hazardous given that half the world's population lives within 50 miles of the coast. Even if GHG emissions were eliminated tomorrow, it would take many decades for the oceans to rebound.

Snow and ice, referred to as the "cryosphere," reflect a great deal of sunlight. As their quantity diminishes, so do their cooling properties. Glaciers around the world are getting smaller and their melting rate has increased in the last 10 years.⁶³ Snow and ice levels are also declining, which influences global air temperatures, sea level, ocean currents, and storm patterns. Additionally, scientists are seeing local and global changes in biodiversity in the creatures that feed in these areas, including polar bears, seals, and migratory birds.⁶⁴

Water quality is also critical for ecosystems, human health, sanitation, and agriculture. Increases in temperature, changes in precipitation, sea level rise, and extreme weather events reduce water quality. Saltwater from rising sea levels and storm surges threaten water supplies in coastal areas and on small islands.

Given that the oceans provide food, oxygen, and water, regulate climate and temperatures, stabilize our coasts, support pollution filtration and waste processing, and provide humans recreation and fun, the United States and many other countries have intensified their dedication,

emphasis and funding towards slowing, ending, and possibly reversing the harmful effects of climate change on our precious water resources. All of humankind must take environmental science and restoration to the next level. It is time to end the debate on climate change and increase personal, national, and global efforts to save our planet from ourselves.

Lieutenant Colonel L. Karl Paulsen, US Air Force

The Economic Case for Tackling Climate Change

Economics depicts global climate change as a massive market failure -- or as former World Bank chief economist Nicholas Stern put it, the “greatest market failure that the world has seen” with large externalities (since emitters of greenhouse gases seldom bear the costs of emissions) and collective action problems (since national economies reap the full benefits of fossil fuel use and conversion of forests to agriculture, but only a small fraction of the damage to global climate). The latest assessment by the Intergovernmental Panel on Climate Change, the premier scientific body examining the issue, calls climate change a “collective action problem at the global scale” and concludes that “effective mitigation will not be achieved if individual agents advance their own interests independently.”⁶⁵ Thus, policies to address climate change must address the skewed economic incentives, which have led to record global emissions even as the damage from climate change looms larger.

Economic models allow us to estimate the *costs of climate change and of potential responses to climate change* (e.g. policies to reduce deforestation and the use of fossil fuels). In the two decades since Yale economist William Nordhaus pioneered linking economic activity and energy use to a warming climate, economists and climate scientists have developed sophisticated integrated models (e.g., showing how land use changes as water scarcity drives up food prices, leading to even greater pressure to convert forests to agricultural production.)⁶⁶ Using such models, an interagency panel estimated in 2013 that a metric ton of CO₂ emissions (mtCO₂e) causes future harm with a present value of \$37, but prominent economists have argued that this figure undervalues the damage from climate change.^{67,68} The implication is that policies that prevent or sequester GHG emissions at a cost below \$37 per ton will be welfare-improving. (This kind of cost-benefit analysis is not new, and is in fact mandated for any federal regulation with a prospective economic impact over \$100 million per year.)

The burgeoning field of *behavioral economics* (BE) -- which holds that choices are shaped not just by material interests, but also by decision context, cognitive biases, and norms such as fairness -- suggests ways to promote action on climate change. Originating in the “bounded rationality” work of economist Herbert Simon and “prospect theory” experiments of Daniel Kahneman and Amos Tversky (all Nobel laureates), BE has shown that individuals and organizations are not strictly rational and often cooperate even when narrow self-interest suggests otherwise. Experiments and case studies show that *reciprocity norms and “conditional cooperation”* are widespread: individuals contribute to public goods (often at the expense of personal gain) where others join them, and in particular where they perceive that others are doing as much or more.⁶⁹ Similarly, individuals respond to *cognitive signals* in ways that social science cannot fully explain: for instance, “eco-labeling” has been shown to alter consumer behavior, perhaps by acting as a form of subtle peer pressure.⁷⁰

Individuals also demonstrate a *disproportionate loss aversion* -- and tend to have lower discount rates when faced with future losses than with future gains -- which should be good news

for motivating action in the face of climate disaster scenarios. Unfortunately, evidence also suggests a *status quo bias* -- when told that their energy-intensive lifestyles are unsustainable and a major cause of global warming, many Americans reject the message rather than change their behavior.⁷¹ Finally, *sanction mechanisms* are critical to maintaining common-good resource regimes, as documented in the seminal work of Elinor Ostrom.⁷² Taken together, the BE literature suggests that a global climate accord should include elements that negotiators have typically avoided, such as messaging about dire negative consequences (to stimulate loss aversion), reciprocal provisions (which make parties' obligations contingent on others acting), and binding sanctions (e.g. trade remedies or punitive financial measures).⁷³

