

## Entry #1: The Ecosystem

Today, the Chesapeake Bay includes 11,000 miles of shore and expands over 200 miles.<sup>1</sup> The Bay is more than 10,000 years old. It has always been a dynamic ecosystem in constant flux. However, since the industrial revolution human impacts have changed the bay significantly.<sup>2</sup> With humans hastening climate change, the Bay could be gone by 2050. The bay's shallow depth creates more wind and temperature problems that are a result of global warming, which has increased through the years, along with minerals, nutrients, and sediments.<sup>3</sup>

According to the book *Chesapeake Bay Blues*, an estuary can be interpreted as a "semiclosed coastal body of water that has a measurable salinity gradient from its freshwater drain to its ocean entrance."<sup>4</sup> The ecosystem of the Chesapeake Bay is a complex algorithm including the watershed which consists of freshwater mixing with the ocean to create an estuary. The Bay has become an important renewable resource, full of fresh seafood, as well as utilization for commercial use on various East coast ports and the overwhelming human population among the watershed threatens this thriving ecosystem. Maryland and the District of Columbia are the major "Regions of Concern" in the Bay's ecosystem, which is a cause for alarm with pollution of chemical substances and a loss of biodiversity, making possible solutions seem even farther away.<sup>5</sup> The ecosystem accumulates water from the Atlantic Ocean and its own watershed of approximately 64,000 miles.<sup>2</sup> The Bay is shallow due to human interference specifically it covers one-tenth that of the average bay.<sup>6</sup>

Overall, all of this land results in a significant large Bay with dollars of economic progress and production of life, as long as people do not stand in the way of nature's course. The watershed can be described as a group of interconnected parts working to keep the peace.<sup>7</sup> So-called resilience will result when an estuary declines too much. For example, when marshes are filled with water, energy is lost while trying to increase the production of an estuary.<sup>8</sup> The ecosystem of the Bay is influenced by the Susquehanna River, along with the saltwater zones flowing differently depending on specific depths moving into the Atlantic. The overall health of the Bay is documented in the *State of the Bay* report as it assists in measuring thirteen sections on a 100 point scale, manipulating factors to determine natural life supporting potential.<sup>9</sup> In years to come, this estuary will shrink due to human effect, while the water will still permeates the Bay, its volume will decay and spread to more deposits in the earth.<sup>10</sup>

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<sup>1</sup> Tom Horton, *Turning the Tide: Saving the Chesapeake Bay* (Washington, DC: Island Press, 2003), 11.

<sup>2</sup> Ibid.

<sup>3</sup> *Chesapeake Bay: introduction to an ecosystem*. (Annapolis: Printed by the U.S. Environmental Protection Agency for the Chesapeake Bay Program, 2012), 5.

<sup>4</sup> Howard R. Ernest, *Chesapeake Bay Blues*. (Lanham: Rowman & Littlefield, 2003), 10.

<sup>5</sup> *Chesapeake Bay*, 3.

