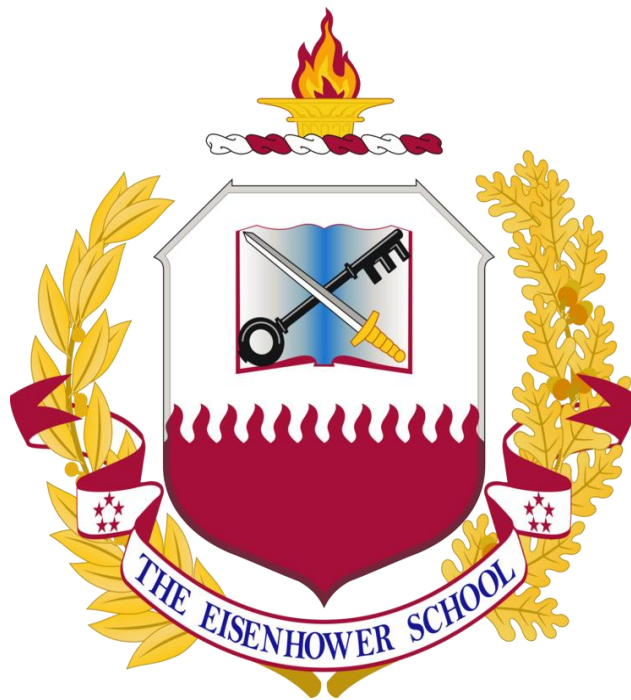


**Spring 2013  
Industry Study**

**Final Report  
*Environment Industry***



**The Eisenhower School for National Security and Resource Strategy**

National Defense University  
Fort McNair, Washington, D.C. 20319-5062





## ENVIRONMENT 2013

**ABSTRACT:** The Eisenhower School for National Security and Resource Strategy Environment Industry Seminar reviewed the complex factors involved in the connection between environmental degradation and national security and the ramifications for industry. The seminar concluded that the environment industry is a complex and heterogeneous industry that, while healthy, is subject to not only domestic and international market forces, but also international competition and economic realities. The environment industry is not currently oriented toward a national security function, but is subject to regulation, customer demand, and public influence in providing product and service solutions to the threat of environmental degradation.

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## PLACES VISITED

### Guests and Local Trips:

National Aeronautics and Space Administration  
 United Nations Foundation  
 Bureau of Oceans, International Environmental & Scientific Affairs U.S. Department of State  
 U.S. Agency for International Development  
 U.S. Department of Energy  
 Population Action International  
 Johns Hopkins University  
 Center for the Management of Ecological Wealth  
 White House Council on Environmental Quality  
 Economics, Exposure and Technology Division Environmental Protection Agency  
 National Oceanic & Atmospheric Administration  
 Director, Regional and Bilateral Affairs Environmental Protection Agency  
 Waste Management Incorporated  
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 Environmental Council of the States  
 Keep America Beautiful  
 PricewaterhouseCoopers Advisory LLC  
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 Marstel Day LLC  
 Smithfield Foods, Inc.  
 Washington Post  
 Committee on Natural Resources, U.S. House of Representatives  
 Committee on Natural Resources and Water  
 Personal Staff, U.S. Senate  
 Washington Aqueduct  
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 US Green Building Council  
 Chesapeake Bay Foundation  
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 The Nature Conservancy  
 National Marine Sanctuary Foundation  
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 The Ocean Foundation  
 Covanta Energy Corporation  
 Global Environment Facility  
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### **Domestic Trips – Hawaii**

Asia-Pacific Center for Security Studies  
PACOM Engineering  
Disaster Management & Humanitarian Assistance - Asia-Pacific Center for Security Studies  
Humpback Whale National Marine Sanctuary  
He'eia Native Hawaiian Fishpond  
Kalaheo Renewable Energy Park  
Hunt Solar Development Hawaii  
Swinerton Renewable Energy  
The Nature Conservancy, Hawaii  
Environmental Compliance Branch, US Army Garrison, Hawaii  
Hawaiian Electric Company  
Dept. of Land and Natural Resources, Naval Facilities, Hawaii  
Clean Islands Council  
Hawaii State Senate - Energy and Environment Committee  
Hawaii State House of Representatives - House Energy & Environment Committee  
First Wind, Hawaii

### **New York**

Global Reporting Initiative  
Mitsubishi Corporation  
UN Environment Program  
UN Department of Field Support  
UN Department of Economic and Social Affairs  
UN Development Program  
US Mission to the United Nations  
U.S. Coast Guard



## Introduction

One of the greatest long-term challenges the world faces is environmental degradation. Global population is growing and, with rapid economic development, as many as three billion people are poised to move into the middle class by 2030.<sup>1</sup> Many developed nations are making progress on environmental sustainability; however, other states' economic development increasingly degrades the environment. Environmental degradation is a complex issue. The threat of environmental degradation is particularly difficult to confront given the considerable debate over the existence and causes of certain environmental challenges (i.e., climate change) and the cost and complexity of solutions. The dynamics of the political and social accord necessary to achieve security from the threat of degradation are also complicated.

The link between the environment industry and national security should not be underestimated nor overstated. To deliberately evaluate the link, policy makers should understand the threat, its potential relevance to national security, and the government role in responding to that threat. While the threat of environmental degradation is not an immediate existential threat, the cumulative effects, if not understood and mitigated, could create a threat to the security of the U.S., and its allies and partners.

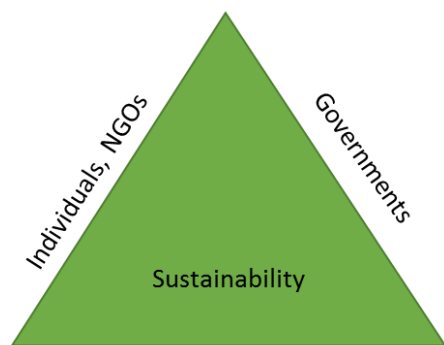
Individuals, special interests, and governments, each to varying degrees, turn to industry for solutions and products to mitigate environmental degradation. Examining the environmental industry, its innovations, and forces influencing the industry are important in a deliberate and comprehensive review. The existence of a healthy environment industry allows the private and public sectors in the United States to conduct environmental mitigation, facilitate environmental protection, respond to crises, and export products and services to the world. The environment industry is complex, healthy, and growing. It provides jobs, innovates, and more importantly, provides products and services that enable society to mitigate environmental degradation.

### Dynamics Affecting the Environment Industry in the National Security Context

Procurement activities within the military industrial complex (MIC) often place Congress, the Department of Defense (DoD), and industry on the three sides of a mutually supporting relationship, such as seen below in Figure 1.

The triangle can also be used to depict the relationship between the public, government, and industry in coping with environmental sustainability. The triangle delineates the major forces and stakeholders who are wrestling with the problem of environmental sustainability. Within the groups represented on the sides of the triangle exist dependencies of culture, politics, economics, technology, and personal belief. Individuals and NGOs interact directly with government and industry. Due to a lack of alignment and consensus between these groups, the future threat of degradation appears to be less about what people have done to their environment than it is about future cooperation. Stakeholders' divergent interests in efforts to reverse environmental harm complicate the future of sustainable development. The response to environmental degradation involves an enormous number of stakeholders that interact with each other and the environment. These stakeholders make a staggering array of consequence-laden choices each day. Annex 1 depicts the complex interactions between individuals, governments, and industry as they engage on environmental issues.





Environment Industry  
**Figure 1 – Relationship of  
 Industry to Society**

The threat of environmental degradation is complex. Part of the complexity is a lack of agreement about the exact nature and degree of the environmental threat to national security. Former Vice President Al Gore added environmental degradation to the national security agenda when, in 1990, he stated that degradation “threatens not only the quality of life, but life itself. The global environment has thus become an issue of national security.”<sup>2</sup> “In the same year, Sen. Sam Nunn...created the Environmental Research and Development Program to redirect military resources toward “developing and analyzing the data needed for alerting us to possible security threats.”<sup>3</sup> Nunn spoke about the newly recognized threat before approval of the legislation:

“I am persuaded that there is also a new and different threat to our national security emerging—the destruction of our environment. The defense establishment has a clear stake in countering this growing threat. I believe that one of our key national security objectives must be to reverse the accelerating pace of environmental destruction around the globe.”<sup>4</sup>

As the National Security Strategy of 2010 does not address environmental degradation as a national security threat or goal, environmental degradation is not perceived as a priority. However, DoD’s Quadrennial Defense Review (QDR) and Department of State (DOS) Quadrennial Diplomacy and Development Review (QDDR) addressed the potential security and diplomatic challenges of climate change and environmental degradation. This acknowledgement may be an early step in planning a response. However, until there is a generally accepted way of measuring the threat posed by climate change and an acknowledgement of the government’s ability to mitigate it, serious consideration of the threat and allocation of the resources required to combat it is not likely.

Whereas the MIC triangle is used to illustrate how weapons systems are procured, the dynamics are notably different regarding the environment industry and society. In the MIC triangle, the fundamental unifying goal is the national security of the United States. The dynamics that surround the environment industry are not uniformly focused on a single definition of sustainability, but contain inconsistent and often contradictory positions that must be balanced to result in international environmental sustainability. Because the global biosphere does not recognize sovereign boundaries, the United States must balance its own sustainability with other nations. World economic and political pressure on resource exploitation, particularly in developing nations, complicate matters tremendously. The views and economic goals of developing giants, such as India and China, clash with the environmental movements of more prosperous nations seeking to maintain their standard of living while preserving the biosphere. International environmental pressures and phenomena can affect the environmental industry.

### **International Environmental Concerns**

In the past 100 years, the world has experienced vast growth in population, industrialization, and the size of the global economy. Much of this expansion has been positive for human development, yet this growth has put enormous pressure on global natural resources. In recent decades, scientists have realized this pressure adversely affects earth’s complex biophysical



systems.<sup>5</sup> Most scientists and many policy makers now realize that environmental challenges must be addressed both at the national and international level before this pressure wreaks irreversible havoc on the natural world.

