Spring 2011
Industry Study

Final Report
Environment Industry

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

ENVIRONMENT 2011

ABSTRACT: This report of the Spring 2011 Industrial College of the Armed Forces Environment Industry Study concludes that the environment industry is a mature industry, though its focus is shifting from pollution control and remediation to issues of sustainable development. From a strictly business growth point of view, the environment industry may no longer be strategic in nature. However, from a cost, risk and effect perspective, environmental issues, and therefore the actions of the environment industry are definitely strategic and have national security implications. This report looks at the current condition of the environment industry and concludes that the forces that drive the industry are shifting from a regulatory focus to a focus on the perceived benefits of reducing waste, energy use, and future liabilities. From a U.S. government goals and role perspective, the Obama Administration appears to have a renewed enthusiasm for, and focus on, environmental issues, though the current hierarchical regulatory system may no longer be the most effective approach. The report highlights a trend toward pragmatic policy approaches, with strong movement in the direction of shared federal and state responsibility, performance rather than design standards, and reliance on financial incentives, emissions trading, and information disclosure to gain compliance. The report concludes that dealing with climate change promises to be one of the most significant environmental and technological challenges of the 21st century and includes a special essay on current industry technologies.

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Domestic:

Bechtel Corporation, San Francisco, CA
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San Francisco Department of the Environment, San Francisco, CA
Hamilton Army Airfield Wetlands Restoration Site, Novato, CA
Bay Model Visitor Center, Sausalito, CA
Webcor Consulting/Builders, San Francisco, CA
U.S. Export Assistance Center/U.S. Commercial Service, San Francisco, CA
San Francisco Bay Conversation and Development Commission, San Francisco, CA
Chevron Energy Solutions, San Francisco, CA
Farella, Braun and Martel, LLP, San Francisco, CA
Draper, Fisher and Jurvetson, Menlo Park, CA
Pacific Gas and Electric Company, San Francisco, CA
The Nature Conservancy, San Francisco, CA
Lawrence Berkeley National Laboratory, Berkeley, CA
The World Bank, Washington D.C.
Alexandria Sanitation Authority, Alexandria, VA
Chesapeake Bay Foundation, Annapolis, MD
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Tanzania Coastal Management Program, Bagamoyo, Tanzania
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Sokoine University of Agriculture, Morogoro, Tanzania
African Wildlife Fund, Arusha, Tanzania
Eco-Tour, Lake Manyara National Park, Tanzania
Visit to Traditional Masai Village, Tanzania
Olduvai Gorge Museum, Tanzania
Eco-Tour, Serengeti National Park, Tanzania
Eco-Tour, Ngorongoro Conservation Area, Tanzania
Eco-Tour, Ngorongoro Crater, Tanzania
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U.S. Agency for International Development
United Nations Foundation
Office of the Federal Environmental Executive
White House Council on Environmental Quality
Koetz Duncan, LLC
Office of the Maryland State Attorney General
U.S. Environmental Protection Agency
Rocky Mountain Institute
Dow Chemical
Soyka & Company
Hogan Lovells US, LLP
Booz Allen Hamilton
Marstel Day, LLC
Waste Management, Inc.
Center for International Environmental Law
Keep America Beautiful
Global Environmental Management Initiative
Smithfield Foods
Veolia Energy North America
ARCTECH, Inc.
Parsons Corporation
International Union for the Conservation of Nature
CH2M Hill
National Marine Sanctuary Foundation
Environmental Council of the States
The Ocean Foundation
Environmental Defense Fund
World Business Council on Sustainable Development
International Finance Corporation
United Nations Global Environment Facility
United Nations Environment Programme, Regional Office for North America
Export-Import Bank of the United States
Japan New Energy and Industrial Technology Development Organization
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INTRODUCTION:

This report reviews the work of the 2011 Industrial College of the Armed Forces (ICAF) Spring Environment Industry Study (IS). The Environment IS examined the extraordinarily varied and complex network of actors, processes, legal and regulatory mechanisms, and perspectives that converge at the intersection of environmental concerns, economic performance, and security. This examination was conducted through briefs by, dialogues with, and visits to the full range of organizations and businesses associated with the environmental sector, including federal, state, and local government agencies, international governing mechanisms, business (both domestic and international), and non-governmental organizations (NGOs).

After what has been described as a leveling out of environmental initiatives during the first decade of the new millennium, there appears to be a renewed enthusiasm for, and focus on, environmental issues by the Obama administration, captured in part by both Executive Order 13514 and the new forward-leaning stance of the Environmental Protection Agency (EPA). Countering this renewed enthusiasm is a heightened sense of skepticism towards environmental issues in the current U.S. House of Representatives. One of the recurring themes noted by the group throughout this Environment IS session was the notion that governments, businesses, and individuals have traditionally abused the global environmental commons and have not factored their true environmental costs and impacts (including the costs of environmental damage or externalities) into either their budgets or the prices of the products they produce.

THE INDUSTRY DEFINED:

The North American Industry Classification System (NAICS) classifies industries or sectors by type of economic activity. NAICS provides government agencies, trade associations, private businesses, government policy analysts, academia, researchers, and the public a standard for the collection, tabulation, presentation, and analysis of data relating to industries and sectors and promotes uniformity and comparability in the presentation and analysis of statistical data describing the North American economy.[1] But, there is no unique code to represent the environment industry. The 2007 NAICS database contains 16 separate codes for environmental establishments: two within the construction sector; three within the manufacturing sector; five within the professional, scientific, and technical services sector; two within the administrative support and waste management and remediation services sector; one within the other services sector; and three within the public administration sector.

The U.S. Department of Commerce, Organization for Economic Co-operation and Development (OECD), European Union, and many others rely on a less complex classification system developed by Environmental Business International, Incorporated (EBI), a private company. EBI began analyzing and tracking the environment industry in 1987 and was the first to define the industry in detail in its international monthly *Environmental Business Journal* (EBJ). "EBJ defines 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."[2] EBI divides the industry among three broad categories (services, equipment, and resources) and 14 sub-segments. (See Exhibit 1)[3]

A broader definition of the environment industry would also consider the industry's many stakeholders. As previously defined, the environment industry is about revenue generation

associated with environmental protection, assessment, and other factors. However, many environmental stakeholders are less concerned with profits; instead, they are genuinely passionate about protecting and preserving the environment. Environment issues affect many stakeholders, which often leads to extremely polarized opinions. Today, there are hundreds of agencies, associations, councils, societies, governments, and organizations, which are deeply involved with environment issues and which directly affect revenue for companies within the environment industry. In general, these organizations fall into one of the following groups: national governments, state/local organizations, trade associations, international organizations, non-governmental organizations (NGOs), private volunteer organizations (PVOs), and other industry sectors. NGOs are organizations that have no government status. PVOs are a type of NGO that is specifically tax-exempt and non-profit. Under the 'other industry sectors' category, we met with representatives from industries that would not be considered environmental, but who are striving to make their particular industry more environmentally friendly (e.g., the Vice President of Sustainability for Smithfield Foods). This IS interacted with organizations from each of these stakeholder groups.

Generally, industries have four development stages: emerging, growth, mature, and declining. According to EBJ, the environment industry in the United States "has displayed the characteristics of a maturing industry since the mid-1990s in the form of decelerating growth, heightened competition, growing sophistication among its client base, greater emphasis on marketing, consolidation of market share in larger players, heightened M&A [merger and acquisition] activity and other factors."[4] In general, this assessment applies when referring to a strict business definition of the environment industry. The industry appears to be experiencing a renaissance with renewed enthusiasm and a focus on the effects of climate change on the environment. It has embraced sustainable development as a new sub-set of the environment industry, and perhaps the future of the entire environment industry, by establishing "new practice areas, technical offerings, and products supportive of the new economic paradigm to complement traditional lines of business."[5]

The ICAF definition of a strategic industry is, "An industry that is a primary cause of significant economic growth at a given time."[6] Drawing on this definition in the context of a mature industry, however, it is unclear from a business perspective whether the environment industry remains a strategic industry. The environment industry met this definition of strategic in the past when average growth within the industry was in double digits and well above GDP growth. From the early 1990s to the mid-2000s, however, growth remained between 1 and 5%, though it has increased recently.

Using the larger definition of the environment industry which includes stakeholders, the industry does convey significant external benefits and high external costs "to society in general, far exceeding the market value of their products or the industry."[7] The environment and environmental changes also have far-reaching strategic implications for the military, as documented in several major recent reports, including the 2007 Center for Naval Analyses study and the 2011 U.S. Navy Task Force Climate Change Study. Unlike the economic growth criteria, environment issues, and subsequently the actions of the environment industry, are definitely strategic from a cost, risk and effect perspective.

Exhibit 1: EBI Environment Industry Structure

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

CURRENT CONDITION:

In past decades, fortunes of companies in the environment industry rose and fell on national tides of politics and the economy. When the economy was booming and a pro-environment government was in power, profits rose in the industry. When recessions hit, companies focused less on environment and sustainment issues as survival became paramount. Many expected the current global economic downturn to cripple companies focused on environmental issues. Yet indicators reveal resilience, implying the industry's perceived value has become more global, enduring, and mainstream.[8]

In the early 1970s, then-President Richard Nixon signed several pieces of legislation that changed the general business perspective concerning environment issues. Once implemented, the Clean Air, Clean Water, Resource Conservation and Recovery, and the Superfund Acts required industries to halt the dumping of toxic substances into the air, water, and ground.[9] These acts also forced federal, state, and local governments to adopt new enforcement techniques to ensure better treatment of sewage and the evaluation of environmental impacts from government activities. These actions helped create the initial environment industry as firms responded to a market demand for pollution controls, environmental cleanup, and consulting services. In addition, new markets emerged as waste management, water treatment, and utilities became more privatized.

Some believed this new market was not sustainable and would dry up after the largest violations were addressed. Yet thirty-five years later, the industry continues to change and adapt to meet new needs and to create sustainable value to society. Core markets have matured over time and have gone through stages of reduced margins, consolidation, and a shift to the mainstream. No longer do many companies view environmental responsibilities as an afterthought; they are often now an integral part of operations often through use of an environmental management system (EMS) such as the ISO 14000 standard. They proactively look at ways to prevent pollution, streamline their production, reduce their long-term environmental liabilities, protect their brand names, and sometimes even promote global action that is good for all. Adhering to sound principles of environmental stewardship has proven to be profitable for business.

The estimated total value of the global environment industry market was $750 billion in 2009.[10] Within the United States, the industry had estimated annual revenues of almost $300 billion, or 2% of annual GDP during the same period. This includes earnings from some 30,000 private companies and 80,000 public sector entities such as water treatment facilities. Within the private sector, the largest market segments in terms of number of companies are solid waste management (10,000 companies), resource recovery (5,000 companies), and consulting and engineering (3,500 companies). Total estimated employment within the industry in the United States was 1.6 million people.[11]

Environment industry revenues in the United States in 1970 totaled approximately $20 billion. Throughout the 1970s and 1980s, industry revenues grew by an average annual rate of 11%, compared to 3.5% to 4% for the economy as a whole. From 1990 through 2000, industry revenues only grew an average of 3% per year, compared to 3.5% growth for the economy in general. During the last ten years, industry revenues have grown by 4%, compared to 2% growth for the economy in general. In 2009, however, industry revenue shrank by 1.3%. This was a big drop from the previous two years which had growth of 9% and 5%, above the general economy. In 2010, revenue growth rates within the industry were expected to be nearly 4% and to remain

at that level for the next several years. The industry as a whole remains a potential growth sector but with great uncertainty. As EBI notes, "What was once promoted by Wall Street and others as a recession proof industry was revealed as recession-prone. Whereas recession subsided, regulatory uncertainty has persisted and the foundation of the environmental industry of regulations and enforcement gets progressively weaker as time goes on."[12]

Of the estimated $300 billion of annual revenues in 2009, one-third was generated by public entities, including water, solid waste, and waste water utilities. The private sector accounted for two-thirds of revenues, with some 70% generated by large corporations and 30% by small ones.[13] The source of the revenue is nearly even between public and private funds. The private funds come two-thirds from industrial entities and one-third from commercial or other sources.[14] Net exports accounted for 14% of total revenues and were largely produced within the resource recovery and water equipment sectors. The industry enjoyed a total trade surplus of $11 billion in 2009. Imports also grew over the last few years at a 10% rate causing some loss of U.S. market share within the U.S.[15] Yet the U.S. share of foreign markets also grew from 5.7% in 1997 to 10% in 2007. This increase was significant as key competitors in Japan and Western Europe were already exporting in excess of 20% of their production.

