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## **Designing the City, Sustainably: Sustainability and Climate Change Resiliency in New York City**

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Designing the City, Sustainably

Sustainability and Climate Change Resiliency in New York City

Cosima Balletti-Thomas

## *Abstract*

This paper explores how New York City and especially Manhattan has integrated sustainability into its agenda as a coastal metropolitan nucleus. Secondly, it assesses the New York City's resiliency strategies that utilize environmental policy and design to confront its vulnerability to changes in the environment on account of global climate change, which has primarily manifested in the Northeastern region in the form of sea level rise, storm surge, and frequent flooding.

Chapter 1 uses quantitative climate data from a multitude of sources such as the New York State Department of Environmental Conservation's report on the "Impacts of Climate Change in New York," the Federal Advisory Committee's "National Climate Assessment" and the Intergovernmental Panel on Climate Change's fifth assessment report to evaluate the physical and meteorological impacts of climate change on the city and planet at large. Chapter 2 explores the environmental history of New York City both before and since industry transformed the world and set it out on a trajectory towards global climate change. Chapter 3 examines the sustainable and resilient design methods adopted to reinforce the city and prepare it for future disaster. Chapter 4 discusses the environmental policies and economics involved in the city's mission of resiliency and its commitment to renewable energy and a carbon free economy. In addition, my internship at *Our Climate* is used as a case study about an ambitious and recently enacted state-wide climate bill. Finally, integrating what is already detailed in Chapters 1-4, Chapter 5 presents a comprehensive set of policy recommendations rooted in the general attitude that venturing towards a more sustainable and resilient future for New York City is a necessary and urgent goal.

*Keywords:* environmental policy, environmental economics, climate data, urban design, environmental history, climate change resiliency, sustainability

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*Introduction: The Big, Green, Sustainable Apple*

Every city exhibits its own environmental setbacks ranging from having to compensate for a lack of natural greenspace to congestion control to designing efficient and extensive water treatment and management systems. New York City, as every other capital juggernaut, has exhibited all of these, and many more. That said, it is also regarded as one of the greenest cities in the United States, along with Austin, Texas; Washington D.C.; San Francisco, California; and Portland, Oregon.<sup>1</sup> While climate change is a global issue, how it affects a specific area is rooted in a multitude of factors, including geography and climate. New York has been afflicted by a series of natural disasters, most recently was Hurricane Sandy and Irene, from which the city and larger Northeastern region are still reeling. As a major coastal city, New York's goal of climate change resiliency is rooted in mitigating its vulnerability to future disaster whereas its mission of general sustainability and climate action involves reducing its carbon footprint altogether. Both aspirations are primarily being achieved through more robust design strategies and stricter, more comprehensive environmental policy.

This research paper will focus on how New York City and especially Manhattan have confronted and been adversely impacted by changes in the environment due to global climate change such as sea level rise and more frequent and intense storm surge. Utilizing a multitude of sources and specific case-studies that collectively offer both a systematic and creative perspective, this paper will expound on how New York City has integrated sustainability and climate change resiliency into its urban fabric, focusing on particular projects such as Mayor of New York City Bill De Blasio's comprehensive strategy plan called *OneNYC* (adopted from

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<sup>1</sup> Megan Johnson, "The 10 Greenest Cities In America Are Models For A Cleaner Future," *The Huffington Post*, HuffPost Environment, May 2, 2017, accessed September 27, 2018, [http://www.huffingtonpost.com/entry/the-10-greenest-cities-in-america-are-models-for-a\\_us\\_5908c691e4b05279d4edc031](http://www.huffingtonpost.com/entry/the-10-greenest-cities-in-america-are-models-for-a_us_5908c691e4b05279d4edc031).

former Mayor Bloomberg's *PlaNYC*) and the United States Department of Housing and Urban Development's *Rebuild By Design*, the central authority to the rebuilding and restoration of the Lower East Side post-Hurricane Sandy.

The first chapter of this research paper will employ the best available climate data collected by credible sources such as the Intergovernmental Panel on Climate Change's fifth assessment report and the New York State Department of Environmental Conservation's report on the "Impacts of Climate Change in New York" to provide quantitative analysis of the impacts of climate change on New York City and the planet at large. This information will be useful in assessing the general framework adopted by New York City to counter climate change that will be more thoroughly expounded on in the next three chapters that individually focus on environmental history, sustainable design, and environmental policy and economics.

This chapter will also discuss the urgency for climate change resiliency, using data that reflects the impacts of our business-as-usual operations to give insight into the trajectory of mankind, should we as a collective people be unable or unwilling to take immediate and extreme action towards mitigating emissions. The second chapter will focus on the environmental history of New York City and Manhattan (formerly known as Mannahatta) and the relatively recent introduction of design into urban operations that originally served to beautify the city and ward against public health and infrastructural crisis due to rapid industrial and population growth, as well as a lack of foresight and experience with such unprecedented issues.

The third chapter will discuss the sustainable and resilient design methods adopted by the city, utilizing specific case-studies such as aforementioned *Rebuild by Design's* latest design proposal, the "Big U." The fourth chapter will explore how New York City integrates mitigative and adaptive environmental policy into its mission of sustainability and resiliency, as well as

how environmental economics factors into the implementation of such legislation. In addition to other relevant case studies featured in this chapter, I will also utilize what I have learned and worked on in my current internship at a magazine and non-profit climate action organization as an editorial writer and lobbyist/activist for New York based environmental matters and legislation to provide further insight into the city's mission of sustainability and resiliency through climate policy. In the fifth chapter, I will compile what will be discussed in Chapters 1-4 to produce a comprehensive set of policy recommendations inspired by what New York City has already accomplished by way of combating global climate change, reducing its vulnerability to coastal damage, and generally bolstering resiliency and sustainability.

### *Chapter 1. Climate Change in New York City*

There is no dialogue about New York City's strive for sustainability and resiliency without a thorough discussion of how global climate change has specifically affected the city. New York's climate mission acts as both product of and solution to climate change which has impacted the city largely through intensified and more frequent storms and flooding. This has ultimately fueled a sense of urgency to take effective climate action through methods such as hard armoring against flooding and stricter environmental policy. This chapter provides an in depth analysis of the physical and meteorological influences of climate change on New York City and the planet.

The United Nations "Millennium Ecosystem Assessment" explores the tight-knit relationship between human welfare and ecosystem services with an urgent call for global climate action. The four ecosystem services are provisioning (i.e. food and water), regulating (i.e. climate and water quality), habitat and supporting (i.e. nutrient cycling and photosynthesis),

and cultural (i.e. the recreational and aesthetic benefits we derive from the environment).<sup>2</sup> This aforesaid relationship is rooted in our dependency on the environment to provide us with adequate resources in order to lead relatively comfortable lives such as food security and freedom of choice, both of which are either directly or indirectly contingent upon the four ecosystem services as one collective resource.<sup>3</sup>

The conceptual framework of this assessment essentially views the environment as both a resource that all organisms require for self-preservation as well as a space in which our lives and social relations take place.<sup>4</sup> The assessment posits that it is in our best interest to act in accord with the environment primarily because of our total reliance on its irreplicable natural capital.<sup>5</sup> It furthers that some ecosystem services have exhibited degradation due to our drive to increase other services, such as provisioning with respect to the global food supply.<sup>6</sup> As a result, the costs of primarily industrial nations' unsustainable practices are being exhibited disproportionately by people in other parts of the world, and will also be deferred to people in perpetuity.<sup>7</sup> According to the assessment, around 60% of the services are being degraded.<sup>8</sup> The majority of the degradation has taken place within the second half of the twentieth century and coincides with major global events such as industrialization and population growth, especially between the years of 1960 and 2000 when the global population nearly doubled reaching 6 billion people.<sup>9</sup> These services are all essential; however, for the purpose of this chapter it is beneficial to hone in on "regulation" as it specifically affects New York City's climate, strive for resiliency, and the

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<sup>2</sup> "Ecosystems and Human Well-Being: General Synthesis," United Nations Millennium Ecosystem Assessment, 2005, accessed September 11, 2018, <https://www.millenniumassessment.org/en/Synthesis.html>.

<sup>3</sup> "Ecosystems and Human Well-being: General Synthesis," United Nations Millennium Ecosystem Assessment, V.

<sup>4</sup> *Ibid.*, V.

<sup>5</sup> *Ibid.*, 1.

<sup>6</sup> *Ibid.*, 1.

<sup>7</sup> *Ibid.*, 1.

<sup>8</sup> *Ibid.*, 1.

<sup>9</sup> *Ibid.*, 5.

three other services that would not be possible without climate regulation (e.g. cultural/recreational services afflicted by rising sea levels and frequent flooding due to climate change).

In October 2018, the Intergovernmental Panel on Climate Change released its fifth assessment titled, “Global Warming of 1.5 degrees Celsius” in which it reports that humans must cap average global temperature rise at 1.5 degrees Celsius above pre-industrial levels to mitigate future mass global devastation beyond what was already taken place such as exacerbated and rampant food scarcity, poverty, and disease.<sup>10</sup> The report predicts with high confidence that the average global temperature will likely reach 1.5 degrees Celsius between the years of 2030 and 2050 if operations continue business-as-usual, with a 0.2 degrees Celsius increment each decade.<sup>11</sup> The report compares the impacts at 1.5 degrees Celsius and 2 degrees Celsius and concludes that although a seemingly negligible difference, the magnitude of devastation increases considerably at 2 degrees Celsius. For example, sea level rise at 1.5 degrees Celsius is projected at 0.1 meters less than at 2 degrees Celsius.<sup>12</sup> The report reasons with medium confidence that although sea level rise is inevitable, working to slow it down may give us and especially low-lying ecosystems more time to adapt.<sup>13</sup>

In his *Six Degrees: Our Future on a Hotter Planet*, Mark Lynas explains how humans have reached a point of no return, that if we continue operations business-as-usual, average global temperature could rise above three degrees Celsius by 2050.<sup>14</sup> Naomi Klein’s *This Changes Everything: Capitalism vs. the Climate* also raises an important point about business-as-

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<sup>10</sup> “Summary for Policy Makers,” Special Report: Global Warming of 1.5 °C, The United Nations Intergovernmental Panel on Climate Change, October 2018, accessed September 12, 2019, <https://www.ipcc.ch/sr15/>.

<sup>11</sup> “Summary for Policy Makers,” Special Report: Global Warming of 1.5 °C.

<sup>12</sup> Ibid.

<sup>13</sup> Ibid.

<sup>14</sup> Mark Lynas, *Six Degrees: Our Future on a Hotter Planet* (Washington D.C.: National Geographic Society, 2008), 134.

usual, that this attitude held by so many of our most influential policy makers and other public figures is no longer an option, describing 2 degrees Celsius as a “a utopian dream.”<sup>15</sup> Even if we were to achieve carbon neutrality tomorrow, we could anticipate at least a half degree Celsius more of warming as carbon dioxide and greenhouse gasses linger in the atmosphere for centuries.<sup>16</sup> At 2 degrees Celsius the world may exhibit collapsed ice sheets, hundreds of millions of people without access to sufficient and potable water, and inhospitable equatorial cities.<sup>17</sup> At 3 degrees Celsius Southern Europe may face irreparable drought.<sup>18</sup> Klein furthers that some climate authority groups, such as the World Bank predict with confidence that we could reach 4 degrees Celsius by the turn of the century, adding that adapting to 4 degrees Celsius may not even be within our capacity.<sup>19</sup>

As reported in the Panel’s fourth assessment, the sum of our anthropogenic greenhouse gas emissions has increased between 1970 and 2010, with the greatest absolute increase occurring between 2000 and 2010 and where almost 80% of those emissions were caused solely by industrial combustion.<sup>20</sup> Klein expands on this in her discussion of the consequences of federal inaction, explaining that since the climate change discussion materialized largely in the 1990’s, global emissions of carbon dioxide have increased by 61% as of 2013.<sup>21</sup> She describes the world at 4 degrees Celsius as “calamitous” with submerged island nations and coastal regions, jeopardized cities, chief of which include New York, Boston, Los Angeles, London, and

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<sup>15</sup> Naomi Klein, *This Changes Everything: Capitalism vs. The Climate* (New York: Simon and Schuster, 2014), 11.

<sup>16</sup> David Wallace-Wells, *The Uninhabitable Earth: Life after Warming* (New York: Tim Duggan Books, 2019), 11.

<sup>17</sup> Wallace-Wells, *The Uninhabitable Earth*, 12.

<sup>18</sup> *Ibid.*, 13.

<sup>19</sup> Klein, *This Changes Everything*, 12.

<sup>20</sup> “Summary for Policymakers,” AR5 Synthesis Report: Climate Change 2014, The Intergovernmental Panel on Climate Change, 2014, accessed September 12, 2019, <http://www.ipcc.ch/report/ar5/syr/>.

<sup>21</sup> Klein, *This Changes Everything*, 11.

Hong Kong.<sup>22</sup> Additionally, we can expect life threatening heat waves on every continent besides Antarctica, massive crop loss, widespread disease, and so on.<sup>23</sup>

Klein adds, “When you add ruinous hurricanes, raging wildfires, fisheries collapses, widespread disruptions to water supplies, extinctions, and globetrotting disease to mix, it indeed becomes difficult to imagine that a peaceful, ordered society could be sustained.”<sup>24</sup> The key word here is “could” as again, many top scientists are not confident that modern societies could function or even exist at such high temperatures and with such catastrophic consequences. Moreover, the International Energy Agency released a report back in 2011 that describes 4 degrees Celsius as conservative and instead projects 6 degrees as more realistic.<sup>25</sup> The Agency adds that 6 degrees Celsius will produce a kind of instability and uncertainty unprecedented to society, plagued by catastrophic “tipping points” such as astronomical methane releases from melting permafrost on top of everything else.<sup>26</sup>

According to the New York State Department of Environmental Conservation’s “Impacts of Climate Change on New York,” since 1970, the state’s annual average temperature has increased by approximately 2.4 degrees Fahrenheit which amounts to approximately a 0.25 degree Fahrenheit increment each decade since 1900.<sup>27</sup> As reported by the United States’ Global Change Research Program’s “2014 National Climate Assessment,” on a national level, average temperature rise has increased by 1.3°F to 1.9°F since the year 1895, where the majority of this

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<sup>22</sup> Klein, *This Changes Everything*, 11.