The Organization for Economic Development (OECD) recently identified four areas of environmental concern that warrant urgent action to avoid significant economic and human costs: climate change, biodiversity, water, and the health effects of pollution.<sup>6</sup> Other international bodies, such as the United Nations (UN), have identified socio-economic drivers that influence or pressure the environment: population growth, economic development, urbanization, globalization, energy, and transport.<sup>7</sup> The UN and other international bodies report that the scale of global drivers, and their rate of change, are without precedent and “...are pushing environmental systems to destabilizing limits.”<sup>8</sup>

Global environmental challenges range from melting ice caps in the polar regions to rainforest deforestation in South America, Africa, and Asia, to rising sea levels in the South Pacific. While all regions of the world experience environmental challenges, the type of challenges, and their scale and scope, vary by region. The effect these environmental challenges have on individual nations varies greatly because of myriad climates, complex geography and oceanography, diverse populations, and huge differences in educational and socio-economic status.

Climate change is a challenge worldwide, but is especially problematic in regions bordering the poles, where ice sheet melting is evident, and in island nations where sea level rise is an existential threat. Deforestation in the rainforests across the equator is causing rapid biodiversity loss. Desertification in North Africa is an endemic problem and, coupled with extreme water scarcity, is quickly shrinking the amount of arable land. Pollution remains a major problem in Russia and some of the former Soviet Union, as well as in Asia, where poor air quality in Chinese cities regularly makes international news. Latin America is experiencing rapid biodiversity loss due to deforestation and poor land management practices. The Middle East faces extreme water scarcity, pollution, and excessive consumption of natural resources.

The ability of individual nations to address environmental challenges also varies greatly. In general, less developed nations lack sufficient legal, regulatory, and industrial capacity to assess, mitigate, or reverse environmental problems. Less developed nations also generally have lower environmental awareness despite the fact that they experience environmental degradation most acutely. Conversely, in highly developed countries, such as in Europe, concepts such as resource efficiency, green economy, and green growth are increasingly reflected in mainstream political discourse.

Several trends exacerbate the global environmental threats. One of the most critical trends is rapid population growth. The OECD expects population to reach over 9 billion by 2050. This growing population will increase pressures on natural resources that supply energy and food. Increasing urbanization is a second exacerbating trend. Cities are likely to absorb almost all of the world population growth and, by 2050, nearly 70 percent of world population will live in urban areas. Finally, global growth of gross domestic product (GDP) will exacerbate environmental challenges. On the positive side, this growth will raise the average standard of living for millions around the world. Conversely, it will also vastly increase resource requirements (especially energy and water), contribute to an already enormous waste management problem, and may result in land scarcity, increase land usage for agriculture, and more extensive deforestation.





The combination of environmental challenges and exacerbating trends requires national and international leaders to better understand the science behind environment projections, embrace the necessity for environmental stewardship, and consider environmental issues as one of the most critical, pressing, and potentially destabilizing global concerns.

### **Human Security and the Environment**

The 2010 QDR identified climate change as a global threat. “While climate change alone does not cause conflict, it may act as an accelerant of instability or conflict, placing a burden to respond on civilian institutions and militaries around the world.”<sup>9</sup> Climate change may have significant geopolitical effects, contributing to poverty, further weakening failing states, and potentially provoking violence and mass migration. Environmental threats, even that of climate change, have become a risk to economic development, stalling development in more fragile states and burdening development in more established states. The Environmental Justice Foundation believes that close to ten percent of the world’s population is at risk of displacement as a result of climate change. They predicted that 150 million climate refugees will migrate to other regions by 2050.<sup>10</sup> Kiribati, Tuvalu, Fiji, the Solomon Islands, and the Marshall Islands are all in danger of losing territory to sea level rise while Papua New Guinea and its neighbors could see an influx of migrants. The World Bank has pushed the 16-member Pacific Islands Forum to develop programs in response to sea level rise. As a result, both Australia and New Zealand created new visa categories to accommodate climate refugees from Tuvalu and Kiribati.<sup>11</sup>

Recognizing climate change threats to national security, U.S. Government (USG) assessments predict many important allies and partners will have water security challenges within the next 10 years.<sup>12</sup> Intelligence analysts estimate that fresh water supply will not keep up with demand by 2040, which will prevent countries from being able to produce food for themselves, let alone export for economic growth in support of the global food market. People living in sub-Saharan Africa, the Middle East, and South Pacific will face major challenges in coping with water stress. This reality potentially creates instability, economic collapse, and regional tensions, which stresses US efforts to maintain peace and security. The people living in ecological hot spots understand the reality of climate change. In a meeting with Eisenhower School students, New Zealand’s Ambassador to the United States, Michael Moore explained why New Zealand decided to forego wealth today for wealth tomorrow by eliminating coal production and reducing greenhouse gas emissions. On another occasion, the Fijian Ambassador to the United States echoed similar comments by acknowledging climate change as the country’s number one national security threat.<sup>13</sup>

The directors of the Office of Management and Budget and the Office of Science and Technology Policy identified the need to move towards a clean energy future as a national security priority. “The Administration intends for the United States to lead the world in clean energy technology R&D to help reduce dependence on oil and to help reduce air pollution and greenhouse gas emissions while creating clean energy jobs and businesses.”<sup>14</sup> They stressed the importance of environmental stewardship as it relates to global climate change and its impact on human security.<sup>15</sup> Dependence upon air, water, and food resources calls for federal sustainability policies that link security to the environment. Other studies from within the USG predict similarly dire consequences for China and India in the next 30 years.<sup>16</sup> The USG is exploring options that will protect the environment, support long-term energy needs, and preserve national interests. In his inaugural address, President Obama outlined a vision for a sustainable future:



“Some may still deny the overwhelming judgment of science, but none can avoid the devastating impact of raging fires, and crippling drought, and more powerful storms.

The path towards sustainable energy sources will be long and sometimes difficult. But America cannot resist this transition; we must lead it. That is how we will preserve our planet, commanded to our care by God.”<sup>17</sup>

The President’s call for action by Congress to work on a solution to climate change and his reference to “belief in the overwhelming judgment of science” highlighted the gap between the consensus of the scientific community regarding the serious threat of climate change, evolving public perceptions of global warming, and the relatively modest political initiatives being undertaken by the United States to address the issue. While the Administration and Department of Defense have moved forward in factoring climate change into long term planning and characterize it as a fundamental strategic concern<sup>18</sup>, the public views it as a relatively low priority<sup>19</sup>, and from a political perspective the issue has fallen prey to effective lobbying by the oil industry, sharp partisanship, and gridlock.

### **Industry Definition**

The environment industry is complex and difficult to define. As the environment industry is not a traditional monolithic industry, researchers have taken various approaches to describe it. The industry has clearly identifiable businesses that are completely dedicated to environmental products or services, but also has elements nested within other corporate entities. In short, the environment industry is an industry comprised of producers of single and multi-purpose products and services that can be arrayed to prevent damage to the environment, mitigate damage to the environment, or replace existing products and services with new net-zero products and approaches to human interaction with the environment.

The environment industry consists of companies that produce a heterogeneous set of services and goods rather than a group of homogeneous goods like aircraft or automobiles.<sup>20</sup> This makes it very difficult to define outputs that are directly attributed to the industry. There is some agreement on the actual boundaries of the industry and the criteria for defining those boundaries. Inclusion of clean technologies and renewable energy within the purview of the environment industry changes the structure of the overall industry. Environmental goods and services that are made by non-environmental specialty companies make it difficult to count revenues produced from those manufactured goods and environmental services as part of the industry unless represented as business units in a larger private company. Various studies that tried to define the industry were not consistent on the range of categories that were included and some were devoted to the supply side. Others were focused on the demand side for environmental goods and services.<sup>21</sup> Despite these hurdles, the OECD and the U.S. Department of Commerce have accepted a measurable group of environmental goods and services that form the “core” of the environment industry. This definition is one that has been developed by the Environmental Business International (EBI), a “publishing and research company that generates strategic market intelligence on emerging opportunities in the Environmental Industry, Climate Change Industry, the Green Economy, and Health & Wellness Market.”<sup>22</sup>

The EBI Annual Report, Report 2020-B, defines the Environment Industry as:

“All revenue generation associated with environmental protection, assessment, compliance with environmental regulations, pollution control, waste management,



remediation of contaminated property and the provision and delivery of environmental resources.”<sup>23</sup>

This description includes a range of functions from solid waste management and air pollution control equipment to “end of pipe” remediation systems to natural resource recovery, and clean energy systems and power, such as solar power, wind turbines, and waste-to-energy technologies. There are other definitions and even a construct referred to as a “green economy.” However, EBI has presented a long standing, consistent, and widely accepted approach.

## Environment Industry Structure

EBI’s methodology centers on classifications of types of businesses from the perspective of what the companies sell or provide, in the case of environmental services. This allows for a broader segment definition that includes companies that provide environmental engineering services or environmental laboratory services (which may relate to more than just one particular environmental problem) or companies that manufacture specific environmental equipment. Basically, “service revenues are those generated as fees paid for service, equipment revenues are sales of hardware, and resources are sales materials, water or energy.”<sup>24</sup> The chart below (Figure 2) is from the most recent EBI Report (2012) and it depicts three environmental business categories and 14 industry segments. See Annex 2 for complete descriptions.

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

**Figure 2 – Industry Sectors**

For example, the leader in manufacturing wind turbines and providing associated services is a Danish company called Vestas. Vestas leads all other competition in global sales and installed power. However, while Vestas produces in many markets outside of Denmark (for the simple reason of transport efficiency), it does not dominate the sales of turbines in the United States, where GE produces about one-third of total turbines.<sup>25</sup> Of course, of the thousands of parts that go into each installed turbines, a large, unknown number are produced throughout an international supply chain.