To remain competitive, U.S. firms continue to seek foreign market penetration but are confronted with trade barriers, some of which rise to the level of the World Trade Organization. Many other countries maintain tariffs of 15-20% and subsidize local environment industries. In China, Brazil, and Malaysia, such tariffs can reach 40%.[16] Furthermore, many non-tariff barriers exist including packaging, standards, and documentation requirements that favor local competition.

Of the 14 sectors defined by EBJ, the largest in terms of revenue was solid waste at $51 billion. Waste water and water utilities both generated revenues totaling near $42 billion. Clean energy generated some $36 billion in total revenues. Water equipment, resource recovery, and consulting generated approximately $25 billion in total revenues. Remaining sectors generated significantly smaller amounts.[17]

Growth across these sectors varied significantly in 2009. Clean energy grew by 14% and was a clear leader. However, this represented a considerable decrease from 20%, 52%, and 45% growth rates from the previous three years. A drop in the price of oil was the main reason. The U.S. already has the largest non-hydro renewable energy capability, twice that of Germany and five times that of China. The U.S. growth rate is 11% compared to 100%, 67%, and 54% for Turkey, China, and South Korea respectively.[18] A second sector with significant growth was waste water at 7.5%. Stimulus funds helped spur this gain. Sectors experiencing the greatest declines were the resource recovery, vehicular air pollution control, building abatement, and industrial hazardous waste disposal. Each of these sectors suffered an 11-14% drop in revenues. This resulted largely from a rapid drop in the price of recyclables, a fall in commercial real estate development, and troubles in the auto industry. All remaining sectors saw growth rates decline from 2-7%, although most are expected to experience higher growth rates over the next several years. The three exceptions are likely to be air pollution control, resource recovery, and clean energy. Growth within the air pollution control sector is likely to be flat or even decline, while the resource recovery sector is likely to rebound from its 2009 down turn. Growth within the clean energy sector is expected to accelerate as energy prices rise in the future.[19]

Based on client surveys, EBI anticipates growing demand over the next 3 years in the areas of power and water utilities, petroleum, mining, and Department of Defense (DoD) spending. Sectors that are most likely to experience reduced spending in environmental areas are property

development, paper mills, and state and local governments. Both declining government budgets and political swings are expected to slow spending over the next few years. The surveys continue to point toward China, India, and South America as countries likely to enjoy significant growth in their environment industries. Australia and the Middle East represent the next tier of countries and regions with environment industry development opportunities.[20]

As discussed previously, not all environmental or sustainability efforts show up in business trends. Many companies are instituting internal practices that are saving costs and protecting the environment without adding to environmental industry revenues. These actions are implemented to prevent pollution, add to the value stream, or reduce the long term environmental liability of the company. All add value to the company's bottom line. Promotion of sustainability and the environment also can benefit a company by attracting customers and investors. According to the Brookings Institution, the market value of corporations was increasingly being driven by intangibles not reflected in financial statements.[21] Sustainable governance, transparency, and social reputation are near the top of the list of powerful intangible value drivers.[22]

But, the environmental industry is not recession proof. It suffered a significant down turn during the economic crisis in 2008 and 2009 and sustained only a partial recovery in 2010. But the industry continues to provide value to customers and investors. It outperformed the global market again in 2010 and there are signs that the industry increasingly is shifting from government-sponsored regulation as a driver to a perceived benefit in reducing waste, energy use, and future liabilities. The area with the greatest volatility is renewable energy due to a lack of stable and long-term policies across the globe.[23] Overall, the industry continues to mature with global proliferation, increased product sophistication, corporate consolidation, and incorporation of increasingly sophisticated business models.

CHALLENGES:

Dealing with climate change promises to be one of the most significant environment challenges of the 21st century. While there are still uncertainties surrounding climate change, the scientific consensus is that the earth is warming. Much of this warming is due to man's activities and this warming is expected to adversely impact both the planet and human welfare. "Climate change is occurring and caused largely by human activities, and poses significant risks for —and in many cases is already affecting—a broad range of human and natural systems."[24] Because of these activities, the climate will continue to change, but many scientists say the worst impacts can be avoided if we act soon.

Although some confuse climate with weather, climate change affects more than just a change in the weather. Climate change refers to seasonal changes over a long period of time, while weather refers to atmospheric conditions over a relatively short period of time. "Climate includes patterns of temperature, precipitation, humidity, wind and seasons. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them."[25] According to the United Nations Framework Convention on Climate Change, climate change refers to "a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods."[26]

The patterns of climate change play a role in shaping the world economy, people's way of life, and ecosystems. In fact, climate change presents one of the greatest challenges to our current way of life and that of our future, as well as to the global environment. The overuse of

natural resources and the degradation of ecosystems play an important role in increasing human vulnerability to illness, undermining livelihoods by the destruction of farmland and fishing zones, creating instability, and potentially generating or worsening conflict. "The depletion of water resources, decimation of forests, and alteration of natural cycles and ecosystems are among the principal concerns."[27]

Extreme weather has become increasingly common, and this trend will likely continue in the future. Many believe climate change has a considerable impact on local and global weather patterns. For example, the International Panel on Climate Change predicts that "warming oceans and melting glaciers due to global warming and climate change could cause sea levels to rise 7-23 inches by the year 2100."[28] The rising sea level could increase the risk of flooding and excessive erosion in coastal communities which in turn could lead to infrastructure damage. There also are other serious effects. Scientists have noted that hurricanes are getting stronger.[29] These stronger hurricanes would likely have the same damaging impact of the rising sea levels but at a much more rapid rate.

Local changes in temperature and precipitation could affect many things important to life. More rain when not needed and less rain when needed may cause changes in the growing season. These changes may force farmers who are used to planting fields in their current environment to adapt to other crops. Food supplies could be at risk if environmental changes prevent the cultivation of certain crops in certain areas. Human health also can be at risk. More rain may equate to more respiratory problems as molds grow and asthma becomes more prevalent. Changes in disease such as malaria may proliferate as mosquitoes use the excess water to breed.[30] Economics also will be affected as more resources are used on rerouting transportation routes to accommodate the changing food supply. The population also will be more likely to spend more money and resources on health and on pesticides which will further harm the earth and further throw off the environmental balance. Because humans are so linked to the environment, the ability to sustain life depends in large part upon human's ability to adapt to these changes.[31]

There will always be some uncertainty when attempting to understand something as vast as the climate. Human activities which produce greenhouse gases likely account for most of the climate change. Exhibit 2 shows the relationships between the impacts of, and responses to, climate change. The clockwise arrows show impacts from climate change on the eco-system, human health and other vulnerabilities, which in turn affect socio-economic development. The counterclockwise arrows show possible paths and global emissions controls via laws and technology which would reduce the risk of future impacts.[32]

What does this mean? It means the world and the actions of humans are all inter-related. Humans produce greenhouse gases which have an impact on many things. With legislation and a more educated populace, the world can also create solutions. Solutions such as green technologies, efficient use of resources, and management of the ecosystem could prevent, or at least slow down, climate change.

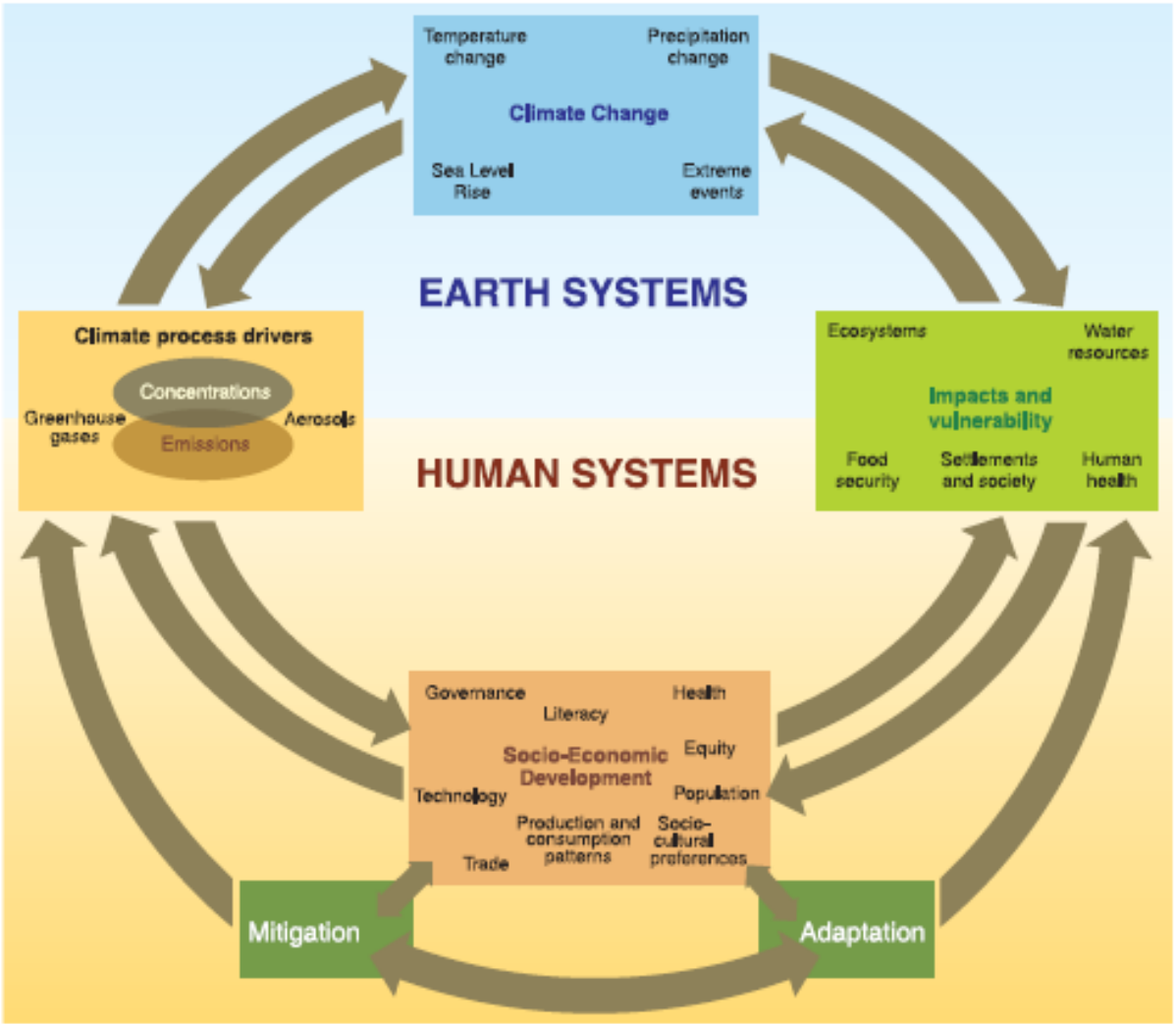


Exhibit 2: Impacts and Responses to Climate Change[33]

National security is also affected by climate change. Dr. Gregory Foster states in *Environmental Security: The Search for Strategic Legitimacy*, "there is a growing acceptance today of the proposition that the environment and security are indissolubly linked."[34] Climate change is likely to cause profound global changes, and such changes could pose risks to national and international peace and security. Secretary of Defense, Robert M. Gates remarked at the 2008 U.S. Global Leadership Campaign, "We also know that over the next 20 years…certain pressures – population, resource, energy, climate, economic, and environmental – could combine with rapid cultural, social, and technological change to produce new sources of deprivation, rage, and instability."[35] Climate change could lead to new conflicts over resources, natural disasters, the degradation of land, and could affect the stability of nations.