Mr. Daniel Froats, US Department of State

Strong Environmental Policy: Germany

Germany is a rich source of experience on policy-induced environmental innovation thanks to its long history of ambitious environmental policy. Germany continues to be a leader in environmental policy today.⁷⁴ According to the 2014 Environmental Performance Index (EPI),⁷⁵ Germany ranks 6th out of the 178 countries that were ranked. Germany ranked number one in the categories of Health Impacts, Water and Sanitation, and Biodiversity and Habitat. Its three weakest areas consisted of Air Quality (94th), Agriculture (95th), and Fisheries (91st).⁷⁶

Germany's eco-industry has begun to take a more aggressive global leadership role. For example, the Noell GmbH,⁷⁷ a subsidiary of trade conglomerate Preussag AG,⁷⁸ is one of the small numbers of multi-dimensional suppliers of environmental remediation for air, water, and waste. The company is currently building a new sewage plant in Bitterfeld, a heavily polluted chemical town in eastern Germany. Noell GmbH also has two major Canadian contract orders for scrubbing plants aimed at eliminating sulfur and nitrogen oxide.

German eco-companies see the US Clean Air Act opening up even more international opportunities for them. For instance, CEA AG recently built two assembly plants in the United States for the manufacture of air-cooled condensers and combined cycle-gas turbine-diesel engines. Thanks to an identified need to replace older, less-efficient power plants in the United States, demand for these products and services is growing.

Water quality represents another growth area for German eco-industry. The European Union's (EU) efforts to improve European waters has taken on a more aggressive stance and the environmental commission has taken several member states to the EU Court of Justice for not meeting water quality standards. The German environment ministry estimates that 100 billion Euros will be spent to repair environmental damage to water works in five eastern states alone.⁷⁹ Colonel Karolyn "K" Hooper, US Army

Weak Environmental Policy: Africa

Sub-Saharan Africa's environmental conditions have the potential of contributing to instability and conflict on the continent, with ripple effects for US national security. While many

government structures in the region are ill equipped to confront environmental issues, there is a tradition of homegrown environmental activism that, coupled with international and African regional technical know-how and financial resources, is trying to improve the continent's environmental outlook.

In contrast to the weak or absent environmental governance in much of Africa, renowned environmentalists Wangari Maathai of Kenya and Ken Saro-Wiwa of Nigeria have raised their fellow citizens' awareness about the environmental degradation. Maathai introduced the idea of community-based tree planting and continued to develop this idea into a broad-based grassroots organization, the Green Belt Movement, whose main focus is poverty reduction and environmental conservation through tree planting. Since the founding of the movement, 30,000 women have trained in forestry, food processing, and bee-keeping, and over 40 million trees have been planted.⁸⁰ In 2004, Maathai became the first African woman and first environmentalist to win the Nobel Peace Prize. Saro-Wiwa, a playwright, was an outspoken environmental activist in the Niger Delta who denounced the damage of the land, air, and water by Royal Dutch/Shell and complicit government authorities. He employed non-violent resistance techniques to push for the preservation of Nigeria's Ogoni homeland.⁸¹

Across the continent, there is growing public concern about environmental threats. A Pew Research Global Attitudes survey in six African countries found that between 41 and 68% of respondents saw global climate change as a major threat. Islamist extremist groups and international financial stability were the other top concerns.⁸² This is an important change from a decade ago when a survey in 10 African countries found that people were less worried about pollution and the environment (between 8 and 24%) than HIV/AIDS (between 56 and 90%), religious and ethnic hatred, nuclear weapons, and the rich/poor gap.⁸³

The United States can ill afford to ignore Sub-Saharan Africa's environmental challenge. If we are truly interested in protecting our strategic partners from further environmental degradation, we should find a way to mobilize US government and non-government resources to strengthen environmental governance among African states. The EPA's modest governance program in Africa should be bolstered, and US environmental diplomacy should place a higher priority on reinforcing good governance. US non-governmental organizations should be encouraged to increase their technical assistance to African governments.

Mr. Joel Maybury, US Department of State

ENDNOTES

¹ For a detailed description of a qualitative case study, see Sharan Merriam, *Qualitative Research: A Guide To Design And Implementation*. San Francisco, CA: Jossey-Bass, 2009.

² Robert Yin. *Case Study Research: Design And Methods*. Thousand Oaks, CA: Sage Publications, Inc., 2009, p. 18.

³ Merriam, 2009.