*Current Condition* - The industry is continually changing and growing globally, making a solid industry definition more difficult. In 2011 in the United States alone, the environment industry grew by 5.5 percent across all segments and grossed \$320 billion in annual revenues, constituting approximately 2.5 percent of the nation’s Gross Domestic Product (GDP) and employing over 1.6



million Americans.<sup>26</sup> These revenues grew by nearly \$20 billion from 2010. The global environmental market is valued at about \$900 billion in 2012.<sup>27</sup> The environment industry's sustained growth in recent years is a result of the pressures of the stakeholders that have impacted other industries as well. With increasing frequency and urgency, all stakeholders, most importantly corporations, are changing their approach to the environment and increasingly inculcating environmental stewardship and sustainability into their core principles.

The environment industry in the United States not only performs well in terms of growth it also is expanding employment and contributing to exports for the U.S. economy. In fact, the environment industry gains about 10 percent of their revenue from export activities with trading partners such as Canada, Mexico, and Japan.<sup>28</sup> The U.S. environmental trade balance as of 2010 ran to 14.5 percent export, even accounting for the repatriated profits of foreign held businesses.<sup>29</sup> Regarding employment, the EBI-defined sectors of the environment industry have, on aggregate, increased payroll positions by about eight percent from 2006–2011, despite a decrease in jobs of 2.5 percent in 2009, during the economic contraction.<sup>30</sup> These increases are perhaps deceptive, as the industry is so broadly defined. At any given time, one part of the industry is in a different evolutionary phase than another, requiring intense hiring even while another part is phasing out. In fact, subtracting the declining sectors (Air Pollution Control Equipment and Hazardous Waste Management) from the total numbers of jobs in the industry from 2006–2011, job growth almost reached 11 percent. Further, nascent sectors such as Resource Recovery and Clean Energy Systems and Power grew significantly more quickly than other sectors, increasing the number of jobs by 20 and 91 percent respectively during the same timeframe.<sup>31</sup> See Annex 3.

**Structure** - The industry, as defined by EBI, consists of numerous companies, large and small. As of EBI's 2012 executive summary, the industry surveyed consists of almost 1500 companies and public sector utilities. It is impossible to compare all of these companies, representative as they are to 14 subsectors. However, one thing each sector has in common is that in every sector exists substantial competition, particularly in emerging technologies such as clean energy systems and power. In a very few sectors, such as solid waste management, the steady nature of predictable demand and the large size of revenues to be gained have resulted in a few companies dominating the sector. The top three, Waste Management Incorporated (WMI), Allied Waste Industries, and Republic Services, account for about 93 percent of revenue in solid waste.<sup>32</sup> Due to the high cost of entry into this market and economy of scale enjoyed by WMI, competition in this market sector is not very active. However, because waste collection is virtually a utility, sometimes regulated in certain areas, WMI is unable to achieve a monopoly and their profits, while steady, demonstrate this reality. Recently posting a return on investment of 5.6 percent, its value appears on a par with other utilities, and is higher than many. WMI is certainly profitable enough and its long term debt to equity ratio (1.6) indicates its high level of investment on new equipment and expansion within the United States. The solid waste management sector is one that appears to resist foreign penetration and expansion. In fact, WMI has withdrawn from earlier investments abroad, acknowledging the difficulty of operating in a foreign country where politics affect competition.<sup>33</sup>

Other sectors are engaged in what appears to be perfect competition, even in the international market space. While WMI is almost in a monopolistic relationship with consumers, this is an aberration among the rest of the industry. An example from the waste and waste water equipment sector demonstrates the point very well. Within this sector, which features industrial giants such as General Electric and 3M are also smaller companies such as Clarcor, a producer of filters and associated products used to mitigate industrial harms. Clarcor is a financially healthy

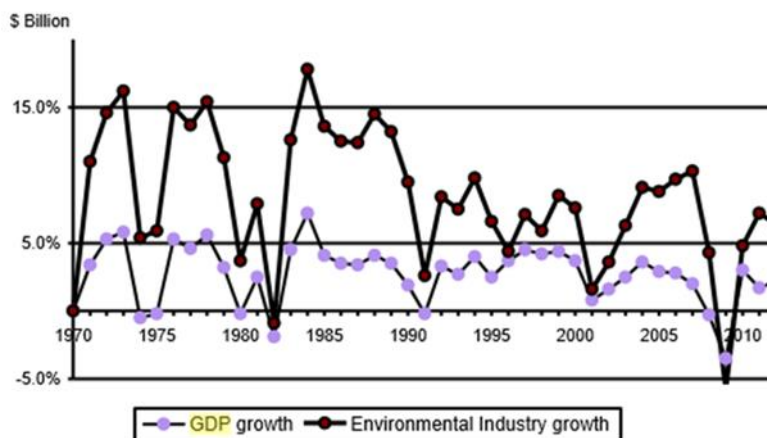


corporation producing environmental products internationally and achieving a 13.5 percent return on investment on over \$1 billion in annual revenue. Clarcor and its primary competitor, Culligan, in this sector account for \$1 billion in sales (in this specific sector according to EBI), but that, in turn only represents 3.6 percent of the \$26 billion dollar annual sales throughout the sector. In comparison, GE sells about \$2 billion in this sector each year, a total of about seven percent of the sector. This sector is healthy, steadily growing over time and benefitting from regulation (the Clean Water Act (CWA) of 1972) as well as public demand for cleaner water. The sector grew by 22 percent from 2002 to 2010. Expected upgrades to the CWA and other legislation may drive the sector to further than expected growth in coming years.<sup>34</sup>

One of the strengths of this sector is the variable degree of entry into market. While it is not cheap to build a manufacturing company to produce filters, the technology is not a barrier. Also, the retrofit requirements as well as new design requirements continually drive a demand for a variety of filtration implements. Another strength and a major factor in the health of the industry, which allowed most companies to readily survive the 2009 economic contraction, is the relationship many of the companies have with local communities, as in utility-related services that are always priority services, such as solid waste management and water utilities. Over the previous five years, while several companies saw a reversal of fortune in revenues, by and large, companies in most sectors bounced back in 2010 and 2011.<sup>35</sup>

*Challenges* - The growth of the environment industry appears to be closely linked to global economic growth, as evinced by a correlation with U.S. GDP growth. This correlation, illustrated in Figure 3, seems to suggest that customers of environmental products and services do not highly prioritize these expenditures during periods of economic contraction. Where changes to environmental performance are not regulated or mandated, purchasers may postpone orders of products and services during a financial crisis. As seen in Figure 3, during the economic downturn in 2008- 2009, when the U.S. economy contracted (as did the environment industry).

**Figure 3 – GDP growth and Environmental Industry Growth**



The chart also shows a distinct sensitivity to economic contraction, but thrives proportionally well when the economy grows. While the relationship is not strictly correlational, it would suggest that purchases of industry products and services, related to GDP terms actually decline during times of economic contraction. Whether this is a leading or lagging indicator is a





matter of debate, but spending growth in the environment industry exceeds GDP growth during years of economic expansion.

One of the lowest points for the industry was in 2008-2009, during the economic contraction, which might indicate the industry's relationship to GDP growth as a lagging indicator quite well. However, as the global economy sputtered back to life, companies began to link their sustainability strategy to critical business activities.<sup>36</sup> According to many sources, including the GreenBiz annual report, corporations are discovering and accepting that while investment in sustainability does not produce revolutionary returns, it does pay off. And while the growth of sustainability executive positions seems to have peaked in 2008,<sup>37</sup> it is too early to tell whether that is an indicator of saturation in corporate demand for professionals or that sustainability is already becoming embedded in corporate operations. In either case, it would appear that the continued emphasis corporations are putting on sustainability is good news for the environment industry. In fact, despite this countervailing information, there are other promising indicators, such as the continued growth in Leadership in Energy and Environmental Design (LEED) certification for companies. LEED certification has grown at a rate of over 50 percent in the past five years, and the applications for evaluation continue to come to the Green Building Council Offices. In this voluntary program aimed at providing third-party verification of green buildings, the USGBC oversees efforts to make living and work spaces environmentally sustainable. At the moment, more than 45,000 LEED projects are in the works around the world.<sup>38</sup>

*Outlook* - The environment industry, like many dependent on technology and facing adoption resistance, will change throughout the next 50 years, and in fact, probably diminish as a somewhat distinct industry. The information technology industry, for example, started as a distinctly separate industry and merged its services sector into the mainstream operations of all organizations, becoming so diffuse and ubiquitous that it is hard to separate from daily operations. As companies write sustainability into their corporate culture, adoption of processes, behavior, and equipment will likely obviate many of the independent environmental services companies.

However, many sectors of the industry will certainly grow. There are several categories in which this appears to be certain: solid waste management, environmental services, renewable energy, and water-related services. In the sectors that are responding to eminent challenges, environmental services will continue to grow in response to a demand for environmental action plans, LEED certification, and sustainability planning. Solid waste and water sectors will grow with population growth. Adjacent sectors will also keep pace. This trend will be steady for the immediate future.

The most volatile sector, renewable energy, will likely continue to add jobs and see strong revenue growth through 2020. According to surveys by EBI<sup>39</sup> this sector is expected to outpace all others. The industry is particularly susceptible to changes in incentive legislation. According to several industry representatives with whom the seminar met<sup>40</sup>, the uncertainty of the Production Tax Credit (PTC) has hampered industry's capability to expand facilities and production. Also, the uncertainty has hampered the rapid accumulation of capital for developmental projects. Dependent on tax credits for profitability, the renewable energy sector, while growing quickly, cannot keep up with demand for renewable power. GE, in their 2012 10K report, cited an 11 percent loss of profitability in wind turbines due to productivity losses in 2011. These losses were partly due to their inability to predict whether Congress would renew the PTC. All told, GE claimed that orders for wind turbines exceeded their production capability.