<sup>23</sup> Klein, *This Changes Everything*, 12.

<sup>24</sup> *Ibid.*, 12.

<sup>25</sup> *Ibid.*, 15.

<sup>26</sup> *Ibid.*, 15.

<sup>27</sup> “Impacts of Climate Change in New York,” Freshwater Wetlands Program, NYS Dept. of Environmental Conservation, accessed September 11, 2018, <https://www.dec.ny.gov/energy/94702.html>.

increase has taken place within the last fifty years or so since 1970.<sup>28</sup> These values are expected to increase by 2-4 degrees Fahrenheit within the next few decades.<sup>29</sup> It is important to note that this increase is not uniformly exhibited throughout the nation; in reality, warming is occurring faster in the Northeastern region and especially Alaska whereas the Southeast has barely exhibited any warming at all.<sup>30</sup> Although the effects of climate change are not always visible, in New York, there are seasonal indicators such as premature bee pollination and flower blossoming, not to mention that sea levels along the state's coasts have increased by over a foot since 1900 with approximately a 1.2 inch increment each decade, which is almost twice as much as the average global rate of increase of approximately 0.7 inches each decade,<sup>31</sup> or eight inches since 1900.<sup>32</sup>

Climate data modeling demonstrates a trajectory of gradual and continued warming for New York State where temperatures are expected to reach up to 3 degrees Fahrenheit by the 2020 decade and up to 6 degrees Fahrenheit by the 2050 decade.<sup>33</sup> While many regions of the world are suffering from drought, New York, with four out of its five boroughs sitting on islands, is in the opposite position.<sup>34</sup> New York is particularly vulnerable to sea level rise given its "2,400 kilometers of coastline" and situation between New Jersey and Long Island that consequently "funnels water right into the city's harbor."<sup>35</sup> Moreover, between the years of 1958 and 2010, precipitation during heavy downpours increased by at least 70% throughout the Northeast and is

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<sup>28</sup> "National Climate Assessment," U.S. Global Change Research Program, 2014, accessed October 29, 2019, <https://nca2014.globalchange.gov/>.

<sup>29</sup> "National Climate Assessment," U.S. Global Change Research Program.

<sup>30</sup> *Ibid.*

<sup>31</sup> "Impacts of Climate Change in New York," Freshwater Wetlands Program.

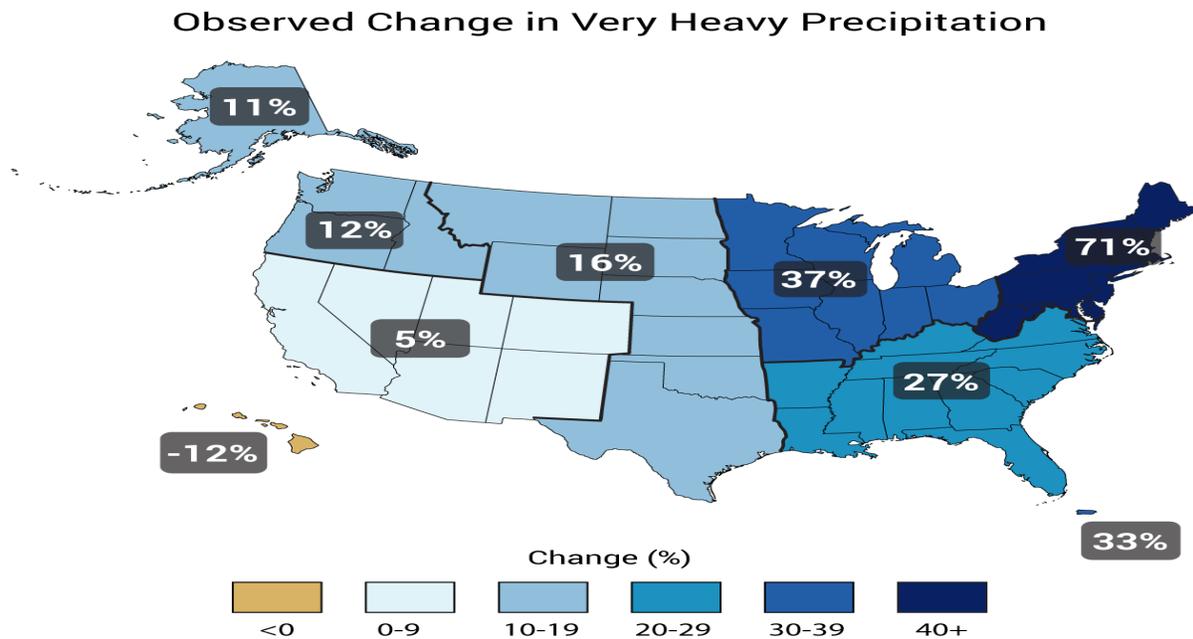
<sup>32</sup> "National Climate Assessment," U.S. Global Change Research Program.

<sup>33</sup> "Impacts of Climate Change in New York," Freshwater Wetlands Program.

<sup>34</sup> Lynas, *Six Degrees*, 167.

<sup>35</sup> Lynas, *Six Degrees*, 167.

projected to increase by 8% by the 2020 decade and 12% by the 2050 decade.<sup>36</sup> These values contrast substantially to that of the rest of the United States (see graphic below).<sup>37</sup> Lastly, by year 2050, state-wide sea levels are projected to increase by 2.5 feet along the coast and could exhibit a six foot increase by 2100.<sup>38</sup> This is contrasted to the one to four foot average global sea level increase projection, also by 2100.<sup>39</sup>



*Figure 1. "Observed Change in Very Heavy Precipitation."*<sup>40</sup>

Julie Maguire's thesis on "Hurricane Sandy: Using Environmental History, Economics, Politics and Urban Planning to Prepare for the Next One" discusses how climate data has revealed a correlation between temperature rise and storm intensity and frequency where each increment of global temperature rise since 1945 has resulted in an increase in the number of

<sup>36</sup> "Impacts of Climate Change in New York," Freshwater Wetlands Program.

<sup>37</sup> "National Climate Assessment," U.S. Global Change Research Program.

<sup>38</sup> "Impacts of Climate Change in New York," Freshwater Wetlands Program.

<sup>39</sup> "National Climate Assessment," U.S. Global Change Research Program.

<sup>40</sup> *Figure 1. "Observed Change in Very Heavy Precipitation."* "National Climate Assessment," U.S. Global Change Research Program.

tropical storms.<sup>41</sup> However, the Northeast has exhibited the majority of its storms within the last twenty years.<sup>42</sup> Maguire furthers that oceanic temperature increase influences the direction of these storms and “from the year 1970 until 2005 there has been an increase in vertical wind shear, which scientists believe correlates to the increase in more serious hurricanes, such as those measuring the category 4 and category 5 standards.”<sup>43</sup> In fact, climate data has revealed that on average New York experiences a hurricane at least once every century since the rise of industry.<sup>44</sup> Climate data also predicts floods of a similar magnitude to that of Hurricane Sandy inundating the city up to seventeen times more frequently by 2100.<sup>45</sup>

Both Hurricane Irene and Sandy were watershed events in New York City’s mission of resiliency and sustainability as they demonstrated the devastating consequences of climate change. Furthermore, Hurricane Sandy demonstrated the risks of our dependency on central energy,<sup>46</sup> after causing 150 deaths and approximately 70 billion dollars in damages from severe flooding of the New York City subway system, inundated beaches, loss of biodiversity, 650,000 damaged or destroyed households, and 8.5 million without power.<sup>47</sup> This catastrophic aftermath called for a revision in the city’s capacity to be prepared for the next event through reinforced infrastructure and better emergency response. Moreover, climate change resiliency may require forward thinking to protect against disaster; however, it also calls for a shift in the collective social attitude towards the environment. New York’s strive for climate change resiliency is at the heart of its environmental agenda, accelerated within the last decade of devastation by natural

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<sup>41</sup> Julia Maguire, "Hurricane Sandy: Using Environmental History, Economics, Politics and Urban Planning to Prepare For the Next One," *Student Theses 2001-2013*, (2013): [https://fordham.bepress.com/enviro\\_theses/15](https://fordham.bepress.com/enviro_theses/15), 8.

<sup>42</sup> Maguire, "Hurricane Sandy," 8.

<sup>43</sup> *Ibid.*, 9.

<sup>44</sup> *Ibid.*, 9.

<sup>45</sup> Wallace-Wells, *The Uninhabitable Earth*, 81.

<sup>46</sup> Klein, *This Changes Everything*, 105.

<sup>47</sup> "National Climate Assessment," U.S. Global Change Research Program.

disaster. The information presented in these sources demonstrates how localized environmental issues caused by global climate change can be, and perhaps one of the reasons that New York City is so dedicated to countering climate change is because of its personal and enduring experience with its devastating impacts, having been afflicted by such mass destruction year after year.

### *Chapter 2. The Environmental History of Mannahatta*

The arrival of Henry Hudson and his crew in 1609 was a watershed moment in American history that would ultimately cause a fundamental shift in the region's relationship with nature as it would now be one rooted in profit and economic incentive as opposed to harmony and worship that was principle to many Indigenous communities.<sup>48</sup> By the late 18th century, what was originally a verdant, watery span of land rich in biodiversity called Mannahatta had been transformed into a geometric landscape now called New Amsterdam as agriculture and livestock overran the ecological base that had served as a vital resource and habitat for many communities and species.<sup>49</sup> In other words, a *landscaped* nation was in the making.

*Disease and Public Health.* By 1740, New York City was comprised of a few small villages with a population of no more than 10,000 residents.<sup>50</sup> At this point, the city's main environmental challenges were fire and disease.<sup>51</sup> Many buildings were fire-prone as they were composed of wood, prompting the city to pass a law in 1731 mandating that all homeowners keep a bucket by their door in the event of a fire.<sup>52</sup> The challenge of disease primarily manifested

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<sup>48</sup> David Stradling, *The Nature of New York: An Environmental History of the Empire State* (Ithaca, New York: Cornell University Press, 2010), 14-15.

<sup>49</sup> Stradling, *The Nature of New York*, 29.

<sup>50</sup> *Ibid.*, 40.

<sup>51</sup> *Ibid.*, 40.

<sup>52</sup> *Ibid.*

through smallpox and yellow fever outbreaks throughout the 18th and early 19th century.<sup>53</sup> Some people routinely burned coal hoping it would eradicate disease by purifying the air while most simply fled the city in search of safer living conditions, which at the time largely entailed moving to downtown Manhattan, which was still rural.<sup>54</sup> Although the influence of mosquitoes on the spread of disease was not yet common knowledge, it soon became apparent that there was some correlation between public health and the swampy, moist terrain that characterized the city as all kinds of waste collected in the streets due to a lack of any sewage or water management.<sup>55</sup>

Despite minor improvements to its sewage management system, the city was still afflicted by poor sanitation which ultimately led to an outbreak of cholera in 1832 and again in 1849, ultimately killing 5000 people in total, the majority of which lived in the city's lower income neighborhoods.<sup>56</sup> Some New Yorkers wrote off the outbreak as a punishment for these poor and crime ridden communities which concentrated around the aforesaid swampy areas, a conclusion which, although incorrectly drawn, led to an assumed correlation between disease, filth, and ethics prompting city officials to dry out the swamps to facilitate drainage which ultimately mitigated the presence of mosquitoes, as well as yellow fever.<sup>57</sup> In other words, it was not common knowledge yet the connection between contaminated water and disease; however, what was clear was that clean water was going to become an increasingly necessary provision as the city expanded and faced added challenges of space, congestion, and generally meeting the needs of its residents. In 1870, as a temporary solution to poor sanitation and inadequate water access, the city began building public baths with clean water in poor neighborhoods.<sup>58</sup> This

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<sup>53</sup> Stradling, *The Nature of New York*, 40.

<sup>54</sup> Stradling, *The Nature of New York*, 40.

<sup>55</sup> *Ibid.*, 41.

<sup>56</sup> *Ibid.*, 117.

<sup>57</sup> *Ibid.*, 41.

<sup>58</sup> *Ibid.*, 119.

solution proved effective and ultimately caused the state of New York to create legislation in 1895 requiring all cities with populations exceeding fifty thousand to build public baths.<sup>59</sup> These methods reflected the city's increasing awareness of the relationship between the environment and public health, as well as the myriad benefits of intelligent urban design.

*Urban Green Space.* Before the construction of Central Park, built greenspace in New York City was largely private and only accessible to nearby residents.<sup>60</sup> Not only did private parks exclude the public majority, they also drove up property values.<sup>61</sup> In the early 19th century, many New Yorkers would travel to the countryside, which at the time could be accessed by foot or bike; however, by mid-century, urban expansion had effectively pushed back the natural greenspace making it difficult for people to maintain a consistent relationship with nature.<sup>62</sup> Many believed that creating more greenspace would not only enhance the city's aesthetic but moral quality, which was largely believed to have been impaired by the lower class communities.<sup>63</sup> In 1831, construction of Gramercy Park commenced as yet another private space reserved for the city's elite.<sup>64</sup> This called for a new kind of urban landscape that could be universally enjoyed, in addition to other incentives such as health benefits, morale, and reputation, all of which were severely lacking especially compared to many European cities at the time.<sup>65</sup>

In the mid nineteenth century, Frederick Olmsted and Calvert Vaux began construction on what would ultimately become one of the nation's first public parks upon its completion in

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<sup>59</sup> Stradling, *The Nature of New York*, 119.

<sup>60</sup> Stradling, *The Nature of New York*, 92.

<sup>61</sup> Catherine McNeur, *Taming Manhattan: Environmental Battles in the Antebellum City* (Cambridge, MA: Harvard University Press, 2014), 46.