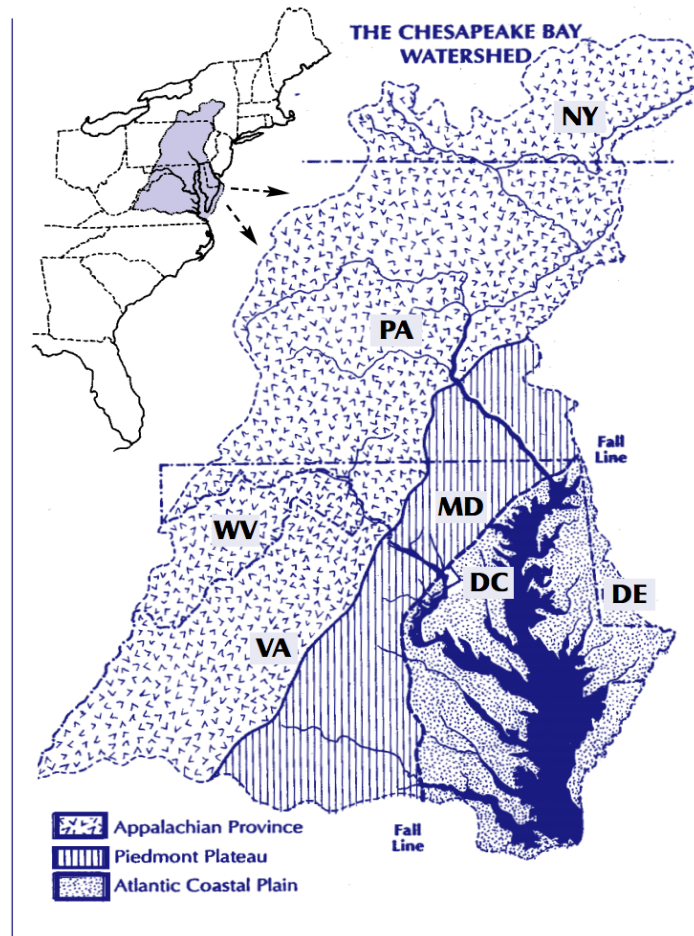
<sup>6</sup> Horton, 4.

<sup>7</sup> Horton, 31.

<sup>8</sup> Horton, 32.

<sup>9</sup> Ernest, 26.

<sup>10</sup> Horton, 11-12

Figure 1: Chesapeake Bay Watershed<sup>11</sup>

The watershed of the Bay as demonstrated by Figure 1 is the “total land area that contributes drainage to a water body” which contains “physical ecological units” that tend to be “self-contained”, can be measured through mitigation, and where water is tested.<sup>12</sup> It encapsulates the District of Columbia and six states: Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia, dealing with types of land masses.<sup>13</sup>

<sup>11</sup> *Chesapeake Bay*, 6.

<sup>12</sup> Basic Ecology Lecture, September 23 2015.

<sup>13</sup> *Ibid.*

## Entry #2: Water Quality

The Chesapeake Bay has multiple water runoff issues that adversely affect the water quality. Due to the urbanization and suburbanization of communities, pollutants flow off of streets, gutters, houses, roads, and farms into local streams that flow to the Bay creating a major source of point source pollution.<sup>14</sup> Although abiotic organisms need the nutrients of phosphorus and nitrogen, they continue to be bad for water quality and when the land layout changes, these nutrients increase.<sup>15</sup> Pollutants from power and industrial plants, cars and other transportation, animal fertilizer, pesticides, oil and other fluids soak into the ground of the Bay. While point source plant emissions have decreased, most air contaminants continue to be unregulated.<sup>16</sup>

A main pollution source is the sewage treatment plants because septic systems that serve communities are separated from town sewer system lines. These sewage issues could lead to runoff from storm water. Where natural forestry is not available, fake habitats such as artificial ponds are created.<sup>17</sup> Farmers have tried to control their fertilizer runoff, but runoff persists. The Chesapeake's sediment has recently been a target for decreasing runoff, but this position has not yielded any results and will likely take years to notice.<sup>18</sup> For example, the reduction of nitrogen to 15% took fifteen years because no "trends in nutrient loads" were present.<sup>19</sup> In 1996, a study was conducted for pollution of phosphorus and nitrogen sources in the Bay. The results stated that for point source, 25% was phosphorus and 22% was nitrogen, for nonpoint source, 66% and 57%, and for atmospheric 9% and 21%.<sup>20</sup> The majority, nonpoint source is the result of excessive fertilizer runoff that the farmers are unable to control. Hopefully, controlling pollutants and fixing the poor water quality can be addressed by regulating the point and nonpoint sources amount of nutrient and sediment.<sup>21</sup>

Monitoring the water quality and regulating pollutants, needs to be a top priority and the Total Maximum Daily Load must be enforced. This TMDL principle identifies nonpoint or point sources, setting pollution limits per area to lead to a decrease of phosphorus, nitrogen, and sediment pollution.<sup>22</sup> "If level of pollutants entering a body of water exceeded the maximum allowed, regulatory actions would be taken to address the sources", only if this issue is not forgotten can it work and if it works, the implementation process will be long, even if the EPA is involved.<sup>23</sup> The "fish-eye" view calculates the current pollution, and how much the Chesapeake can sustain and be considered healthy.<sup>24</sup>

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<sup>14</sup> Scott W. Phillips, *Synthesis of U.S. Geological Survey Science for the Chesapeake Bay Ecosystem and Implications for Environmental Management* (Reston, VA: U.S. Geological Survey, 2007), 10.