*Trends and Indicators – Renewable Energy* – According to the International Energy Agency (IEA), the percent of energy created by renewable and non-fossil sources is slowly but steadily growing. Since 2005, the trend indicates an increase of 35 percent to 2012, when projections show production capacity growing to 4.5 million gigawatt hours.<sup>41</sup> However as a percentage of generation, these new sources of energy have gained on fossil fuels by only about 1.5 percent in the same period. And hydropower is still the most significant contributor to renewable figures, accounting for about 16.5 percent of power generation. Nonetheless, demand for renewables, while not drastically outpacing cheaper fossil-based power, is growing, particularly with wind and solar power. These markets have grown by 24 and 43 percent respectively since 2005.<sup>42</sup>

**Wind** – Across the world, wind generated 344 terawatt-hours from 2005 to 2011. Analysts expect this sector to grow as long as the Producer Tax Credit (PTC) remains in force.<sup>43</sup>

**Solar** - Solar generation in the United States grew strongly due to declining photovoltaic costs. According to the U.S. Energy Information Administration, solar generation will increase by 31 percent in 2013 and 28 percent in 2014.<sup>44</sup>

**Bioenergy** - The IEA believes the biofuel industry is growing. Although currently producing more power than solar on a global basis, solar growth will place solar on a par with biofuel by 2017.<sup>45</sup>

### **Environmental Innovation Intersects With Other Industries**

Technology could help resolve resource scarcity and mitigate degradation. Advances in environmental technology may reduce, or eliminate, the anticipated effects of overpopulation – increase in energy demand, water scarcity and food insecurity.

**Nuclear** - Nuclear reactors are still one of the most effective low-carbon energy producers. Detractors say that mining uranium, the process of molding it into rods and transporting the rods to the plant increase the carbon footprint. Others use Japan’s Fukushima plant as proof that nuclear reactors are unsafe. The future of nuclear power depends on innovations to make nuclear power plants even safer. For example, China designed a prototype that uses balls made of graphite and uranium instead of rods and “heat gas” instead of water.<sup>46</sup> Developers claim that reactor accidents would cool autonomously.

**Bioenergy** - Converting Municipal System Waste (MSW), into electricity is a form of renewable energy called bioenergy. Bioenergy also includes: liquid biofuels (e.g., ethanol, biodiesel) and biomass solids, such as pellets, chips and previously used, recovered wood.<sup>47</sup> Covanta’s waste to energy facilities have removed over 350 million tons of greenhouse gases (GHG) using biomass (MSW) to generate electricity instead of dumping into a landfill.<sup>48</sup> Waste to energy conversion is expected to contribute 5% of the global electricity generation.<sup>49</sup> DoD is also experimenting with bioenergy as the Navy tests biofuel use in aircraft and ships. Scientists are studying algae and plant fungi. In late 2011, researchers at Montana State University “trapped enough fungal hydrocarbons to make a gasoline blend” to successfully run a large capacity engine.<sup>50</sup>

**Geothermal** - Geothermal energy provides an estimated 20% of electricity to the largest island in Hawaii. In addition to the United States, geothermal energy is used in 23 countries to generate electricity and is used for heating and cooling in 78.<sup>51</sup> By 2015, electricity will be generated by geothermal facilities in every inhabited region of the globe except India and the Middle East. Those countries will use geothermal energy for heating and cooling purposes only. Technological



innovation in drilling exploration is required to make the future of geothermal energy economically sound.

*Ocean Energy* - The Ocean contains several sources of renewable energy: waves, tidal range, tidal currents, ocean currents, and ocean thermal energy conversion (OTEC) and salinity gradients. There are a few prototypes for tidal currents and its design is approaching commercialization. Technologies for ocean currents and salinity gradients are still in the early stages of research and development. Lockheed Martin developed a mini OTEC plant in the early 1970s that successfully generated 50 kW of electricity. In 2009, the U.S. Navy awarded them a contract to design an OTEC prototype plant.<sup>52</sup>

*Wind Power* - Currently, global wind power contributes about 2% of the world's generated electricity. In the U.S., wind farms are all on land. The first wind farm at sea is expected to start construction in 2013. According to the Department of Energy, wind power is expected to generate up to 20 percent of the U.S. electricity by 2030 (see Annex 4).<sup>53</sup> Technological advances are required to reduce cost and determine the most efficient way to construct wind turbines at sea. Some sources anticipate that 25 percent of the wind farms in 2030 will be offshore.

*Solar Power* - Offshore solar power is the new frontier for harnessing solar energy. Water covers about 72 percent of the earth, therefore, water is receiving the majority of the energy emitted from the sun. The western United States is becoming populated with solar farms. Residential homes are using solar power to offset their utility bills. An opportunity exists for the installation of Concentrated Solar Power and Photon Solar Power at sea. The future of solar power is dependent upon the cost, which must decrease if solar power is expected to proliferate globally. As technology improves and more companies enter the industry, the expense of Photovoltaic Solar Power should decrease for individual consumers. Advances in energy storage and grid demand forecasting are needed to make solar power a leader in renewable energy.

*Desalination Plants* - Solar power is good source of energy to use from the portfolio of renewable energies to offset the cost of electricity at desalination plants. There are approximately 12,500 plants worldwide. A professor at the New Jersey Institute of Technology has developed a "direct-contact membrane distillation (DCMD) system that can efficiently wring drinking water out of up to 20 percent-salt-concentrated brine."<sup>54</sup> This system can produce 40% more fresh water than the standard desalination plant. As the sea level rises, more desalination plants will be constructed by those countries that can afford to build these very large, expensive systems. Technology and innovation are needed to make them scalable, less expensive, and safe for the environment. One example is a wind-powered turbine that takes in air through vents in the nose of the cone. The air heated into steam, which is condensed and stored. (Annex 5).<sup>55</sup>

## **Transportation - Moving Away from Oil**

*Cars* - Bioenergy and biofuels have captured the attention of automobile manufacturers, perhaps motivated by a 1990 California state regulation mandating the introduction of Zero Emission Vehicles. General Motors in 1996 introduced the EV-1, the first mass produced plug-in electric car of the modern era. However, GM pulled the design despite promising early demand. Many observers believe that the petroleum lobby was to blame for the failure of this early example of an electric vehicle.<sup>56</sup>





Toyota's successful hybrid models have helped avoid the emission of 30 million tons of CO<sub>2</sub> worldwide since 1997, and saved 2.9 billion gallons of gasoline over conventionally powered vehicles.<sup>57</sup> Naturally, Toyota shares the market with other manufacturers including Ferrari.<sup>58</sup> Buyers are generally eligible for a \$7,500 federal tax credit, U.S. state tax credits of up to \$7,500 and in some locations, other incentives and perks. Government incentives and policies clearly have a role to play in greening the automotive industry. Higher taxes for vehicles that use more gasoline, coupled with tax credits and other incentives for drivers of more fuel efficient vehicles, particularly hybrids and electric cars, will help consumers save time and money while reducing the amount of greenhouse gases (GHG) emitted into the atmosphere.

Engineers are developing lighter materials to use in automobile construction, with goal of reducing weight. Cars built with carbon-fiber-reinforced plastic (CFRP) weigh up to fifty percent less than alternatives, improving fuel efficiency. CFRP is currently not economically feasible for car production, but BMW, has perfected a new automated method for production and plans to use it as the primary material for a new plug-in hybrid.<sup>59</sup> The U.S. Department of Energy's Oak Ridge National Laboratory is conducting research on producing carbon fiber from natural gas or lignin, a waste produced during the manufacture of paper; some major manufacturers have signed agreements with carbon fiber producers for future products.<sup>60</sup>

*Flying the Green Skies* - Air travel generates an enormous amount of GHG. A passenger flying round trip between New York and London would cause emissions equal to those for heating a home for an entire year. Emissions from air travel in the EU alone rose 87% between 1990 and 2006.<sup>61</sup> The United States leads the world in carrying over 730 million passengers in 2011. Given the massive increase in air travel, reducing the environmental impact of air travel by the use of cleaner, renewable fuels and more efficient aircraft has become a critical goal for the near future.<sup>62</sup> In 2011, United Airlines became the first airline to operate a passenger flight in the U.S. with biofuels, using an algae-based fuel to power a 737 between Houston and Chicago. Alaska Airlines followed suit with 75 flights between Seattle and Washington DC, and Seattle and Portland, using a blend of conventional jet fuel and a biofuel produced from used cooking oil.<sup>63</sup>

Environmental improvements to aircraft technology go beyond renewable jet fuels. NASA in 2011 commissioned the three largest U.S. aircraft manufacturers, Boeing, Northrop Grumman and Lockheed Martin, to design future passenger aircraft with the goal of using half as much fuel as aircraft in service in 1998, reducing harmful emissions by 50 percent, and shrinking the size of areas impacted by airport noise by 83 percent. Two of the designs, which NASA hopes to see in production by 2025, feature modified "flying wing" designs similar to the B-2.<sup>64</sup> Boeing's new 787 passenger aircraft represents another important advance in greener aviation. The 787 flies using 20 percent less fuel than comparable aircraft and is manufactured using 50 percent composite materials, including the fuselage and wing, with approximately 35 tons of CFRP per aircraft.<sup>65</sup> Airbus has used similar lightweight design features in its A380. The A380, also constructed using composite materials, has the lowest fuel usage per passenger of any current passenger aircraft.<sup>66</sup>

## **Sustainability and Business**

As outlined above, almost all business have green requirements and to some degree are either regulated or participating in the "green economy." As such, these stakeholders are in a position not only to add to environmental degradation, but also to greatly reduce it. As much of industry causes a large portion of degradation, all parts of man's economic activities can work to reverse it. Corporations already compete against one another regarding their sustainability actions.