What are public attitudes toward climate change? What makes our planet's natural resources worth saving and why should we care? Traditional concern for the environment grew out of social movements. Groups, such as Greenpeace, became a part of the lexicon. People became aware of their surroundings and took action believing they could make a difference. Armed with mounting scientific evidence, Americans are paying more and more attention to climate change.

While there are many pressures and forces in the world today competing for attention, no nation, rich or poor, large or small, can escape the impact of climate change. Climate change is a global problem. Depending on their wealth and size, however, countries may view the impacts differently. To determine where countries stood on climate change, the World Bank conducted a multi-country poll to determine public attitudes toward climate change. Exhibits 3 through 6 depict those findings.[36] As seen in Exhibit 3, all countries polled believed that climate change is a problem. In all countries, most believed it is either a very serious or a somewhat serious problem. The results showed that people are at least thinking about climate change and believe it is an issue. Exhibit 4 indicates that wealthier countries are less apt to place a higher priority on actions related to countering climate change if such actions result in slower economic growth and some loss of jobs. In Exhibit 5, some 46% of those polled believe harm from climate change is happening right now or will happen in the next 10 years. Exhibit 6 indicates the majority of the people polled believe climate change would have a major affect on their country.

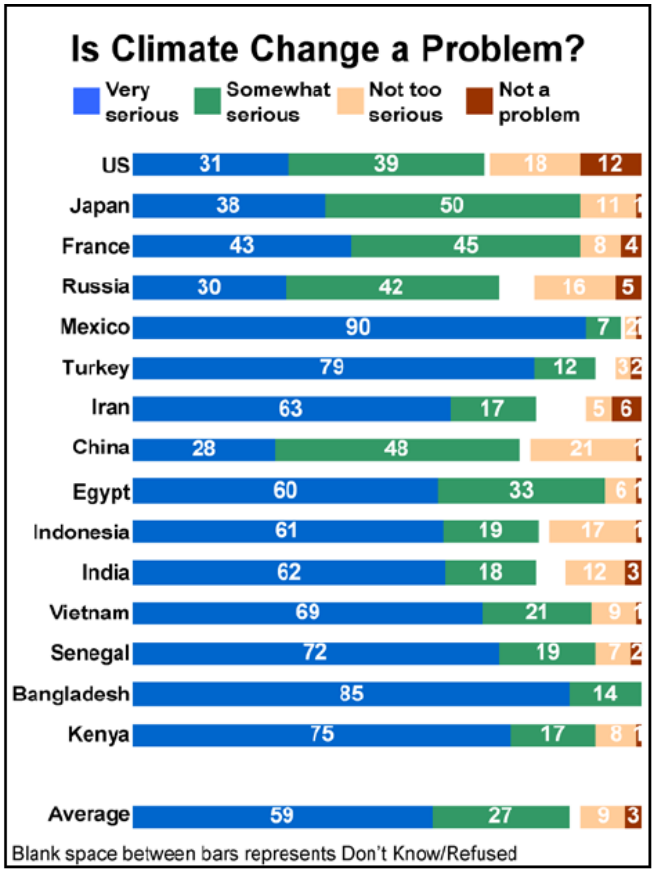


Exhibit 3

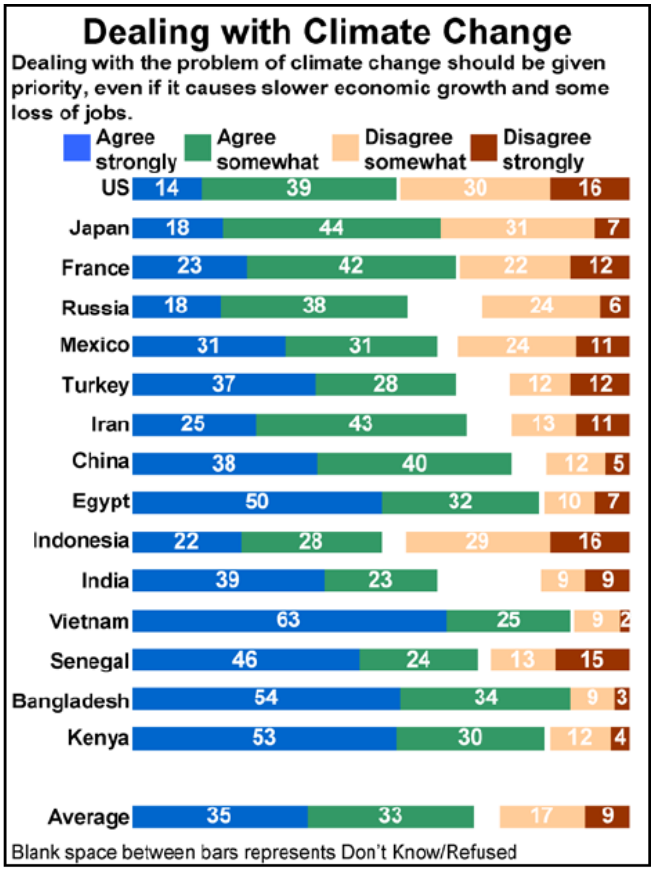


Exhibit 4

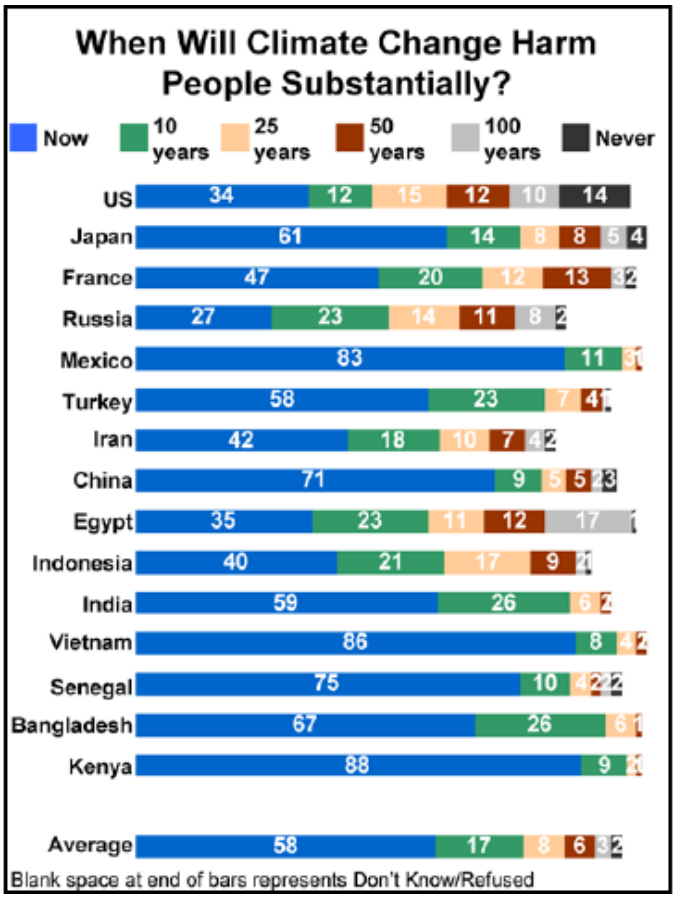


Exhibit 5

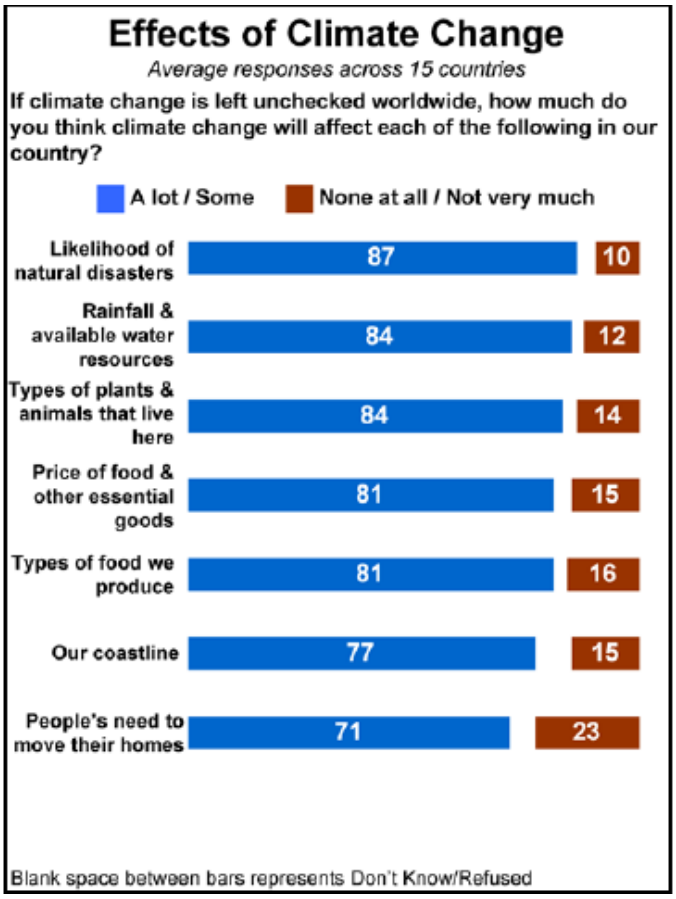


Exhibit 6

Although U.S. poll respondents showed a modest lack of concern for climate change, they nonetheless saw climate change affecting the United States in multiple ways. While the poll information provides interesting perspectives, it does not reflect how willing people are to take responsibility for climate change and how they balance it with other values. When compared with the wars in Iraq and Afghanistan, terrorism, gas prices, housing issues and job loss, the environment does not rank in the top 20 of American's concerns.[37]

The American Environmental Values Survey dove deeper into American opinion on environment issues, behaviors and concerns. The results provide insight into American values. Specifically:

1. Americans' environmental concerns are divergent and polarized.
2. Libertarian values are ascendant over communal values.
3. Issue complexity has paralyzed many Americans.
4. Men and women have some very different environmental concerns, with women responding more sensitively to traditional environmental appeals while men are more concerned about tradeoffs.
5. Environmentalism is hampered by anti-science attitudes.
6. Indifference is a major factor among some groups of Americans.
7. Competing priorities affect all groups of Americans.
8. There are three major environmental issue groupings among Americans: destruction of the planet, degradation of resources, and human ecology concerns.
9. The pocketbook is the most powerful leverage point for changing personal behavior.
10. Environmental responsibility is getting more personal.
11. Environmentalism and environmentalists have a negative image.[38]

The main lesson is that American values and beliefs are not "one size fits all." There is no common agreement on what we need to do to fix climate change. While the survey information reflects awareness of, and some concern about, the problem, there are still many skeptics. The November 2009 "Climategate" scandal (in which allegations were made against scientists of exaggerating evidence to support climate change and destroying data that did not support climate change) may have affected some opinions, along with worries about what it would cost to fix the problem during a time of deep economic recession.[39]