<sup>15</sup> *Chesapeake Bay Foundation* (2015). "Nitrogen & Phosphorus," <http://www.cbf.org/about-the-bay/issues/dead-zones/nitrogen-phosphorus>.

<sup>16</sup> Horton, 38.

<sup>17</sup> Horton, 39.

<sup>18</sup> Ibid.

<sup>19</sup> Ernest, 53.

<sup>20</sup> Ernest, 55.

<sup>21</sup> Ernest, 98.

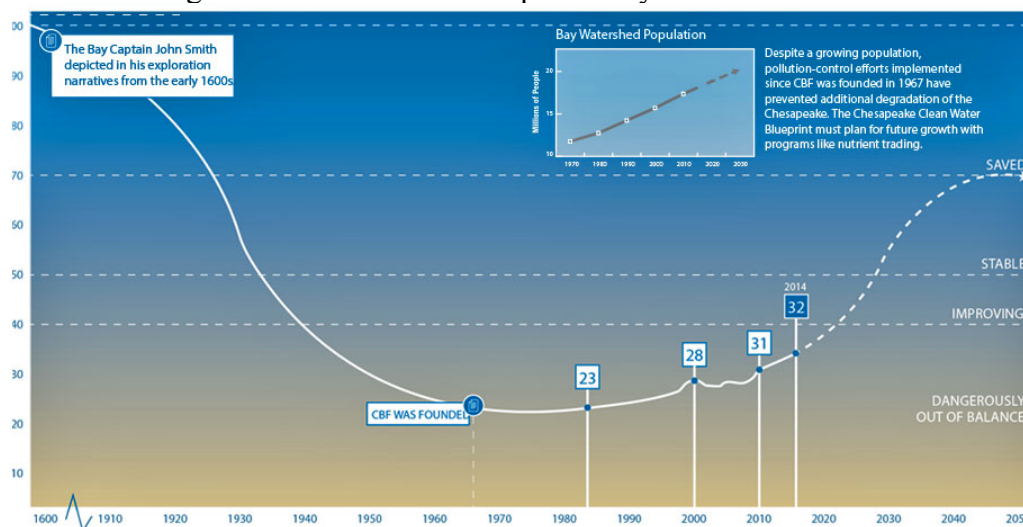
<sup>22</sup> Ernest, 132-133.

<sup>23</sup> Ibid.

<sup>24</sup> Horton, 39-40.

The water quality is so bad, according to Captain John Smith's narrative from the 1600's in Figure 2, that the Bay may be on the verge of ceasing to function in its most basic capacity.<sup>25</sup> The Chesapeake might not be able to provide a place for people to swim and recreate; the Bay as a source of seafood and underwater grasses for crabs specifically, and its utilization as a system to support tourism and regional pride might be lost forever.<sup>26</sup> "All functions could be lost to next generation."<sup>27</sup> Dead zones, areas with very little or no oxygen are hurting and killing aquatic life forms; while too much oxygen, creates algae blooms where the sun cannot reach the grasses that provide food and fuel to these species.<sup>28</sup> Another negative aspect of the bay is the process of eutrophication which enriches nutrients, causes the create of algae blooms, and decreases the BOD does not aide in the cleaning up the pollution of the bay or in assisting wastewater treatment centers.