The Dow Jones Sustainability Index (DJSI), which originated in 1999 as the first global index “tracking the financial performance of the leading sustainability-driven companies worldwide,”<sup>67</sup> suggests that sustainability is a competitive issue. The DJSI website claims that “corporate sustainability performance is an investable concept,” implying sustainable actions are profitable for investors.”<sup>68</sup>

Just as with many environmental issues, sustainability and its economic benefits are divisive in that some agree that pursuing sustainable activities is profitable and others do not. Nonetheless, corporations are beginning to demonstrate that sustainability is important and drives economic profits. “NYSE Euronext recognizes that a sustainably managed, natural environment is vital to our business, our employees, our clients and the global community.”<sup>69</sup> It is noteworthy that a company responsible for facilitating global investment is talking about sustainability, was admitted to the DJSI in 2012, and won an EPA Green Power award.<sup>70</sup> Additionally, a University of San Francisco article documents the environmental sustainability practices of eBay, Starbucks, and Google that praises their “big picture approach...examining every step of their product lifecycle and applying green supply chain management practices across the board.”<sup>71</sup> These steps have the “...potential to eliminate waste and generate cost savings, leading to a stronger bottom line” with possible side benefits to include “favorable public opinion and greater customer loyalty.”<sup>72</sup> In 2012, three academics presented the results of their study of 180 companies and concluded, “Our research provides convincing evidence that sustainability pays off. Critics of sustainability argue that it destroys shareholder value. We found exactly the opposite.”<sup>73</sup> In quantifiable terms, “a dollar invested in 1993...would have grown to \$22.60 by 2010, versus only \$15.40 for traditional firms.”<sup>74</sup>

There are also those in the corporate world who, though they want to be bullish on sustainability, see things a bit differently. John Davies and his colleagues at the GreenBizGroup whose motto is “defining and accelerating the business of sustainability” describe their views in their “State of the Profession 2013” presentation delivered in early January.<sup>75</sup> Among the key concerns noted is a decline in companies and establishing full-time sustainability positions. Sustainability budgets are shrinking with 94 percent of companies earmarking \$10 million or less for these efforts and 56 percent of existing sustainability managers say their companies have other priorities.<sup>76</sup> To get out of this rut, 49 percent say competitive pressure would advance their cause and 51 percent said more customer inputs would be of benefit; things sustainability managers cannot control either.<sup>77</sup> In summary, though the report paints a relatively gloomy present picture, the GreenBizGroup is heartened by what they see as the facts being, “the role of the sustainability executive in corporate America is still in its early stages,” and “the role of dedicated sustainability professionals...is becoming more associated with value creation and not just a cost to be managed.”<sup>78</sup>

Together, the MIT Sloan Management Review and Boston Consulting Group recently provided the results of their third annual study on sustainability and concluded their results by titling it “Sustainability Nears a Tipping Point.”<sup>79</sup> Of the 4,000 managers queried from 113 countries, 70 percent say sustainability is now on their corporations’ agenda though there is an open question about its prioritization. Nearly two-thirds indicate sustainability is now viewed as a part of being competitive, but only one-third agreed that sustainability activities contribute to profitability.<sup>80</sup> In summary, Haanaes et al. conclude, “Taken together, the data suggest that the sustainability movement is nearing a tipping point, the point at which a substantial portion of



companies are not only seeing the need for sustainable business practices but are also deriving financial benefits from these activities.”<sup>81</sup>

### **Governments and Regulation**

“We understand global environmental governance (GEG) as the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection.”<sup>82</sup> Adil Najam, International Institute for Sustainable Development, Denmark.

The broad construct of “environmental governance” refers to the management or synchronization of those aspects of human life dealing with the external world; the eternal provision of food, water and shelter in a manner that ensures their continued availability. This view allows one to rapidly discern the interconnected relationships between actions and people, and helps set the context for a discussion of government’s role as regards the environment.

As our understanding of environmental threats, risks and human health has increased, the scale, type and extent of government organizations responsible for fulfilling this purpose have also increased. International, national, and state organizations currently fulfill responsibilities for promoting the general welfare by protecting health and preserving the environment.

**International Framework** - The UN is the leading international organization that most closely resembles an international governing body. There are now over 30 UN agencies and programs with a stake in managing the global environment. Added to that significant body a wide assortment of international organizations, NGOs, and a mixture of treaties, conventions and international laws, and the understanding of responsibility and authority for international environmental coordination is even more complex. Four organizations and programs within the UN’s purview focus on environmental issues and governance. The *UN Environmental Program* (UNEP) (subordinate to the UN General Assembly (UNGA)) has the mission to “provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.”<sup>83</sup> The *UN Development Program* (UNDP) includes in one of seven core mission areas the protection of the environment and access to clean energy. Through this focus, UNDP works to strengthen national environmental management capacity, integrate environmental considerations into development plans and support programs of sustainable, low-carbon development activities.<sup>84</sup> The *Global Environment Facility* (GEF) is an independent financial organization created to act as the primary global funding mechanism for investing in the four principle global environmental conventions.<sup>85</sup> The UN Commission on Sustainable Development ensures follow up of agreements made during the UN Conference on Environment and Development.<sup>86</sup> Still working 20 years later, this organization has become involved in promoting and sharing sustainable practices globally.

Beyond these global, environmentally-focused organizations, are other powerful entities such as the World Bank, the World Trade Organization, and the International Monetary Fund that implement significant policies and materially support accomplishing global environmental goals and conventions. Hundreds of international organizations remain, and are contributing towards global environmental governance, but they are focused on a specific region, a specific species, or focus on one particular aspect of the overall challenge. The influence of international organizations is often strong, but agreements are generally voluntary, making the enforcement of agreements and regimes difficult.



## National Framework

Congress - Congress has several primary committees that authorize and appropriate funds for environmental legislation.

*House Committee on Energy and Commerce* – oversees consumer protection, food and drug safety, public health, environmental quality and energy policy. The committee also oversees the Department of Energy, Health and Human Services, and the Environmental Protection Agency.<sup>87</sup>

*House Committee on Natural Resources* – oversees public lands. The last 60 years have seen gradual broadening of jurisdiction. Oversees fisheries and marine affairs, wildlife, forests and national parks, minerals and mining, and water resources in relation to irrigation.<sup>88</sup>

*Senate Committee on Energy and Natural Resources* - oversees energy resources and their development and conservation, including nuclear energy, public lands and resources, including mining, and water resources.<sup>89</sup>

*Senate Committee on Environment and Public Works* - oversees environmental protection policy and research, resource utilization and conservation, air, noise and water pollution, toxic substances, solid waste, ocean dumping, water resources and associated public works.<sup>90</sup>

Executive Branch - The responsibility to monitor compliance, promulgate standards and policies, and punish violations is shared by a collaborative web of federal, state and local officials. This organizational framework is as complex as the sources and types of potential impact to the air, water and soil we rely on to survive. Additionally, human-induced complexity from economic, social, and political considerations, including regional variations to each, all combine to make the protection of the environment complex. Annex 6.

The *White House Council on Environmental Quality* (CEQ) - facilitates development of environmental policy and initiatives between the Administration and various agencies while advancing the President's environmental agenda.

The *Environmental Protection Agency* (EPA) – with jurisdiction across air, land and water, the EPA is the leading federal agency responsible for but not exclusive jurisdiction over the environment. The agency's responsibilities have evolved and expanded in concert with legislation, to encompass principle policy and regulatory responsibility for twelve major environmental statutes existing in the United States.<sup>91</sup>

The *Department of Agriculture* (USDA) - manages the US Forest Service (USFS) and the Natural Resources Conservation Service (NRCS). USDA is responsible for environmental conservation, restoration, water resources and wildfire prevention for 75% of the total land area of the United States.<sup>92</sup> The department partners with EPA, states and other jurisdictional agencies concerning impacts to forests, pasture, water quality in connection with agriculture, pesticides, as well as soil erosion and sediment control.<sup>93</sup>

The *Department of the Interior* (DOI) - manages the nation's public lands, minerals, national parks and refuges, and holds responsibility for western water resource management and the Federal trust relationship with Indian tribes.<sup>94</sup> Significant DOI agencies with environmental roles include the US Fish and Wildlife Service, the Bureau of Reclamation, the US Geological Survey, the Bureau of Land Management, and the Bureau of Ocean Energy Management.



The *Department of Commerce's* National Oceanic and Atmospheric Administration (NOAA) is responsible for environmental assessment, prediction and stewardship of America's ocean, coastal and living marine resources.<sup>95</sup> Anchored in science and research, this is a key agency concerning climate change, fisheries, aquaculture, and coastal development as well as overall environmental security. NOAA operates, amongst other offices, the National Marine Fisheries Service and the National Ocean Service with special jurisdiction in coastal water quality, estuarine habitat, marine resources and anadromous fish.<sup>96</sup>

The role of the *Department of State* (DOS) in environmental governance is growing quickly. Currently centered in the Bureau of Oceans and International Environmental and Scientific Affairs (OES), DOS presents and protects US global interests in oceans, environmental protection and developmental policy.<sup>97</sup> In addition, DOS has special jurisdiction with regard to international environmental impacts of US activities.

The *Department of Defense* (DOD) has a large magnitude of operations, facilities, real estate, and unique equipment and technology, often placing DOD at the forefront of assessing environmental impacts as well as placing unique importance in the stewardship, conservation and protection policies pursued by the armed services. Program areas of installation management and civil works are managed respectively by the US Army Installation Management Command and the Army Corps of Engineers, have environmental responsibilities.

### **Regulation in the Domestic Context**

The gradual awareness that population growth, urbanization, and increased consumption were degrading the environment and driving an increasing large amount of unregulated industrial pollution, resulted in a response from the above segments of government. Environmental laws, regulations and treaties have been developing and evolving since the second half of the twentieth century. Governments have tried many approaches to compel constituents: command and control (CAC) legislation; economic incentives to change behavior; consensus through international cooperation; or appealing to a global sense of duty. However, the overall story of global environmental treaties and regulations has been a mixed bag of success and failure. Nonetheless, the government is a critical actor to attain environmental sustainability.

