

**Spring 2007
Industry Study**

Final Report
Environment Industry



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

ENVIRONMENT 2007

ABSTRACT: The members of the 2007 Industrial College of the Armed Forces (ICAF) Environment Industry Study (EIS) evaluated a wide range of local, regional, and global environmental issues. It was clear the growths in the world population and global industrial activities have elevated the impact of environmental issues from localized issues to increasingly global concerns with potentially strategic implications. In contrast to the early environmental efforts in the 1960s and 1970s, in this increasingly complex, interdependent global economy, the environment industry is totally interdependent with all other sectors of the economy, especially energy, transportation, agriculture, and communications. This paper evaluates the status of the United States (US) and global environment industry; discusses implications regarding environmental national security, and provides recommendations to address the major challenges of the coming decades, including the impact of greenhouse gases (GHG) and climate change. The US Government (USG) plays a critical role in developing strategies to address these environmental challenges and to connect our national efforts with those of global and private institutions to achieve the needed synergies around the world. During the course of our study, we spoke with leading environmental leaders, both inside and outside the US. We learned first hand that clear and decisive leadership is critical at all levels and the opportunities for collective action to improve the environment are clear and compelling. More importantly, collective action is critical to success if we are going to develop truly global solutions that will be economically viable and effective for the entire world ecosystem.

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PLACES VISITED

Domestic:

- Local -

British Petroleum Solar, Frederick, MD
 Wheelabrator Technologies, Baltimore, MD
 Alexandria Sanitation Authority Advanced Wastewater Treatment Facility, Alexandria, VA
 World Resources Institute, Washington, DC
 Dupont Spruance Plant, Richmond, VA
 Virginia Department of Environmental Quality, Richmond, VA
 Export-Import Bank of the United States, Washington, DC

- Florida -

US Army Corps of Engineers – Jacksonville District, West Palm Beach, FL
 South Florida Water Management District, West Palm Beach, FL
 South Florida Ecosystem Restoration Task Force, Miami, FL
 Miami-Dade County Seaport Department, Miami FL
 Dade County Department of Environmental Quality, Miami, FL
 Audubon of Florida, Miami, FL
 Royal Caribbean International & Celebrity Cruises, Miami, FL

- Louisiana -

US Army Corps of Engineers – New Orleans District, New Orleans, LA
 Entergy Corporation, New Orleans, LA
 New Orleans Department of Environmental Quality, New Orleans, LA

International:

- Turkey -

Consulate General of the United States, Istanbul, Turkey
 British Petroleum Turkey, Istanbul, Turkey
 The Turkish Foundation for Combating Soil Erosion, for Reforestation, and the Protection of Natural Habitats (TEMA), Istanbul, Turkey
 Turkish Marine Environment Protection Association (TURMEPA), Istanbul, Turkey
 Çalik Holding Officials, Istanbul, Turkey
 The Foundation for the Promotion, and Protection of the Environment, and Cultural Heritage (CEKÜL), Istanbul, Turkey
 Istanbul Technical University, Istanbul, Turkey
 Ihlas Holding Executives, Istanbul Turkey
 National Energy Forum of Turkey, Istanbul, Turkey
 Mercedes-Benz, Türk A.Ş., Istanbul, Turkey
 Turkish Straits Vessel Traffic Services, Istanbul, Turkey
 Industrial Development Bank of Turkey (TSKB), Istanbul, Turkey
 Total Gas & Power, Istanbul, Turkey
 İÇDAŞ, Istanbul, Turkey
 Petrol Ofisi A.Ş., Istanbul, Turkey

- Greece -

Hellenic National Defense General Staff, Athens, Greece

Hellenic National Defense College, Athens, Greece

Polyeco S.A., Aspropyrgos, Greece

Elefsis Shipyards, Aspropyrgos, Greece

Environmental Protection Engineering S.A., Piraeus, Greece

Hellenic Marine Environmental Protection Association (HELMPEPA), Athens, Greece

National Technical University of Athens, Zografos, Greece

Costamare Shipping Company S.A., Athens, Greece



Why Study The Environment Industry?

The “environment is the total of all things or circumstances around an organism.”¹ This is a very broad concept that illustrates how hard it is to define the size and scope of the environment and as a consequence the industry that it serves. The US Office of Technology Policy defines the environment industry as all revenue-generating activities associated with the following:

- (1) Compliance with environmental regulations;
- (2) Environmental assessment, analysis, and protection;
- (3) Pollution control, waste management, and remediation of contaminated property;
- (4) Provision, and delivery of the environmental resources of water, recovered materials, and clean energy; and
- (5) Technologies and activities that contribute to increased energy and resource efficiency, higher productivity, and sustainable economic growth (enabling pollution prevention)².

Traditionally, the environment industry is often categorized in terms of environmental media such as air, land, water or ownership such as environmental business goals and decision making frameworks. In terms of business fundamentals and analysis, environment industry activities are often divided into three major categories: services, equipment, and resources.

Regardless of how the industry is defined, at the strategic level, the growths in the world population and global industrial activities have elevated environmental issues from localized problems to global concerns. The environment is totally interdependent with all other sectors of the economy, especially energy, transportation, agriculture, and communications. The increasing scarcity of water and energy sources and the worldwide impact of pollution, serve as market drivers that are transforming the environmental market into a web of interrelated (and often conflicting) political, social, and economic demands. It is impossible to separate the need for reliable and secure energy supplies, access to clean water and air, and overall economic productivity from environmental policies; especially with regards to climate change resulting from carbon dioxide (CO₂) emissions, and our expanding knowledge of the impact of man’s activities and pollution on regional and global ecosystems. Developing viable long term solutions that minimize carbon and other pollution footprints is one of the biggest challenges of the 21st century. How can we get the benefits of hydrocarbons or new energy sources without excessive pollution? How can we ensure acceptable levels of clean air and water for all nations? How can struggling economies ensure their continued development without further degradation of their environment? Do the firms that lead the US environment industry have a competitive advantage that can lead to further economic growth and support the development of innovative solutions for the benefit of global ecosystems?

Status of the US Environment Industry

The aggregation of available environmental technologies, goods, and services comprise an industry that serves to advance sustainable development by reducing risk, enhancing cost effectiveness, improving process efficiency, and creating products and processes that are environmentally beneficial or benign. Individual markets within this industry include: air, water,

and soil pollution control; solid and toxic waste management; site remediation; environmental consulting services; and environmental monitoring and recycling. Globally, this market generates \$556B in revenue annually. The US share is 38% of the total, with water/wastewater management services comprising 45% of the global market.

The US is the largest single market for environmental technologies in the world, having grown 37% from 1990-2000, with imports rising 130% from 1993-2003. In 2002, there were an estimated 60,000 firms active in the US environment industry, generating \$220B in revenues and supporting approximately 1.6 million US jobs. While the US is a leading producer of environmental technologies, it exports only about 11% of its output while key competitors (Japan, Germany, and Great Britain) export over 20%.