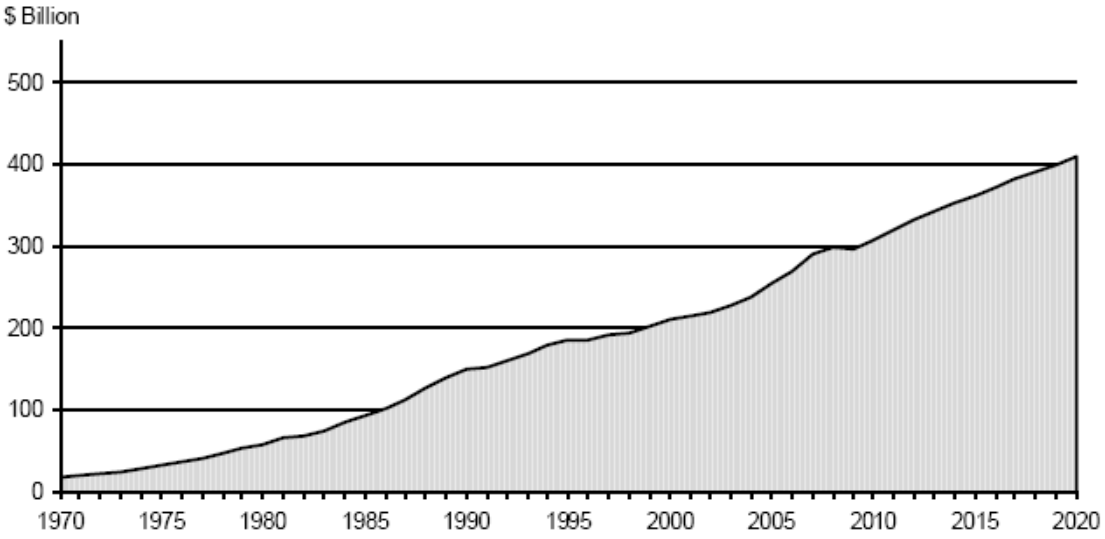
Meanwhile, society is starting to realize climate change and global warming are real problems. People know there are things they can do to make a difference; however, they do not always know what they can do. President Obama's May 2010 United States National Security Strategy highlights where we, as a nation, need to begin, "Our effort begins with the steps that we are taking at home. We will stimulate our energy economy at home, reinvigorate the U.S. domestic nuclear industry, increase our efficiency standards, invest in renewable energy, and provide the incentives that make clean energy the profitable kind of energy."[40]

Public and private sectors must employ many different strategies to address the issue of humans and the environment. Unfortunately, people do not always know what to do to help the environment and believe the small sacrifices they make will not affect the overall environment.[41] Strategic communication and education are critical in helping people, communities and industries understand the risks of climate change and that even the smallest changes will make a difference. Once people understand, they can adapt their behavior and support other actions to abate climate change. An environmentally well-read person is more likely to engage in activities that help the environment than one who is not. The media is especially important as a tool for communication and education. Children and adults get more information via the media than from any other source and such sources should be exploited.[42] Finally, parents should encourage kids to play outside and embrace the outdoors. Playing outside may naturally influence a pro-environment attitude and behavior. Using these strategies will educate the over 300 million people living in the United States and will reinforce that even small changes in behavior will have a huge impact. The danger from climate change is real, critical, and severe. In coming years, our citizens will be increasingly bombarded with statistics, information, and media attention, and will need to understand more about the environment and the issues surrounding it. They will have to choose if they are going to be part of the climate change solution. In the end, society no longer has the luxury of waiting to see what will happen, for climate change is already happening.

OUTLOOK:

Although the environment industry suffered a significant down turn during the economic crisis in 2008 and 2009 and sustained only a partial recovery in 2010, the outlook for the industry is bright. Over the long run, the industry has shown steady growth, which has outpaced U.S. Gross Domestic Product (GDP) growth (Exhibit 7). President Obama and the Environmental Protection Agency (EPA) have demonstrated support for future environmental related initiatives, though there is increased skepticism on environmental issues in the current U.S. House of Representatives. Additionally, the effects from global climate change may compel the U.S. and the rest of the world to invest in adapting and mitigating further affects from climate change. Despite these developments, the industry remains vulnerable to economic downturn and regulatory uncertainty.

Exhibit 7: Historical and Projected Size of U.S. Environmental Industry[43]



President Obama recently outlined new environment initiatives in his 2011 State of the Union Address. These include providing 80% of Americans with high-speed rail access in 25 years, placing one million electric vehicles on the road by 2015, and providing 80% of the country's electricity come from clean-energy sources by 2035.[44] These remain only goals, however, and without funding from Congress, such initiatives will go nowhere.

Meanwhile, EPA's proposed new emission standards for power plants have the potential to support another significant growth phase in the environment industry. The EPA has also proposed the first national standard for mercury pollution from power plants. These mercury and air toxics standards represent one of the strongest health protections from air pollution since passage of the Clean Air Act and will provide employment for thousands, by supporting 31,000 short-term construction jobs and 9,000 long-term utility jobs.[45]

GOVERNMENT GOALS AND ROLE:

Oversight, funding, development and execution of government policy regarding the environmental industry is convoluted and complex. Hundreds of federal and state agencies, including water districts, irrigation districts, coastal commissions, air pollution control districts, fish and game departments, forestry departments, energy commissions, parks and recreation departments, national resources departments, health departments, and agriculture departments are part of the process of developing, protecting, and sustaining the environment. Two Executive Branch organizations in particular that have seen a renaissance of late are the Council on Environmental Quality (CEQ) and the EPA, which focus on the current regulatory structure affecting the environment industry.

The CEQ is responsible for advising the President on environmental policy and coordinating and mediating between federal agencies, through inter-agency working groups, on the implementation of environmental impact assessments to balance social, economic, and environmental goals. Additionally, the CEQ oversees the Office of the Federal Environmental

Executive, which promotes sustainable environmental stewardship within the federal government.

The EPA has primary responsibility for enforcing environmental statutes and regulations of the United States. To administer this broad mandate, EPA is organized into ten regional offices responsible with enforcement within specific states/territories and three offices of broader scope responsible for the Chesapeake Bay watershed, the Great Lakes, and the Gulf of Mexico, respectively. EPA also administers labs and research centers focused on all aspects of environmental impact.

The United States has made enormous strides in cleaning up the environment and protecting endangered species since the 1970s. Major industries have sharply reduced or eliminated dangerous discharges, today's cars emit a small fraction of the pollution of those built in the 1960s, and thousands of acres of wildlife and marine habitat have been protected or restored. Much of this progress is directly attributable to the robust regulatory framework established by the federal and state governments since the early 1970s. U.S. leadership also played a role in establishing international agreements that have tackled serious global challenges, such as trade in endangered species and ozone depletion.

Polls, votes in Congress on issues other than climate change, and the efforts of companies to cultivate a green image suggest that protection of the environment retains strong popular support. Yet environmental challenges remain and solutions are often hindered by our existing regulatory framework. Laws and regulations enacted since the 1970s have been effective in limiting or eliminating "point" sources of pollution, i.e., large, easily identifiable sources such as factories, power plants, or municipal sewage treatment facilities. Efforts have been much less successful in curtailing pollution from more numerous, smaller and widely distributed sources, such as family farms and urban storm sewer systems or air pollutants from small businesses and older vehicles. For example, the Chesapeake Bay Foundation gives failing grades on efforts to reduce pollution in that watershed resulting mainly from agricultural runoff, despite years of progress on point source emissions.[46]

In her review of domestic U.S. environmental law, *The Morning After Earth Day*, Mary Graham notes that, apart from point source pollution, our regulatory framework has been most successful when the required changes were technological rather than behavioral, and when businesses bore the direct costs.[47] Once forced to accept new pollution standards, the auto industry made remarkable progress within a decade in reducing auto emissions through technical innovation. Consumers ultimately bore the cost, but did so without complaint since they could not easily separate the price of emissions controls from the cost of all other innovations and improvements included in new vehicles. While the public supports environmental protection broadly, particularly when businesses and governments have borne the initial costs, it has been much less responsive to calls for behavioral changes, for example, driving less and relying more on public transportation. It is also difficult to get the public to make sacrifices when the benefits do not accrue locally, are only realized long-term, or impact the "American way of life." With the "low-hanging fruit" of environmental protection mostly already harvested, pressing problems, such as surface runoff and climate change, may require such behavioral changes and sacrifices in exchange for benefits that may seem far away in space and time. Complicating the challenge is political gridlock in Washington that has resulted in little new environmental legislation for the past two decades. This gridlock is likely to become even more important with the current make-up of the U.S. House of Representatives and its opposition to climate change legislation.

Much of the regulatory framework that accounts for improvements in environmental and habitat protection over the past 40 years was put in place in a flurry of federal legislative activity in the early 1970s and 1980s (See Exhibit 8 for a partial, but representative, listing and capsule descriptions of major federal environmental legislation, presented chronologically). Motivating these initiatives was a sense of crisis resulting from environmental incidents that galvanized public concern about the environment in the 1960s and 1970s.

However, the roots of environmental protection go back to the conservation movement and measures aimed at improving public health in the early 20th century. The latter took the form of local smokestack and sewage discharge ordinances, while habitat protection often occurred at the behest of hunters and fishermen. Graham reports that all states had water pollution control agencies by 1948, though funding for treatment facilities was limited and authorities tended to ignore pollution that flowed downstream and out of their jurisdiction.[48] Congress increased federal funding for local agencies throughout the 1950s and '60s, but with mixed results. By the late 1960s, it concluded that no more than half the cities that needed air pollution controls had them, and that most of those that existed were inadequate.[49]

By the end of the 1960s, worsening environmental conditions and highly visible accidents fed a growing sense that state and local governments were too beholden to special interests to do an effective job of regulation and cleanup. Rachel Carson's book *Silent Spring* raised the alarm about the devastating effects of DDT (dichlorodiphenyltrichloroethane) on bird population and warned of a future of despoiled landscapes if urgent steps were not undertaken.[50] A 1969 offshore oil well blowout spewed oil into waters off the coast of Santa Barbara for ten days before it was brought under control. That came on top of oil spills the same year in Long Island Sound, near Cape Cod, and in the Mississippi River.

The most spectacular accident of the year occurred when chemicals dumped into Cleveland's Cuyahoga River caught fire, leaving an indelible public image of pollution and industry out of control. These incidents fueled a sense of crisis that motivated Congress to pass significant new legislation over the next four years that established the nation's core regulatory framework and a centralized, federally-driven approach to environmental protection that remains evident to this day.

In fact, state and federal authorities had begun to take more forceful action even before 1969. Responding to frequent smog alerts threatening public health in Los Angeles, California imposed the first auto emissions standards in 1960. Congress passed the first major national pollution control legislation in 1963, an early version of the Clean Air Act, and imposed the first national auto emissions controls in 1965. New federal legislation enacted between 1970 and 1974 and the bureaucratic and financial resources it made available added muscle and transformed how environmental protection was done.

Graham identified four drivers that led the public to look to the federal government for environmental protection, shaping the regulatory regime and approach that emerged:

- the public's sense that there was a crisis requiring immediate action;
- confidence that Congress could solve the problem, coupled with a lack of confidence that bureaucrats would have the independence to do the job;
- distrust that states and localities would have the capability or political will to regulate effectively, given powerful local interests and the need to compete with neighboring states to attract businesses; and
- faith in the technical ability of businesses to solve pollution problems, coupled with a lack of faith in their willingness to do so.[51]

Exhibit 8: Major National Environmental Legislation – Chronological[52] [53] [54]

(1970) National Environmental Policy Act: Was the first of the modern environmental statutes. NEPA created environmental policies and goals for the country, and established the President's Council on Environmental Quality. Its most important feature is its requirement that federal agencies conduct thorough assessments of the environmental impacts of all major activities undertaken or funded by the federal government. Many states have enacted similar laws governing state activities.

(1970) Clean Air Act (updated and strengthened the 1963 version): Sets goals and standards for the quality and purity of air in the United States. By law, it is periodically reviewed. A significant set of amendments in 1990 toughened air quality standards and placed new emphasis on market forces to control air pollution.

(1972) Clean Water Act: Establishes and maintains goals and standards for U.S. water quality and purity. It has been amended several times, most prominently in 1987 to increase controls on toxic pollutants, and in 1990, to more effectively address the hazard of oil spills.

(1972) Coastal Zone Management Act: Provides a partnership structure allowing states and the federal government to work together for the protection of U.S. coastal zones from environmentally harmful overdevelopment. The program provides federal funding to participating coastal states and territories for the implementation of measures that conserve coastal areas.

(1972) Marine Mammal Protection Act: Seeks to protect whales, dolphins, sea lions, seals, manatees and other species of marine mammals, many of which remain threatened or endangered. The law requires wildlife agencies to review any activity -- for example, the use of underwater explosives or high-intensity active sonar -- that has the potential to "harass" or kill these animals in the wild. The law is our nation's leading instrument for the conservation of these species, and is an international model for such laws.