In 1962, the modern global environmental movement was propelled forward by Rachel Carson's book *Silent Spring*.<sup>98</sup> High profile environmental disasters of the 1960s such as the Santa Barbara Oil Spill, smog in Los Angeles and the burning of the Cuyahoga River further galvanized public opinion for environmental action.<sup>99</sup> This ultimately led to the National Environmental Policy Act and the creation of the Environmental Protection Agency (EPA) in 1970. Congress granted EPA sweeping new powers to regulate pollution and toxic chemicals, to require state and local governments both to implement and comply with these regulations, and to subsidize both state regulatory agencies and local wastewater treatment facilities.<sup>100</sup> A Command and Control (CAC) regime of legislation was begun in the early 1970s. A rules and deterrence model, it assumed a "zero-sum" environment where the motivations of industry were at odds with the needs of society and only the blunt instrument of regulation from government could modify industry behavior.<sup>101</sup> Most of the major U.S. environmental legislation and regulation is of the CAC type, and is still largely in force today.<sup>102</sup>

Initially the CAC approach yielded a solid return on investment through iconic legislation such as the Clean Air Act (1970), the Clean Water Act (1972), Resource Conservation and





Recovery Act (1976), Comprehensive Environmental Response, Compensation and Liability Act (1980) and the Oil Pollution Act (1990). By attacking "end-of-pipe" and point sources of pollution, great improvements in air and water quality have been achieved, as well as the elimination of many harmful chemicals from commerce. It has been hailed as a major policy success of the second half of the twentieth century.<sup>103</sup> However, the CAC regime has its critics. Some deem it too costly, creates an adversarial atmosphere of distrust that inhibits innovation, and offers no incentive to exceed the standard. In spite of some efforts by the EPA to take a more collaborative and incentive based approach, there has been a growing feeling that the CAC regime is not the right tool for the future.<sup>104</sup> To tackle more vexing problems such as climate change and biodiversity, a more integrated approach is required. The role of non-governmental organizations, the interdependence of the global economy, pollution from diffuse and non-point sources, incentives for industry to "green" itself, and questions of equity and environmental justice must be taken into account.<sup>105</sup>

Environmental problems do not respect international boundaries. International regimes include international policy, regulatory, and administrative systems, and often fall in the category of "soft law."<sup>106</sup> The array of extant regimes contrast international environmental regimes with the CAC approach of U.S. environmental law. For example, the Stockholm Convention on Persistent Organic Pollutants (POPs) is the only chemicals treaty that includes binding global controls on the production, use, emissions, of specific toxic chemicals, such as dioxins, DDT and polychlorinated bi-phenyls (PCBs). This is as one of the success stories of global environmental regime development with 160 parties to the agreement. It has also been successful in dealing with the thorny issues of developed versus developing states and financial compensation, and creating a mechanism for adding additional chemicals to the list.<sup>107</sup>

The biggest challenge to environmental regulation is developing the political will necessary to support legislation. Ideally, global regimes would also result in regulatory action in participating states for consistency. However, individual states still pursue issues based on sovereignty, and are loathe to submit themselves to external enforcement of international environmental regimes.<sup>108</sup> Future regulation will also have to deal with the challenges of environmental justice. This will entail environmental equity globally. Executive Order 12898 attempts to integrate environmental justice and environmental regulation, but integration remains a challenge.<sup>109</sup> Globally, environmental equity will have to reconcile the differing interests of the developed and developing world, within the context of an interconnected, globalized economy. The most fragile and impoverished populations of the world are most vulnerable to the effects of climate change.

Environmental regulation has come a long way in the past half century, and it has a successful legacy of which regulators and legislators can be justifiably proud. However, the challenges ahead are too formidable for the old model of CAC and state-centered solutions. On a national level, both the economy and the environment could be better served by innovative policy that promotes more integrated and collaborative solutions, more self-enforcing incentives, and more robust, yet more consistent, environmental performance standards.<sup>110</sup> This could be achieved with a reflexive law approach that will induce to people and institutions to continually assess their actions and adjust them to society's goals.<sup>111</sup> Internationally, there is a need to move away from the state-centered problems of sovereignty. A social-political governance approach, in which governments act in a communicative and collaborative way with both public and private actors, will encourage a dynamic problem solving environment that delivers solutions to challenges with measurable results.<sup>112</sup>



## Science, Interest Groups, Politics, Public Opinion

The policy debate is framed around several intersecting dynamics: science, interest groups, political responsiveness, and public opinion. From the scientific community there is nearly unanimous agreement about the nature and causes of climate change.<sup>113</sup> However, as policies to deal with greenhouse gases were being considered, fossil fuel associated industries and proponents of free market growth began a campaign to counter science, raise arguments against “big government”, establish uncertainty in the minds of the public, and forestall legislation.<sup>114</sup> These efforts were amplified during the 2008-2009 economic downturn and public support for action declined as other concerns such as job growth became increasingly paramount.<sup>115</sup> However, the implications of climate change are also being depicted as growing strategic national security risk rather than simply an environmental problem.<sup>116</sup>

*Scientific Perspective* - Among nearly 1,400 climate scientists, a 2010 survey by the American Academy of Science found that a “striking consensus” had emerged, with 97 percent agreeing that global warming is occurring and that human activity is the likely cause. The world’s largest general-scientific society, the American Association for the Advancement of Science, states: “The scientific evidence is clear: Global climate change caused by human activities is occurring now, and it is a growing threat to society”<sup>117</sup> Similar statements have been made by the international science community. Not a single scientific body of international or national standing has dissented from this opinion.<sup>118</sup>

*Interest Group Activities* - The scientific evidence regarding global warming began to gain focused attention from policy makers and global leaders, resulting in the 1997 adoption of the Kyoto Protocol. Kyoto and subsequent carbon reduction and clean energy initiatives such as tax credits were backed by environmentalist groups like the Environmental Defense Fund, the Union of Concerned Scientists, World Wildlife Fund, Sierra Club, as well as proponents of incentives for developing renewable energy systems including wind, solar, electric vehicles, and electrical grid scale battery storage technology. The potential growth of non-carbon initiatives pushed lobbying by clean energy advocates up significantly over the last decade, as total expenditures rose twelve-fold, to over \$55 million by 2009.<sup>119</sup>

However, the efforts of NGO’s were dwarfed in terms of total spending and sophistication by lobbying efforts from industry. For example, the fossil fuel and mining industry spent \$175 million over the same period.<sup>120</sup> Meanwhile, in order to counter proposed carbon emission controls such as those established under the Kyoto framework, the petroleum lobby sought to attack the underlying science of climate change.

*Political Dimension* - The effort by industry interest groups to shape the political debate on climate change has fed into the increasing partisanship in Washington - with Republicans, who have benefited from 75 percent of the \$284 million in political contributions from the oil-and-gas industry between 1998 and 2010,<sup>121</sup> moving to slow or block action. President Bush, with input from Exxon and allied corporations,<sup>122</sup> rejected the Kyoto treaty in 2001, citing it as unfair to developed nations like the United States and contending that the treaty would have cost nearly \$400 billion and almost 5 million American jobs.<sup>123</sup> Although President Bush admitted that global warming was a growing concern, he expressed ambivalence about specifics of the science.<sup>124</sup> However, by 2010 the landscape for Republicans had shifted even further toward inaction and in some cases passionate hostility toward of climate change initiatives.



*Public Opinion* - Extensive polling data about global warming reveal a number of trends and partisan differences among the public. Among the findings: 1) global warming is viewed as a relatively low priority issue by Americans (ranking last in the Pew survey of policy priorities);<sup>125</sup> 2) the effort to create doubt about the scientific consensus on climate change appears to have been effective, particularly among Tea Party adherents; 3) attitudes on climate change are split along party lines, and 4) there is a gap between mainstream Republicans and Tea Party voters. The industry-backed push to undercut the science of global warming has created confusion about the scientific consensus on climate change.<sup>126</sup> Public recognition of the evidence of global warming is rebounding from lows in 2009 across all party affiliations, but the difference between Democrats and Republicans is nearly 40 points.<sup>127</sup>

*Policy Implications* - The national response to climate change has become caught up in the partisan gridlock that now dominates the political process. Special interests have attempted to shape the debate, with environmentalists and clean energy proponents pushing for aggressive action, while fossil fuel companies and allied free enterprise supporters seek to slow steps they fear will harm their near term financial interests, cost jobs, and slow the economy. America's standard of living, and the basis for much of its economic growth, has been predicated on abundant use of carbon-based energy and dealing with global warming threatens some of the fundamental assumptions of capitalism.<sup>128</sup> Furthermore, because the issue does not represent an immediate crisis, and the solution to the problem is neither certain nor quick and will require global support, it is difficult to galvanize the public or national leaders to take difficult steps to address the problem.

## **Conclusion**

Environmental degradation adversely affects all countries and is exacerbated by population growth and increasing urbanization. Related phenomena such as climate change, water scarcity, air pollution, and deforestation could result in significant geopolitical security implications, affecting individuals, nations and the international community.

Attempts to regulate human interaction with the environment in the United States have achieved some success, but further efforts are hobbled out of fear of burdening the economy. The developing world, seeking to promote economic development is lagging in environmental protection. As the global effects of degradation are a universal problem, the world would benefit from durable and enforceable international legal regimes. The existing international regulatory framework does not adequately address the jurisdictional issues that prevent successful environmental protection integration.

Achieving the goal of environmental security is burdened with complexity that derives from environmental and economic inequity, sovereignty concerns, economic development, and a lack of common understanding of the nature and even reality of the threat of environmental degradation. Other priorities in the international arena as well as the lack of an international government mean that sustainability solutions will require a critical mass of motivated parties.

Industry depends on predictability to develop strategic plans that support growth and expansion of operations. Public and corporate commitment to environmental sustainability help derive revenues and profits which allow investment in research and larger scale production that lowers costs. Additionally, some sectors of this relatively new industry, still in a fledgling stage, are somewhat dependent on regulation to increase and maintain demand for products and services.