Recent trends in the environment industry show little growth among developed countries (less than 2% per year, the US included). Meanwhile, emerging markets in developing regions of the globe are seeing in excess of 10% growth per year due to the impact of sustainable industrial development in these areas.³

Development of Environmental Laws and Regulations in the US

Since 1970, the US economy, especially the industrial sector, has changed dramatically as a result of a landslide of legislation aimed at preserving the earth's natural balance. Early efforts toward achieving this goal were generally reactive in nature, consisting of so called "end of pipe" investments to capture pollutants in the final stages of production but without requiring substantial disruption to mainline manufacturing processes. As the volume and stringency of regulations imposed on industry increased, firms found this approach added significantly to their overhead costs without benefit to their bottom lines. Some sought to challenge the basis for these environmental regulations that were extracting a high economic toll for compliance. Most of these efforts failed. The federal government firmly established with the passage of the National Environment Policy Act (NEPA) that it would not turn back the gains it had achieved in ecological quality resulting from enforcement of environmental laws, regulations, and international treaties.

The successes generated by NEPA opened the floodgates for other environmental legislation. The federal government rose to the challenge by creating the Environmental Protection Agency (EPA). Prior to the establishment of the EPA, the federal government was not structured to effectively address pollutants that harm human health and degrade the environment. EPA is still a relatively small agency given the broad and complex task it has been given in support of US environmental issues, many of which have global implications. The agency has over 20,000 employees assigned across the country in ten key regional offices (Figure 2, Appendix), more than a dozen labs, and the headquarters in Washington, D.C.

EPA leads the nation's environmental science, research, education, and assessment efforts, working to develop and enforce regulations that implement environmental laws enacted by Congress. These responsibilities are shared with other federal agencies such as the Council on Environmental Quality, the Department of Justice, and the Department of the Interior. These environmental responsibilities are extended to the international community through organizations such as the Department of State, and the US Agency for International Development (USAID).

EPA has the responsibility of managing, implementing and enforcing federal programs under certain environmental statutes such as the Clean Air Act, the Clean Water Act, and the

Resource Conservation and Recovery Act. It also has the authority to delegate this responsibility to individual states that demonstrate the capability of assuming these programs. All but five states have separate environmental protection management agencies that have been delegated this authority.

Over the past forty years the US has passed a number of significant laws to improve the environment and given the EPA broad discretion to regulate pollution. The major laws include: the Resource Recovery Act (1970), the Ocean Dumping Act (1972), the Safe Drinking Water Act (1974), the Resource Conservation and Recovery Act (1976), the Toxic Substances Control Act (1976), the Lead Contamination Control Act (1988), and the Ocean Dumping Ban Act (1988). At the international level, the US has become a party to 99 environmental treaties, most of which mirror rules already set forth to address domestic environmental issues. In cases where a proposed international treaty's standards might exceed those of domestic law or be found not to be in the national interest, the US generally refrains from becoming a party, as was the case with the Kyoto Protocol of 1997.

Many larger, forward-looking US companies have undertaken new research and development programs intended to bring their business processes into alignment with their need to comply with environmental rules. These firms have seen their revenues actually increase in relation to their implementation of environmental controls, viewing expenditures for compliance not as sunk costs but as investments in efficient business operations. Costs borne by the private sector to comply with environmental regulations (estimated to be 3-6% of a typical firm's revenues⁴) come in the form of remediation of existing violations, implementing corporate environmental management systems and establishing processes to segregate and reduce wastes. The money spent by these firms to achieve compliance represents sales and income to environmental product/service providers, who themselves are private businesses in the "Pollution Control" industry. This symbiotic business practice has had a positive impact on both the US and global economies and has served to make US companies more competitive within the global markets in which they compete.

Environment Industry Business Fundamentals

State and federal governments, financial equity research firms, and environmentally affiliated non-governmental organizations (NGOs) have slightly different definitions for the environment industry. As a consequence, there is a mix of industrial classification codes for environmental companies. The US government uses the North American Industry Classification System (NAICS) to classify business establishments and collect statistical data for comparability in business statistics. Using the NAICS classification system, Environmental Business International⁵ (EBI) categorizes environmental firms into 14 industry segments, and estimates that the total private sector revenue in 2004 was \$245B in the US, and \$600 billion globally⁶ (Table 1, Appendix). These totals increase dramatically when all public sector revenues are included.

Even when the public sector is included, the NAICS is still a narrow definition. The environmental business activities fit within several of the NAICS codes and historically there hasn't been a comprehensive set of data used systematically across the industry. Over the last decade the Organization for Economic Cooperation and Development (OECD), and the United Nations (UN) have worked to standardize industry tools in order to provide a standard framework for industry analysis and for analysis of regional and global environmental problems.

An analysis of the US domestic environment industry shows dramatic growth from the 1970s through the mid 1990s, but now is a relatively stable and mature market. The environment industry is distinguished from many other industries by the plethora of laws, and regulations that have driven the industry from its infancy. This has a stabilizing effect so that, although private sector spending may go down somewhat during an economic slowdown, the decline in the past has been minimal. The industry is composed of a very large number of small, and medium sized firms, with few firms operating in more than one of the 14 sectors. The overall US market is not expected to rise dramatically in the next 5-10 years. Currently exports comprise about 10% of the total market with total US environmental export trade of \$31.8B in 2005, and import trade of \$23.6B?

In contrast to the US market, the global environmental market is expected to grow dramatically (Figure 2, Appendix). This provides a clear economic opportunity for US exports in areas where the US has a competitive advantage such as environmental instrumentation, and information systems, air, and water equipment, and pollution controls. Within the global export market, "the United States is the largest supplier of water, and wastewater equipment with a market share above 80%, but European companies are trying to increase their share of the market."⁷ Nonetheless, international companies such as Lyonnais de Eaux, Vivendi, and Aguas de Portugal are beginning to compete with American companies for this market. In the pollution control equipment arena, US companies are losing ground to companies from Japan, Germany, Canada, Spain, and France.

It is important to note that the fragmented structure of the industry, typified by many small and medium firms, means that few domestic companies have the capacity to pursue large international projects or promote overseas business without USG support. The close cooperation, and integration between US energy, and environmental firms may provide an example, and a strategic advantage, to the US in developing innovative solutions to global environmental challenges, and thereby further expanding US global influence. Due to the pressure created by water scarcity, depleting energy sources, and the global impact of pollution, market drivers are transforming the global energy and environmental market into a web of conflicting political, social, and economic demands. The US is one of the few nations able to take the lead in developing the technologies, and market force solutions to these critical environmental challenges. The US robust capital markets and business efficiency ensure that solutions are economically feasible. This will be especially important if we are to develop solutions that are viable in poor and developing nations.

Environmental Technologies

Technology is one of the keys to addressing the complex array of global environmental challenges. For example, the development, and continual improvement of multiple technologies was required to meet the new clean air and water standards of the US in the 1970s. When scientists recognized that chlorofluorocarbons (CFCs) used in aerosols and air conditioners were destroying the atmospheric ozone in the 1980s, governments reacted quickly to ban the use of these gases. The result is that the ozone layer today appears to be on the mend⁸. This remedy would have been much harder to implement if a suitable (albeit more expensive) technological alternative had not been developed, and available. Innovation and new technologies must now focus on tackling the challenges of climate change which is one of the predominant concerns of this era.