(1973) Endangered Species Act: Is designed to protect and recover endangered and threatened species of fish, wildlife and plants in the United States and beyond. The law works in part by protecting species habitats.

(1974) Safe Drinking Water Act: Establishes drinking water standards for tap water safety, and requires rules for groundwater protection from underground injection; amended in 1986 and 1996. The 1996 amendments added a fund to pay for water system upgrades, revised standard: setting requirements, required new standards for common contaminants, and included public "right to know" requirements to inform consumers about their tap water.

(1976) Federal Land Policy and Management Act: Provides for protection of the scenic, scientific, historic and ecologic values of federal lands and for public involvement in their management.

(1976) Fisheries Conservation and Management Act: Governs the management and control of U.S. marine fish populations, and is intended to maintain and restore healthy levels of fish stocks and prevent overharvesting. Better known as the Magnuson Stevens Act.

(1976) Resource Conservation and Recovery Act: Seeks to prevent the creation of toxic waste dumps by setting standards for the management of hazardous waste. Like the 1980 CERCLA, this law includes some provisions for cleanup of existing contaminated sites.

(1976) Toxic Substances Control Act: Authorizes the EPA to regulate the manufacture, distribution, import and processing of certain toxic chemicals.

(1977) Surface Mining Control and Reclamation Act: Is intended to ensure that coal mining activity is conducted with sufficient protections of the public and the environment, and provides for the restoration of abandoned mining areas to beneficial use.

(1980) Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): Requires the cleanup of sites contaminated with toxic waste. This law is commonly referred to as "Superfund." In 1986 major amendments were made in order to clarify the level of cleanup required and degrees of liability. CERCLA is retroactive, which means it can be used to hold liable those responsible for disposal of hazardous wastes before the law was enacted in 1980.

(1986) Emergency Planning and Community Right-to-Know Act: Requires companies to disclose information about toxic chemicals released into the air or water or disposed of on land.

(1990) Oil Pollution Act: Enacted a year after the disastrous Exxon *Valdez* oil spill in Alaska's Prince William Sound, this law streamlines federal response to oil spills by requiring oil storage facilities and vessels to prepare spill-responses and provide for their rapid implementation. The law also increases polluters' liability for cleanup costs and damage to natural resources and imposes measures -- including a phaseout of single-hulled tankers -- designed to improve tanker safety and prevent spills.

(1996) Food Quality Protection Act: Is designed to ensure that levels of pesticide residues in food meet strict standards for public health protection. Under this law, which overhauled the Federal Food, Drug, and Cosmetic Act and the Federal Insecticide, Fungicide, and Rodenticide

A fifth driver could be the trans-boundary nature of air and water pollution. Apart from the Cuyahoga River, much of the water pollution Clevelanders suffered was not from local sources. No matter what actions Ohio authorities might have taken, Lake Erie would have remained heavily polluted because its source was the Detroit River, which delivered sewage and industrial wastes from Detroit, Windsor, Ontario, and all the other population centers in the upstream Great Lakes.

As noted, environmental legislation passed in the 1970s achieved a great deal in terms of environmental and biodiversity protection, reversing worrying trends in a relatively short time. However, the concentration of resources and regulatory power over a wide range of highly complex problems and industries in the hands of federal authorities caused conflict and resentment among businesses and state and local officials. Not surprisingly, by the 1980s, there was a backlash. Although strong bipartisan majorities continued to back new legislation, the pace of environmental lawmaking slackened considerably. In particular, the Reagan administration actively sought to scale back regulations and to weaken enforcement capacity through budget cuts.

As Exhibit 8 indicates, a trend away from legislative solutions has continued, with no major environmental legislation being enacted since the mid-1990s. Despite constituencies for environmental protection in both parties, the highly partisan mood that has characterized politics in Washington during this period has made finding legislative solutions increasingly difficult. This has led environmental authorities increasingly to seek pragmatic solutions that combine strong enforcement with flexible approaches such as customized standards, financial incentives, and information disclosure.[55]

The United States has contributed to the development of a robust international environmental and habitat protection regime, and is party to many of its key agreements. (See Exhibit 9 for a partial, but representative, listing and capsule descriptions of key international agreements, presented chronologically.) Several of these agreements were not negotiated principally to protect the environment, though they have had that effect. Nuclear-related treaties, for example, were intended foremost to prevent nuclear proliferation and war, while the 1961 Antarctica Treaty aimed to prevent a dangerous competition for resources; nonetheless, that treaty and subsequent agreements established important protections for the continent and its biodiversity.

A lack of political support needed to negotiate international agreements, and the difficulty of gaining Senate ratification, has sometimes led the United States to back away from agreements that it had a hand in drafting. For example, the 1994 UN Convention on the Law of the Sea (UNCLOS) provides a comprehensive legal regime and environmental protections for the oceans and seas. The United States supports and adheres to its main provisions, regarding them as enforceable under customary law.[56] Presidents from both parties have tried and failed to gain Senate ratification due to domestic objections to its restrictions on deep seabed mining and concerns about a possible loss of U.S. sovereignty and freedom of action.

Another example is U.S. efforts within the international arena to deal with climate change. The United States is a party to the UN Framework on Climate Change, and a signatory to the Kyoto Protocol to the Convention, which provided for binding limits on greenhouse gas emissions. However, the Protocol faced strong opposition from conservatives and business interests. The Bush administration withdrew from the Protocol in 2001, stating that it was "deeply committed to addressing the problem of global warming," but believed the Protocol was fundamentally flawed in unfairly apportioning the burden of addressing the problem. Instead, the Bush administration unilaterally committed to "cutting greenhouse gas intensity by 18%"

over the next ten years.[57] Conservatives and business interests subsequently launched a campaign to cast public doubt on the scientific arguments pointing to human activity as a main culprit in global warming.

Given an increasingly sharp partisan divide in Washington, it remains difficult to see how the United States will be able to lead international efforts to tackle global environmental challenges. Addressing in a timely manner serious global problems – for example, climate change and over-fishing – will likely require binding international agreements to ensure meaningful results.

In 2006, researchers under the auspices of the New York Law School and the New York University School of Law launched the project "Breaking the Logjam: Environmental Reform for the New Congress and Administration," which aimed to bring together the best ideas for statutory reform from more than 50 environment experts of diverse views.[58] The researchers concluded the current statutory system is obsolete in four ways:

1. Over-reliance on hierarchical regulations;
2. Misalignment of power between the federal government and states (regulatory power was concentrated at the federal level because up until recently, states were seen as incapable or unwilling to enforce environmental regulations themselves);
3. Lack of transparency on inevitable trade-offs between environmental protection and other goals/concerns (e.g., economic costs); and
4. Compartmentalization of crosscutting problems.[59]

The project noted that the consequences of these problems include unnecessary conflict and costly litigation, wasted time and resources, a stifling of innovation, and an inability of regulators to cope with the huge volume and complexity of problems.

To address these weaknesses, the authors advocated a shift toward "network" solutions, specifically, market-based approaches that empower networks of individuals to make independent decisions about their behavior, penalize failure to move in the right direction, and reward success.[60] Examples include cap and trade mechanisms, taxes on emissions, credit offsets, and information disclosure requirements. Noting that the states are far more willing and capable of protecting the environment than they were in the 1970s when the existing hierarchical framework was established, the authors argued for the federal government to relinquish responsibility for environmental protection to the states, except when the problem is clearly national or global in scope or the states fail to do act. The authors preferred solution to climate change is an international cap and trade scheme that encompasses the broadest possible range of greenhouse gas sources.[61]

Some of these ideas have gained support. As Mary Graham noted, pragmatism has been the dominant theme of environmental policy in recent decades, with strong trends toward shared federal and state responsibility, performance rather than design standards, and reliance on financial incentives, emissions trading, and information disclosure.[62] The authors of the "Logjam" report want to accelerate these trends and to see a sharper, more formalized departure from a federally led, hierarchical approach. With Washington focused on addressing the debt crisis, it is unlikely to have the appetite for sweeping environmental reform anytime soon. Meanwhile, incentives provided by current approaches and markets could spur the technological innovations and changes in behavior needed to confront remaining environmental issues.

Exhibit 9: Major International Agreements Pertaining to the Environment[63 64 65]

(Entry Into Force – EIF - 1961) Antarctic Treaty: The first of several international agreements concerned with use and protection of Antarctica. US is among 46 parties.

(EIF – 1966) Convention on Fishing and Conservation of Living Resources of the High Seas: Among the first of several international agreements aimed at protecting fisheries and marine life. US is among 38 parties. 21 have ratified but not yet signed.

(EIF 1970) Nuclear Non-Proliferation Treaty (NPT): A multilateral treaty signed in 1968 which aims to control the spread of nuclear weapons; extended indefinitely in May 1995. The treaty has been signed by over 175 nations. US is one of 189 parties.

(EIF 1975) Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (London Convention): An international agreement to control pollution of the sea by dumping and to encourage regional agreements supplementary to the Convention. US is among 88 parties. There are two "associate members"; 3 have signed, but not yet ratified.

(EIF 1975) Convention on International Trade in Endangered Species (CITES): An international agreement to protect certain endangered species from overexploitation by means of a system of import/export permits. US is one of 170 parties.

(EIF 1983) Convention on Long-Range Transboundary Air Pollution: An agreement to gradually reduce and prevent trans-boundary air pollution. Several subsequent Protocols controlled or regulated specific airborne pollutants. US is among 51 parties.

(EIF 1989) Montreal Protocol: International agreement signed by more than 150 countries to limit the production of substances harmful to the stratospheric ozone layer, such as CFCs. US is one of 194 parties.

(EIF 1992) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel): An international agreement to: reduce transboundary movements of listed wastes; minimize the amount and toxicity of wastes generated and ensure their environmentally sound management; and to assist Least Developed Countries in managing hazardous wastes. 172 parties. US +2 others have signed but not yet ratified.

(EIF 1993) Convention on Biological Diversity (CBD): An international agreement to develop national strategies for the conservation and sustainable use of biological diversity. 191 parties. US has signed but not ratified.

(EIF 1994) UN Convention on the Law of the Sea (UNCLOS): An international agreement establishing a comprehensive legal regime for the sea and oceans; to include rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment. 157 parties. US participated in drafting and recognizes UNCLOS as customary law, but has not signed or ratified, due to objections over seabed mining provisions.

(EIF 1994) United Nations Framework Convention on Climate Change: An international agreement for dealing with climate change, adopted at the United Nations Conference on Environment and Development (the "Earth Summit") in Rio in 1992. AKA Climate Change Convention; Climate Treaty. (See also Kyoto Protocol.) US is one of 192 parties.

(EIF 1995) Convention on Wetlands of International Importance (Ramsar): An international agreement aimed at stemming the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. US is one of 154 parties.

(EIF 1996) UN Convention to Combat Desertification (CCD): An international agreement to combat desertification and mitigate the effects of drought in countries subject to desertification through national action programs and international partnership arrangements. US is one of 193 parties.

ESSAY: LATEST TECHNOLOGIES IN THE ENVIRONMENT INDUSTRY

Technology is a pervasive aspect of modern life – it has become a part of who we are in American society and around the world. From energy, to the Internet, to social media, to high definition television and smart cars, technology makes products more attractive and more useful to consumers. With the advances of current technology, environmentalists and even those just looking to be good stewards of resources believe more can be done to conserve, preserve, reduce, or even to alter radically the way natural resources are protected and conserved. Further, reducing dependence on foreign oil is a positive step in U.S. energy security, and therefore, national security. Large power generators and distributors, car manufacturers, water distributors, and even managers of waste and waste products use technology to make better use of resources and be better stewards of the environment.

Many government Agencies, including the Department of Energy (DoE) and the Environmental Protection Agency (EPA) are promoting research and technology grants to advance environmentally friendly technologies. The EPA has as a portion of its goals: healthy communities and ecosystems; clean and safe water; and compliance and environmental stewardship.[66] To help achieve these goals, supporting technologies can be applied and categorized, such as: energy, automotive/fuels, water, waste and waste treatment. There are numerous efforts going on in each of these technology categories. However, no single technology has emerged as the next big thing to change the landscape of environmental stewardship.