And several sectors of the environment industry depend on incentives and tax credits to encourage consumption until product demand is well established and perceived as affordable.

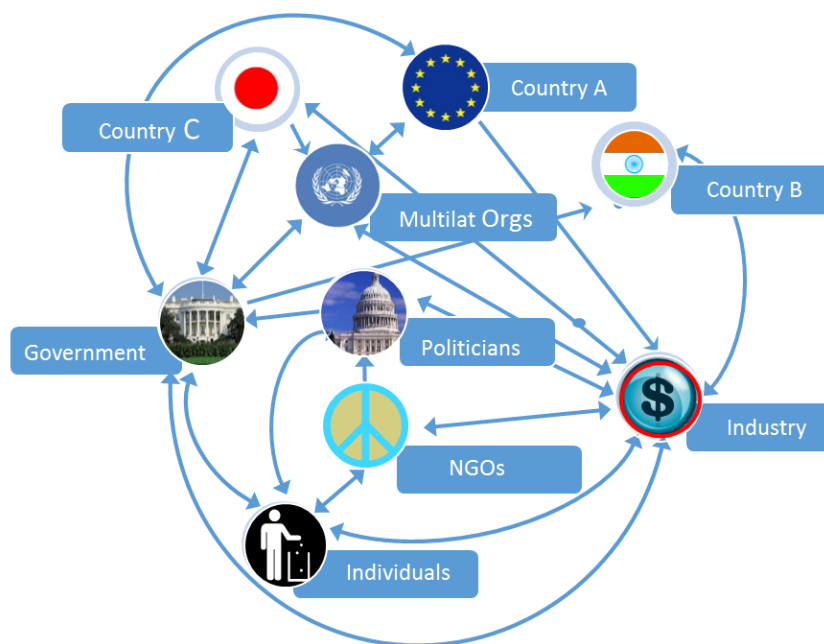
The link between the environment and national security is also seen in DoD's preparation and capability to mobilize some sectors of the industry to address environmental disasters. As disasters such as oil spills and chemical discharges threaten the nation's ability to protect its citizens, DoD should continue to work with the environment industry to develop equipment and processes to respond to such threats.

The United States may not completely tame the complexity of the environmental triangle of government, industry and individuals to the extent necessary to marshal the political will to achieve environmental sustainability. However, the USG should organize most government environmental regulatory and management efforts under one cabinet-level agency. This agency should also support the environmental industry and technology development, seeking public/private partnerships. Within the national security structure, the USG should hire and train professionals in environmental management and crisis support operations.

However, the United States should continue to work within international fora such as the UN to cooperate with other major economies to develop equitable and realistic combatting environmental degradation. The United States should ratify the UN Convention on the Law of the Sea and embrace further international efforts. Recognizing the inequity that developing countries face in environmental sustainability, the United States should cooperate with developed nations to incentivize and assist development of all nations in their environmental efforts.



## Annexes



### Annex 1 - The Interaction of Stakeholders on Environmental Protection<sup>129</sup>

Ideally, when individuals and their interest groups, and businesses demand a sustainable approach to economic development they work with their politicians and or buy products from industry. Politicians create legislation that governments enforce, also creating a demand for products and services. Because the threat is transnational, each government conducts bilateral and multilateral environmental and economic diplomacy and engages in a broad array of fora in an attempt to take a more holistic approach to protecting the environment. Ultimately, industry lies at the center of all interactions, responding to demand from individuals, businesses and governments. The environment industry, like all other industries, is at once a client and a regulated entity that must produce its products and services while also conforming to environmental regulations in production that also create demand for their products. However, it is unlike most other industries due to the fact that the ultimate effects and uses of some of the environment industry's products and services remain in dispute in public fora. The phenomenon of the threat of climate change is increasingly better understood and accepted by scientists. However, the application of products and services to reverse, slow or stop that trend suffers from a causality controversy and debate, sometimes as fierce as any political dialectic.

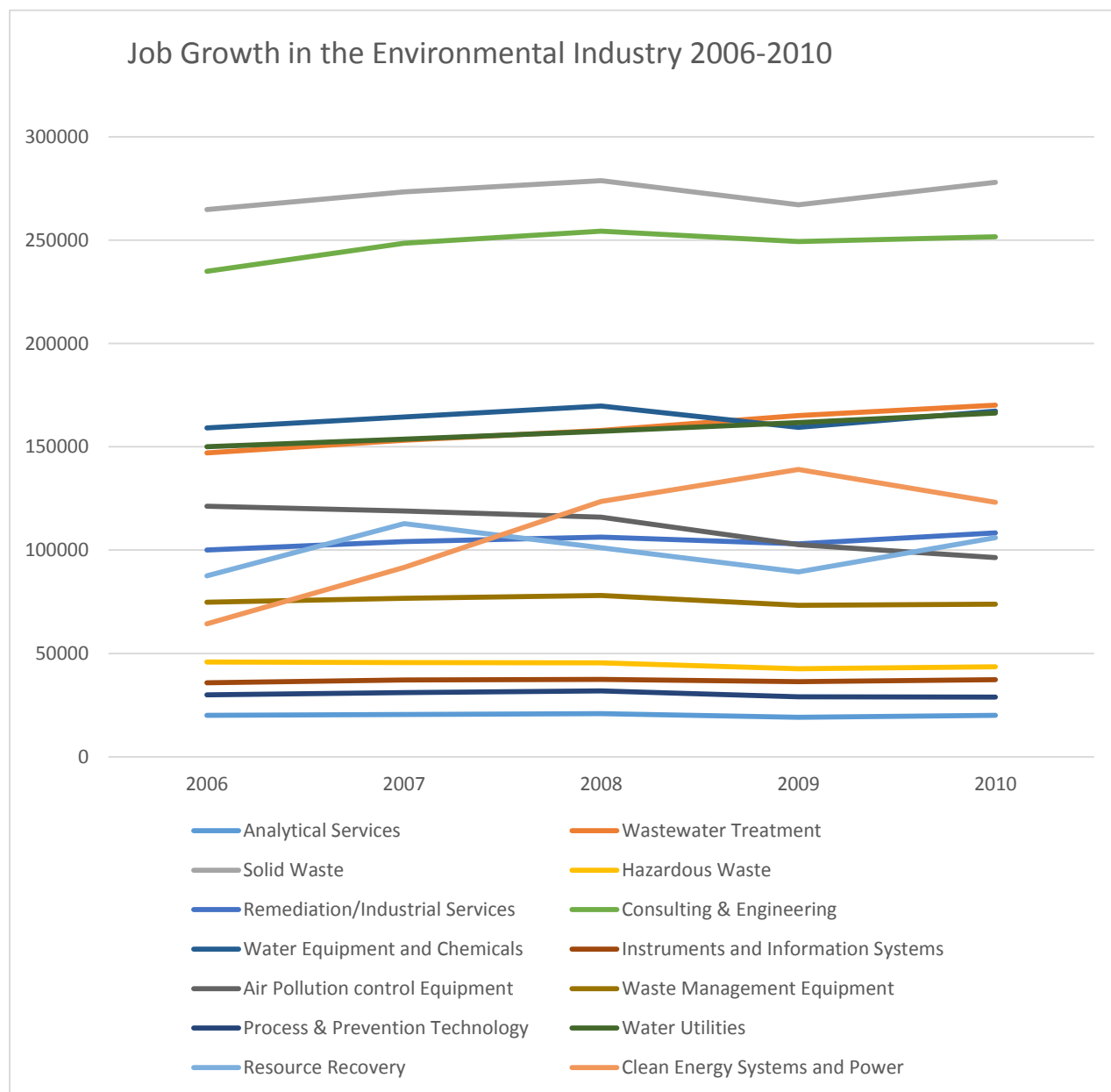


Segment	Description	Examples of Clients
<b>Environmental Services</b>		
Environmental Testing & Analytical Services	Provide testing of "environmental samples"	Regulated industries, Government, Environmental consultants Hazardous waste and remediation contractors
Wastewater Treatment Works	Collection and treatment of residential, commercial and industrial wastewaters	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.	Chemical companies, Petroleum companies, Government agencies
Remediation/Industrial Services	Physical cleanup of contaminated sites.	Government agencies, Property owners, Industry
Environmental Consulting & Engineering (C&E)	Engineering, consulting, design, assessment, permitting etc.	Industry, Government Municipalities, Waste Mgmt. companies, POTWs
<b>Environmental Equipment</b>		
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	Analytical services, Government, regulated companies
Air Pollution Control Equipment	Produce equipment and tech. to control air pollution.	Utilities, Waste-to-energy Industries, Auto industry
Waste Management Equipment	Equipment for handling, storing or transporting solid, liquid or hazardous waste.	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
<b>Environmental Resources</b>		
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
Environmental Energy Sources	Selling power and systems in solar, wind, geothermal, small scale hydro, energy efficiency and DSM	Utilities, All industries and consumers