Despite the USG reluctance to regulate GHG emissions, research in the area of climate change has steadily increased in recent years. The 2001 National Energy Policy directed federal agencies to develop new technologies and identify environmentally sound and cost-effective ways to utilize market mechanisms to address global climate change. In January 2002, President Bush established a Cabinet-level Committee on Climate Change Science and Technology Integration with the principal aim of the technology portion to “accelerate the development of new and advanced technologies to address climate change.”⁹ The Climate Change Technology Program (CCTP) focuses on the following six strategic goals to reduce GHG emissions: (1) improved energy end-use efficiency; (2) reduced emissions for energy supply sources; (3) capture and sequestration of CO₂ from emissions; (4) reduction of non- CO₂ GHGs; (5) improved measurement and monitoring; and (6) bolstered basic science in technology development. The American Association for the Advancement of Science (AAAS) reports that the Department of Energy’s (DOE) Office of Science will get a boost of 15.4% in their research and development funding in fiscal year 2008, compared to 2007. The \$4.1B includes a 20% increase in basic energy sciences, a 34% increase in fusion research, and increases across the portfolio of renewable energy.¹⁰ It is clear that remediation of climate change and the development of new energy technologies are inextricably linked.

Increase Energy Efficiency. Great strides can be made in reducing GHG emissions in the near to mid-term¹¹ through substantially increasing energy efficiency. Irrespective of breakthroughs in energy source technology, efficiency gains are economically advantageous. Reducing end-use emissions should stem from technological advances across the transportation, construction, and industrial sectors. Additional efficiencies could be gained in the national power production infrastructure, including “smart” storage, transmission, distribution, and control.

CO₂ Capture and Sequestration. In the near to mid-term, it may be necessary to employ methods of CO₂ emission sequestration while longer-term energy technologies are developed. Technologies exist today that separate CO₂ into a form that can be pumped into a geological storage media. One concern is over how much energy may be required from fossil fuel sources to achieve this. Many concepts have been advanced regarding appropriate media for long-term sequestration, including the use of geological formations or the deep ocean. Although analysis indicates the ocean has tremendous potential for sequestration, uncertainty about second and third order environmental effects of raising CO₂ concentrations in the sea (including the likely impact on marine life) makes this option less viable. Although debate and analysis continues over the potential risks of leakage and unintended chemical reactions of sequestered CO₂ in geological formations, geological sequestration exhibits a strong degree of viability.

Non-CO₂ GHG Emissions. While CO₂ is by far the largest component of GHG emissions from human sources, methane, nitrous oxide, and halocarbons are other significant components. Although the Intergovernmental Panel on Climate Change (IPCC) and the EPA attribute only a sixth of GHGs emissions to methane, new calculations by a National Aeronautics and Space Administration (NASA) scientist predict methane may contribute up to a third¹². The primary source of methane emissions in the US is from landfills. The CCTP includes a focus on innovations such as landfill bioreactors that capture methane releases for energy use while accelerating decomposition through promotion of microorganisms¹³. Other methane capturing innovations address industry and agriculture.

Energy Supply Sources. Much of the technological focus for future energy revolves around the concept of a “hydrogen economy.” The President’s Hydrogen Fuel Initiative envisions the “transformation of the nation’s transportation fleet from a near-total reliance on

petroleum to steadily increasing use of clean burning hydrogen.”¹⁴ Hydrogen is extremely clean and abundant. However, one problem is that separation of hydrogen requires energy—probably energy from fossil fuels in the near term, creating the likelihood of emitting more GHGs from using hydrogen as a fuel source than from gasoline. A \$1B flagship DOE initiative, entitled “FutureGen” is slated to demonstrate a new “clean coal” power plant in 2012 that will use a gasification process to produce electricity and hydrogen while sequestering concentrated CO₂.¹⁵ Nuclear fission, which does not produce GHGs, also stands on the verge of a potential “renaissance.” New light-water reactor technologies, termed “Generation IV,” are being developed with several international partners. These technologies focus on improved safety, security, and reduced waste. Fission is also a source for producing hydrogen.

Renewable energy sources and biofuels have gained new enthusiasm in the wake of public acknowledgement of the effects of GHG emissions. Devices such as wind turbines and solar panels, which initially garnered acclaim during the oil crisis of the 1970s, are regaining the status of economic viability. Technologies such as geothermal or ocean/hydropower are now available for specific applications, and flexible biofuels are being produced. However, care must be taken to ensure the manufacture of these devices or the land use to produce biomass crops does not actually increase net GHGs emissions. Although techniques to harness natural energy are limited by geographical location, a smart/distributed power grid can substantially compensate for regional weather conditions and create more normalized power production.

Developing nuclear fusion is a long-term potential energy solution that warrants significant government investment. Fusion can offer cheap, clean, and abundant electricity as well as hydrogen without the safety, security, and waste concerns of fission. Serious technological challenges face the commercialization of fusion power. However, the basic technology has been demonstrated and progress continues in the US (including research institutions such as the Princeton Plasma Physics Laboratory) and at the International Thermonuclear Experimental Reactor (ITER) fusion demonstration project. Despite the fact that fusion research will receive a 34% increase in US federal research funding from last year, investment at the level of \$428M in 2008 is inadequate, considering the potential return.

Environmental Education

“Development of effective solutions to environmental problems, and effective implementation of environmental programs requires a well educated, and trained professional workforce.”¹⁶ Environmental Education is the field of applied science dedicated to the study of the effects of human activities on ecology, and natural resources. It combines a broad scope of disciplines, including earth sciences (such as meteorology, oceanography, geology, and hydrology), biological sciences (such as horticulture, agriculture, and marine biology), applied engineering (civil, mechanical, and chemical), chemistry, and medicine. Since the 1970s, many governmental and private organizations have endeavored to improve environmental education in order to foster an understanding of the complex interactions between man and the environment, and to expand public outreach to increase comprehension and awareness.

In November 1990, the US Congress enacted the National Environmental Education Act, directing EPA to:

“...work with local education institutions, State education agencies, not-for-profit educational, and environmental organizations, noncommercial educational broadcasting entities, and private sector interests to support development of curricula, special projects, and other activities, to increase understanding of the natural, and built environment, and to improve awareness of environmental problems.¹⁷”

The act directed EPA to establish an Office of Environmental Education (OEE) to develop, and support environmental education programs, create, and disseminate training materials, and publications; organize seminars, and training programs, and manage grant assistance. The act established the formation of the National Environmental Education, and Training Foundation (NEETF), a non-government non-profit organization “...to encourage, accept, leverage, and administer private gifts for the benefit of, or in connection with, the environmental education, and training activities of the US EPA¹⁸.” Additionally, the act established the National Environmental Education Advisory Council (NEEAC) and a Federal Task Force to assess the processes, policies, and progress of the OEE, and make recommendations to the EPA Administrator. The act authorized an annual budget of \$12M to \$14M between 1992, and 1996. Since then the annual appropriation has averaged approximately \$7.1M, a meager amount given the responsibilities of the office, and the overall benefit to society of effective environmental education. An annual grant authority of \$2-3M is considered insufficient to significantly motivate any positive process changes, especially when spread over all fifty states.