Figure 2: Timeline of Chesapeake Bay's Health Index<sup>29</sup>



Source: <http://www.cbf.org/image/area---news-and-media/2014-sotb/history-graph.jpg>

A main issue with water quality will continue to be the public and federal government's loss of interest in cleaning the Bay, in regards to the lack of political will.<sup>30</sup> While science investments have explained how to clean the Bay, our country has determined that we can afford the expense, but we just do not want to pay for it.<sup>31</sup> After the 1970's, water quality movements inherently stopped after President Nixon had the EPA sue polluters and banned DDT.<sup>32</sup> Wastewater treatment utilizes the process of nitrification which oxidizes ammonia to

<sup>25</sup> *PBS Frontline* (2009). "Chapter 1: Imperiled Chesapeake Bay," <http://www.pbs.org/wgbh/pages/frontline/poisonedwaters/view/>.

<sup>26</sup> *Ibid.*

<sup>27</sup> *Ibid.*

<sup>28</sup> *Chesapeake Bay Foundation* (2015).

<sup>29</sup> *Chesapeake Bay Foundation* (2014). "2014 State of the Bay Report,"

<http://www.cbf.org/image/area---news-and-media/2014-sotb/history-graph.jpg>.

<sup>30</sup> *PBS Frontline* (2009).

<sup>31</sup> *Ibid.*

<sup>32</sup> *Ibid.*

nitrate, where nitrite is formed in response, as technology to remove the nitrogen from the Bay.<sup>33</sup> Wastewater treatment does not solve the issue of water pollution, simply because it is impossible to remove all toxic chemicals from nonpoint sources, such as human waste product. Since piping and treatment systems are getting older and only using primary treatment, people are getting sicker from these toxic chemicals.<sup>34</sup>

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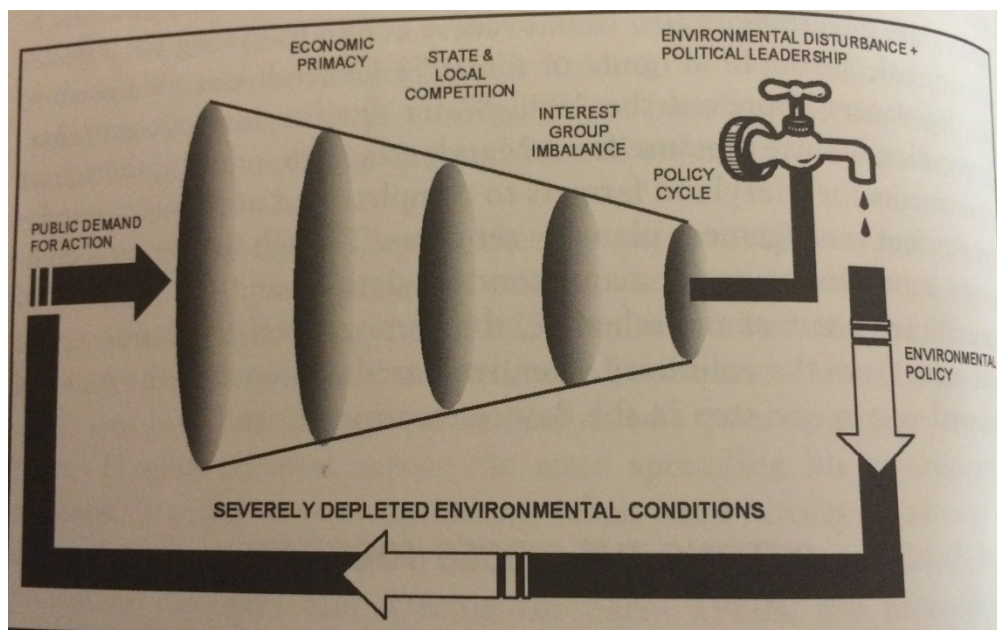
<sup>33</sup> *Chesapeake Bay*, 32.

<sup>34</sup> Richard T. Wright and Dorothy F. Boorse, *Environmental Science Toward a Sustainable Future* (Boston: Pearson, 2014), 520.