<sup>62</sup> Stradling, *Nature of New York*, 92.

<sup>63</sup> McNeur, *Taming Manhattan*, 46-47.

<sup>64</sup> Stradling, *The Nature of New York*, 92.

<sup>65</sup> Stradling, *The Nature of New York*, 92.

1864.<sup>66</sup> Olmstead and Vaux's vision was to create a space that would essentially cause park goers to forget the fact that they were in a city.<sup>67</sup> The park combined rural aesthetic and romanticism, accounting for both people's desire to have a space in which they could engage in public activities and escape the ills of the congested urban environment that lay just outside the park's boundaries.<sup>68</sup> Additionally, Olmstead and Vaux had hoped that the park would improve public health and happiness.<sup>69</sup> In other words, to "humanize" life in a metropolitan city.<sup>70</sup> That said, it is important to point out that the area in which Central Park is located was largely upper class. Nevertheless, Central Park became a national paradigm for built urban greenspace, inspiring other cities to develop similar projects. Furthermore, Central Park was an example of citizen power and influence and helped to facilitate the integration of greenspace into the urban fabric of New York City.<sup>71</sup>

*Congestion, Transportation and Air Pollution.* As New York City expanded in population and industrial activity, it was met with new challenges, notably congestion, pollution, and lack of space. Aside from Central Park and a few other public spaces, the city still lacked adequate greenspace, especially in the lower class neighborhoods that were heavily concentrated by industrial and manufacturing activity, in addition to residential spaces.<sup>72</sup> These neighborhoods were plagued by overcrowding, as well as disease and domesticated animals such as pigs, which were fortunately banned from public spaces later on.<sup>73</sup> To say the least, the city simply could not keep up with its rapid population growth, which by 1910 had reached almost five million people,

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<sup>66</sup> David M. Scobey, *Empire City: The Making and Meaning of the New York City Landscape* (Philadelphia, PA: Temple University Press, 2002), 17.

<sup>67</sup> Stradling, *The Nature of New York*, 93.

<sup>68</sup> Stradling, *The Nature of New York*, 93.

<sup>69</sup> Ibid.

<sup>70</sup> Scobey, *Empire City*, 17.

<sup>71</sup> Scobey, *Empire City*, 17.

<sup>72</sup> Stradling, *The Nature of New York*, 109.

<sup>73</sup> McNeur, *Taming Manhattan*, 7.

a large percentage of which resided in this industrial-residential center.<sup>74</sup> Ultimately, transportation became an integral factor and solution to the city's scramble for space.

Horse drawn carriages known as Omnibusses popularized in the 1830's as a viable solution as they became more regulated by way of scheduling and route planning thus allowing people to live further away and commute to the congested parts when necessary.<sup>75</sup> Steam engines were sometimes used instead of horse technology but were eventually banned in 1844 from running below thirty-second street, and later, forty-second as they emitted smoke and sparks, and occasionally exploded.<sup>76</sup> By the 1860's; however, steam powered elevated railroads were developed and within a few decades were running throughout all of Manhattan.<sup>77</sup> Although effective in pushing people away from the congested center and attracting industrial activity, these railroads were highly opposed by those who stayed put as they were noisy, smoky, and diminished the aesthetic and property value of neighborhoods.<sup>78</sup> By the late nineteenth century, electric power began to replace horsepower as trolleys could travel faster and farther, ultimately allowing for an easier transition between home and the workplace, as well as home and the natural environment outside of the city.<sup>79</sup>

Coal combustion by industries created environmental problems across America beyond air pollution as the soot produced from partially burned coal caused respiratory issues, injury to plants, and damage to goods and furniture.<sup>80</sup> This also prompted the idea to create avenues stretching across Manhattan to facilitate air circulation; however, supporters of this idea failed to

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<sup>74</sup> Stradling, *The Nature of New York*, 108.

<sup>75</sup> Stradling, *The Nature of New York*, 110.

<sup>76</sup> *Ibid.*, 111.

<sup>77</sup> *Ibid.*, 111.

<sup>78</sup> *Ibid.*, 112.

<sup>79</sup> *Ibid.*, 114-115.

<sup>80</sup> *Ibid.*, 124.

take into account the city's topography and natural waterways.<sup>81</sup> That said, New York City maintained remarkably clean air relative to cities such as Pittsburgh and Cincinnati due to its use of clean coal.<sup>82</sup> Still, by the early twentieth century New York had passed several anti-smoke laws and assigned new municipal authorities to oversee smokestacks and fine industries for emitting excessive smoke.<sup>83</sup>

*Water Transportation and Pollution.* As its population burgeoned, New York City continued to implement changes to its urban landscape to protect against water-related environmental issues such as filling in low-lying areas to ward against contaminated water collecting as well as filling in wetlands to avoid fog production.<sup>84</sup> In addition, the Common Council of New York City created a ditch beneath Canal Street in order to drain water from the area.<sup>85</sup> However none of these initiatives confronted the city's urgent water transportation challenges, until the construction of the Erie Canal.

By 1825, construction of the Erie Canal concluded as a medium through which the state could be interconnected and its waterscape could be regulated.<sup>86</sup> The canal also connected to canals in other states to the extent that nearly the entire state of New York was now linked to water routes outside of its boundaries.<sup>87</sup> While successfully regulating the waterscapes, the canal wreaked havoc on the natural landscape, an arguably necessary cost of reinforcing the productivity of nature to meet the needs of a city.<sup>88</sup> The canal in and of itself fueled growth as it created tens of thousands of jobs, facilitated extensive trade networks, and popularized

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<sup>81</sup> Stradling, *The Nature of New York*, 124.

<sup>82</sup> Stradling, *The Nature of New York*, 124.

<sup>83</sup> Ibid.

<sup>84</sup> Ibid., 43.

<sup>85</sup> Ibid., 43.

<sup>86</sup> Ibid., 46.

<sup>87</sup> Ibid., 53.

<sup>88</sup> Ibid., 47-52.

agriculture, which exacerbated the receding natural greenspace.<sup>89</sup> By 1860, the state of New York contained five of the top vegetable crop yielding counties in the United States, three of which were located in New York City.<sup>90</sup>

Despite the canal's success in bringing water into the city, there was still the challenge of local water accessibility to meet the needs of its rapidly growing population.<sup>91</sup> In the absence of any sort of advanced, *internal* water management system, many residents' primary options for obtaining water was from wells and cisterns, which was expensive and often contaminated.<sup>92</sup> In 1835, the state of New York formed a commission to construct a new drinking water system.<sup>93</sup> The commission looked to the Croton River in Westchester County as a potential solution, proposing that it be dammed and an aqueduct be constructed to transport potable water downstream into the city, entirely facilitated by gravitational pull.<sup>94</sup> In December of 1835, a substantial portion of New York City was destroyed in a fire, which ultimately placed a greater sense of urgency on the plan's completion as the fire demonstrated the devastating consequences of an inadequate water system as firefighters struggled to control the fire with what little water pressure they could obtain.<sup>95</sup> In 1842, the Croton water system was completed and the aqueduct spanning over forty miles began filling the Murray Hill reservoir.<sup>96</sup> In response to the successful accomplishment of this revolutionary pinnacle of urban design, more water-ways were constructed to increase efficiency. To New Yorkers, the completion of this project signified the end of the panic and misery that had plagued the city for too long.<sup>97</sup> However, it would still take

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<sup>89</sup> Stradling, *The Nature of New York*, 53-55.

<sup>90</sup> Stradling, *The Nature of New York*, 58.

<sup>91</sup> *Ibid.*, 70.

<sup>92</sup> *Ibid.*, 70.

<sup>93</sup> *Ibid.*

<sup>94</sup> *Ibid.*, 71.

<sup>95</sup> *Ibid.*, 71.

<sup>96</sup> *Ibid.*

<sup>97</sup> McNeur, *Taming Manhattan*, 118.

years for the benefits of this system to reach the poorest and most congested neighborhoods where any form of plumbing to accommodate the water was insufficient and sparsely located.<sup>98</sup>

Moreover, this still did not address the city's problem of sewage management which was largely exacerbated by industry that not only created a foul stench but caused irreparable injury to tidal streams and aquatic populations.<sup>99</sup> Even Manhattan which now had rudimentary sewer lines still lacked any form of treatment at the end of the lines so hundreds of thousands of gallons of untreated sewage entered surface waters just outside municipal boundaries.<sup>100</sup> Many industries also constructed lines to carry sewage directly into one of the rivers, which created ideal conditions for disease.<sup>101</sup> The fertilizer and oil refinery industries concentrated along Newtown Creek between Brooklyn and Queens were at the heart of the problem as sludge acid produced by both industries was dumped into the creek, ultimately leading to total ecological collapse.<sup>102</sup> Many industries also had political power that allowed them to operate largely unregulated, despite public and media outcry.<sup>103</sup> Besides industrial by-products, other unhealthful waste such as sewage and garbage were consistently dumped into waterways.

In response, by 1857 the state of New York finally invoked a ban on dumping waste into the harbor, followed by a law mandating that New York City dispose of its waste in more remote and distant oceanic areas to prevent pollution of its beaches and shorelines.<sup>104</sup> Even so, this was not a viable solution and ultimately caused permanent damage to the waterways and other aquatic ecosystems.<sup>105</sup> It was not until the early twentieth century that the city had a

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<sup>98</sup> Stradling, *The Nature of New York*, 118.

<sup>99</sup> Stradling, *The Nature of New York*, 125.

<sup>100</sup> *Ibid.*, 127.

<sup>101</sup> *Ibid.*, 127.

<sup>102</sup> *Ibid.*, 125.

<sup>103</sup> *Ibid.*, 125.

<sup>104</sup> *Ibid.*, 127.

<sup>105</sup> *Ibid.*, 128.

comprehensive water and sewage treatment network to not only bring safe drinking water to each and every home, but to bring wastewater out of the city through separate designated routes, though it was still taken straight to the various waterways just outside of the city.<sup>106</sup>

*Beautification and Regulation.* Although political clout in industries made it difficult to implement any pollution reform, efforts to beautify the city were very successful by the early twentieth century, dawned as the Progressive Era.<sup>107</sup> Methods of reform adopted by the city were primarily rooted in public wellbeing and urban aesthetic in an effort to heighten morale through projects such as improved living conditions, cleaner streets, and more trees and playgrounds.<sup>108</sup> In 1897, the “Tree Planting Association” was formed as a beautification strategy that especially targeted poorer neighborhoods.<sup>109</sup>

In 1894, George Waring was appointed as head of the city’s Department of Street Cleaning and quickly took initiative by implementing a waste processing program mandating that city residents separate their waste into ash, garbage such as food scraps, and rubbish such as recyclable items.<sup>110</sup> Waring’s program created many jobs where workers used ash and other materials as landfill and extracted marketable materials such as fertilizer to reuse and repurpose. Child mortality rates plummeted in the late nineteenth century and Waring’s department became an archetype for the nation. This era gave rise to a new movement known as *City Beautiful* which, at its core, reflected both the public’s drive and desire to beautify their city as well as the regaining of the people’s confidence in their government’s capacity to solve urban problems.<sup>111</sup>

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<sup>106</sup> Stradling, *The Nature of New York*, 128.

<sup>107</sup> Stradling, *The Nature of New York*, 128.

<sup>108</sup> Ibid.

<sup>109</sup> Ibid.

<sup>110</sup> Ibid., 128-129.

<sup>111</sup> Ibid., 129.

In 1860, the city passed a law requiring that fire escapes be integrated in all new buildings and later all buildings containing more than eight apartments.<sup>112</sup> In 1879, a law was passed that mandated that each room have at least one window to bring in external air.<sup>113</sup> Then in 1901, the “Tenement House Law” was passed which comprehensively addressed and regulated every aspect of tenement housing.<sup>114</sup> Lastly, the Triangle Waist Company fire in 1911, which killed 146 young women served as an important trigger event as it facilitated a discussion among public officials and lawmakers regarding workplace conditions, ultimately leading to several laws requiring safety measures such as safer fire escapes and regular fire drills.<sup>115</sup>

In 1916, New York became the first city in the country to implement zoning laws into its urban political fabric.<sup>116</sup> The new laws were a response to increasing urban congestion and gave municipal entities authority to regulate land use and divide the city into residential and commercial designated areas.<sup>117</sup> The legislation also gave these entities authority to restrict the building heights as well as the amount of land that could be developed in each neighborhood.<sup>118</sup> Lastly, the laws regulated the percentage of a given area on which tall buildings could be built so as to address increasing concerns about sufficient light and air exposure, especially in crowded areas.<sup>119</sup> This led to the popularization of the skyscraper, a tall and slender building that tends to sit further back from the sidewalk (e.g. the Chrysler Building).<sup>120</sup> The introduction of zoning

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<sup>112</sup> Stradling, *The Nature of New York*, 120.

<sup>113</sup> Stradling, *The Nature of New York*, 120.

<sup>114</sup> *Ibid.*, 121.

<sup>115</sup> *Ibid.*, 130.

<sup>116</sup> *Ibid.*, 130.

<sup>117</sup> *Ibid.*

<sup>118</sup> *Ibid.*

<sup>119</sup> *Ibid.*

<sup>120</sup> *Ibid.*, 131.

laws effectively put into place protections of residential neighborhoods from industrial activity as well as reflected an increasing amount of power within municipal authorities.<sup>121</sup>

*Hurricane History.* By the twentieth century, hurricanes were inflicting the East Coast at greater frequency and with greater intensity (e.g. Category 5 Hurricane Hugo in 1989).<sup>122</sup> That said, the city exhibited its first hurricane well before in the 20th century with the Norfolk Long Island Hurricane of 1821.<sup>123</sup> The second storm of the century was the Atlantic Hurricane of 1893 followed by a series of twentieth century storms including the Long Island Express Storm of 1938, Hurricane Carol in 1954,<sup>124</sup> Donna in 1960, and Agnes of 1972 which caused 122 casualties and over six billion dollars in damages.<sup>125</sup> Climate data reveals that New York has experienced at least one hurricane every century largely since the peak of the Industrial Revolution in the early nineteenth century.<sup>126</sup> Meteorological modelling also demonstrates that had a storm similar to that of 1821 occurred in the present century, its impacts would be analogous to that of Superstorm Sandy in 2012, and would actually surpass Sandy in terms of damage costs.<sup>127</sup> It was not until the 1870's that the city began to think more intellectually and realistically about infrastructure and how to incorporate it in a more permanent, productive, and protective way against storm damage and other hazards.<sup>128</sup> For the most part, this entailed building stronger and sturdier piers along the city's coastline.<sup>129</sup> While economically beneficial

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<sup>121</sup> Stradling, *The Nature of New York*, 131.