The efforts of the EPA’s OEE have been complicated over the last six years. The current administration has not supported the efforts of the OEE, attempting to zero out the program every year since 2002.¹⁹ Lacking a reauthorized National Environmental Education Act, Congress has continued to appropriate a sustained level of funding to the program. The OEE’s responsibilities have been somewhat clouded by similar environmental education efforts at other agencies such as the Department of Commerce’s National Oceanic, and Atmospheric Administration, and the National Science Foundation. Currently, there are two proposed bills that will continue to compete with the responsibilities of the OEE. A revision to the No Child Left Behind Act is being drafted to include environmental sciences as a required subject, and authorizing up to \$100 million to the Department of Education for teaching grants.²⁰ Representative M. Honda of California has introduced a “Global Warming Education Act” which would authorize the National Science Foundation to develop and execute a training and instructional programs very similar to the current environmental education programs at EPA.²¹

In March 2005, the EPA’s NEEAC submitted their statutorily required report to Congress on the status of environmental education, making eight significant recommendations to improve, strengthen, and streamline the processes of the EPA, and numerous governmental, public, and private environmental education organizations. The main themes of their recommendations are: that the National Environmental Education Act of 1990 needs to be revamped to reflect the progress and changes over the last fifteen (now seventeen) years; that funding is insufficient and needed to be increased; and that processes for increased collaboration need to be put in place.²² In September 2005 the NEETF reported that although the vast majority of the American public agreed with the importance of environmental education, “...our citizenry is by, and large both uninformed, and misinformed.”²³ A similar conclusion was made by the non-profit Campaign for Environmental Literacy that claimed “Americans still widely lack the environmental knowledge that would enable them to safeguard public health, protect natural resources, support

energy conservation efforts, and engage in the movement towards a more sustainable future.”²⁴ Although there are a number of different environmental education efforts, it is clear from a large number of studies that progress to date has been lacking, and the myriad efforts are not synchronized. The North American Association for Environmental Education (NAAEE), and others that significant strategic level improvements must be committed to at the highest levels of local, state, and federal government for quality environmental education to reach schools in particular, and the overall US population in general.

Status of the Global Environment Industry

In the International arena, the Organization of Economic Co-operation, and Development (OECD) reports that the world’s population will increase to 7.5 billion by 2020, and urban populations will almost double to over 4 billion in that same period. These dramatic increases and the resulting “volume effect” will inevitably lead to large increases in pollution if current trends and policies continue. Additionally, the effects of industrial globalization may create spiraling pollution in developing countries that do not possess, and enforce laws to restrict emissions. In May 2001, the OECD adopted an Environmental Strategy for the First Decade of the 21st Century. Underlying the overall strategy was a focus on developing environmental policies that centered on sustainable development both within OECD countries, and non-member countries. The overall OECD strategy identified five interlinked objectives that must be the central focus of integrated efforts:

1. Maintaining the integrity of ecosystems through the efficient management of natural resources.
2. De-coupling environmental pressures from economic growth.
3. Improving information for decision making: Measuring progress through indicators.
4. The social and environmental interface: Enhancing the quality of life.
5. Global environmental interdependence: Improving governance, and co-operation²⁵.

These objectives provide a framework that should underlie the efforts of the USG to address some of the critical global and regional environmental challenges outlined in the following section.

Regional Environmental Analysis – Regional Trends, and Challenges

North America. As a whole, the overall environmental state in the region of North America is better than many parts of the world. The US, and Canada pioneered efforts for environmental protection. However, these countries are also the largest consumers of natural resources and the greatest sources of pollution and GHG.²⁶ Low population density and their advanced economies have mitigated the impacts of this pollution. Adoption of ground breaking laws, and policies in the 1960s, and 1970s led to rapid growth of the environment industry and improvement of the environment as well. The domestic environment industry is now mature²⁷ and future growth will largely depend on effective penetration of the highly competitive global market. In order to accomplish this, the environment industry will have to be flexible and adaptive. The role of the USG to ensure fair, and balanced global regulations, promulgate

research and development and provide tax incentives, financial packages, and risk amelioration measures will be discussed in more detail later in this paper.

Latin America. One of the richest biological regions in the world, Latin America continues to face serious environmental problems despite some improvement in the protection of natural resources. Regional and national economies are based to a large degree on the exploitation of natural resources. Expanding population combined with economic disparity, and limited urban planning place strong pressures on the environment. Pressures on the region's natural resources are not only due to internal consumption patterns but are also due to the demands of global markets.²⁸ The region has the largest reserve of arable land in the world, but a lack of planning, contamination, deforestation, erosion, and urban expansion have resulted in the degradation of over 300 million hectares of agricultural land.²⁹ Due to degradation of aquifers through pollution, and salt water intrusion, more than half the urban population suffer from diseases associated with inadequate water, and sanitation.³⁰ The region accounts for 25% of global forest cover but at the same time accounted for 40% of the world's deforestation in the last 30 years. Thirty one of Latin America's 178 eco-regions are listed in "critical" condition, and 30% of the coral reefs are in danger of disappearing.³¹ Major fisheries are threatened by over-fishing. Air pollution in the major cities is a serious health hazard. The region faces a challenge in balancing economic development with conservation. Nonetheless, the Latin America, and Caribbean regions remains fertile ground for environmental initiatives to protect its biodiversity, perform carbon dioxide sequestration projects and implement environmental management activities that range from pollution reduction, and control to clean up, and remediation. Due to its proximity to the region, US environmental businesses, equipment, expertise, and advisory support will find a supportive market in this area.

Africa. Even though Africa is rich in resources, it remains the poorest region in the world, with large numbers of people living on less than a dollar a day. Environmental conditions lie at the root of many of the continent's problems: border disputes, ethnic conflict, extreme poverty, disease, and widespread famine. Deforestation, land degradation, air quality, and water scarcity are the most pervasive environmental challenges facing Africa. Climate change is a serious concern, as some regions have experienced over three decades of drought. In sub-Saharan Africa, only 58% of the population has access to improved water, and only 36% has access to improved sanitation.³² Water borne diseases such as malaria and cholera are widespread. Central Africa, home to the second largest rain forest in the world, is being deforested at a rate of two million acres a year.³³ The USG has sponsored a number of environmental initiatives such as the Clean Energy Initiative, the Presidential Water for the Poor Initiative, the Congo Basin Forest Partnership, and the Presidential Global Climate Change Program. NGOs and international donors are crucial in the continent's development; however, violent conflicts impede aid and sustainability initiatives. Trade barriers, corruption, and high infrastructure costs deter foreign investment. Development partners that drive growth, and build capacity are needed for long-term progress, and sustainability for Africa. Otherwise, as nations struggle to focus on the immediate problems of hunger, poverty, and disease, the development could be achieved at the expense of further environmental degradation and depletion of resources.

Middle East and North Africa. The greatest environmental pressure facing the Middle East and North Africa is water scarcity. The region contains less than 1% of the earth's renewable fresh water. Environmental problems stemming from water issues have been estimated to cost countries in the region between 0.5, and 2.5% of their gross domestic product (GDP) every year. Forecasts estimate that by the year 2050 per capita water availability will be reduced by 50% due to the effects of climate change. Though some of the countries in the region contain significant oil and gas reserves, the resources are being consumed with limited investment in future infrastructure. It is estimated that over \$117B will be required to cope with potable (including desalination), and wastewater issues in the region. US export revenues currently account for 10% of the region's environmental market. It is estimated that this market will grow between 8, and 12% over the next four years. One difficulty to market penetration is lack of ease for market entry and exit due to legal and bureaucratic obstacles for foreign firms.