## Entry #3: Economy of the Chesapeake Bay

Howard Ernest has observed that, “to restore the environmental health of the Bay while managing a regional economy that is larger and more dynamic than many European countries. Economic factors [always] take precedent”, over environmental factors.<sup>35</sup> Public concern goes through a complex political process, as Figure 3 below shows. Although, political connections can be made to assist the process of improving the Bay, little environmental goals are met due to empty promises. Deteriorated environmental conditions result in the public demand to take action which creates improved environmental policy through political leadership.<sup>36</sup>

Figure 3: Framework for Environmental Policy in relation to the Bay Economy by Christine Jamison<sup>37</sup>



The agricultural industry, remains important for the Chesapeake Bay, which has the power to resist regulation. As it stands, the EPA estimated that over 300 millions dollars are needed to create nonpoint sources nutrient pollution controls for the Bay and that for the average farmer to adopt these environmentally important standards could eat at their profit.<sup>38</sup>

The Chesapeake Bay’s crab industries generates \$30 million per year.<sup>39</sup> Because regulation of crab distribution is not equal, commercial crabbing has become the heart of the crab management industry, as well as crab meat processing plants.<sup>40</sup> Jobs are lost simply because of

<sup>35</sup> Ernest, 37-38.

<sup>36</sup> Ernest, 48.

<sup>37</sup> Ibid.

<sup>38</sup> Ernest, 80.

<sup>39</sup> Ernest, 91.

<sup>40</sup> Ernest, 115.



the high demand in regulation of the size and type of the harvested crabs, creating political strife among the Bay states.<sup>41</sup>

In order to control the Chesapeake Bay economy and its politics, society needs to follow Howard Ernest's ten-point approach to be economically successful in the future. This approach includes<sup>42</sup>:

1. A Bistate Approach to Managing the Bay's Living Resources
2. Controlling Pollutants: Welcoming the TMDL Approach
3. Expanding the Role of the Chesapeake Bay Commission
4. Expanding the Central Role of Water Quality Monitoring
5. Taking the Initiative: Circumventing the "Normal" Political Process
6. Advocate or Abdicate: Reinvigorating the Bay's Interest Group Community
7. Making the Most of Disturbances
8. From Dollars to Percents: Rethinking the Cost of Environmental Restoration
9. Keeping the Bar High: Protecting Natural Processes and Native Resources
10. A Legal Strategy for the Bay: The Role of the Judicial System

These approaches will be discussed thoroughly in these entries. In regards to this ten-point promise, society knows that it is affordable to fix the Bay, but it is only economically friendly when environmental complications are at their poorest. There are also other motives to refurbishing the Bay. Tourism makes certain that the Chesapeake is of immense economic value, as well as a vital necessity to job growth and protection of the lives of the millions of people who visit this massive bay every year.<sup>43</sup> Statistics show that \$2 billion and 32,000 jobs per year are created just for Maryland's recreational boating business.<sup>44</sup> While according to the EPA, people take 900 million trips to U.S. coastal areas each year and spend billion of dollars; wildlife experts spend similar money on trips to the Bay states, as well as to support their wildlife gear, resulting in ecotourism.<sup>45</sup> *The Baltimore Sun* uses reasonable insight to explain that investing in our ecosystems is investing in future tourism; if the Bay will not be cleaned up to better its health at least clean it up to better our economy.<sup>46</sup> The deterioration of the Bay must be reversed to restore health and resilience to bring this ecosystem into balance.

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<sup>41</sup> Ernest, 116.

<sup>42</sup> Ernest, 130-143

<sup>43</sup> *Chesapeake Bay Foundation* (2015). "The Economic Importance of the Bay," <http://www.cbf.org/about-the-bay/issues/cost-of-clean-water/economic-importance-of-the-bay>.

<sup>44</sup> *Ibid.*

<sup>45</sup> *Chesapeake Bay Foundation* (2015). "The Economic Argument for Cleaning Up the Chesapeake Bay and its Rivers," <http://www.cbf.org/document.doc?id=591>.