Electricity for home and business in the U.S. comes from a number of sources, including petroleum (1%), natural gas (18%), coal (48%), nuclear (22%), and renewable sources.[67] Based on estimates of the availability of these sources, especially coal and natural gas, the U.S. energy and electricity situation is plentiful for many years to come. The problem with these most popular fossil fuels is the green house gas (GHG) emissions and air pollution that results from producing the electricity -- a hot topic among developing countries, politicians, and environmentalists. The availability of fossil fuels, along with politics and financial influence, and shortcomings in alternative energy technologies keep a significant transition to alternative energy from happening as fast as environmentalists advocate.[68] [69] However, because of the GHG problem and its associated link to global warming and climate change, alternative energy sources are being vigorously pursued in many sectors. Only time will tell what will be the next breakthrough, disruptive technology, natural phenomenon or social/political driver that will change the face of energy and electricity production. Appendix 1 shows the top clean energy technologies, limited to electrical power generation and distribution.

In the U.S., transportation is the largest consumer of petroleum-based products and drives dependency on foreign oil. From cars to light- and heavy-duty trucks, to buses, and airplanes, petroleum-based fuel is required in large amounts. The U.S. imports more than 4 billion barrels of oil and oil products annually, which does not even account for all of its oil requirements.[70] Along with the national security harm of sending billions of dollars per year to other, even unfriendly countries, are the huge environmental effects of utilizing fossil fuels to power personal, business, and commercial vehicles. Many companies have put much effort into seeking out or creating the next best technology to help move the U.S. off foreign oil dependence and to support a cleaner environment. No single technology has become the one that will end petroleum-based vehicle operations, but several show excellent promise. However, as long as

fuel prices remain relatively low and product is available, everyone from politicians, to vehicle manufacturers, to individuals, are not highly motivated to make a transition to alternative fuel vehicles. Appendix 2 describes some of the latest and greatest alternative fuels in this sector of clean energy products for vehicles.[71]

Water may be the most critical resource in the world, and more than 1.2 billion people, or 18% of the world's population, lack access to enough clean drinking water.[72] Another 1.6 billion people, or almost one quarter of the world's population, face economic water shortage (where countries lack the necessary infrastructure to take water from rivers and aquifers).[73] That statistic, along with the fact that the world's population continues to grow and water is becoming scarcer via climate change problems, necessitates new ways of conserving water, making potable that which is available, and devising new methods or technologies for generating new water sources, such as making ocean water drinkable. Appendix 3 illustrates some of the more recent advancements in the area of providing a clean water supply.

The United States generates and moves about 400 million tons of garbage per year, which is enough to cover nearly 1 million football fields six feet deep. That amount of refuse quickly fills landfills and is a serious problem to transport. Also knowing exactly what is in the garbage, presents many problems to the environment. Waste Management, the leading waste handling company in the U.S., has more than 30,000 trucks on the road and moving tons of garbage daily.[74] The problem comes in developing new ways to transport the trash, and new or different ways to dispose of or do away with the trash so that it does not continue to harm the environment for decades. Appendix 4 lists several of the most promising and emerging technologies centering on waste to energy, which solves a couple of problems – it keeps trash from the landfills and creates energy.

Many of the products discussed herein have technologies that can be or have already been adapted to home use so that individuals can do their part to conserve and be a better steward of the environment. Individuals can do their part to conserve and be good stewards of the environment by supporting solar, wind, and geo-thermal electricity generation to electric cars. Further, when politics or bureaucracy gets in the way of new technologies, or the implementation of projects such as waste-to-energy, individuals, groups, and businesses should advocate for the environment.

CONCLUSION:

This report defines the environment industry, expanding the traditional business-focused definition to include all aspects of the environment as well as the multiple stakeholders involved in environmental issues. From a strictly business growth point of view, the environment industry may no longer be strategic in nature. However, from a cost, risk and effect perspective, environmental issues, and therefore the actions of the environment industry, are definitely strategic and have national security implications. The report concludes that dealing with climate change promises to be one of the most significant social, technological and policy challenges of the 21st century.

Though environmental problems and the policies needed to address them are extremely complex, the Environment IS feels there are several opportunities:

- For environmental policy makers: Existing regulations have been successful in dealing with easily identifiable, "point sources" of pollution. The policy challenges ahead are

significantly greater, because they include addressing non-point source pollution, such as run-off from farms and yards, and problems that are global in scale, such as climate change. Addressing these challenges will often require changing the environmental behaviors of individual citizens. At the same time, the bipartisan consensus for strong environmental regulation that existed in the 1970's and 1980's has evaporated. In the short term, government policy should focus on developing pragmatic, market-based approaches (e.g., cap and trade, emissions taxes, credit offsets, etc.) to penalize failure and reward success. To tackle the bigger challenges (climate change, ocean acidification, etc.) the leadership of both parties will need to help rebuild consensus on a way forward for the United States to resume meaningful leadership.

- For industry: Historically, government regulation was a key driver of the environment industry. Increasingly, the industry is seeing profit potential in technological innovation and sustainable practices. In shifting its focus from pollution control and remediation to sustainable development, the environment industry appears to have found a path to remain profitable and relevant in the future. As noted, the U.S. environment industry currently generates a trade surplus, though it is not capturing as much of a share of rapidly growing overseas markets as it should. The U.S. environment industry should place more emphasis on capturing a greater share of overseas markets. U.S. policy makers should shape policies in a manner to help expand markets for U.S. environmental goods and services and thus strengthen the competitiveness of U.S. industry.
- For national security: It is clear that environmental problems, such as water scarcity, climate change, and use of natural resources, can be a source of conflict. However, there is growing evidence that in the context of good governance, cooperation in addressing environmental problems and resource scarcity (i.e., peace parks, waterway management, etc.) can provide a solid foundation for stability. Those in the national security arena should be aware of this possibility and attempt to leverage these opportunities when they arise.

As noted, public support for aggressive action on climate change is currently lacking, and there is no political consensus on a way forward through further regulation. However, absent U.S. leadership, meaningful international action is unlikely. We believe there is an opportunity for U.S. political leaders to begin building a renewed consensus, but it will require shifting the debate purely from wrangling over climate change to a broader message about what the public has to gain from a change in practices that negatively affect the environment – i.e., enhanced national security, broader commercial opportunities (and thus jobs) for U.S. industry, improved quality of life for future generations. All change is dislocating to some: until the American public sees that we have more to gain than lose from actions that help address climate change, the United States will be unable to provide the international leadership needed to confront this challenge.

Appendix 1: Clean/Renewable Energy Technologies

	Availability	Most Recent Technologies	Issues
Solar	Solar panels and systems widely available for commercial or private use. Home Depot offers systems through BP Solar.	Back contact silicon PV panels, Micro-inverters, concentrating PV panels, thin film panels, solar storage.[1] However, these technologies still only increase efficiency in to the 24% range, which is not enough to overcome the issues noted.	Very large arrays (and sun) needed for significant MW production, which is resisted by the general public. For individuals, expense and installation is a problem. Gov't subsidies available. ROI typically in the 10-year period.
Wind	Large turbines widely available for industrial or power company use. Smaller turbines available for home use throughout the US.	Blade, generator and storage capability improving for home use. Most popular: http://www.hurricanewindpower.com/servlet/StoreFrontnd, and http://www.skystreamenergy.com/index-main.php	Very large turbine fields needed for significant MW production, which is resisted by public, whether on or off-shore. Home use still expensive, but can be used to supplement traditional sources with a 5-year ROI. Commercial and private use still has power storage problems.
Hydro	Water or flow power is used to move turbines, which in turn power a generator to create power. Available on very large scale, such as Three Gorges Dam in China. Some small scale projects in rivers for smaller applications.	Wave power, wave riding, slow water power generation in rivers are the latest, most promising technologies that are somewhat non-invasive.[2] However, nearly 200 technologies are available for power generation from rivers, oceans, and waves; for more information, see http://www1.eere.energy.gov/windandhydro/hydrokinetic/listings.aspx?type=Tech	Mainly for commercial use. Even then, significant issue is the affect of projects on water flow and systems, and aquatic life. Large projects such as the Three Gorges Dam can change the entire eco-environment of a region, so hydro-power can be both friendly and unfriendly to the environment at the same time.
Geothermal	In large scale projects, heat energy from the earth is used to power generators to create electricity. Currently being used on wide scale in 24 countries around the world to generate power for millions. Also available for home systems to assist traditional commercial power.	For large power generation and distribution, three geothermal power plant technologies being used to convert hydrothermal fluids to electricity. The conversion technologies are dry steam, flash, and binary cycle. The type of conversion used depends on the state of the fluid (whether steam or water) and its temperature. See http://www1.eere.energy.gov/geothermal/powerplants.html. Other systems also widely available for home use and application. For more information on these systems, see http://www.consumerenergycenter.org/home/heating_cooling/geothermal.html.	On large scale for distribution, mainly needs to be centered around tectonic plates, i.e. on a significant geothermal source. For home use, Geothermal is more expensive than traditional systems ($10-20k), but saves in the end. ROI requires 10+ years, but over the life of a home and considering the environment, could be well worth the investment.
Clean Coal Technology	Coal is used for the majority of electric power generation in the US, and the world for that matter. Because of problem with GHG resulting from using coal, the world is looking to transition off coal or advance clean coal technologies.	Clean coal technologies are being advanced in this area. Coal is burned and "purified" prior to actual burning for power generation. Termites have also been used in the purification process. See these links for more info: MicGas: http://www.arctech.com/ DOE Projects: http://www.fossil.energy.gov/fred/feprograms.jsp?prog=Clean+Coal+Power+Initiative Clean Coal Technology, Inc.: http://www.cleancoaltechnologiesinc.com/	Widely available for large power generation, but retrofitting old plants or building new plants to use this technology is quite expensive. Also, the problems with GHG, although they are considerably cleaned up with this new technology.

Appendix 2: Alternative Vehicle Fuels

	Description	Benefit / Issue	Emissions	Availability
Biodiesel	Renewable alternative fuel produced from a wide range of vegetable oils and animal fats. Pure biodiesel blended with petroleum diesel can be used to fuel diesel vehicles.	Increases energy security, improves public health and the environment, and provides safety benefits.	B20: Reduce PM emissions 10%, CO 11%, and unburned HC 21% B100 is better but engine not as efficient.	Available and being used in 46 states, but stations are sparse. 20 or fewer stations in 40 states.
Electricity	Mileage ranges from less than 100 miles for most vehicles available and under development. Hybrids can get 500+, depending on the range of traditional fuel systems.	Low or no carbon emissions, lower costs to operate, energy security. But there is problem with batteries and their toxicity.	All electric: None. Hybrids: Some emissions based on traditional fuel usage.	Available and being used. Charging available in 36 states. 10 or fewer stations in most states. Can be charged at home.
Ethanol	Renewable fuel made from various plant materials, which collectively are called "biomass." Nearly half of U.S. gasoline contains ethanol in a low-level blend to oxygenate the fuel and reduce air pollution. Studies have estimated that ethanol and other biofuels could replace 30% or more of U.S. gasoline demand by 2030.	Whether used in low-level blends, such as E10 (10% ethanol, 90% gasoline), or in E85 (85% ethanol, 15% gasoline), ethanol helps reduce imported oil and GHG emission. A recent report claims there is an economic return on investment of nearly five to one for each dollar spent.	According to Argonne National Laboratory, on a life-cycle analysis basis, corn-based ethanol production and use reduces greenhouse gas emissions (GHGs) by up to 52% compared to gasoline production and use. Cellulosic ethanol use reduces GHGs by 86%.	Significant availability throughout the U.S. with exception of several N.E. states.
Hydrogen	The interest in hydrogen as an alternative transportation fuel stems from its clean-burning qualities, its potential for domestic production, and the fuel cell vehicle's potential for high efficiency (two to three times more efficient than gasoline vehicles). Hydrogen is considered an alternative fuel under the Energy Policy Act of 1992.	Can be produced from diverse domestic resources, with the potential for near-zero GHG emissions. Once produced, it generates power without exhaust emissions in fuel cells.	Because hydrogen has a low volumetric energy density, storing hydrogen on a vehicle using available technology would require a large tank—larger than the trunk of a typical car. Advanced technologies needed to reduce required storage space and weight.	Not widely available; technology still in development. Recent breakthroughs make this technology more attractive.[75]
Natural Gas	High octane rating and excellent properties for spark-ignited internal combustion engines. Non-toxic, non-corrosive, and non-carcinogenic. It presents no threat to soil, surface water, or groundwater. Most natural gas is extracted from gas and oil wells. Much smaller amounts are derived from supplemental sources such as synthetic gas, landfill gas and other biogas resources, and coal-derived gas.	Natural gas is a domestically available, inherently clean-burning fuel. Using compressed natural gas (CNG) and liquefied natural gas (LNG) as vehicle fuels increases energy security, paves the way for fuel cell vehicles, and improves public health and the environment.	Lessons from developing natural gas technologies can aid the transition away from conventional liquid fuels to gaseous hydrogen fuel. Issues shared with hydrogen include: Fuel storage, fueling, station siting, training, facilities, public acceptability. A step toward a hydrogen-based transportation network.	Widely available through current U.S. infrastructure. Adjustments/mods would need to be applied at businesses and homes to facilitate fueling vehicles.