⁴ Ontology refers to the study of the meaning of existence. It can also denote knowledge as a set of concepts within a domain. Ontology is generally either realist (there is a universal and objective reality) or nominalist (reality is a manmade concept and thereby subjective). Epistemology refers to the study of knowledge and how knowledge is conveyed. For a detailed description of these terms, see Gibson Burrell, & Gareth Morgan. *Sociological Paradigms and Organisational Analysis*. Revised Edition (2008). Burlington, VT: Ashgate, 1979, pp. 25-28. Post-positivism emphasizes the acquisition of human knowledge through the use of empirical observation and experimentation. Post-positivism allows for the use of qualitative and quantitative research design. See Joseph Ponterotto. "Qualitative Research in Counseling Psychology: A Primer on Research Paradigms and Philosophy of Science." *Journal of Counseling Psychology*, 2005, 52(2), 126–136.

⁵ In qualitative research, this concept is known as reflexivity. According to Maxwell, reflexivity poses a powerful and unavoidable influence for researchers. Reflexivity cannot be removed or minimized in research. Rather, researchers can only acknowledge it. Researchers must then account for how their own biases and interactions within the world at large can influence their data collection and the inferences drawn from that data. For more on reflexivity, see Joseph A. Maxwell. *Qualitative Research Design: An interactive Approach*. Thousand Oaks, CA: Sage Publications, 2nd edition, 2005.

⁶ In this context, triangulation refers to the effort of a researcher(s) to utilize multiple sources of data in the hope that they will converge to support an integrated description of the phenomenon (in this case, the environment industry). Triangulation is a common technique utilized in qualitative research. See Paul D. Leedy & Jeanne Ellis Ormrod. *Practical Research: Planning and Design*. Boston, MA: Pearson, 10th edition, 2013.

⁷ In this context, the term etic means to look from the outside in, as opposed to an emic perspective that examines a phenomenon from the perspective of a participant. These terms are commonly used in anthropological research. See Clifford Geertz. *The Interpretations Of Cultures*. Chapter 1. New York, NY: Basic Books Inc. 1973. See also Ponterotto, 2005.

⁸ Ibid.

⁹ For a description of validity and trustworthiness in qualitative research, see R. Burke Johnson. "Examining The Validity Structure Of Qualitative Research." *Education*. 118 (2), 1997, pp. 282-292. See also Yin, 2009.

¹⁰ Gregory Foster. "Environmental Security: The Search for Strategic Legitimacy," *Armed Forces and Society*, 27(3), Spring 2001, p. 375.

¹¹ US Department of Defense. "Environmental Security," Department of Defense Directive 4715.1E. March 19, 2005, p.9, <http://www.dtic.mil/whs/directives/corres/pdf/471501p.pdf>.

¹² Examples may include: air, water, food, clothing, sanitation, and shelter. For more on the Hierarchy of Human Needs, see Abraham H. Maslow. "A Theory of Human Motivation". *Psychological Review*, 1943, 50 (4), pp. 370–396.

¹³ Subhabrata Bobby Banerjee. "Organisational strategies for sustainable development: developing a research agenda for the new millennium." *Australian Journal of Management* 27, no. 1 suppl (2002), p. 113.

¹⁴ Carmen Castrejon Cardenas. "A Simple Life?: the symbolic significance of environmentalism in the construction of a community: case study in the ecovillage of Las Nubes in Veracruz, Mexico." (2007), p. 20.

¹⁵ Environmental Business International Online, <http://www.ebionline.org/about-ebi> as downloaded on 12 May 2014.

¹⁶ 2020B, EBI Report. *US Environmental Industry Overview*. Research, Consulting and Publishing, San Diego: Environmental Business International, Inc., 2013.

¹⁷ Klean Industries, "*Klean Industries Market New Report*". October 14, 2008. <http://www.kleanindustries.com/s/PressReleases.asp?ReportID=325076>, April 14, 2014.

¹⁸ R. Glenn Hubbard & Anthony Patrick O'Brien. *Economics*. 4th edition. Upper Saddle River, NJ: Pearson, 2013, p. 4.

¹⁹ Mike Hulme, Suraje Dessai, Irene Lorenzoni, and Donald R. Nelson. "Unstable climates: Exploring the statistical and social constructions of 'normal' climate." *Geoforum* 40 (2), (2009), p. 197.

²⁰ Ibid.

²¹ Ibid.

²² EBI Report 2020B, "US Environmental Industry Overview." Research, Consulting and Publishing, San Diego: Environmental Business International, Inc. December 2013.

²³ See Michael E. Porter, "The Five Competitive Forces That Shape Strategy," *Harvard Business Review*, January 2008

²⁴ U. S. Environmental Protection Agency homepage, Pollution Prevention page, <http://www.epa.gov/ems/> (accessed April 4, 2014).

²⁵ A market failure is a situation in which a given market fails to produce an efficient level of output. For more on this phenomenon, see Hubbard & O'Brien, p. 140.

²⁶ Hardin, Garrett. "The tragedy of the commons." *Science* 162, no. 3859 (1968): 1243-1248.