<sup>122</sup> Stradling, *The Nature of New York*, 223-224.

<sup>123</sup> Kate Sheppard, "Report Warns That Superstorm Sandy Was Not 'The Big One'," *The Huffington Post*, HuffPost Politics, December 6, 2017, accessed October 29, 2019, [https://www.huffingtonpost.com/2014/09/18/sandy-hurricane-damage-co\\_n\\_5842958.html](https://www.huffingtonpost.com/2014/09/18/sandy-hurricane-damage-co_n_5842958.html).

<sup>124</sup> Maguire, "Hurricane Sandy," 19.

<sup>125</sup> "A History of Major Storms in NYC," *NBC New York*, NBC Universal Inc., October 26, 2012, accessed October 29, 2019, <https://www.nbcnewyork.com/news/local/Hurricane-Sandy-Storm-Tri-State-Major-Storms-History-176019471.html>.

<sup>126</sup> Maguire, "Hurricane Sandy," 19.

<sup>127</sup> Sheppard, "Report Warns That Superstorm Sandy Was Not 'The Big One'."

<sup>128</sup> Maguire, "Hurricane Sandy," 15.

<sup>129</sup> Maguire, "Hurricane Sandy," 15.

with respect to reduced damage costs and increased revenue, this created a disturbance in the surrounding aquatic environment ultimately demonstrating the tradeoffs involved in finding solutions to urban issues.<sup>130</sup> In other words, what might resolve one issue and create economic benefit may also exacerbate problems elsewhere.

All of these trends, from the advent of cholera in the early nineteenth century to the rise in hurricane frequency in the twentieth century demonstrate the importance of environmental regulation in urban processes, as well as the utility of environmental history to address issues in the present day. Moreover, New York City's environmental history upholds the power of urban design in the making of a livable and organized city where the public has access not only to basic provisions such as potable water but other important elements of urban living such as built greenspace to maintain a bond with nature that will be discussed further in the next chapter on sustainable design. Lastly, the city's environmental history also speaks volumes about the power of civic engagement and local government, especially in times when federal government does not act efficiently or swiftly enough to address an environmental crisis, which will be further expounded on in Chapter 4 on environmental policy and economics in New York City.

### *Chapter 3. Sustainable Design of the City*

Within the last fifty years or so cities like New York have been exhibiting environmental challenges unprecedented in their history. In the nineteenth century when disease was one of its primary challenges, the city created building and sanitary codes to mitigate the influence of overcrowding on the spread of disease.<sup>131</sup> Today, however, New York City's environmental

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<sup>130</sup> Maguire, "Hurricane Sandy," 15.

<sup>131</sup> Alexandros Washburn, *The Nature of Urban Design: A New York Perspective on Resilience* (Washington, D.C.: Island Press, 2013), 7.

challenges are less rooted in one aspect of urban living and more so in the city as one metropolitan machine. This begs the question of how climate change is affecting New York City by way of forcing city leaders and urban planners to rapidly innovate and rethink the city's structure? This introduces the notion of *resiliency*, a vital ambition upheld by many of these stakeholders in order to address the city's vulnerability to the impacts of climate change. Additionally, *sustainability* is a second major goal that involves generally reducing the city's impact on the environment. And one of the most effective ways to heighten a city's resiliency and sustainability is through urban design of which there are two major types: *adaptive* which refers to methods implemented to adjust to changes in the environment, and *mitigative* which involves reducing one's footprint and waste in an effort to combat climate change. Thus, the focus of this chapter is how New York, being that it is a major coastal city, utilizes urban design to bolster its resiliency against and adaptive capacity to storm surge and flooding and mitigate its footprint as part of its commitment to sustainability and a carbon-free economy.

*New York City's Distinctive Urban Layout.* There are several reasons why New York is considered one of the greenest major cities. Some might attribute it to its progressive government, others to its cultural ideology, while a third driving factor, according to David Owen's *Green Metropolis* is rooted in the structure of the city that fundamentally does not allow for these oversized, energy-inefficient homes that are archetypal of other parts of the nation.<sup>132</sup> Instead, homes are smaller which forcibly minimizes the amount of space occupied per capita.<sup>133</sup> Secondly, the separation between the home, workplace, and amenities such as grocery stores, restaurants, and laundromats tends to be relatively small. Lastly, with a subway system as efficient and widespread as New York's Metropolitan Transportation Authority (MTA), there is

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<sup>132</sup> David Owen, *Green Metropolis*, (New York, NY: Penguin Group, 2009), 46.

<sup>133</sup> Owen, *Green Metropolis*, 47.

less need to drive places that are not within walking distance. In fact, in most cases it is actually faster to walk or take public transit which aids congestion control by making transit more convenient and driving less so.<sup>134</sup> Owen adds that the layout of Manhattan especially facilitates walking as street blocks are relatively short which makes a mile down Broadway seem miniscule whereas in other, less lively areas a mile may seem more daunting. And even in Manhattan, walking uptown or downtown along avenues is a very different experience from walking eastward or westward across streets as street blocks tend to be longer and more residential.<sup>135</sup>

*Running the Numbers.* In 1950, New York City's population reached ten million making it the world's first megacity.<sup>136</sup> Therefore, it should come as no surprise that the primary source of New York's greenhouse gas emissions comes from its buildings and how they power, heat, and cool themselves, ultimately resulting in almost 70% of the city's emissions with the lion's share from commercial buildings, followed by larger and smaller residential spaces (updated from 80% to accurately reflect progress since source publication in 2013).<sup>137</sup> In contrast, the national average for building emissions is approximately 30%.<sup>138</sup> Owen suggests that this disparity stems from the relatively small number of cars in the city compared to that of the rest of the nation which offsets the proportion of emissions from other sources while low car emissions in New York drives up emissions from its other sectors making building emissions appear more significant.<sup>139</sup> In fact, only 7% of carbon emissions come from the MTA, which is used by approximately seven million people daily.<sup>140</sup> Moreover, 27% of the city is open space, more than

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<sup>134</sup> Owen, *Green Metropolis*, 122.

<sup>135</sup> Owen, *Green Metropolis*, 168.

<sup>136</sup> Timon McPhearson, Zoé A. Hamstead, and Peleg Kremer, "Urban Ecosystem Services for Resilience Planning and Management in New York City," *Ambio* 43, no. 4 (May 2014): accessed November 6, 2018, doi:10.1007/s13280-014-0509-8.

<sup>137</sup> Washburn, *The Nature of Urban Design*, 28.

<sup>138</sup> Owen, *Green Metropolis*, 16.

<sup>139</sup> Owen, *Green Metropolis*, 16-17.

<sup>140</sup> Washburn, *The Nature of Urban Design*, 29.

any other major city in the nation.<sup>141</sup> This is not to suggest that that 70% is illusory, rather, it highlights the city's environmental successes in other sectors such as efficient transportation, while also emphasizing areas for improvement (i.e. more energy efficient buildings).

In total, New York City's carbon footprint amounts to 49.3 million metric tons of emissions per year.<sup>142</sup> For reference, Los Angeles' footprint is approximately 52 million metric tons<sup>143</sup> and its population is less than half of that of New York.<sup>144</sup> Individual emissions of city buildings also depend on how they were built; for example, a relatively older building with excellent insulation and thick walls yet an old boiler that runs on fuel oil emits twice the amount of emissions than if it were to run on natural gas.<sup>145</sup> With that being said, the city is constantly under construction with new energy efficient building plans equipped with climate controls and it is estimated that if every old building were to be revamped with these features, the city could reach a 30% reduction in carbon emissions by 2030.<sup>146</sup> Unfortunately, this would require an extensive undertaking as almost 80% of city buildings standing by 2030 have been built already.<sup>147</sup> Nevertheless, in order to reach its ambitious climate goals, the city intends to undertake several large scale green initiatives in multiple areas, including building laws and codes, all of which will be discussed in Chapter 4 on environmental law and economics.

*Resilient Design of the Coastal City.* Mayor of New York Bill De Blasio's *OneNYC* is a strategy plan to improve and accelerate the city's resiliency and sustainability efforts. The plan is

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<sup>141</sup> McPhearson, Hamstead, and Kremer, "Urban Ecosystem Services for Resilience Planning and Management in New York City."

<sup>142</sup> Washburn, *The Nature of Urban Design*, 29.

<sup>143</sup> "City Carbon Index: Los Angeles," Global Green, Global Green, USA, May 12, 2015, accessed October 29, 2019, <https://www.globalgreen.org/blog/city-carbon-index-los-angeles>.

<sup>144</sup> United States Census Bureau, U.S. Department of Commerce, accessed October 27, 2019, [https://www.census.gov/glossary/#term\\_Populationestimates](https://www.census.gov/glossary/#term_Populationestimates).

<sup>145</sup> Washburn, *The Nature of Urban Design*, 27.

<sup>146</sup> Washburn, *The Nature of Urban Design*, 27.

<sup>147</sup> Ibid.

an extended and more comprehensive version of former Mayor Bloomberg's *PlaNYC*, which will occasionally be referenced when appropriate. The current plan is broken down into nine individual sections, though volume seven titled "A Livable Climate" will primarily be used in this paper.

With 35% of its surface comprised of water<sup>148</sup> and a population of nearly nine million people, around 500,000 of which live along the approximately 570 miles of coastline, New York City is incredibly vulnerable to storm surge and flooding.<sup>149</sup> To address this, *OneNYC* adopts several green infrastructure efforts to confront and adapt to the city's flood and water management issues, undertaken by the Department of Environmental Protection.<sup>150</sup> The department has since devised several water management and flood protection programs that integrate green infrastructure, such as turning impermeable rooftops and abandoned lots into more productive spaces with storm water absorption capacity that also function as habitats.<sup>151</sup> The department also plans to invest over \$185 million dollars into the designing of rainwater retaining green and blue roofs for several building types, and bioswales and rain gardens to absorb additional runoff.<sup>152</sup> Other design methods include human-made infrastructure, also known as "hard armoring" such as levees and dikes as well as naturally occurring "soft armoring" such as through the restoration of ecosystems like wetlands and beaches.<sup>153</sup> Lastly, the city has partnered with the United States Army Corps of Engineers to reinforce the shoreline and

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<sup>148</sup> McPhearson, Hamstead, and Kremer, "Urban Ecosystem Services for Resilience Planning and Management in New York City."

<sup>149</sup> Washburn, *The Nature of Urban Design*, 41.

<sup>150</sup> McPhearson, Hamstead, and Kremer, "Urban Ecosystem Services for Resilience Planning and Management in New York City."

<sup>151</sup> McPhearson, Hamstead, and Kremer, "Urban Ecosystem Services for Resilience Planning and Management in New York City."

<sup>152</sup> *Ibid.*

<sup>153</sup> Jenna Schweitzer, "Climate Change Legal Remedies: Hurricane Sandy and New York City Coastal Adaptation," *Vermont Journal of Environmental Law* 16, no. 2 (Fall 2014): accessed September 23, 2019, doi:10.2307/vermjenvilaw.16.2.243, 257.

harbor by investing over \$1 billion dollars into resiliency projects such as the construction of almost five miles of dunes spanning across Rockaway and the creation of the “Staten Island Levee Project” which will confront flood risk and increase the area’s adaptive capacity along the shore.<sup>154</sup>

All urban design programs that are not specifically designed to protect against storm surge and flooding in and of themselves are expected to be carried out in accord with the city’s “Climate Resiliency Design Guidelines” which maintain that any effective plan should be able to not only adapt to adverse environmental changes but help to mitigate them as well.<sup>155</sup> For example, buildings that are particularly vulnerable to heavy precipitation and flooding should A) minimize impermeable surfaces B) integrate efforts to reduce storm water volume such as evaporation, water recycling, and delayed drainage C) implement water storage methods such as bioswales D) protect especially low-lying areas from flooding E) devise strategies to maintain clear catch basin grates F) account for exterior and interior water management in the protection of perimeters G) develop water damage protective measures of basement level utilities.<sup>156</sup>

In addition to this, city architects and engineers of new building development projects are expected to account for the “Urban Heat Island” effect (i.e. the impacts of urban living and operations on local temperature) and make efforts to mitigate the building’s contribution to said effect.<sup>157</sup> Effective mitigative methods include fortifying the reflective capacity of the building and surrounding area such as through constructing lighter surfaces, adding more natural shade sources (i.e. trees and vegetation), installing solar panels, meeting and/or exceeding city

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<sup>154</sup> “A Livable Climate,” OneNYC 2050, NYC.Gov, accessed October 21, 2019,

<https://onenyc.cityofnewyork.us/wp-content/uploads/2019/05/OneNYC-2050-A-Livable-Climate.pdf>, 23.

<sup>155</sup> “Climate Resiliency Design Guidelines,” Mayor's Office of Resiliency, City of New York, March 2019, accessed September 27, 2019, <https://www1.nyc.gov/site/orr/index.page>, 17.

<sup>156</sup> “Climate Resiliency Design Guidelines,” Mayor's Office of Resiliency, 19.