Central and Western Europe. After experiencing large-scale increases in pollution stemming from post-WWII reconstruction, Europe implemented laws, regulations, and treaties that have resulted in substantial mitigation of environmental damage. Current European environmental policy focuses on four priority areas: climate change, biodiversity, environment, and health, and sustainable management of resources, and waste.³⁴ Despite notable achievements, some reports indicate that the environment has continued to deteriorate. Every year two billion tons of waste are produced, a figure that increases 10% each year. CO₂ emissions from vehicles and homes are increasing, as is energy consumption. The European environment market, valued at \$181.6B per year, is mature, and ranks second in the world (surpassed only by the US). The advanced countries of Western Europe have the know-how, and resources to compete in the international environmental market in segments as diverse as renewable energy, fuel-cell technology, carbon footprint trade, and pollution control. Newer member states still grapple with problems such as water, wastewater and sewage treatment, and air quality. US environmental companies are active in the European market. Among the top 30 U.S. export markets, 8 are EU countries. The list of leading foreign markets for US purifying machinery for liquid or gases, European countries represent 14.7%, number two only to Canada. Ease of market entry and the high quality of US products bodes well for a continued robust US presence, though a high priority on research, and development, and improvements to sometimes weak after-sale service needs to be addressed for US firms to maintain their position.

Russia and the Former Soviet Union. Any listing of the environmental horrors left in the wake of the Soviet collapse is inadequate to fully describe the damage. The Aral Sea has shrunk by two thirds. Vast agricultural areas are permanently poisoned. Parts of Kazakhstan have seen an epidemic of radiation-related cancers resulting from nuclear testing, and the Urals, and the coasts are devastated by industrial pollution, and radiological contamination. Only a minority of the population has access to clean drinking water, and few waste water plants meet national standards. Urban air pollution is extreme. Climate change represents a threat to Central Asia's glacier-fed rivers, and to Russia's permafrost regions. Though the potential environment industry market is significant, insufficient government resources, corruption, and a lack of political will limit the current reality. US aid is conditional on political and social criteria. International organizations and non-governmental organizations (NGOs) serve as the primary source of foreign environmental aid and expertise. To cite just a few examples, the European Bank for Reconstruction and Development provided investments for water treatment, and waste

management in the Caucasus.³⁵ In 2002, United Nations Development Program (UNDP) and Organization of Security Cooperation in Europe joined forces to cleanup and dispose of rocket fuel (an environmental hazard and potential security threat) throughout the region.³⁶ The United Nations Environmental Program (UNEP), in conjunction with other multi-lateral organizations, has initiated an Environmental Security (ENVSEC) program to identify and assess potential environmental projects such as trans-boundary land and water management programs in Central Asia, with a view toward improving regional security.³⁷ Despite significant international efforts undertaken on a great number of projects, the magnitude of the region's environmental malaise ensures that remediation will be a decades-long process.

South and Southeast Asia. A recent report by the Asian Development Bank concluded that the remarkable rise in Asia's living standards has come at the expense of the environment.³⁸ The continent today faces mounting levels of pollution, and rapid degradation of its natural resources.³⁹ This trend is particularly true in South and Southeast Asia where increasing industrialization, expanding populations, and rapid urbanization are damaging the environment, and threatening public health. The larger cities in the region are among the world's most populous, and polluted. Water pollution is endemic, and exploitation of natural resources is adversely impacting habitats and biodiversity. Increasing public awareness and pressure is forcing governments, and the private sector to pay more serious attention to environmental issues. From India, to Thailand, to the Philippines, countries have enacted laws, and measures to encourage conservation, reduce pollution and protect the environment, and are beginning to make progress in addressing key environmental problems. Despite these developments, the lack of resources, corruption, unclear laws, and inadequate systems for enforcing regulatory compliance are impeding further progress in solving environmental problems, and, as a result, environmental conditions in both regions are continuing to worsen.⁴⁰

The region's accelerated economic growth is creating a significant market for environmental equipment, and services, presenting both opportunities, and challenges for US firms. The extent of risk American companies are willing to take, availability of project financing for infrastructure purposes, and the pace, and extent that rule of law reforms take place in the countries will affect the viability of US investment.

East Asia and the Pacific. Environmental conditions in the region are critical. One third of the population does not have access to safe drinking water. Air pollution is twice the world average and China's is the worst in the world. Desertification has doubled in the past 30 years. The majority of countries in this region avoid investing substantially in environmental protection, fearing such policies will jeopardize economic growth. From a market perspective, the current regional environmental market, at \$100B per year, represents 20% of the world market. The environmental market is focused primarily in Japan which has a mature environment industry. Japan and international organizations provide most of the environmental aid to the region. China represents an enormous potential market in the future, and is presently the largest recipient of environmental aid from the World Bank. USG agencies are barred for political reasons from operating in China.⁴¹

Sustainable Development

As the US and European nations found in the early parts of their industrial revolutions, an open, free market capitalist society does not automatically lead to business practices that are environmentally sound. Pollution is an example of a market failure, where the normal allocation of resources by firms at their profit maximizing price and quantity leads to an outcome that is not optimal from the overall perspective of society. The negative impacts of pollution and the cost of environmental damage are not borne by the firm, but rather are borne by those external to the firm. These negative social costs do not appropriately enter into the firms decision making processes, which rely only on their internal costs, resulting in a market failure where the output/consumption is too high due to externalization of costs, and the price does not reflect the true cost to society.

The United States, Western Europe, and Japan have worked for decades to reverse some of the most egregious pollution issues that were created by our industrial development. Some of those same problems now plague the developing nations of the world. The industrialized nations, in concert with global organizations like the United Nations (UN) and environmental NGOs, can play an important role in assisting those nations in a more holistic development approach too avoid some of the environmental sins of their collective pasts. This is a politically sensitive issue. Many developing nations feel that developed ones are trying to inhibit their industrial economic development by adding the additional burden of environmental stewardship, which was not a consideration during the industrial development of most developed nations. This is so even when past experience has demonstrated that the long term cost to society can be dramatic. Governments have a role to play in determining a public policy response to the market failure of pollution.