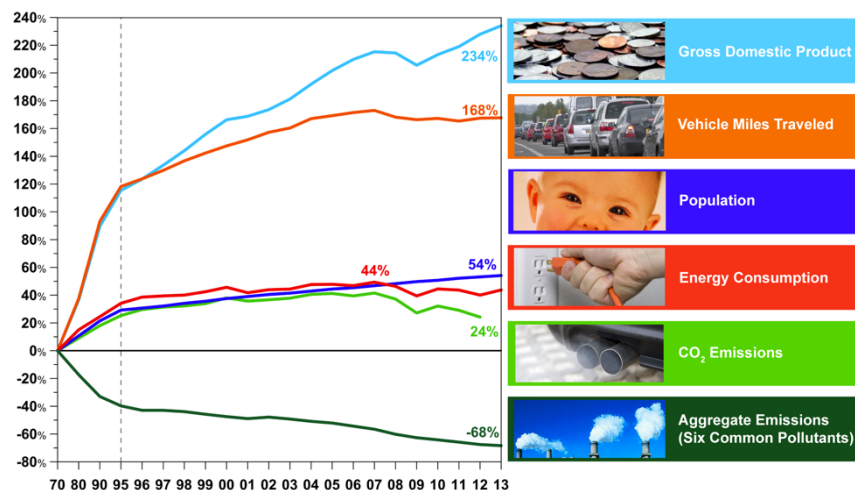
<sup>46</sup> *Baltimore Sun* (2010). "Will tourism industry clean up if environment can't?" [http://articles.baltimoresun.com/2010-08-09/news/bs-ed-bay-tourism-20100809\\_1\\_virginia-tourism-fishing-guides-clean-environment](http://articles.baltimoresun.com/2010-08-09/news/bs-ed-bay-tourism-20100809_1_virginia-tourism-fishing-guides-clean-environment).

## Entry #4: Governance

There are numerous regulations and environmental laws that govern the Chesapeake Bay. The Clean Water Act of 1972 deals with the prevention of point and non-point source pollution, setting technology and water quality standards known as the Total Maximum Daily Load (TMDL).<sup>47</sup> In addition to this federal law, the Clean Air Act of 1970, the Comprehensive Emergency Response, Compensation and Liability Act (CERCLA) of 1980, the Chesapeake Bay Preservation Act of 1988, the 1983, 1987, and 2000 Chesapeake Bay Agreement, the National Environmental Act Policy Act (NEPA) of 1970, and other local legislation regarding the Chesapeake Bay, strive to support, govern, and manage the bay to ensure ‘long-term results’.<sup>48</sup>

The 1970 Clean Air Act includes air quality and performance standards, a cap and trade system, and citizen law suits. These air standards set by the National Ambient Air Quality Standards government organization target reducing the rates of carbon monoxide, lead, nitrogen oxides, ozone, particulate matter, and sulfur dioxide with each state classifying where this reduction has been successful and unsuccessful.<sup>49</sup> As Figure 4 shows, the goals put forth in this act have been extremely successful in pollution decline of these six chemical compound emissions.<sup>50</sup>

Figure 4: Comparison of Growth Areas and Emissions from 1970 to 2013



Source: [http://www3.epa.gov/airtrends/images/y70\\_14.png](http://www3.epa.gov/airtrends/images/y70_14.png)

The performance standards show the pollutant emissions over time and how technology has assisted in reducing these emissions based on the category, type, location, and if it is new or inexistence.

<sup>47</sup> Environmental Law Lecture, November 18, 2015.

<sup>48</sup> Ibid.

<sup>49</sup> Ibid.

<sup>50</sup> U.S. Environmental Protection Agency (2015). “Overview of the Clean Air Act and Air Pollution,” [http://www3.epa.gov/airtrends/images/y70\\_14.png](http://www3.epa.gov/airtrends/images/y70_14.png).



An excerpt from the Clean Air Act states that its' purpose is to<sup>51</sup>:

(1) to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population.