<sup>157</sup> *Ibid.*, 13.

insulation standards, and integrating green and blue roofs to maximize cooling capacity.<sup>158</sup> Other methods that are both mitigative and adaptive include adding bioswales, rain gardens, and other porous greenspace wherever possible to promote carbon sequestration and water retention.<sup>159</sup> Lastly, the design guidelines refer to infrastructure projects that may be located in particularly flood-prone areas such as along coastlines and shores, specifying that architects of such projects should first explore alternative sites and, if they deem that no better or alternative site exists, they are expected to include barriers with adaptive capacity to storm surge and water damage such as flood walls.<sup>160</sup> Moreover, these projects should install protective and adaptive measures for electrical equipment, including backup equipment, and might even designate a total flood proof area for the most important and/or costly equipment.<sup>161</sup>

*Case Study: The Big U.* In 2012 Hurricane Sandy ripped through the Northeast, resulting in tens of billions of dollars in damages in the Tri-State area alone.<sup>162</sup> In New York City, the storm especially decimated the Lower Manhattan neighborhood, as well as a large portion of the subway system. As part of its mission to rebuild Lower Manhattan and reinforce it through more robust and self-sufficient infrastructure in anticipation of the next extreme event, New York City has undertaken several climate change adaption and mitigation design projects, ultimately investing approximately \$500 million dollars into their completion. The main authority of this venture is the Bjarke Ingels Group, a Danish architecture firm who's design proposal, the "Big U," was selected in the United States Department of Housing and Urban Development's competition, *Rebuild by Design*.<sup>163</sup>

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<sup>158</sup> "Climate Resiliency Design Guidelines," Mayor's Office of Resiliency, 13.

<sup>159</sup> "Climate Resiliency Design Guidelines," Mayor's Office of Resiliency, 14.

<sup>160</sup> *Ibid.*, 28.

<sup>161</sup> *Ibid.*, 28.

<sup>162</sup> "National Climate Assessment," U.S. Global Change Research Program.

<sup>163</sup> "NYC: The BIG U," Rebuild by Design, accessed November 03, 2018, <http://www.rebuildbydesign.org/our-work/all-proposals/winning-projects/big-u>.

The Big U is set to begin construction in Spring 2020 and will integrate armoring along Manhattan’s low-lying terrain extending from West 57th Street, to the Battery, and to East 42nd Street.<sup>164</sup> The plan caters to the characteristics and topography of each neighborhood with respect to both the kinds of protective measures to implement and the specific amenities to maximize benefits in each community, which includes East River Park, Two Brides and Chinatown, and the area stretching between the Battery and the Financial District, up to the Brooklyn Bridge (pictured below).<sup>165</sup> In other words, the Big U will implement multi-purpose and self-sufficient infrastructure to serve as flood protection and mediums for community engagement and recreation through parks, waterfront access, and other amenities around this infrastructure. Aside from necessary hard armoring such as floodwalls, the proposal also utilizes soft armoring as a method of biomimicry that will build off of the natural greenspace of each area and construct new topography features to control flooding and bolster water retention.<sup>166</sup>

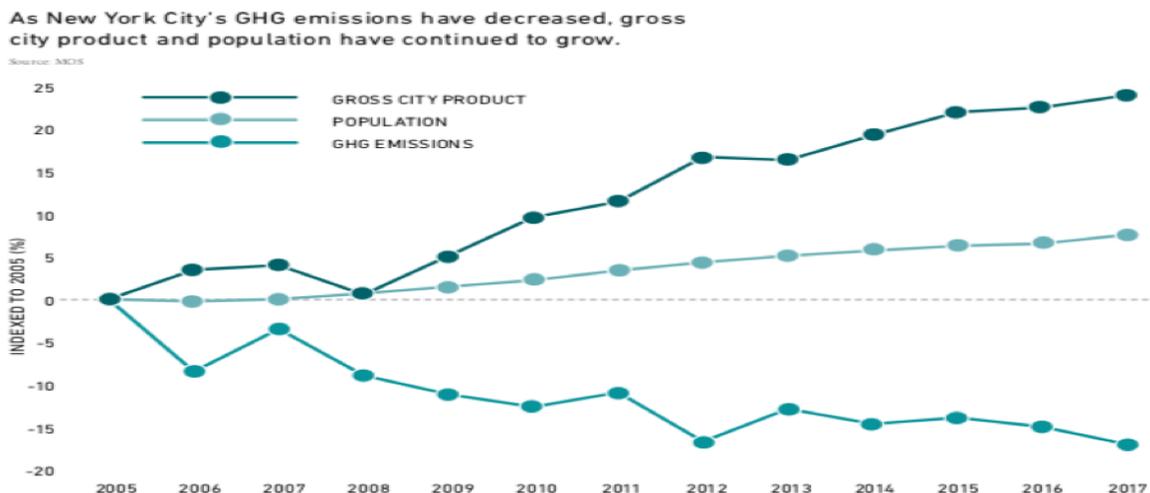


Figure 2. Lower Manhattan Coastal Resiliency Area.<sup>167</sup>

<sup>164</sup> "NYC: The BIG U," Rebuild by Design.

<sup>165</sup> "NYC: The BIG U," Rebuild by Design.

<sup>166</sup> Bjarke Ingels Group, "The Big U," Rebuild by Design, The U.S. Department of Housing and Urban Development, accessed September 28, 2019, <http://www.rebuildbydesign.org/data/files/675.pdf>, 117.

<sup>167</sup> Figure 2. Lower Manhattan Coastal Resiliency Area. "A Livable Climate," OneNYC 2050, NYC.Gov, accessed October 21, 2019, <https://onenyc.cityofnewyork.us/wp-content/uploads/2019/05/OneNYC-2050-A-Livable-Climate.pdf>, 22.

*The Big U: East River Park.* The East River Park component of the proposal will be carried out under the East Side Coastal Resiliency project, while the other two areas will be implemented under the Lower Manhattan Coastal Resiliency project.<sup>168</sup> To address the specific damage caused to the East River Park area, a “bridging berm” will be constructed as a protective and adaptive measure as well as an extensive multi-berm system spanning between the park and Franklin D. Roosevelt Drive (FDR Drive), both of which will shield the neighborhood from storm surge and flooding while also contributing to the aesthetic appearance of the area by providing additional greenspace.<sup>169</sup> Moreover, a green corridor will be constructed to extend over the bottom level roadway, giving upland residents easy access to the elevated park and waterfront, as well as bike lanes and public space for sports and other recreation.<sup>170</sup> Salt-tolerant vegetation will also be planted for community enjoyment, as well as water retention, carbon sequestration, and shade.<sup>171</sup> Lastly, the already existing greenspace near the waterfront will be expanded and deployable panels will be installed to form a “line of vertical protection” that can be utilized as barriers during periods of flooding and storm surge.<sup>172</sup>

*The Big U: Two Bridges and Chinatown.* The specific design proposal for the Two Bridges and Chinatown area features a new highway with adaptive “deployable walls” that can come down vertically in the event of extreme weather to reduce impact.<sup>173</sup> When the walls are up and horizontal during periods of “rest,” they will act as the ceiling to the highway that local artists can decorate and under which people can walk and participate in community activities.<sup>174</sup> Using digital rendering, the image on the next page depicts these walls during periods of rest and

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<sup>168</sup> "NYC: The BIG U," Rebuild by Design.

<sup>169</sup> Bjarke Ingels Group, “The Big U,” Rebuild by Design, 117.

<sup>170</sup> Bjarke Ingels Group, “The Big U,” Rebuild by Design, 117.

<sup>171</sup> "NYC: The BIG U," Rebuild by Design.

<sup>172</sup> Bjarke Ingels Group, “The Big U,” Rebuild by Design, 117.

<sup>173</sup> Bjarke Ingels Group, “The Big U,” Rebuild by Design, 11.

<sup>174</sup> Ibid., 11.

demonstrates their transformation during both a storm surge and blizzard. The plan will also flood-proof nearby public housing by moving utilities to safer locations and fortifying basements. It will also construct new public housing and provide compensation to incentivize the evacuation of ground-floor apartments, which will be replaced with public amenities such as laundromats.<sup>175</sup> Lastly, porous space will line city streets to promote water absorption and drainage.



*Figure 3. Digital Rendering of Deployable Walls.*<sup>176</sup>

*The Big U: The Battery and Financial District:* The Battery and Financial District area will feature an extensive system of berms so as to form an upland landscape acting as both a barrier against flooding and water retention source.<sup>177</sup> Moreover, the plan proposes converting the Coast Guard building into a maritime museum and constructing an elevated pathway that will connect to the Battery Maritime Building’s mezzanine level, as well as elevated bike paths that lead to other amenities such as pavilions, all of which will serve as flood protection in and of

<sup>175</sup> Bjarke Ingels Group, “The Big U,” *Rebuild by Design*, 11.

<sup>176</sup> *Figure 3. Digital Rendering of Deployable Walls.* Bjarke Ingels Group, “The Big U,” *Rebuild by Design*, 145.

<sup>177</sup> *Ibid.*, 159.

themselves.<sup>178</sup> In addition to this, some pavilions will be anchored by subsurface foundation and will have flood walls in their center containing “pocket flood doors” to be deployed as “continuous vertical flood barrier[s].”<sup>179</sup> Lastly, a floodwall will be constructed in alignment with FDR Drive as it connects to the maritime building.<sup>180</sup> The image below depicts this vision in its entirety.



Figure 4. *Digital Rendering of Design Proposal for the Battery.*<sup>181</sup>

*Case Study: “East Shore Special Coastal Risk District and Rezoning.”* The “East Shore Special Coastal Risk District and Rezoning” is another example of adaptive policy that was adopted in September 2017 and effectively rezones especially vulnerable areas along Staten Island’s East Shore.<sup>182</sup> The three affected areas include Oakwood Beach, Ocean Breeze, and Graham Beach that were designated “Enhanced Buyout Areas” after Hurricane Sandy due to their particularly low-lying position and proximity to the coastline.<sup>183</sup> Qualifying properties

<sup>178</sup> Bjarke Ingels Group, “The Big U,” *Rebuild by Design*, 159.

<sup>179</sup> Bjarke Ingels Group, “The Big U,” *Rebuild by Design*, 162.

<sup>180</sup> “NYC: The BIG U,” *Rebuild by Design*, 12.

<sup>181</sup> *Figure 4. Digital Rendering of Design Proposal for the Battery.* Bjarke Ingels Group, “The Big U,” *Rebuild by Design*, 173.

<sup>182</sup> “East Shore Neighborhoods,” *Resilient Neighborhoods*, Department of City Planning, accessed October 26, 2019, <https://www1.nyc.gov/site/planning/plans/resilient-neighborhoods/east-shore-rezoning.page>.

<sup>183</sup> “East Shore Neighborhoods,” *Resilient Neighborhoods*, Department of City Planning.

include those that were substantially damaged by Hurricane Sandy and can be sold to the state at “pre-storm value.”<sup>184</sup> The state then demolishes the buildings and uses the land to develop new open space to serve as a protective buffer against future storm surge and flooding in the area.<sup>185</sup> In addition to this, as part of a rezoning strategy, more land is being converted into open space and future development is restricted in particularly vulnerable areas.<sup>186</sup> The strategy also creates a “Special Coastal Risk District” in an effort to ensure that public safety will be prioritized in all new development plans, as well as wetland conservation and open space.<sup>187</sup> Within this district, new development is restricted to “single-family detached residences” and must be approved by the given area’s City Planning Commission.<sup>188</sup> Lastly, the strategy allows damaged homes to be rebuilt as aforesaid detached residences as well as for minor resiliency measures such as elevations to be incorporated into existing homes and buildings.<sup>189</sup>

The future of New York City will involve more intense and frequent flooding and storm surge, so its mission of resiliency must be carried out with a degree of urgency to avoid even more damage on par with or even worse than that of Hurricane Sandy as described in Chapter 1. The Big U and other planning documents laid out in this chapter are all excellent examples of how cities can unite their built and natural environment through adaptive and mitigative design to reduce their vulnerability to the impacts of climate change, as well as their overall footprint. This chapter demonstrates how the city pursues both short term and long term strategies where short term for the most part refers to adaptive and resilient measures against the threat of impending natural disaster whereas long term largely includes sustainable and mitigative design

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<sup>184</sup> “East Shore Neighborhoods,” Resilient Neighborhoods, Department of City Planning.

<sup>185</sup> “East Shore Neighborhoods,” Resilient Neighborhoods, Department of City Planning.

<sup>186</sup> Ibid.

<sup>187</sup> Ibid.

<sup>188</sup> Ibid.

<sup>189</sup> Ibid.

methods adopted by the city to combat climate change and reduce its footprint over the next few decades in alignment with its commitment to a carbon free economy. Both kinds of design strategies together make for a comprehensive action plan to address what is perhaps the greatest challenge faced by humanity yet.

#### *Chapter 4. Environmental Policy and Economics*

In the absence of strong federal climate action, New York City alone is pursuing some of the most ambitious climate initiatives in the nation.<sup>190</sup> That said, in order for a major city like New York to foster change, it must gauge how much intervention and regulation is appropriate and adequate while still allowing free enterprise to function.<sup>191</sup> The risk being that excessive intervention can threaten innovation whereas a lack of intervention can result in environmental injustice, which describes an inequality in the way that environmental damage and burdens are distributed among people and communities.<sup>192</sup> This chapter will explore how New York City's local government manages to promote and pursue climate action without encroaching on the urban operations and enterprises that characterize the city. It also expounds on how the city and policy makers are working to resolve environmental injustice, which refers to the inequalities and burdens of climate change that disproportionately afflict disadvantaged communities largely in the form of damage from extreme weather events and respiratory issues caused by air pollution from smokestacks and fossil fuel combustion.<sup>193</sup> Similar to Chapter 3 which focused on

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<sup>190</sup> Christina D. Rosan, "Can PlaNYC Make New York City "Greener and Greater" for Everyone?: Sustainability Planning and the Promise of Environmental Justice," *Local Environment* 17, no. 9 (October 2012): 959-76, accessed September 11, 2018, doi:10.1080/13549839.2011.627322, 960.