Approaches for economic development in poor and developing nations, adapting to, and mitigating climate change, and other environmental security threats, must focus on sustainable security, and development. The real sources of insecurity extend to unsustainable development, which can be the root cause of or exacerbate traditional forms of conflict, which could spread internationally⁴². Emphasis on sustainable security and development can provide opportunities to mitigate environmental threats to security. Sustainable development hinges on improved governance at all levels from local to global by implementing effective norms, rules, policies, laws, and institutional arrangements that constitute organizations and structure the behavior, and relations of people.⁴³

Water Issues

Across each region, water issues are a major challenge that requires close multilateral and regional cooperation. The availability of potable water is a requirement for human existence and survival, yet less than 1% of the earth's water resources are available for human consumption and use. In both the developing and the developed countries of the world, water shortages are pervasive for a variety of reasons. Water stress is defined as the annual availability of less than 1,700 m³ of water per person per year, a quantity dramatically lower than the global average of 8,462 m³ per person annually. According to the World Health Organization (WHO), approximately one-third of the world's population currently lives in a water stressed environment. If projections for population growth and water consumption remain constant, up to two-thirds of the global population will be existing in water stressed conditions by 2025. The

importance of access to freshwater is evidenced by the UN referring to water as a basic human rights issue.⁴⁴

Regrettably, an estimated one billion people lack access to potable water, and according to the World Health Organization 1.6 million people die each year due to diarrheal diseases caused by unsafe water, poor sanitation, and hygiene. As the Director-General of the WHO recently stated, "Water and Sanitation is one of the primary drivers of public health. Once we can secure access to clean water, and to adequate sanitation facilities for all people, irrespective of the difference in their living conditions, a huge battle against all kinds of diseases will be won."⁴⁵

The world's 263 river basins provide approximately 60% of the available freshwater. These river basins are also home to approximately 40% of the world's population providing ample opportunity for conflict and interstate rivalry with regard to water use. "Water is the only scarce resource for which there is no substitute, over which there is poorly developed international law, and the need for which is overwhelming, constant, and immediate."⁴⁶ Although water is recognized as an essential element of national security, there is no international framework to define how countries should share international waters in a manner that is both equitable, and reasonable with regard to other states. Despite the proliferation and technological advances in water purification and waste water treatment, the right policies must be established, and implemented to reduce the intensity of water use and improve the quality of water available for all consumers.⁴⁷ "Poor water management hurts the poor most, allocate water to its highest value, and move towards full cost pricing rational use, and recover costs."⁴⁸ Countries need to adopt effective and equitable water management practices similar to the ones proposed under the Integrated Water and Resource Management framework with its three governing principles of: the user pays; the polluter pays; and subsidize the good, tax the bad. In this way economic instruments (prices, incentives, and tariffs) along with appropriate regulations are used to allocate resources.⁴⁹

Environmental Management Systems

Environmental Management Systems (EMS) enable public and private sector organizations to employ an integrated, non-reactive approach to environmental compliance to enhance core business practices, and foster corporate responsibility, and stewardship. When integrated fully in the core functions, and ultimately the corporate culture, an EMS will help to identify the environmental aspects of the mission, highlight, and assess risk, promote pollution prevention, and track progress towards environmental goals, and compliance.

An EMS, as defined by the EPA allows an organization to systematically manage its environmental and health safety matters by adopting a continual cycle of planning; implementing, reviewing, and improving processes and actions that an organization undertakes to meet its business and environmental goals⁵⁰. An EMS is a continuous operational risk management analysis employed daily at every level of an organization or business and codified to improve compliance, performance, and stewardship with a view towards the bottom line. Most EMS models are based on the Deming Cycle of Change: plan, do, check, and act. The EMS models, designed for continuous improvement can result in benefits to the environment and to business profitability. According to EPA analysis, development and implementation may enhance environmental performance; enhance compliance; prevent pollution/conserves resources; reduce/mitigate risks; attract new customers and markets; and increase efficiency, competitive advantage, potential accident reduction; and reduce costs. Additional benefits, although not as

tangible, can also be realized. Examples include enhanced employee morale; enhanced trust and image with the public, regulators, lenders, investors; improved employee awareness of environmental issues, and responsibilities; and incentive qualification and liability reduction. Costs however, may preclude some small, medium, and larger sized businesses or organizations from implementing an EMS. These costs, according to the EPA, include investment of internal resources; costs for training of personnel; and costs associated with hiring EMS consultants, and potentially the hiring of technicians.⁵¹

Not all organizations develop their respective EMS program on one model. The International Organization for Standardization (ISO), the European Union (EU), the EPA, and the American Chemistry Council (ACC) have developed principles and guidelines for public, and private organizations to gain outside certification of their EMS programs using their proprietary model or standards. This is not to say that one is better than the other, or that a melding of the aspects of each into one comprehensive model would be more effective. However, each provides a professional certification or validation that is internationally, regionally, or industrially accepted to outwardly demonstrate organizational commitment to achieving compliance and stewardship.

ISO 14000 is one of a family of 16,077 internationally recognized standards from the ISO which acts as a “toolbox” for conformity assessment covering all aspects from the supplier to third-party certification and accreditation⁵². Although complex, the ISO 14001 series developed in 1993 and refined in 1996, is an environmental risk management framework that provides a proactive approach for small, medium, and large organizations to gain outside accreditation of their respective EMS. ISO is the internationally recognized standard and provides the global approach to EMS development. This global approach provides a common environmental operating picture that according to ISO is flexible enough to enable access of small as well as multi-national organizations to the global market place where business and environmental concerns may collide⁵³. End state for ISO 14001 is to level the environmental playing field thus reducing potential trade barriers.

The EU ECO Management and Audit Scheme (EMAS) was established in 1995 by the EU Council. According to the European Commission Regulation, for an organization to be EMAS certified its EMS must meet the following conditions: conduct an environmental review considering all environmental aspects of the organization’s activities, products, and services, methods to assess these; its legal and regulatory framework; and existing environmental management practices and procedures⁵⁴. The most significant difference between EMAS and ISO 14001 is that EMAS has legal status within the EU; thus, it can take a more prescriptive/punitive approach to environmental management issues. ISO 14001 standard compliance relies on voluntary acceptance by all interested parties⁵⁵.

EMS integration into the normal operating procedures of any public and private sector organization will enhance regulatory compliance as well as core business practices and corporate net worth. Where compliance existed in a reactive non-integrated approach in the past, an EMS provides a structured approach to synchronize regulatory operational controls in a comprehensive manner in order to improve effectiveness and efficiencies.

Environmental Security - Implications of the Environment Industry for US National Security

Environmental degradation, natural resource depletion, and the increasing demand of the world's rapidly growing population for limited resources contribute to conflict and instability, and if not addressed, can undermine US and global prosperity and threaten our national security. The environment and security are inextricably linked and the interrelationships between these two domains are ubiquitous. Natural resource depletion, over consumption, overuse of resources, and their unequal distribution when combined with fragile political, economic, social, and cultural conditions often cause unrest. Environmentally linked instability can spill over borders fomenting regional and global instability.

Water is arguably the most precious resource on our planet. Insufficient quantity and poor quality is generating social, public health, and economic problems that, in turn, diminish national security. Conflicts related to water scarcity are likely to strike hardest in regions already confronted with strife and can potentially result in enormous pressure on existing cross-boundary and domestic instabilities. Social conflicts involving water are increasing. As a result of advances in communications and democratic revolutions, conflicts that were once largely local matters have permeated the international arena.⁵⁶ Not only is water critical for human survival, it is also essential for food security, which is an issue of concern in many regions.