²⁷ Kjell Arne Brekke and Olof Johansson-Stenman, "The Behavioural Economics of Climate Change." *Oxford Review of Economic Policy* 24, no. 2 (2008), p. 289. See also Elinor Ostrom. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge, UK: Cambridge University Press, 1990.

²⁸ Applicable Executive Orders (EO) include: EO 13148-Greening of Government Through Leadership in Environmental Management (Clinton Administration);

EO 13423-Strengthening Federal Environmental, Energy, and Transportation Management (G. W. Bush Administration); and EO 13514-Federal Leadership in Environmental, Energy, and Economic Performance (Obama Administration).

²⁹ J. G. Spath. *Red Sky at Morning: America and the Crisis of the Global Environment* New Haven: Yale University Press. 2004, p. 95.

³⁰ http://ozone.unep.org/new_site/en/treaty_ratification_status.php.

³¹ For example, see Gordon Adams. "The Department of Defense and the Military-Industrial Establishment: The Politics of the Iron Triangle." *Critical Studies in Organization and Bureaucracy* (1984): 320-34.

³² Jeff H. Smith. 2003. "The Shareholders vs. Stakeholders Debate." *MIT Sloan Management Review* 44 (4), pp. 8. Business Source Complete, EBSCOhost (accessed May 15, 2014).

³³ Banerjee.

³⁴ Ibid.

³⁵ EBI Report 2020B. December 2013.

³⁶ Industry Value Added is the market value of goods and services produced by an industry minus the costs of goods and services used in production. See Hubbard & O'Brien, p. 624.

³⁷ The growth rates provided here are ten-year averages projected from 2009-2018. See IBIS World. Industry Reports. <http://www.ibisworld.com/industry/home.aspx>.

³⁸ European Union Website, Environment Page. http://europa.eu/pol/env/index_en.htm (accessed March 15, 2014).

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⁴⁰ United Nations Environment Programme, "UNEP YEAR BOOK Emerging Issues In Our Global Environment" (2013), (pgs. 2-3), *Publications*, <http://www.unep.org/publications/>.

⁴¹ Nafeez Mosaddeq, "How Resource Shortages Sparked Egypt's Month-Long Crisis," *The Atlantic*. <http://www.theatlantic.com/international/archive/2013/08/how-resource-shortages-sparked-egypts-months-long-crisis/278802/>.

⁴² Glenn E. Curtis, "Russia: A Country Study-Environmental Problems," *Library of Congress*, <http://countrystudies.us/russia/25.htm>, April 24, 2014.

⁴³ Larry A. Henry and Vladimir Douhovnikoff, "Environmental Issues in Russia," *Bowdoin College*, (2008): 439, <http://www.bowdoin.info/faculty/v/vdouhovn/pdf/douhovnikoff-environmental-issues-in-russia.pdf>.

⁴⁴ "Latin America struggles to cope with record urban growth", retrieved from <http://www.theguardian.com/world/2012/sep/11/latin-america-urbanisation-city-growth>, accessed on March 3rd 2014.

⁴⁵ "Brazil's largest environmental program leaves legacy of preserved lands and species", The World Bank, retrieved from <http://www.worldbank.org/en/news/feature/2012/07/19/ppg7-maior-programa-ambiental-brasil>, accessed on March 15th 2014.

⁴⁶ The Carnegie Corporation of New York, "Preventing Deadly Conflict: Final Report," (Washington, DC: Carnegie Commission on Preventing Deadly Conflict, 1997), p. xxxiii.

⁴⁷ Helga Haftendorn, "The Security Puzzle: Theory Building and Discipline in International Security," *International Studies Quarterly*, Vol. 35, No.1 (1991): pp. 3-17.

⁴⁸ Elizabeth L. Chalecki, *Environmental Security: A Guide to the Issues*, (Santa Barbara, CA: Praeger, 2013), p.2.

⁴⁹ Ibid, p. 5.

⁵⁰ Paul Ehrlich, *The Population Bomb*. Cutchogue, New York: Buccaneer Books, (1968), p. 3.

⁵¹ Chalecki, p. 5.

⁵² Foster, *ibid*.

⁵³ *Ibid*.

⁵⁴ National Aeronautics and Space Administration. Global Climate Change. <http://climate.nasa.gov/evidence/>.

⁵⁵ Ibid.

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ The Discovery of Global Warming. The Carbon Dioxide Greenhouse Effect. <http://aip.org/history/climate/co2.htm>.

⁶¹ United States Environmental Protection Agency. Climate Change. <http://www.epa.gov/climatechange/>.

⁶² Global Issues. Climate Change and Global Warming Introduction. <http://www.globalissues.org/article/233/climate-change-and-global-warming-introduction>.

⁶³ Lonnie G. Thompson. *Climate Change: The Evidence and Our Options*. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2995507/>.

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