<sup>191</sup> Tyler G. Miller and Scott Spoolman, *Living in the Environment: Principles, Connections, and Solutions*, 17th ed., Chapter 24: Politics, Environment, and Sustainability, (Belmont, CA: Brooks/Cole Publishing, 2011), 638.

<sup>192</sup> Miller and Spoolman, *Living in the Environment*, 638.

<sup>193</sup> "The New York State Climate and Community Protection Act," NY Renew.

climate change adaptation and mitigation through urban design, this chapter explores the adaptive and mitigative policies implemented by New York City to confront the climate crisis.

*New York City's "Green New Deal."* New York is one of the most ambitious cities with respect to climate action and legislation. It has demonstrated time and time again its commitment to climate action despite resistance and inaction in the federal government, articulated through its withdrawal from the Paris Climate Agreement, among other monumental decisions.<sup>194</sup> In April 2019, Mayor de Blasio released the city's own "Green New Deal" which commits \$14 billion dollars to climate action through investment and legislation that will chiefly target inequality, renewable energy expansion, and the retrofitting of city buildings.<sup>195</sup>

The deal lays out several strategies for accelerating the city's mission of climate action, including A) a commitment to carbon neutrality by 2050 and 100% clean electricity by 2040 B) mandating that all existing buildings of 25,000 square feet or more cut emissions through upgrades C) transforming the city government into a 100% carbon-free network through a new connection with Canadian hydropower D) requiring a city-wide organic collection and recycling system and providing more composting locations E) reducing waste and specifically single-use plastic ware along with the phasing out of processed meat and beef purchases F) and lastly committing to the "Sustainable Development Goals" laid out by the United Nations which will also make New York the first city to voluntarily submit itself for local review to the United Nations effectively giving it more authority and involvement in the city's climate action.<sup>196</sup>

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<sup>194</sup> "Action on Global Warming: NYC's Green New Deal," The Official Website of the City of New York, City of New York, April 22, 2019, accessed October 17, 2019, <https://www1.nyc.gov/office-of-the-mayor/news/209-19/action-global-warming-nyc-s-green-new-deal#/0>.

<sup>195</sup> "Action on Global Warming," The Official Website of the City of New York.

<sup>196</sup> Ibid.

*Case Study: “Climate Leadership and Community Protection Act.”* For the past two semesters I have had the pleasure of working with *Our Climate*, a non-profit environmental activism organization geared towards bolstering youth engagement in climate action. Last Spring, I lobbied for the enactment of the “Climate Leadership and Community Protection Act,” which confronts many of the goals laid out in the “Green New Deal” on a state level. In June of this year, the act passed both the Senate and Assembly and was signed into law by Governor Andrew Cuomo in July.<sup>197</sup> The original act committed the state of New York to a 100% renewable energy economy by 2050 and 40% of revenue to be reinvested in frontline and vulnerable communities<sup>198</sup> but was revised as part of a compromise between the Senate and Assembly resulting in an 85% and 35% commitment, respectively.<sup>199</sup> Even so, this ambitious act will enforce a shift towards renewable energy on a state and economy-wide level and improve present and future conditions in frontline communities.<sup>200</sup>

This semester I continued my collaboration with *Our Climate* as well as interned for a New York based pop culture magazine covering its environmental policy and sustainability section. As part of both positions I focused on the actual implementation of the act that has since been delegated to the “New York State Climate Action Council” to which two major fossil fuel stakeholders have been appointed. Despite this setback, the act is nonetheless written into state law and thus enforceable. Still, my colleagues and I have been campaigning with other groups to encourage local representatives to appoint more appropriate and forward-thinking climate leaders to the committee to ensure the act’s swift and successful implementation.

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<sup>197</sup> “The New York State Climate and Community Protection Act,” NY Renewables, NY Renewables, accessed October 19, 2019, <https://www.nyrenews.org/what-we-do>.

<sup>198</sup> “The New York State Climate and Community Protection Act,” NY Renewables.

<sup>199</sup> “Assembly Passes Climate Leadership And Community Protection Act,” New York State Assembly, June 20, 2019, <https://nyassembly.gov/Press/files/20190620.php>.

<sup>200</sup> “The New York State Climate and Community Protection Act,” NY Renewables.

Another piece of legislation currently in early works is the “Climate and Community Investment Act” which would put a price on pollution through an increasing fee.<sup>201</sup> The revenue collected would then be reinvested into funding for renewable energy and energy efficiency projects, disadvantaged communities, energy rebates, and support for communities that have been financially impacted by the transition away from fossil fuels.<sup>202</sup> In other words, this act ventures to make apparent the hidden costs of pollution and fossil fuels while simultaneously easing the transition away from these practices. Together, both the “Climate Leadership and Community Protection Act” and the “Climate and Community Investment Act” aspire to remediate the environmental injustices and burdens of global climate change which generally manifest in disadvantaged communities and communities of color.<sup>203</sup>

*OneNYC*. Mayor de Blasio’s *OneNYC* is a comprehensive strategy plan for the future of New York. The plan states four goals: to attain carbon neutrality by 2050 and 100% clean electricity by 2040, bolster the resiliency of communities and infrastructure, provide more economic opportunities for people, and advocate for environmental justice.<sup>204</sup> *OneNYC* in part reflects the failures of the federal government to implement swift and effective nation-wide environmental policy, coupled with its rolling back on several important climate initiatives such as its repeal of the Obama Administration’s *Clean Power Plan* and its withdraw from the 2015 Paris Climate Agreement.<sup>205</sup> The plan consists of several resiliency and sustainability initiatives geared towards achieving its goals which in themselves uphold a general mission of climate change adaptation and mitigation.<sup>206</sup>

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<sup>201</sup> “The New York State Climate and Community Protection Act,” NY Renewables.

<sup>202</sup> “The New York State Climate and Community Protection Act,” NY Renewables.

<sup>203</sup> Ibid.

<sup>204</sup> “A Livable Climate,” *OneNYC 2050*, 3.

<sup>205</sup> “A Livable Climate,” *OneNYC 2050*, 3.

<sup>206</sup> Steven Cohen, *Sustainability Management: Lessons From and For New York City, America, and the Planet* (New York, NY: Columbia University Press, 2011), 114.

In addition, the plan confronts environmental injustice and social inequality in several ways including A) creating new and meaningful employment pathways and opportunities B) devising new ownership options for organizations to retain value in frontline communities C) improving public transportation with respect to efficiency, accessibility, and safety D) resolving health inequality through better healthcare access and cleaner air E) increasing access to nature and fresh produce in all communities F) constructing more affordable housing G) bolstering education to ensure every child is equipped with the resources to be successful in life.<sup>207</sup>

*OneNYC, A More Resilient City.* “The first job of city leaders is to protect people, and [Hurricane] Sandy made clear that New York was vulnerable in ways we couldn’t delay addressing.”<sup>208</sup> To reiterate, adaptive policy in the context of global climate change largely refers to measures taken to strengthen and prepare an place for impending and future damage and other hazards. Through a series of legislations and projects to be discussed in this chapter, New York City is striving towards heightened resiliency and increased adaptive capacity after Hurricane Sandy and in anticipation of the next inevitable climate disaster. More specifically, the city will retrofit its one million buildings and invest over \$20 billion dollars into infrastructural and energy efficiency upgrades to protect against sea level rise and other dangerous weather events which, in addition to helping make the city more resilient, will also create thousands of new jobs.<sup>209</sup>

*OneNYC: “Climate Resiliency Design Guidelines.”* As part of its mission of resiliency, New York City will continue to revise and enforce the “Climate Resiliency Design Guidelines” detailed in Chapter 3 which guide design projects in alignment with said mission.<sup>210</sup> Within these

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<sup>207</sup> “A Livable Climate,” OneNYC 2050, 10.

<sup>208</sup> Michael Bloomberg and Carl Pope, *Climate of Hope* (New York, NY: St. Martin’s Press, 2017), 224.

<sup>209</sup> “A Livable Climate,” OneNYC 2050, 28.

<sup>210</sup> “A Livable Climate,” OneNYC 2050, 27.

guidelines is a consideration of the economic benefits of climate conscious design. These benefits are divided into three categories, the first being “direct benefits” which include reduced or avoided loss and harm caused to facilities and the appliances and technology within them.<sup>211</sup> Secondly, “indirect benefits” refer to reduced or avoided loss caused to services such as roads and bridges with respect to the consistent value they bring to daily operations and in times of emergency.<sup>212</sup> The last kind is “other benefits” which includes the social advantages of these facilities.<sup>213</sup>

“*Green Infrastructure Plan.*” Another adaptive strategy undertaken by New York City adopts a “Green Infrastructure Plan” into its agenda which seeks to reduce the risk of disaster while simultaneously upholding ecosystem values (e.g. using rain gardens as a wastewater treatment method).<sup>214</sup> This strategy also involves updating efforts and resources to control and protect against storm surge and flooding such as through the remapping of hazardous areas and additional funding for more advanced surge modelling technology.<sup>215</sup> In addition to this, stricter zoning laws have been implemented that mandate that all large urban design projects conduct thorough climate risk assessments as a response to Hurricane Sandy, which revealed that 95% of the buildings that were destroyed or suffered severe damage from the storm were over 50 years old.<sup>216</sup> Pictured on the following page is a graph demonstrating the cost effectiveness of this “Green Infrastructure Plan” compared to that of traditional, human engineered grey infrastructure.

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<sup>211</sup> “Climate Resiliency Design Guidelines,” Mayor's Office of Resiliency, 35.

<sup>212</sup> “Climate Resiliency Design Guidelines,” Mayor's Office of Resiliency, 35.

<sup>213</sup> Ibid.

<sup>214</sup> William Solecki, “Urban Environmental Challenges and Climate Change Action in New York City,” *International Institute for Environment and Development*, (2012): accessed October 29, 2019, <https://journals.sagepub.com/doi/pdf/10.1177/0956247812456472>, 568.

<sup>215</sup> Solecki, “Urban Environmental Challenges and Climate Change Action in New York City,” 568.

<sup>216</sup> Bloomberg and Pope, *Climate of Hope*, 226.

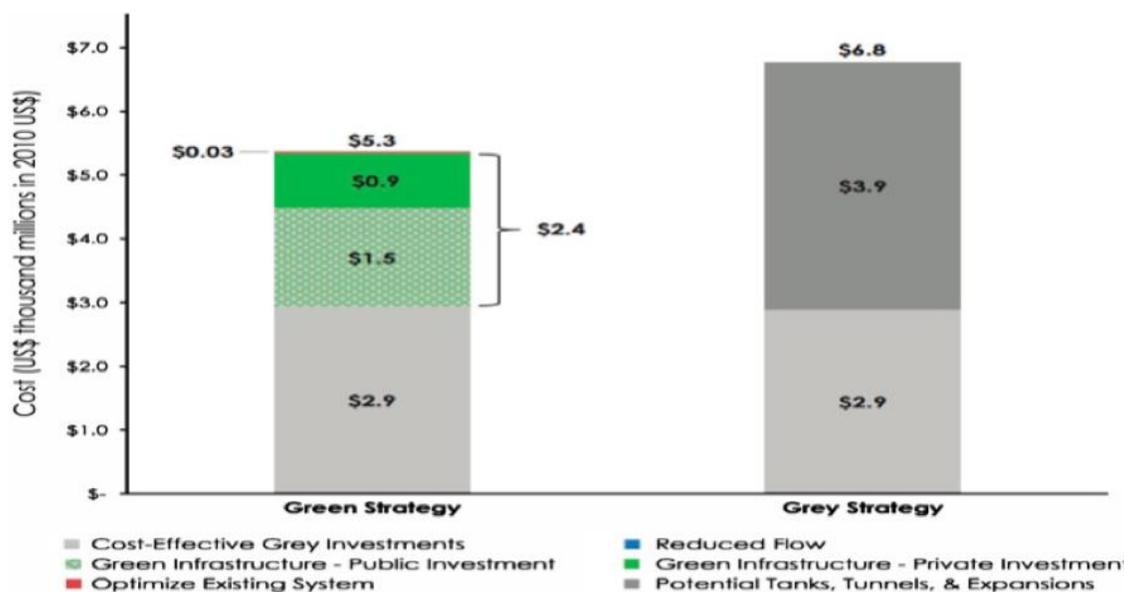


Figure 5. "NYC Green Infrastructure Plan Cost Effectiveness."<sup>217</sup>

*Homeowner Insurance and Protection.* Another resiliency strategy is the city's collaboration with the state's "New York Smart Home Buyout Plan" which incentives particularly vulnerable homeowners to move elsewhere, though this has proven difficult in such a crowded city where space is lacking.<sup>218</sup> Another response to Sandy carried out by former Mayor Bloomberg involved gathering fly-over measurements of the city that was then submitted to the Federal Emergency Management Agency (FEMA) to produce updated flood maps which ultimately required more homes and businesses holding "federally backed mortgages" to enroll in aforesaid flood insurance.<sup>219</sup> In addition, the city will continue to support retrofitting efforts as well as flood-insurance affordability and accessibility by partnering with FEMA to encourage more enrollment from especially vulnerable communities.<sup>220</sup> Moreover, the city will ensure that at least one transportation system will operate during crisis to ensure that emergency services are

<sup>217</sup> Figure 5. "NYC Green Infrastructure Plan Cost Effectiveness." McPhearson, Hamstead, and Kremer, "Urban Ecosystem Services for Resilience Planning and Management in New York City."

<sup>218</sup> Schweitzer, "Climate Change Legal Remedies."

<sup>219</sup> Bloomberg and Pope, *Climate of Hope*, 233.