## Annex 2. Complete Description of Industry Sectors

### EBI 2020B Report

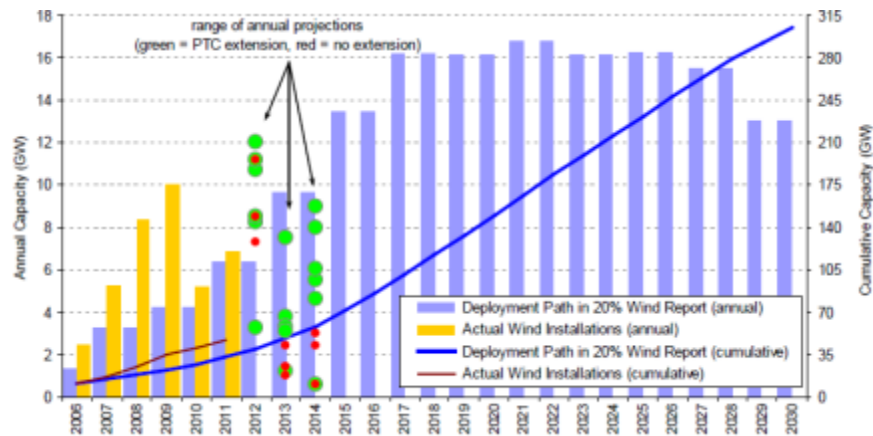




### Annex 3 - Job Growth in the Environmental Industry 2006-2010

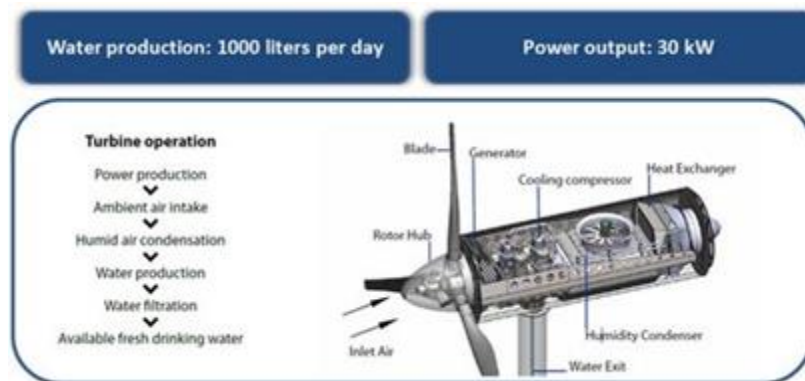
EBI 2020B Report p 33.





#### Annex 4 - The Future of Wind Power

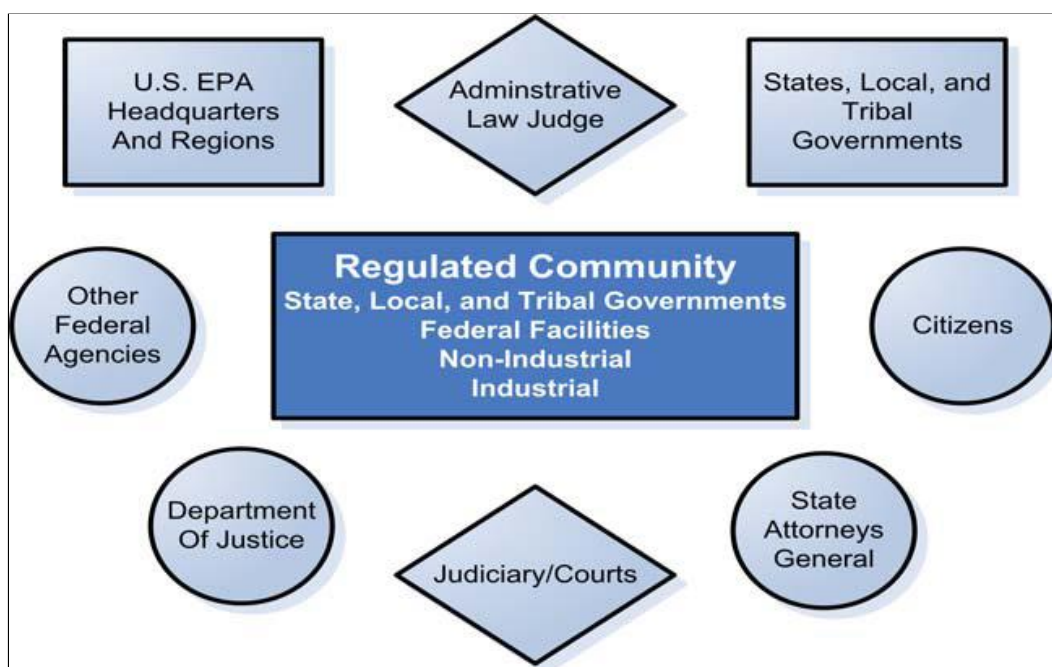
Ryan Wiser and Mark Bolinger, “2011 Wind Technologies Market Report”, *Energy Efficiency and Renewable Energy* (n.p.: U.S. Department of Energy, 2012), 71.



#### Annex 5 – Wind Powered Water Desalination

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### Annex 6 - Key Players in Enforcement of Pollution Control Laws

**Source:** Diagram prepared by the Congressional Research Service (CRS).<sup>130</sup>



## ENDNOTES

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<sup>23</sup> Environmental Business International, Inc., “Report 2020B: The U.S. Environmental Industry Overview, An Executive Review.” Environmental Business International, (2012): 14.

<sup>24</sup> Ibid., 14.

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<sup>72</sup> Ibid.

<sup>73</sup> Robert Eccles, Ioannis Ioannou, and George Serafeim, "Is Sustainability the Key to Corporate Success?" January 6, 2012, *Guardian Home Page*, <http://www.guardian.co.uk/sustainable-business/sustainability-key-corporate-success>.

Because these gentlemen's reputations and locations of employment appear to be impeccable and their claims are so strong regarding sustainability, I am taking a large portion here to further expound on their study methodology within the article, which is important in understanding the support behind their study results and subsequent claims. There are two key areas broken down below: first, their delineation of what distinguishes high versus low sustainability companies, and second, the four main traits they see in high sustainability companies. (Note every word in the remainder of this reference is directly quoted from their article) 1. High versus low-sustainability companies: In their words, "we compared a matched sample of 180 US-based companies, 90 of which we classify as high-sustainability and another 90 as low-sustainability. Our classification was based on the adoption of environmental, social, and governance (ESG) policies in the 1990s that reinforced a cultural commitment to sustainability. Examples of environmental policies included carbon emissions reduction policies, green supply-chain policies and energy and water-efficiency strategies. Social policies included diversity and equal-opportunity targets, work-life balance, health and safety improvement, and favouring internal promotion. Policies related to community included corporate citizenship commitments, business ethics, and human-rights criteria. Finally, other policies we



accounted for related to customers, product risk and customer health and safety. The high-sustainability companies had adopted an average of 40% of these policies early on, while their counterparts had adopted only 10%. We selected these two sets of companies to be identical in terms of financial performance in the early 1990s, in order to examine the long-term performance effects of a culture of sustainability. We found that high-sustainability organisations were characterised by a governance structure that explicitly and directly took into account the environmental and social performance of the company, in addition to financial performance.”<sup>72</sup> High Sustainability company traits: “First, they were significantly more likely to assign responsibility to the board of directors for sustainability and to form a separate board committee for sustainability. They were also more likely to make executive compensation a function of environmental, social, and external perception (e.g. customer satisfaction) metrics. Secondly, we found that high-sustainability companies paid particular attention to their relationships with stakeholders – such as employees, customers and NGOs representing civil society – through active processes of engagement. This begins with reaching agreement with stakeholders on how the process should be conducted, continues through the management of the process itself and ends with providing feedback to the board obtained from stakeholders, and reporting the results of the process to stakeholders and the public in general. Thirdly, high-sustainability companies are more likely to measure and report on environmental and social metrics in addition to their financial results. Fourth, their external communications are also more long-term oriented. Not surprisingly, the high-sustainability organisations have more long-term investors – every company’s desire – than their low-sustainability counterparts.”

<sup>74</sup> Al Bredenberg, “High-Sustainability Companies Perform Better Over The Long Haul,” May 1, 2012, *ThomasNet.com Home Page*, [http://news.thomasnet.com/green\\_clean/2012/05/01/do-high-sustainability-companies-perform-better/](http://news.thomasnet.com/green_clean/2012/05/01/do-high-sustainability-companies-perform-better/) (accessed April 15, 2013).

<sup>75</sup> John Davies et al., “State of the Profession 2013,” January 7, 2013, <http://www.greenbiz.com/research/report/2013/01/07/state-profession-2013>.

<sup>76</sup> Ibid., 3.

<sup>77</sup> Ibid.

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<sup>79</sup> Knut Haanaes et al. “Sustainability Nears a Tipping Point,” *MIT Sloan Management Review Research Report Winter 2012* <http://www.sustainabilityprofessionals.org/system/files/MIT-SMR-BCG-Sustainability-Nears-a-Tipping-Point-Winter-2012.pdf>.

<sup>73</sup> Ibid.

<sup>81</sup> Ibid. Haanaes et al. provided a very interesting graphic in their research that shows which industries are most focused on sustainability. Not surprisingly, perhaps, the most resource-intensive areas (which for the purposes of those of us in the environmental study include many of the companies and interests we’ve researched and/or visited) have placed the most focus on sustainable practices.

<sup>82</sup> Adil Najam, “Global Environmental Governance, A Reform Agenda,” International Institute for Sustainable Development, Denmark, (2006) 3.

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<sup>96</sup> USBR, “Quick Reference-”

<sup>97</sup> Barth, “The United States Government Manual 2012,” 270.

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<sup>99</sup> Richard Andrews. "The EPA at 40: An Historical Perspective," *Duke Environmental Law & Policy Forum*, 21 (2010), p 223.

<sup>100</sup> Ibid. p 223.

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<sup>106</sup> Pamela S. Chasek, David L. Downie, and Janet Welsh Brown, p 19.

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<sup>127</sup> Pew Research, “Climate Change: Key Data Points from Pew Research.”

<sup>128</sup> Naomi Klein, “Capitalism vs. the Climate”, *The Nation*, 9 November 2011, lays out the larger implications of dealing with global warming and the threat such actions may pose to the fundamental assumptions that have driven capitalist and free market decision-making for generations. <http://www.thenation.com>, (accessed 18 April 2013).

<sup>129</sup> Design and graphics by author. The illustration shows how dependencies and influence move between stakeholders on environmental issues. Ultimately, industry and governments lie at the center of the most interaction, requiring a more sophisticated and robust approach than before.

<sup>130</sup> Robert Esworthy, “Federal Pollution Control Laws: “How Are They Enforced?””, *Congressional Research Service*, RL34384 (2012):1. <http://www.fas.org/sgp/crs/misc/RL34384.pdf>.

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