The CERCLA's goal is to clean up hazardous chemical waste and dispose of it properly utilizing retroactive and joint liability standards instead of regulation where people are liable for the entire removal cost. It's nickname, the 'Superfund' establishes the idea to clean up first and litigate later, by creating a reserve to allow for swift removal of the hazards.<sup>52</sup>

The Chesapeake Bay Agreements have established a national Chesapeake Bay Program Council, cooperative sharing among local, federal, and state governments, and manage the entire ecosystem by reducing the major nutrient non-point source pollutants phosphorus and nitrogen. The 1983 agreement acknowledges the need for communication and corporation between the EPA, and the government of Maryland, Pennsylvania, Virginia, and the District of Columbia regarding the problems of the Bay and possible solutions to determine sources of the pollutants.<sup>53</sup> The amended 1987 agreement describes the effort to reduce the nutrient pollutants of nitrogen and phosphorus in the Bay by 2000.<sup>54</sup> Chesapeake Bay 2000 guides restoration through a Chesapeake Bay Water Partnership, assisting with water quality, sound land use, stewardship, and habitat and living resource protection.<sup>55</sup>

A state wide law of the Commonwealth of Virginia, the 1988 Chesapeake Bay Preservation Act aims to improve the Bay's water quality, where "healthy state and local economies and a healthy Chesapeake Bay [can be] integrally related".<sup>56</sup> It provides independent protection of the Bay on a state level. Although this act has been partially successful, it needs to be expanded to gather funds, as well as local county and state political backing.<sup>57</sup> Maryland's Chesapeake and Atlantic Coastal Bays Critical Area Act strives to safeguard the water quality and habitats, by protecting the tidal edges. If the Act were to be amended, the areas of "critical habitat for a range of wildlife and aquatic life" could be cleaner and further more strictly enforced by the Critical Area Commission.<sup>58</sup> On a larger scale, the federal National Environment Policy Act encompasses fixing environmental problems that fall within the guidelines of national importance. Similar to Virginia, the NEPA's goal is to bring together society and the environment to increase the environmental health of the United States,

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<sup>51</sup> U.S. Environmental Protection Agency (2004). "The Clean Air Act," <http://www.epw.senate.gov/envlaws/cleanair.pdf>.

<sup>52</sup> Environmental Law Lecture, November 18, 2015.

<sup>53</sup> Chesapeake Bay Program (2015). "1983 Chesapeake Bay Agreement," [http://www.chesapeakebay.net/content/publications/cbp\\_12512.pdf](http://www.chesapeakebay.net/content/publications/cbp_12512.pdf).

<sup>54</sup> Chesapeake Bay Program (2015). "1987 Chesapeake Bay Agreement," [http://www.chesapeakebay.net/content/publications/cbp\\_12510.pdf](http://www.chesapeakebay.net/content/publications/cbp_12510.pdf).

<sup>55</sup> Phillips, 3-7.

<sup>56</sup> Virginia Department of Environmental Quality (2010). "Chesapeake Bay Preservation Act," <http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay/ChesapeakeBayPreservationAct.aspx>.

<sup>57</sup> Horton, 320.

<sup>58</sup> Horton, 321.

specifically its “ecological systems and natural resources”, through a Council on Environmental Quality.<sup>59</sup>

Various scales of authority, state, local, and federal governments have tried to combat the regulation of the Bay, but numerous complications make in unsuccessful. First, non-point source pollution cannot be regulated, so it does not lie under one specific jurisdiction. While the EPA’s annual budget in conjunction with the six Chesapeake Bay states consists of 4 billion dollars, it is not enough to combat this potential environmental crisis.<sup>60</sup> These funds might have led to equilibrium for conditions of the Bay, but due to a hike in population growth and economic development, the Bay’s habitat, quality of water, and health of species might be in decline.

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<sup>59</sup> *Wetlands Watch* (2015). “Federal Laws & Regulations,” <http://www.wetlandswatch.org/wetlandsprotection/lawsregulations.aspx>.