<sup>220</sup> "A Livable Climate," OneNYC 2050, 24.

still available.<sup>221</sup> Lastly, the mandating of private power companies to satisfy certain criteria to ensure the reliability of their public service in times of disaster and emergency demonstrates how the city collaborates with a private entity in its effort to protect the public.<sup>222</sup>

*OneNYC, A More Sustainable City.* In contrast to adaptive policy which, for the most part, endeavors to make the city more resilient and prepared for the more immediate hazards of global climate change, mitigative policy confronts the climate crisis in a more conceptual manner as it strives to reduce both the short-term and long-term impacts through sustainable measures in an effort to reduce carbon and other greenhouse gas emissions and pursue a carbon free economy.

*OneNYC: Greening the Grid.* In 2009, New York City under Mayor Bloomberg pledged to reduce emissions by 30% by 2030.<sup>223</sup> In 2012, the city joined forces with the Regional Greenhouse Gas Initiative to design a multistate program geared towards reducing emissions by 10% by the year 2020.<sup>224</sup> Today, the city's mitigative policy initiatives fall under a larger goal of attaining carbon neutrality by 2050 and 50% clean electricity by 2030, and ultimately 100% clean electricity by 2040.<sup>225</sup> One venture adopted to achieve 100% clean electricity is by expanding the use of renewable sources in an effort to "green the grid," most notably through nuclear, hydro, wind, and solar power, which already make up a large portion of the city's energy sources, with the exception of natural gas.<sup>226</sup> To that point, the city has begun using

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<sup>221</sup> "A Stronger, More Resilient New York - Transportation Chapter," Adaptation Clearinghouse, Georgetown Climate Center, accessed December 20, 2019, <https://www.adaptationclearinghouse.org/resources/a-stronger-more-resilient-new-york-transportation-chapter.html>.

<sup>222</sup> Bloomberg and Pope, *Climate of Hope*, 234-235.

<sup>223</sup> Cohen, *Sustainability Management*, 62.

<sup>224</sup> "New York Acts on Climate Change," Global Reference on the Environment, Energy, and Natural Resources (GREENR), 2012, accessed October 22, 2019, <http://find.galegroup.com.avoserv2.library.fordham.edu>.

<sup>225</sup> "A Livable Climate," OneNYC 2050, 12.

<sup>226</sup> "A Livable Climate," OneNYC 2050, 13.

organic waste from wastewater to generate renewable gas.<sup>227</sup> As of 2019, it has reached 27% of its 100% clean electricity by 2040 goal and 17% of its carbon neutrality goal as of 2017.<sup>228</sup>

The caveat to this goal is that half of New York City’s electricity is generated outside of its boundaries and thus must be transmitted through power lines, which have reached capacity.<sup>229</sup> As a resolution, the city will construct more lines to bolster capacity and renewable energy generation.<sup>230</sup> In the meantime, it will also ease the installation of renewable energy storage and expand roof-top solar power.<sup>231</sup> While as previously discussed, the city’s layout makes it easier to reduce emissions, especially from the transportation sector, its buildings again pose a challenge with respect to solar power as most people live in apartment buildings which lack adequate space and sunlight conducive to solar power generation.<sup>232</sup> That said, emerging technology has made solar power generation easier and thus more warranted of its high up-front costs.<sup>233</sup>

As aforesaid, the city will also coordinate with New York State to construct a new transmission line that will connect to Canadian hydropower to make the city government 100% carbon free.<sup>234</sup> It is also working towards reducing high energy costs in low-income neighborhoods, reflected through legislation such as the aforesaid Climate and Community Investment Act.<sup>235</sup> The city has achieved over \$60 million dollars in annual savings since investing billions of dollars into the development of more energy efficient municipal buildings –

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<sup>227</sup> “A Livable Climate,” OneNYC 2050, 14.

<sup>228</sup> “A Livable Climate,” OneNYC 2050, 32.

<sup>229</sup> *Ibid.*, 13.

<sup>230</sup> *Ibid.*, 14.

<sup>231</sup> *Ibid.*, 14.

<sup>232</sup> Cohen, *Sustainability Management*, 64.

<sup>233</sup> Cohen, *Sustainability Management*, 64.

<sup>234</sup> “A Livable Climate,” OneNYC 2050, 14.

<sup>235</sup> “A Livable Climate,” OneNYC 2050, 14.

whose operations account for 8% of the city’s total emissions<sup>236</sup> – resulting in a 30% reduction in municipal emissions, as well as a 17% reduction city-wide as of 2017.<sup>237</sup> Lastly, New York City will continue to explore ways to adequately reflect the social costs of fossil fuel emissions through measures such as carbon pricing, which will be discussed later on.<sup>238</sup> The image below reflects the city’s progress in reducing emissions relative to that of the world.

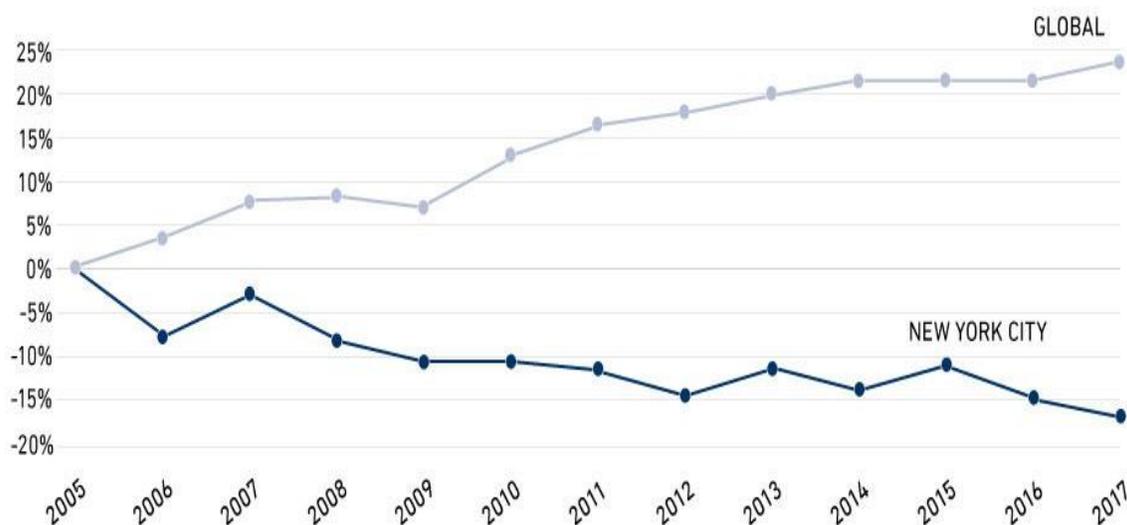


Figure 6. “Change in GHG Emissions, 2005-2017.”<sup>239</sup>

*OneNYC: Transportation.* Mitigative policy measures having to do with transportation include running the nation’s largest “electric municipal fleet” comprised of over 1,750 electric vehicles and expanding the city’s charging network both for public and government use.<sup>240</sup> Moreover, in an effort to reduce fleet emissions by 50% by the year 2025 and ultimately attain carbon neutrality by 2040, the amount and size of the vehicles will be reduced and either

<sup>236</sup> “Aligning New York City With The Paris Climate Agreement,” The City of New York, September 2017, accessed October 20, 2019, <https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/1point5-AligningNYCwithParisAgrmtFORWEB.pdf>, 12.

<sup>237</sup> “A Livable Climate,” OneNYC 2050, 7.

<sup>238</sup> “Aligning New York City With The Paris Climate Agreement,” The City of New York, 14.

<sup>239</sup> Figure 6. “Change in GHG Emissions, 2005-2017.” “New York City Today,” OneNYC 2050, City of New York, accessed October 22, 2019, <https://onenyc.cityofnewyork.us/initiatives/new-york-city-today/>.

<sup>240</sup> “A Livable Climate,” OneNYC 2050, 17.

upgraded or replaced with clean fuel ones.<sup>241</sup> The city will also generally ease the transition towards electric vehicles through additional funding and designating more curb space<sup>242</sup> in an effort to reach an electric vehicle share of 20% of all new vehicle sales by 2025, of which it has reached 1.4% as of 2017.<sup>243</sup> Moreover, an additional 244 miles of bike lane will be added.<sup>244</sup> The city will also fund major improvements to its mass transit systems and expand ride and bike-sharing programs, as well as implement more “smart parking policies” and “low emission zones.”<sup>245</sup>

*OneNYC: Recycling and Composting.* In an effort to reduce waste and emissions from landfills, the city has created the largest “curbside organics program” in the nation which reaches over a third of its urban population.<sup>246</sup> By repurposing products such as paper and plastic, as well as through composting, New York City has diverted over 20% of its waste from landfills.<sup>247</sup> Another way it has achieved this is by restricting and increasing accountability for the design choices and actions of manufacturers such as through a ban on foam material.<sup>248</sup> In order to accelerate this goal of diversion, the city will expand, improve, and mandate an organics management system through curbside pickup and additional composting sites, which will also be diverted for sustainable purposes such as energy generation and soil amending.<sup>249</sup> Additionally, in an effort to promote proper recycling, New York City will increase the accessibility of

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<sup>241</sup> “A Livable Climate,” OneNYC 2050, 17.

<sup>242</sup> “Aligning New York City With The Paris Climate Agreement,” The City of New York, 22.

<sup>243</sup> “The Plan for a Strong and Just City,” One NYC 2050, City of New York, accessed November 02, 2019, <http://onenyc.cityofnewyork.us/strategies/modern-infrastructure/>.

<sup>244</sup> “A Livable Climate,” OneNYC 2050, 7.

<sup>245</sup> “Aligning New York City With The Paris Climate Agreement,” The City of New York, 18.

<sup>246</sup> “A Livable Climate,” OneNYC 2050, 19.

<sup>247</sup> “A Livable Climate,” OneNYC 2050, 19.

<sup>248</sup> “Aligning New York City With The Paris Climate Agreement,” The City of New York, 20.

<sup>249</sup> “A Livable Climate,” OneNYC 2050, 19.

recycling programs and work alongside manufacturers in the recycling and repurposing of products.<sup>250</sup>

*OneNYC: Mitigative Infrastructure.* Despite successes in improvements to energy efficiency, buildings in New York City still account for approximately 70% of greenhouse gas emissions as of 2019.<sup>251</sup> To address this, *OneNYC* has helped to implement several energy efficiency measures such as new legislation to reduce emissions from buildings exceeding 25,000 square feet, exploring an “emissions trading regime” to ease compliance with the legislation, mandating that all new buildings be constructed to net-zero energy in compliance with current energy efficiency standards, substantially reducing city-owned building emissions, pursuing net-zero energy for wastewater recovery systems by recycling organic waste to generate renewable gas, increase support and funding for green initiatives such as retrofitting, and financing energy upgrades.<sup>252</sup>

*OneNYC: Economic Initiatives and Energy Investments.* In order to ease New York City’s transition towards a renewable energy and carbon-free economy, *OneNYC* also takes into consideration the economic benefits and costs of the goals and policies it implements. While this transition inevitably implies a loss of jobs in the fossil fuel industry, it also creates thousands of new opportunities in the renewable industry, such as in the manufacturing, construction, and landscaping sectors. Through programs such as “Urbantech NYC,” the city supports the growth of new companies geared towards sustainability and “responsible innovation” by providing the necessary resources to gain momentum in their early stage.<sup>253</sup> The city will also improve its educational and workforce systems through training programs tailored to specific industries and

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<sup>250</sup> “A Livable Climate,” *OneNYC 2050*, 19.

<sup>251</sup> “A Livable Climate,” *OneNYC 2050*, 16.

<sup>252</sup> *Ibid.*, 16.

<sup>253</sup> *Ibid.*, 28.

coordinate with partners to bring new technology and innovation opportunities to the city.<sup>254</sup> The city also intends to double its investment in climate action initiatives by the year 2021 so as to accelerate its endeavor toward economy-wide carbon neutrality.<sup>255</sup> Additionally, due to recent underperformance, New York City will divest and eventually eliminate city pension fund investments in fossil fuel reserves amounting to \$5 billion dollars as of 2019.<sup>256</sup> Instead, it will double city pension fund investments in renewable energy and energy efficiency from \$2 billion dollars as of 2019 to \$4 billion by the year 2021.<sup>257</sup> The economic benefits derived from the city's reduction in greenhouse gas emissions relative to that of its gross city product and population are represented below.

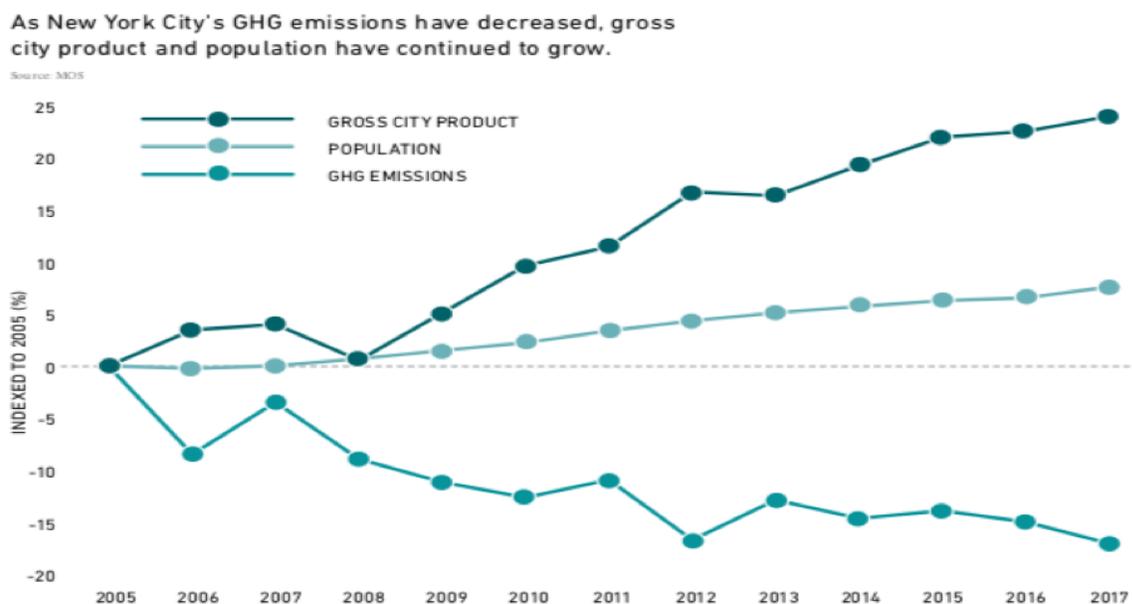


Figure 7. Economic benefits of emissions reduction.<sup>258</sup>

*Other Economic Initiatives.* In 2009, the United Nations announced that total global investments will need to amount to \$500 billion dollars annually in order to stabilize and

<sup>254</sup> "A Livable Climate," OneNYC 2050, 28.