Appendix 3: Clean Water Supply Technologies

	Description/Use	Availability	Issues
Desalination	Process used to remove salt from sea or freshwater. Used aboard Navy ships to provide clean water, and on large scale in places like Saudi Arabia, where a desalination plant provides water to nearly 2M people.	Widely available, but provides only about .2% of world water needs per day. Too energy intensive to provide pressure needed to separate saline (salt) from the water.	Energy required. If half the US water came from desalination, the United States would need more than 100 extra power plants, each with a GW of capacity.[76]
Low Pressure Membrane	Primarily used for particle removal as a stand-alone treatment, retrofit of existing conventional treatment plants, or as for pretreatment to advanced processes such as nano-filtration and reverse osmosis.[77]	Widely available and in use. Decision to install usually influenced by existing, pending, or anticipated regulatory requirements.	No significant problems as used in municipal water systems.
Reverse Osmosis	Desalinization via membrane technology similar to low pressure membrane technology.	Widely available for home or municipal use; has been around for more than 40 years.	No significant issues.
Nano-particles	Using nano-fibers and membranes, process is being used to clean contaminates from underground ponds, to reduce costs of removing saline, and to clean viruses from drinking water. Water product is passed through nano-fiber technology.	Technologies available for use on municipal systems. Decision to install usually influenced by existing, pending, or anticipated regulatory requirements.	No significant problems as used in municipal water systems.
HaloPure beads	HaloPure water purification solutions use very special beads that are composed of patented N-halamine technology to purify the water to U.S. Environmental Protection Agency (EPA) standards. When HaloPure beads are installed in water filtration cartridges, the result is a breakthrough in antimicrobial purification.[78]	Filters water at the user end and is available from HaloPure®.[79]	Not expensive, but providing these to individuals with very little existing water infrastructure or resources to purchase them to begin with is a problem.

Appendix 4: Waste to Energy Technologies

	Description/Use	Availability	Issues
Pyrolysis	Thermochemical conversion technology used to produce energy from biomass. It involves the heating of organic materials in the absence of reagents, especially oxygen, to achieve decomposition. Normally combined with gasification.[80]	Works as a part of Gasification process.	N/A.
Gasification	Converts materials such as coal, petroleum, biofuel, or biomass, into carbon monoxide and hydrogen by reacting the raw material at high temperatures with a controlled amount of oxygen and/or steam. The resulting gas mixture is called synthesis gas or syngas and is itself a fuel. Gasification is a method for extracting energy from many different types of organic materials, such as household refuse.[81]	Gasification of fossil fuels is currently widely used on industrial scales to generate electricity. However, almost any type of organic material can be used as the raw material for gasification, such as wood, biomass, or even plastic waste. *Wheelabrator* uses this type technology.	Some complaints about emissions, but data shows emissions to be far less than that of traditional fossil fuel powered plants. Plasma Arc Gasification eliminates most of the emissions.
Plasma Arc Gasification	Plasma arc gasification is a waste treatment technology that uses electrical energy and the high temperatures created by an electric arc gasifier. This arc breaks down waste primarily into elemental gas and solid waste (slag), in a device called a plasma converter. The process is a net generator of electricity, depending upon the composition of input wastes, and reduces the volume of waste being sent to landfill sites.[82]	Existing power generation facilities in Japan, Canada, and UK. Planned or in process facilities in US, China, and more in Canada and UK.	No significant issues at this time, except for expense of developing the infrastructure and the plant.
Anaerobic Digestion	Biological degradation of organic material in the absence of air. The process provides volume and mass reduction and delivers valuable renewable energy with biogas production. A biogas power plant is an anaerobic digestion system that is designed and operated specifically for the purpose of generating energy. Since the gas is not released directly into the atmosphere and the carbon dioxide comes from an organic source with a short carbon cycle, biogas does not contribute to increasing atmospheric carbon dioxide concentrations; because of this, it is considered to be an environmentally friendly energy source.[83]	Biogas can be sold or used in almost all parts of the world, where it can offset demand on fossil fuel stocks. Alternatively biogas can be used to provide cheap sources of energy in the developing world and help reduce methane emissions to atmosphere. Process widely used by companies in the US and UK. Also, AD technology is well developed worldwide. Of the estimated 5300-6300 MW worldwide anaerobic digestion capacity, Asia accounts for over 95% or 5000-6000 MW.[84]	No significant issues at this time, except for expense of developing the infrastructure and the plant.

[1] The Census Bureau, "NAICS Main Page," http://www.census.gov/eos/www/naics/ (accessed 03/26, 2011).
[2] Environmental Business International, *EBI Report 2020B, the U.S. Environmental Industry Overview, an Executive Review* (San Diego, CA: ,[2010]), p.10.
[3] Ibid, p.11.
[4] Ibid, p.30.
[5] Ibid, p.31.
[6] Don Briggs, *2011 NDU ICAF Industry Studies Handbook* (Washington D.C.: National Defense University,[2010]), p.79.
[7] Ibid, p.81.
[8] *Greening of Corporate America: The Pathway to Sustainability from Strategy to Action*, McGraw Hill Construction, 2009).
[9] Department of Commerce, *Environmental Technologies Industries - FY2010 Industry Assessment* (Washington D.C.: International Trade Administration, 2010), p.3.
[10] Environmental Business International, *EBI Report 2020B, the U.S. Environmental Industry Overview, an Executive Review* (San Diego, CA: ,[2010]), p.10.
[11] Ibid.
[12] Ibid, p.11.
[13] Ibid, p.53.
[14] Ibid, p.17.
[15] Department of Commerce, *Environmental Technologies Industries - FY2010 Industry Assessment*, p.3.
[16] Ibid, p.7.
[17] Environmental Business International, *EBI Report 2020B, the U.S. Environmental Industry Overview, an Executive Review* (San Diego, CA: ,[2010]), p.10.
[18] Joel Makower, "State of Green Business 2011," Greenbiz Group, www.greenbiz.com (accessed 03/08, 2011), p.53.
[19] Environmental Business International, *EBI Report 2020B, the U.S. Environmental Industry Overview, an Executive Review* (San Diego, CA: ,[2010]), p.10.
[20] Ibid.
[21] Lev Baruch, *Intangibles: Management, Measurement, and Reporting* (Washington D.C.: The Brookings Institution, 2001).
[22] Peter Soyka, Corporate Environmental Behavior and Financial Performance, 02/17/2011, 2011.
[23] Department of Commerce, *Environmental Technologies Industries - FY2010 Industry Assessment*, pp.7, 13.
[24] The Pew Center on Global Climate Change, *Climate Change 101: Understanding and Responding to Global Climate Change* (Arlington, Virginia: , 2011).
[25] Washington State Department of Ecology, "What is Climate Change," http://www.ecy.wa.gov/climatechange/whatis.htm (accessed 03/13, 2011).
[26] The Pew Center on Global Climate Change, *Climate Change 101: Understanding and Responding to Global Climate Change*
[27] Michael Renner and Hillary French, "Linkages between Environment, Population, and Development," http://www.wilsoncenter.org/topics/pubs/ECSP_report_10.pdf (accessed 03/13, 2011).
[28] Washington State Department of Ecology, *What is Climate Change*
[29] The Pew Center on Global Climate Change, *Climate Change 101: Understanding and Responding to Global Climate Change*
[30] Reed Karaim, "Climate Change: Will the Copenhagen Accord Slow Global Warming?" *Global Researcher* 4, no. 2 (February 2010, 2010), 25-50.
[31] National Research Council, *Adapting to the Impacts of Climate Change* (Washington D.C.: National Research Council, 2010), p.1.
[32] Lenny Bernstein, "Climate Change 2007: Synthesis Report, an Assessment of the Intergovernmental Panel on Climate Change," http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (accessed 03/20, 2011).
[33] Ibid.
[34] Gregory Foster, "Environmental Security: The Search for Strategic Legitimacy," *Armed Forces and Society* Spring 2001 (2001).
[35] Quotegarden.com, "Environment Quotes, Green Sayings, Ecology, Conservation, Pollution, etc." http://www.quotegarden.com/environment.html (accessed 02/27, 2011).

[36] The World Bank, "Public Attitudes Toward Climate Change: Findings from a Multi-Country Poll," http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/12/09/000333037_20091209011700/Rendered/PDF/520660WP0Publi1und0report101PUBLIC1.pdf (accessed 03/03, 2011).
[37] EcoAmerica, "The American Environmental Values Survey: Research Summary," http://ecoamerica.typepad.com/blog/files/ecoAmerica_AEVS_Report.pdf (accessed 03/13, 2011).
[38] Ibid.
[39] The Chicago Council on Global Affairs, "Constrained Internationalism: Adapting to New Realities, Results of a 2010 National Survey of American Public Opinion," http://www.thechicagocouncil.org/UserFiles/File/POS_Topline%20Reports/POS%202010/Global%20Views%202010.pdf (accessed 03/13, 2011).
[40] The White House, "United States National Security Strategy, may 2010," http://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf (accessed 03/20, 2011).
[41] The National Environmental Education & Training Foundation, "Environmental Literacy in America," http://www.neefusa.org/pdf/ELR2005.pdf (accessed 03/22, 2011).
[42] Ibid.
[43] Environmental Business International, *EBI Report 2020B, the U.S. Environmental Industry Overview, an Executive Review*, p.27
[44] The White House, "Remarks by the President in State of Union Address | the White House," http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address (accessed 02/27, 2011).
[45] Environmental Protection Agency, "EPA Proposes First National Standard for Mercury Pollution from Power Plants / Mercury and Air Toxics Standards Represent One of Strongest Health Protections from Air Pollution since Passage of Clean Air Act," http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/55615df6595fbfa3852578550050942f!openDocument (accessed 3/30, 2011).
[46] The Chesapeake Bay Foundation, "CBF's 2010 State of the Bay Report," *Save the Bay*, Winter 2011, p.13.
[47] Mary Graham, *The Morning After Earth Day* (Washington D.C.: The Brookings Institution, 1999), p.111.
[48] Ibid, p.34.
[49] Ibid, p.42.
[50] Rachel Carson, *Silent Spring* (Cambridge, Massachusetts: The Riverside Press, 1962), pp.1-3.
[51] Graham, *The Morning After Earth Day*, p.29.
[52] Natural Resources Defense Council, "Laws," http://www.nrdc.org/reference/laws.asp2011).
[53] SEDAC, "Environmental Treaties and Resource Indicators," http://sedac.ciesin.org/entri/2011).
[54] CIA, "CIA Factbook Appendix C: Selected International Environmental Agreements," https://www.cia.gov/library/publications/the-world-factbook/appendix/appendix-c.html2011).
[55] Graham, *The Morning After Earth Day*, pp.98-9.
[56] Wikipedia, "U.S. Non-Ratification of UNCLOS," http://en.wikipedia.org/wiki/United_States_non-ratification_of_the_UNCLOS2011).
[57] U.S. Department of State, "Fact Sheet: United States Policy on the Kyoto Protocol," http://www.usembassy.at/en/download/pdf/kyoto.pdf2011).
[58] David Schoenbrod, Richard B. Stewart and Katrina M. Wyman, *Breaking the Logjam: Environmental Protection that Will Work* (New Haven, CT: Yale University Press, 2010), pp.xii-xiii.
[59] Ibid, p.20.
[60] Ibid, p.x.
[61] Ibid, p.65.
[62] Graham, *The Morning After Earth Day*, pp.97, 102.
[63] Natural Resources Defense Council, *Laws*
[64] SEDAC, *Environmental Treaties and Resource Indicators*
[65] CIA, *CIA Factbook Appendix C: Selected International Environmental Agreements*
[66] Environmental Protection Agency, "Programs and Opportunities," http://www.epa.gov/etop/atoz.html (accessed 03/02, 2011).
[67] Department of Energy, "DOE Data Table," http://www.eia.doe.gov/emeu/aer/pecss_diagram.html (accessed 03/02, 2011).
[68] Environmental Protection Agency, "Renewable," http://www.epa.gov/statelocalclimate/state/topics/renewable.html (accessed 03/02, 2011).