Global climate change, deforestation, biodiversity loss, and other environmental threats pose a formidable challenge to human security. The UNDP defines human security as ensuring individual safety from chronic threats such as hunger, disease, and repression and protection from sudden and hurtful disruptions in the patterns of daily life.⁵⁷ Human security focuses on the protection of people and vital freedoms from critical and pervasive threats, and advancement of individuals' strengths, and aspirations. Natural or human-generated environmental changes can cause natural resource scarcity and degradation which may lead to social disorder and either interstate or intra-state conflict subsequently affecting national and regional security. Environmental threats that degrade human well-being could be the antecedent to economic, political, and social issues that cause conflict and violence. Sustainable development is important to advancing human security by ensuring the best outcomes of the human and natural environment now and in the future.

The manner and extent to which increasing global energy demand can be resolved in a framework of sustainable development is one of the great challenges of the 21st century. Conflicts over oil resources, the global environmental impact of the extensive use of fossil fuels and the resultant release of GHG, closely links energy and environmental security policy as the US pursues long term energy independence. The pursuit of energy independence to secure our long term energy needs must be accomplished in an environmentally sound manner to avoid profound environmental impacts that will affect overall health and security.

Abrupt climate change could have a profound impact on the aforementioned concerns over the next half century. This transition of the climate system on rapid time scales which encumbers human and natural systems' adaptive capacity. Scientific evidence supports the contention that human activities have accelerated global warming in recent decades and the impact on environmental degradation, water resources, agriculture, natural ecosystems, and human health could potentially erode global security over the next half century. Increased competition for scarce natural resources will weaken nations' economic well being, leading to increased numbers of environmental refugees, political and social instability, violence, and war.

Challenges and Recommendations

Environmental Education

Challenge. Seventeen years after the enactment of the National Environmental Education Act of 1990 there is still room for improvement, strengthening, and streamlining the processes of within EPA and other governmental, public, and private environmental education organizations. Although there are a number of different environmental education efforts, a large number of studies have concluded that progress to date has been lacking, and that the myriad efforts are not synchronized. Funding is insufficient, and needs to be increased. In addition, the processes for increased collaboration need to be put in place.⁵⁸

Recommendations. *The USG must identify environmental health as a strategic concern which ultimately impacts our fundamental support for “life, liberty, and the pursuit of happiness.” Strategic level coordination, planning, and funding must be committed to at the local, state, and federal government level for quality environmental education to reach schools in particular, and the overall US population in general. The USG must develop “a national [environmental education] capacity building strategy...to identify the national infrastructure, and the support, and implementation steps needed to compliment and leverage efforts at the regional, state, and local levels.”⁵⁹ This should include a reauthorization of the National Environmental Education Act, clarifying the roles and responsibilities of the various organizations that are currently involved in environmental education efforts. Funding levels of \$100M (as proposed in the No Child Left Behind reauthorization) should be considered.*

Sustainable Development

Challenge. The regional overview earlier in this report cites a number of critical environmental challenges facing both developing and developed nations. The World Summit on Sustainable Development, held under UN auspices in 2002, recognized that the “deep fault line between rich and poor poses a major threat to global prosperity, and stability.”⁶⁰ Developed nations pledged funds to help eliminate this gap by changing patterns of development to a sustainable model, developing integrated water management plans, and reducing market distortions that impede development of renewable energy systems. Likewise, the OECD identified sustainable development as a key factor for stability in the 21st century.

Recommendations. *The USG must ensure sustainable development is an integral part of our development assistance programs throughout the world. The industrialized nations, in concert with global organizations like the UN, and environmental NGOs, must play an important role in assisting poor, and developing nations in a more holistic development approach that avoids some of the environmental sins of our past. Sustainable solutions will require the cooperative, integrated, and collaborative effort of NGOs, International Organizations, government, academic institutions, and the private sector. It is important to incorporate a culture of environmentally responsible business practices as a foundation of development rather*

*than an afterthought. The USG must fully align our efforts with the centerpiece of OECD's strategy to foster "sustainable development within, and among OECD countries in a way that is responsive to non-member countries in their search for sustainable development."*⁶¹

In the near term, the US through the Millennium Challenge Corporation, the USAID, the President's Water Initiative, and other efforts must expand its funding support for sustainable development. We cannot do it all therefore, the focus should be on environmental education, changing patterns of behavior, and larger regional issues such as water, energy, and ecosystem management that can benefit the most from a focus on sustainability. In the long term, as the industrial world develops a path forward to address the impact of GHGs, and climate change, the US, and the G8 will have to play a leadership role in sharing those solutions with the rest of the global economy.

Competition for Environmental Exports

Challenge. It is clear from previous discussions that cross-national boundary issues are increasingly important in our foreign policy and foreign assistance programs. US companies had a historical competitive advantage in the planning, execution, and technology implementation of many environmental solutions throughout the world, especially in many "conventional" land, water and air pollution control, and mitigation technologies. Lately though, US companies have been losing ground to French, Japanese, German, and Spanish entities. Maintaining US global leadership in environmental technologies can not only enhance US influence and prestige in those areas, but will also expand export opportunities for US companies.

Recommendations. *The USG must expand support for environmental export programs by increasing research and capital investment; and providing tax breaks or grants to environmentally friendly technologies. This will support our overall sustainable developmental assistance efforts while simultaneously supporting the US economy. Additionally the USG should improve the financial leverage tools available to export companies by expanding credit support, and providing longer credit terms for export loan programs. The US Trade Representative must continue to pursue a reduction in the high tariff barriers and non-tariff trade barriers on environmental goods, especially in markets of China, India, and Brazil. Furthermore, the USG must improve the coordination among the many government agencies such as the Export-Import Bank, the Small Business Administration, the Overseas Private Investment Corporation, the US Trade and Development Agency, and others that support environmental export efforts.*

Technology, and Programs to Address Green House Gases/Climate Change

Challenge. As stated earlier, technologies are available today to address the many "conventional" air, land, and water pollution issues. However, neither the legal nor technological means are currently available to effectively address the issue of rising GHG levels in the atmosphere. Although GHGs, composed primarily of CO₂, have been recognized by the global scientific community as the major culprit for creating global warming conditions for over two decades, US environmental policy until recently had not categorized these emissions as pollutants. Given the predominance of scientific analysis that links global warming to GHG levels, as highlighted by the 2007 report from the IPCC, the US Supreme Court has started the

process of transformation. Following its April 2007 determination that the EPA must take action under the Clean Air Act to address GHG emissions from motor vehicles, the Bush Administration has directed the EPA and the Departments of Transportation, Energy, and Agriculture to take steps toward regulating increased motor vehicle efficiency and implementation of renewable energy sources.⁶²

The challenge to reduce GHG emissions represents the nexus of multiple sectors of the global economy. Stability in the 21st century depends on finding a solution that allows all nations, to reap the benefits of abundant energy without creating GHG emissions. Although US science investment into energy research and technology has experienced a recent boost, there is still a huge deficiency in the public and private sector funding needed to harvest the alternative energy opportunities available across the short to long-term horizon. The USG, in partnership with other nations and institutions, has a significant role to play in solving this market challenge.