<sup>255</sup> "A Livable Climate," OneNYC 2050, 29.

<sup>256</sup> *Ibid.*, 30.

<sup>257</sup> *Ibid.*, 33.

<sup>258</sup> Figure 7. Economic benefits of emissions reduction. "A Livable Climate," OneNYC 2050, 29.

eventually decrease greenhouse gas emissions which calls on both the private and public sector to take strong leadership initiative<sup>259</sup> One initiative from the New York public sector is its adoption of a type of loan legislation known as “Property Assessed Clean Energy” (PACE) which allows state, local, and district entities to provide funding for renewable energy and energy efficiency upgrades for qualifying properties in the form of a loan that is repaid by the owner over time and, should they choose to sell, remains fixed into the property tax bill inherited by future owners.<sup>260</sup>

Another economic initiative is the congestion surcharge that was recently enacted earlier this year.<sup>261</sup> This legislation impacts all for-hire vehicles travelling south of 96th Street known as the “congestion zone,” excluding funeral vehicles, emergency vehicles, public transportation, etc.<sup>262</sup> The surcharge ranges from \$0.75 to \$2.75 per trip depending on the type of vehicle and is charged to the passenger (i.e. individual vs. shared rides).<sup>263</sup> The surcharge has been met with vehement opposition especially from the taxi industry which has already suffered economic loss from the rise of ride-share companies such as Uber and Lyft.<sup>264</sup> Despite the economic harm to drivers, the surcharge is part of a larger cause as an environmental policy measures to reduce emissions by essentially making it more inconvenient to get around the city by car. Additionally, the lion’s share of the revenue generated will go towards MTA improvements to make public transit *more* convenient.

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<sup>259</sup> Cohen, *Sustainability Management*, 52.

<sup>260</sup> Cohen, *Sustainability Management*, 53.

<sup>261</sup> “Congestion Surcharge,” The Official Website of New York State, Department of Taxation and Finance, September 30, 2019, accessed October 29, 2019, <https://www.tax.ny.gov/bus/cs/esidx.htm>.

<sup>262</sup> “Congestion Surcharge.” The Official Website of New York State.

<sup>263</sup> *Ibid.*

<sup>264</sup> Winnie Hu, “‘Suicide Surcharge’ or Crucial Fee to Fix the Subway? Taxi Drivers Brace for Battle Over \$2.50 Charge.” *The New York Times*, The New York Times Company, January 17, 2019, accessed October 29, 2019, <https://www.nytimes.com/2019/01/17/nyregion/taxi-fee-congestion-pricing-nyc.html>.

## *Chapter 5. Proposal for a More Sustainable City*

New York City's commitment to a carbon free economy as well as the Paris Climate Agreement despite the United States' withdrawal reflects not only its commitment to climate action but its role as a leader and representative of global values. This is also demonstrated through a series of both large-scale and smaller-scale initiatives undertaken by the city towards not only creating a more resilient New York but mitigating the climate crisis for the benefit of the world at large. With that, this final chapter will integrate what has already been discussed by way of environmental history, urban design and environmental policy/economics to present a set of adaptive policy recommendations to fortify the city's resiliency and mitigative policy recommendations to address the climate crisis in its entirety.

*How Can We Use Environmental History?* The environmental history of a city can be a useful tool in informing policy makers about how, in the past, approaches to environmental issues have either benefited or harmed the environment and public such as by exacerbating inequality by developing greenspace in exclusively upper-income neighborhoods. On the other side of this are the myriad cultural and psychological benefits of building public parks and generally maximizing greenspace in cities in an effort to maintain a consistent relationship between nature and the public. Another example that was discussed in Chapter 2 was the installment of sturdier and more permanent piers and docks beginning in the 1870's which created a disturbance in the surrounding aquatic environment.<sup>265</sup>

This early act of resilient design demonstrates the importance of pursuing a harmonious relationship between the built and natural environment in order to find effective solutions to urban challenges. That said, it also reveals the economic and environmental tradeoffs involved in

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<sup>265</sup> Maguire, "Hurricane Sandy," 15.

urban decisions where finding a successful solution to one issue may exacerbate another. This ultimately demonstrated to policy makers and city planners the necessity to think more productively and make decisions about the values that they wish to uphold through legislation and design in contrast to those that may be deemed less vital to the overall success and health of the city and public (e.g. economic prosperity vs biodiversity preservation). Environmental history can also be applied to meteorological modelling to draw climate patterns and predict future disasters that could ultimately help save the lives of far more people such as by announcing evacuations earlier and reinforcing flood barriers. In short, environmental history is a primary and valuable tool that should be utilized by all cities to learn from past mistakes and improve foresight into future environmental hazards.

*Mitigation: Reduction and Transportation.* One recommendation to reduce emissions is to create more incentives for homeowners to invest in energy efficiency upgrades such as greater tax breaks and rebates, as well as additional and more inclusive financing programs to reduce up-front costs. As its own program, this would connect to the PACE loan legislation discussed in Chapter 4 which gives state, local, and district entities the authority to provide loans for energy efficiency upgrades to owners of qualifying properties.<sup>266</sup> The loan program as it is currently is not very accessible and this way, the program would become more so to frontline communities who could redirect the rebates they receive from the upgrades towards their loan payments.

For the most part, *OneNYC* addresses transportation within its municipal fleet system or from the perspective of the individual driver with respect to electric vehicle networks and carbon pricing. While these issues are important, there is insufficient reference to public transportation which is unfortunate given the masses of people who use the MTA and other transit systems

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<sup>266</sup> Cohen, *Sustainability Management*, 53.

every day. Thus, another recommendation is to provide more opportunities for public transportation such as additional bus stops to not only reduce driving needs but generally ease commuting, especially from other boroughs to Manhattan. Adding more bus stops would not only make commuting more convenient, it would also heighten safety. Additionally, a city run bike-sharing network should be created and expanded to reach frontline and peripheral communities where such amenities are often lacking, as opposed to concentrating them in the city center, as these kinds of amenities often are. The network should also offer reduced fares for low-income commuters to make bike-sharing more widely accessible. For people without cars, this would heighten accessibility to meaningful job opportunities, stores with fresh produce, as well as general recreation and exercise. More generally, this would tie into De Blasio's *OneNYC* which lists public transit improvements as one of its main strategies for confronting social inequality and environmental injustice in the city.

*Mitigation: Greenspace, Sequestration, and Beautification.* Another recommendation is to require that some form of green, public space, whether it be a park or community garden, be situated within one mile of each home across the city. This would not only provide more sources for carbon sequestration, water retention, and beautification, it would also address the issue of environmental injustice and social inequality that largely results from the city's uneven distribution of resources and funding. Additionally, the city should implement a beautification program in which people can bring recyclables and garbage left around their neighborhood to a collecting site in exchange for subway cards. The card's value would depend on the amount of waste collected to incentivize people to participate consistently. The collecting site could be as simple as a garbage truck located in every neighborhood which would then bring the waste to a facility where it could be separated and properly recycled or repurposed. This is similar to the

“Green Exchange Program” adopted by the world renowned city of Curitiba, Brazil where residents trade recyclables for fresh produce.<sup>267</sup> Not only would this program help to clean up and beautify communities, it would also create jobs and make the city’s public transit system more widely accessible and affordable.

*Mitigation: Congestion Surcharge.* Another mitigative policy recommendation would be to extend the current congestion surcharge discussed in Chapter 4 to apply to non for-hire vehicles, excluding funeral, emergency, and public transit vehicles (i.e. personally owned cars). Depending on if the vehicle is for hire or not, the surcharge will either be included in the total ride fare or in city tolls. A portion of the revenue from this surcharge would then be used to compensate for a fare reduction for the MTA, Long Island Railroad, and the New Jersey Transit System, as the three major commuter channels in order to make living further from the city more convenient. The remaining revenue would be reinvested in public transportation improvements, especially in frontline communities such as additional bus stops in an effort to make public transit more convenient, safe, and affordable for everyone. Although a step in the right direction, the congestion surcharge as it is currently being implemented and as discussed in Chapter 4 does not adequately reflect the social costs of transportation emissions and also unfairly and exclusively impacts for-hire vehicle companies, and taxis especially. Thus, the surcharge should be expanded in order to hold every New Yorker equally accountable for their emissions. This is rooted in a personal stance that no person, corporation, or other entity should be exempt from climate legislation.

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<sup>267</sup> “Curitiba, Brazil Residents Trade Recyclable Materials for Fresh Produce,” Smart Cities Connect, Smart Cities Connect Media and Research, December 30, 2016, accessed December 19, 2019, <https://smartcitiesconnect.org/curitiba-brazil-residents-trade-recyclable-materials-for-fresh-produce/>.

*Mitigation: Cap-And-Trade.* The next policy recommendation is a pollution/emissions tax to be applied to the city's major companies, corporations, and larger residential buildings exceeding 20,000 square feet. This would be a flat rate tax depending on each building's size bracket to be enforced now in addition to a city-wide cap-and-trade emissions program or, an "emissions trading regime" as mentioned in Chapter 4 which will allow building and company owners to buy permits from the city to pollute and emit greenhouse gasses to the degree allowed by the permit. If a building or company owner decides that they need to exceed this amount, they can buy more permits. Similarly, if they are successful in reducing emissions, they can sell their permits. This is a strategy meant to ease the transition of larger buildings and companies towards carbon neutrality and renewable energy and thus should not become a permanent system as the goal is not to allow the most powerful and wealthy corporations to pollute as much as they want but to compel them to reduce their footprint. Eventually, the permit system should cease and any building or corporation that has not reduced its emissions by 40% by 2030<sup>268</sup> will continue to pay the aforesaid pollution/emissions tax, which will then increase by a certain percentage each year that the entity does not meet the 40% reduction standard. Additionally, the revenue generated from the tax and permit system will be reinvested in resiliency, energy efficiency, and retrofitting efforts of buildings in especially low-income communities.

*Adaptation: Infrastructural and Resource Expansion.* It is common knowledge that climate change fosters inequality on a global scale as its adverse environmental impacts and hazards are disproportionately exhibited around the world. This also occurs on a domestic and regional scale, especially with respect to efforts of restoration and resiliency that often neglect

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<sup>268</sup> Erin Durkin, "New York City Unveils Ambitious Plan For Local Steps to Tackle Climate Change," *The Guardian*, Guardian News and Media, April 18, 2019, accessed October 29, 2019, <https://www.theguardian.com/us-news/2019/apr/18/new-york-city-buildings-greenhouse-gas-emissions>.

low-income areas as those deemed essential for recreation, commerce, and tourism tend to receive the lion's share of funding and brainpower.<sup>269</sup> For example, the Big U only focuses on the restoration of Lower Manhattan when all of New York City was affected by Hurricane Sandy.

To confront this inequality, one policy recommendation would be to extend the soft armoring and undulating berms as part of the Big U's plan to reach disadvantaged communities and to integrate hard armoring there in a manner that will minimize adverse impact on aesthetic, such as through more design strategies that combine public amenities with flood protection (i.e. pavilions with flood walls as described in Chapter 3). More generally, I would devote at least \$100 million dollars to resiliency, improvement, and healthcare efforts in frontline communities that have suffered the impacts of climate change disproportionately to that of other parts of the city. Additionally, I would create a Department of Environmental Justice for the city which, together with the New York City Department of Housing and Urban Development would carry out this plan, ensuring that the individual needs and characteristics of each community such as vulnerability to flooding and air pollution are being properly and sufficiently addressed.

*Adaptation: Buildings and Development.* Another recommendation is to allocate more funding towards efforts to fortify and flood proof buildings in especially vulnerable areas and to generally invest more money in the New York City Department of Housing and Urban Development that is tasked with such efforts. Moreover, the Department of Housing and Urban Development should provide partial funding for owners of buildings in particularly vulnerable areas that were constructed before 1950 to help bring them up to code while a tax will be levied onto owners of old and energy inefficient buildings who refuse the funding. This way, buildings

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<sup>269</sup> Christina D. Rosan, "Can PlaNYC Make New York City "Greener and Greater" for Everyone?," 960.

owners would have little reason to continue operating their buildings business-as-usual. Lastly, city architects and engineers should be discouraged from pursuing development projects on new land and should instead be financially incentivized by the department to develop already existing spaces in alignment with the “Climate Resiliency Design Guidelines” detailed in Chapter 3. This would include upgrading existing buildings to be more energy efficient or demolishing outdated or damaged ones and replacing them.

*Conclusion.* Urban design and environmental policy are two distinct and integral disciplines embedded in the urban fabric of all cities. And while it is important to maintain a separation so as to limit government influence on individual and private innovation and entrepreneurship, this paper demonstrates how the two can be properly fused to make cities more sustainable and resilient in the face of the global climate crisis. It also emphasizes the utility of environmental history in understanding correlations between certain elements of urban living, as well as how cities like New York have failed and succeeded in serving the public while maintaining ecosystem values.

Moreover, this paper signifies the power of cities and the ways in which they can partake in a global cause such as combatting climate change in the absence of strong federal leadership. New York City has made immense progress with respect to climate action and global initiative; however, it will need to make more sacrifices and changes to its economy and structure if it intends to realize its ambitious climate goals by 2050. That said, it became a national model with its completion of Central Park in the nineteenth century and today is no different as it abandons business-as-usual and spearheads the trajectory towards a global economy based on renewable energy and ultimately a carbon-free future.

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