[69] "Why Energy Efficiency is a Hard Sell," http://www.altenergystocks.com/archives/2007/08/why_energy_efficiency_is_a_hard_sell_2.html (accessed 03/02, 2011).
[70] Department of Energy, "U.S. Total Crude and Crude Products Data," http://www.eia.doe.gov/dnav/pet/pet_move_impcus_a2_nus_ep00_im0_mbbl_a.htm (accessed 03/02, 2011).
[71] Department of Energy, "Six most Prevalent Fuels," http://www.afdc.energy.gov/afdc (accessed 03/02, 2011).
[72] The United Nations, "International Decade for Action: Water for Life 2005-2015," http://www.un.org/waterforlifedecade/factsheet.html (accessed 03/02, 2011).
[73] Ibid.
[74] Inc Waste Management, "About," http://www.wm.com/about/index.jsp (accessed 03/10, 2011).
[7575] SciencyDaily.com, "Recent Breakthroughs at Los Alamos Research Lab and University of Alabama," http://www.sciencedaily.com/releases/2011/03/110321093701.htm (accessed 03/02, 2011).
[76] Michael Schnider, "Why Desalination Doesn't Work (Yet)," Live Science, http://www.livescience.com/4510-desalination-work.html (accessed 03/10, 2011).
[77] Environmental Protection Agency, "Low Pressure Membrane Filtration for Pathogen Removal: Application, Implementation, and Regulatory Issues," http://water.epa.gov/lawsregs/sdwa/lt2/upload/2005_11_09_disinfection_lt2_report_lt2_membranefiltration.pdf (accessed 03/10, 2011).
[78] HaloPure, "How does HaloPure Work?" http://www.halopure.com/what/faqs/how-does-halpure-technology-work-0 (accessed 03/10, 2011).
[79] Ibid.
[80] BioEnergyWiki, "Pyrolysis," http://www.bioenergywiki.net/pyrolysis (accessed 03/10, 2011).
[81] Wikipedia, "Gasification," http://en.wikipedia.org/wiki/gasification (accessed 03/10, 2011).
[82] Wikipedia, "Plasma Arc Waste Disposal," http://en.wikipedia.org/wiki/plasma_arc_waste_disposal (accessed 03/10, 2011).
[83] BioEnergyWiki, "Anaerobic Digestion," http://www.bioenergywiki.net/Anaerobic_digestion (accessed 03/10, 2011).
[84] California Department of Energy, "Renewable Energy Research: Anaerobic Digestion," http://www.energy.ca.gov/research/renewable/biomass/anaerobic_digestion/index.html (accessed 03/08, 2011).

Bibliography

Greening of Corporate America: The Pathway to Sustainability from Strategy to Action McGraw Hill Construction, 2009.

"Why Energy Efficiency is a Hard Sell." http://www.altenergystocks.com/archives/2007/08/why_energy_efficiency_is_a_hard_sell_2.html (accessed 03/02, 2011).

Baruch, Lev. *Intangibles: Management, Measurement, and Reportin*g. Washington D.C.: The Brookings Institution, 2001.

Bernstein, Lenny. "Climate Change 2007: Synthesis Report, an Assessment of the Intergovernmental Panel on Climate Change." http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (accessed 03/20, 2011).

BioEnergyWiki. "Anaerobic Digestion." http://www.bioenergywiki.net/Anaerobic_digestion (accessed 03/10, 2011).

———. "Pyrolysis." http://www.bioenergywiki.net/pyrolysis (accessed 03/10, 2011).

Briggs, Don. *2011 NDU ICAF Industry Studies Handboo*k. Washington D.C.: National Defense University, 2010.

California Department of Energy. "Renewable Energy Research: Anaerobic Digestion." http://www.energy.ca.gov/research/renewable/biomass/anaerobic_digestion/index.html (accessed 03/08, 2011).

Carson, Rachel. *Silent Sprin*g. Cambridge, Massachusetts: The Riverside Press, 1962.

CIA. "CIA Factbook Appendix C: Selected International Environmental Agreements." https://www.cia.gov/library/publications/the-world-factbook/appendix/appendix-c.html2011).

Department of Commerce. *Environmental Technologies Industries - FY2010 Industry Assessmen*t. Washington D.C.: International Trade Administration, 2010.

Department of Energy. "DOE Data Table." http://www.eia.doe.gov/emeu/aer/pecss_diagram.html (accessed 03/02, 2011).

———. "Six most Prevalent Fuels." http://www.afdc.energy.gov/afdc (accessed 03/02, 2011).

———. "U.S. Total Crude and Crude Products Data." http://www.eia.doe.gov/dnav/pet/pet_move_impcus_a2_nus_ep00_im0_mbbl_a.htm (accessed 03/02, 2011).

EcoAmerica. "The American Environmental Values Survey: Research Summary." http://ecoamerica.typepad.com/blog/files/ecoAmerica_AEVS_Report.pdf (accessed 03/13, 2011).

Environmental Business International, Inc. *EBI Report 2020B, the U.S. Environmental Industry Overview, an Executive Revie*w. San Diego, CA, 2010a.

———. "The U.S. Environmental Industry Overview - an Executive Review - December 2010." http://www.ebiusa.com/ (accessed 03/01, 2011).

Environmental Protection Agency. "EPA Proposes First National Standard for Mercury Pollution from Power Plants / Mercury and Air Toxics Standards Represent One of Strongest Health Protections from Air Pollution since Passage of Clean Air Act." http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/55615df6595fbfa3852578550050942f!openDocument (accessed 3/30, 2011).

———. "Low Pressure Membrane Filtration for Pathogen Removal: Application, Implementation, and Regulatory Issues."

http://water.epa.gov/lawsregs/sdwa/lt2/upload/2005_11_09_disinfection_lt2_report_lt2_membranefiltration.pdf (accessed 03/10, 2011).
———. "Programs and Opportunities." http://www.epa.gov/etop/atoz.html (accessed 03/02, 2011).
———. "Renewable." http://www.epa.gov/statelocalclimate/state/topics/renewable.html (accessed 03/02, 2011).
Foster, Gregory. "Environmental Security: The Search for Strategic Legitimacy." *Armed Forces and Society* Spring 2001, (2001).
Graham, Mary. *The Morning After Earth Day*. Washington D.C.: The Brookings Institution, 1999.
HaloPure. "How does HaloPure Work?" http://www.halopure.com/what/faqs/how-does-halpure-technology-work-0 (accessed 03/10, 2011).
Karaim, Reed. "Climate Change: Will the Copenhagen Accord Slow Global Warming?" *Global Researche*r 4, no. 2 (February 2010, 2010): 25-50.
Makower, Joel. "State of Green Business 2011." Greenbiz Group. www.greenbiz.com (accessed 03/08, 2011).
National Research Council. *Adapting to the Impacts of Climate Change*. Washington D.C.: National Research Council, 2010.
Natural Resources Defense Council. "Laws." http://www.nrdc.org/reference/laws.asp2011).
Quotegarden.com. "Environment Quotes, Green Sayings, Ecology, Conservation, Pollution, etc." http://www.quotegarden.com/environment.html (accessed 02/27, 2011).
Renner, Michael and French, Hillary. "Linkages between Environment, Population, and Development." http://www.wilsoncenter.org/topics/pubs/ECSP_report_10.pdf (accessed 03/13, 2011).
Schnider, Michael. "Why Desalination Doesn't Work (Yet)." Live Science. http://www.livescience.com/4510-desalination-work.html (accessed 03/10, 2011).
Schoenbrod, David, Richard B. Stewart, and Katrina M. Wyman. *Breaking the Logjam: Environmental Protection that Will Work*. New Haven, CT: Yale University Press, 2010.
SciencyDaily.com. "Recent Breakthroughs at Los Alamos Research Lab and University of Alabama." http://www.sciencedaily.com/releases/2011/03/110321093701.htm (accessed 03/02, 2011).
SEDAC. "Environmental Treaties and Resource Indicators." http://sedac.ciesin.org/entri/2011).
Soyka, Peter. . *Corporate Environmental Behavior and Financial Performance*, Edited by Russell Partch. Vol. As referenced by Mr. Soyka in presentation to ICAF Environmental IS., 2011.
The Census Bureau. "NAICS Main Page." http://www.census.gov/eos/www/naics/ (accessed 03/26, 2011).
The Chesapeake Bay Foundation. CBF's 2010 State of the Bay Report. *Save the Bay*, Winter 2011, 13.
The Chicago Council on Global Affairs. "Constrained Internationalism: Adapting to New Realities, Results of a 2010 National Survey of American Public Opinion." http://www.thechicagocouncil.org/UserFiles/File/POS_Topline%20Reports/POS%202010/Global%20Views%202010.pdf (accessed 03/13, 2011).
The National Environmental Education & Training Foundation. "Environmental Literacy in America." http://www.neefusa.org/pdf/ELR2005.pdf (accessed 03/22, 2011).

The Pew Center on Global Climate Change. *Climate Change 101: Understanding and Responding to Global Climate Change*. Arlington, Virginia: 2011.
The United Nations. "International Decade for Action: Water for Life 2005-2015." http://www.un.org/waterforlifedecade/factsheet.html (accessed 03/02, 2011).
The White House. "Remarks by the President in State of Union Address | the White House." http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address (accessed 02/27, 2011).
———. "United States National Security Strategy, may 2010." http://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf (accessed 03/20, 2011).
The World Bank. "Public Attitudes Toward Climate Change: Findings from a Multi-Country Poll." http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/12/09/000333037_20091209011700/Rendered/PDF/520660WP0Publi1und0report101PUBLIC1.pdf (accessed 03/03, 2011).
U.S. Department of State. "Fact Sheet: United States Policy on the Kyoto Protocol." http://www.usembassy.at/en/download/pdf/kyoto.pdf2011).
Washington State Department of Ecology. "What is Climate Change." http://www.ecy.wa.gov/climatechange/whatis.htm (accessed 03/13, 2011).
Waste Management, Inc. "About." http://www.wm.com/about/index.jsp (accessed 03/10, 2011).
Wikipedia. "Gasification." http://en.wikipedia.org/wiki/gasification (accessed 03/10, 2011).
———. "Plasma Arc Waste Disposal." http://en.wikipedia.org/wiki/plasma_arc_waste_disposal (accessed 03/10, 2011).
———. "U.S. Non-Ratification of UNCLOS." http://en.wikipedia.org/wiki/United_States_non-ratification_of_the_UNCLOS2011).