***Recommendations.** The USG must set policies to enhance the effectiveness of basic energy, and transportation research and increase funding for areas such as hydrogen; fuel cells; carbon sequestration; biofuels; renewable energy; clean coal technologies; and efficiency increases in motor vehicles, appliances, and building structures. (Recent analysis predicts an achievable median electrical energy efficiency increase of 24% in US buildings)⁶³ The USG should also consider providing grants and tax incentives for local and state energy conservation programs as well as tax incentives to private industry, and individual tax incentives to increase market adoption of these technologies.*

Create and support public/private partnerships that promote environmentally friendly technologies. Cooperative Research and Development Agreements should be encouraged between national laboratories and industry, using intellectual property rights to ensure technology insertion into market. Furthermore, additional investment must be made in “smart” power grid technology and infrastructure to leverage potential advances and proliferation of renewable energy sources.

The USG should encourage the development of “Generation IV” light-water reactor fission technology through international research collaboration prior to extensive proliferation of less-safe nuclear fission energy plants. (The construction of multiple Generation IV plants may be required in the mid-term to meet US energy needs prior to achievement of long-term solutions.)

The USG should significantly bolster public funding of research programs to develop, test, and field nuclear fusion energy technology by mid-century.

The USG should implement a distributed energy or carbon tax (notionally equivalent to one or two cents per kilowatt hour or 10-20 cents per gallon on fuels). This would drive a market-oriented approach by using the price mechanism to reduce energy consumption, and spur innovation. The revenue generated could be split between educational programs, tax breaks, and grants for conservation programs, energy research, and the capital investment required for the previous recommendations.

The USG should focus on improving climatic modeling tools to allow greater precision and specificity of localized impact to allow better assessment of long-range mitigation or adaptation planning options.

SUMMARY

“Men and nature must work hand in hand. The throwing out of balance of the resources of nature throws out of balance also the lives of men.”⁶⁴

President Franklin Roosevelt

There is still a large gap in our society in dealing with environmental issues. The size, scope, and interconnected nature of environmental issues and the market failure inherent in the global economic system to properly account for the negative cost of pollution demands that the US government, in partnership with the private sector and other nations and institutions, play a significant role in addressing these challenges. A way to overcome potential global security risks caused by environmental degradation is to develop and apply academic, scientific, and industrial capabilities for environmental protection, remediation, sustainable development, and clean energy technologies. Strengthening public outreach is necessary to develop a common sense of awareness and urgency in order to convince the public to commit limited funding resources on a long-term basis toward developing the needed technical capacity.

The USG plays a critical role in developing a strategy to address the environmental/energy challenges of this century and in establishing the associated economic incentives, as our political process slowly develops a collective will on the way forward. However, global benefits will be marginal if the technologies and solutions are not viable and affordable in the rest of the world. Thus, the government’s role is to connect the national effort with those of global and private institutions to achieve the needed synergies around the world.

A government commitment to some type of carbon or energy tax would help support the short and long-term investment in conservation and fund the scientific research to spur technological innovation. In the 2006 American Competitiveness Initiative, President Bush correctly notes that “...one of the great engines of our growing economy is our Nation’s capacity to innovate. Through America’s investments in science, and technology, we have revolutionized our economy, and changed the world for the better.”⁶⁵ This has been true in this country since its founding and especially in the last century. The next challenge is to make that same investment in order to revolutionize the global environment by developing solutions to the myriad challenges that are economically viable for the entire global community. This is both an economic challenge and opportunity for the US in the coming years. How will we respond?

APPENDIX

Table 1. The US Environment industry Segments: Public vs. Private Sector Revenues, 2004 (Source EBI)⁶⁶

INDUSTRY SEGMENT	2004	Revenue Source (\$Bil.)			
		Pub%	Priv%	Pub\$	Priv\$
Analytical Services	1.8	46%	54%	0.8	1.0
Water Treatment Works	33.6	71%	29%	23.8	9.7
Solid Waste Management	45.1	60%	40%	27.1	18.0
Hazardous Waste Management	8.5	18%	82%	1.5	7.0
Remediation/Industrial Services	10.3	58%	42%	6.0	4.3
Consulting & Engineering	20.3	54%	46%	11.0	9.4
Water Equipment and Chemicals	23.6	58%	42%	13.7	9.9
Instruments & Information Systems	4.1	28%	72%	1.2	3.0
Air Pollution Control Equipment	19.1	4%	96%	0.8	18.3
Waste Management Equipment	9.5	22%	78%	2.1	7.4
Process & Prevention Technology	1.4	12%	88%	0.2	1.2
Water Utilities	33.8	65%	35%	22.0	11.8
Resource Recovery	19.6	22%	78%	4.3	15.3
Clean Energy Systems & Power	14.3	15%	85%	2.1	12.1
Total	244.9	48%	52%	116.5	128.4

Table 2 US Environment industry Exports Performance, 1997 - 2003 (Source EBI)⁶⁷.

	1997	1998	1999	2000	2001	2002	2003
Global Market (\$bil)	495	503	520	542	552	566	583
US Market (\$bil)	187	191	201	211	215	221	227
Non-US Market (\$bil)	308	312	319	331	337	345	356
% Exports	8.9%	8.8%	9.1%	9.4%	9.5%	10.0%	10.7%
US Exports (\$bil)	17.3	17.3	18.6	20.1	20.7	22.3	24.7
Growth in US Env'l Exports	15%	0%	7%	8%	3%	8%	11%
US Share of Non-US Market	5.6%	5.6%	5.8%	6.1%	6.2%	6.5%	6.9%
Trade Surplus	6.7	5.6	3.9	3.7	2.4	2.6	2.9

Figure 1 – EPA Regional Structure⁶⁸

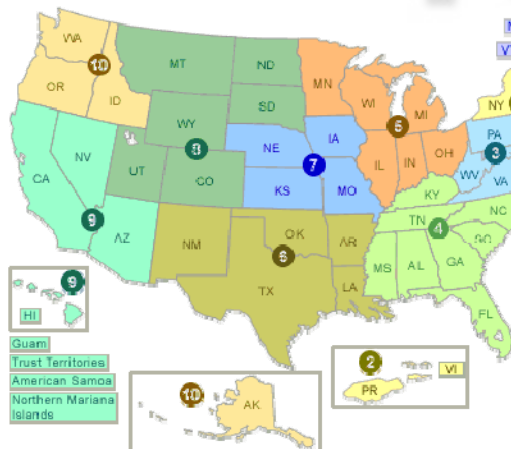
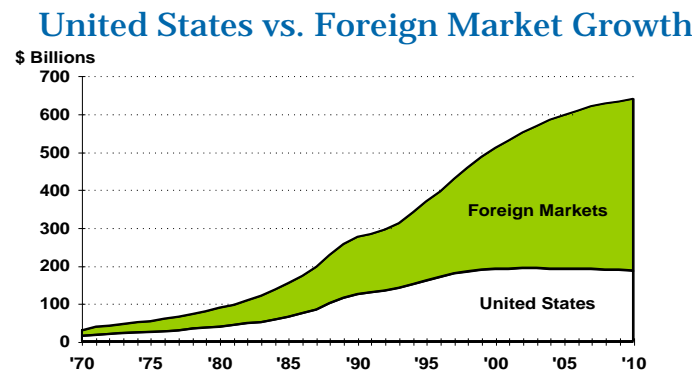


Figure 2 – Projected Global Environmental Market Growth (Source: Department of Commerce)⁶⁹



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