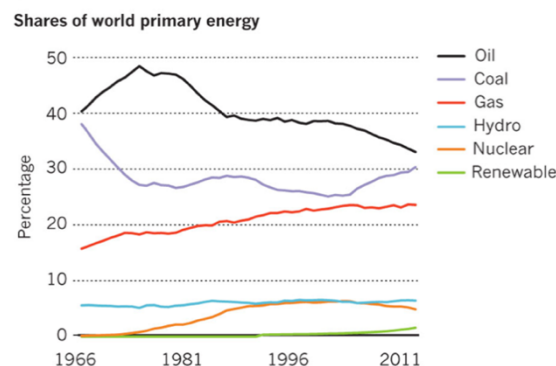
<sup>60</sup> *Ibid.*

## Entry #5: Challenges to Sustainability: Energy

The global challenge to sustainability is establishing renewable energy standards which is “central to achieving the interrelated economic, social, and environmental aims of sustainable human development”.<sup>61</sup> If sustainable energy goals can be met, then environmental health benefits will increase such as cleaner air and water, less disasters, no climate change, and less fossil depletion.<sup>62</sup> It can also assist the occupational health system by making oil rigs safer or nonexistent, less hydrofracking trucking accidents, less work in coal mines involving cave ins and hazardous chemicals.<sup>63</sup> Sustainable energy protects natural systems, ‘Say No to Climate Change’, expands energy systems to those who lack renewable energy and reduces security and conflict around oil and natural gas.<sup>64</sup>

Controlling this energy is extremely difficult because multiple professions manage it such as politicians, engineers, geographers, the public, scientists, and public health experts.<sup>65</sup> Figure 5 demonstrates that the growth of sustainable renewable energy in the past fifty years has been glacially increasing. While oil has drastically decreased, fossil fuels are still a high percent of our primary energy.

Figure 5: Statistical Review of world energy<sup>66</sup>



Source: [http://www.nature.com/nature/journal/v488/n7411/fig\\_tab/nature11475\\_F1.html](http://www.nature.com/nature/journal/v488/n7411/fig_tab/nature11475_F1.html).

If the energy challenge to sustainability can be overcome, then there will be an increase in energy efficiency, reduction of environmental impact, and decline of governmental cost. Furthermore, poverty will decrease and then 2 billion people can meet the energy basics of the 21<sup>st</sup> century.<sup>67</sup>

<sup>61</sup> UNDP (2000). “World Energy Assessment,”

<http://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/sustainable-energy/world-energy-assessment-energy-and-the-challenge-of-sustainability/World%20Energy%20Assessment-2000.pdf>.

<sup>62</sup> Energy Lecture, November 4, 2015.

<sup>63</sup> Ibid.

<sup>64</sup> InterAcademy Council (2015). “The sustainable energy challenge,”

<http://www.interacademycouncil.net/File.aspx?id=24442>

<sup>65</sup> Energy Lecture, November 4, 2015.

<sup>66</sup> Nature (2012). “Figure 1: Statistical Review of world energy,”

[http://www.nature.com/nature/journal/v488/n7411/fig\\_tab/nature11475\\_F1.html](http://www.nature.com/nature/journal/v488/n7411/fig_tab/nature11475_F1.html).

<sup>67</sup> UNDP (2000).

BP Global compares the relationship between energy and natural resources such as minerals, water, land, and atmosphere. Atmosphere can be associated with greenhouse gas emissions, the water withdrawal versus water consumption utilizes fossil fuels, land is connected to biofuels, the different minerals and minerals such as mining and steel further support the fossil fuel powered industry.

The National Science Board's *Building a Sustainable Energy Future*, emphasizes points that aim to assist the United States and National Science Foundation with the energy economy:<sup>68</sup>

1. U.S. Government leadership and coordination
2. R&D development
3. Policy development
4. Energy education and workforce
5. Global cooperation
6. Energy awareness and action

Additionally, the government should be mainly focused on a "less carbon intensive" economy, while the NSF should be mainly concentrated on education and the transformation of technology as it relates to energy needs.<sup>69</sup>

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<sup>68</sup>*National Science Foundation* (2009). "Building a Sustainable Energy Future," [http://www.nsf.gov/nsb/publications/2009/comments\\_se\\_report.pdf](http://www.nsf.gov/nsb/publications/2009/comments_se_report.pdf)

<sup>69</sup> Ibid.

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