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The Sustainable Future of the Metropolis: Greening New York City Building By Building

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Abstract

Due to growth, technology and economic expansion, Western culture has gradually become detached from the natural environment. Industrialism and a culture of consumption have dragged us through a medley of environmental problems, all culminating to our current problem: climate change. The causes and effects of global warming overshadow all of our environmental issues. These problems threaten our way of life, our very existence, and future generations. How can we save the planet without compromising economic growth? Sustainability. In my research I have focused and reported on sustainability pertaining to America's greatest urban center, New York City, with a spotlight on green buildings. In order to do so, I examine American environmental history and industrialism to ascertain how we have gotten to this point. From there, I discuss current and potential design methods and the policies needed to facilitate our transition to sustainability. Through the right mindset and practices, cities and buildings can be self-sustaining microcosms. Sustainability proves that human flourishing and environmental flourishing are one in the same.

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I. Introduction

The Earth today faces many short-term and long-term environmental issues that threaten life, both present and future. Green buildings help combat climate change and other issues through a variety of ways such as reducing air pollution from fuel burning energy production, conserving water, preserving forest lands and farming soil, and protecting plant and animal life necessary for healthy ecosystems. Overall, by practicing sustainable building methods, rethinking the way we design, and viewing environmental and human welfare as a priority, we can dramatically alter the health of our urban and natural environments.

In my thesis I will delve into how New York City's green buildings are proving that along with combatting the ever-growing threat of climate change, cities and their green buildings improve public health (physically and mentally), assure us of a sustainable future, improve the environment, and belie the misconception that economics and ecology cannot exist in a mutually beneficial, sustainable fashion.

History and education have proven that environmental issues, like climate change, can only be addressed and amended with interdisciplinary application. Taking a singular viewpoint into consideration while disregarding others is impractical and leaves great room for error. Thus, I will be applying three different, interconnected disciplines in order to examine green buildings and their role in combating climate change: Environmental History, Design and Architecture, and Politics.

As a case study for this thesis, I will be utilizing my internship with the Urban Green Council and their green building strategies. The Urban Green Council is the New York chapter of the United States Green Building Council. The vision of the organization is to

see cities that coexist in harmony with their natural environment and contribute to the health and well being of all.

I will begin by examining data and research in regards to climate change and city greenhouse gas emissions. Then I will unravel American environmental history with a focus on the Industrial Revolution and the culture of consumption in order to ascertain how American society has gotten to this point. Doing so is crucial if we are to fully understand our current environmental problems, potential solutions, and our future. Using said history as a frame, I will analyze and discuss how green buildings, specifically in New York City, are in essence the next revolution; a new kind of industrialism. Also, how policies facilitate the transition to sustainability and prove that green is in fact gold.

II. A Warming Planet: Causes and Effects

Mass environmental degradation has been occurring since the turn of the twentieth century when industrialism swept through America and became the norm. Growth and economic expansion became engrossed into American culture, and environmental concerns were put on the backburner or forgotten entirely. Our relentless consumption and detachment from the natural world has resulted in a cocktail of environmental issues. Amidst these various environmental problems, there is one overarching issue that poses a grave threat to humanity, the Earth, and future life: climate change. Climate change, along with its causes and effects, casts a shadow over all of the current environmental crises we face – rising sea levels, habitat degradation, nonrenewable resources, air pollution, etc. Climate change is occurring because of air pollution from energy emissions. These emissions are a product of the burning of fossil fuels, such as coal, oil,

and natural gas, which we use for most technologies. When we burn these nonrenewable fossil fuels, the greenhouse gas Carbon Dioxide (CO_2) is released into the atmosphere. This release of CO_2 intensifies the greenhouse effect, causing an unsustainable pattern of global warming. It's crucial to keep in mind that the greenhouse effect is actually a naturally occurring process; in fact, it is what makes life on Earth possible. Without it, Earth would be nothing more than an uninhabitable ball of ice drifting through the cosmos. This naturally occurring process has become a problem because human activity has introduced too many greenhouse gases, subsequently upsetting the Earth's natural balance. When these greenhouse gasses are present in our atmosphere, they function just like the glass of a greenhouse. The Earth's atmosphere and the gases are both transparent to visible light from the sun. As the sun's energy hits the Earth, the surface warms up. The Earth then radiates the heat back. However, rather than passing through the atmosphere as it should, it is absorbed by CO_2 and other greenhouse gases. As a result, the energy that came in as sunlight is now trapped on and near the planet's surface; thus, the Earth's temperature rises. The public and skeptics often ask, "how do we know climate change is happening?" The answer is simply scientific data.

Extensive climate change research has been and is being conducted by scientists across the globe. According to the American Association for the Advancement of Science[1], global surface temperatures have increased 0.5 degrees Fahrenheit every ten years since the 1970s, making it very likely that the planet will be the warmest it has ever been in the last million years. The United Nation's Intergovernmental Panel on Climate

[1] www.aaas.org/news/press_room/climate_change/mtg_200702/aaas_climate_statement.pdf

Change[2] (IPCC), the leading international body for the assessment of climate change, is studying the effects of climate change in order to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. In the IPCC's latest report, they summarize the current understanding of expected temperature changes in three scenarios. First, if industry were to stop all activity tomorrow (an unimaginable catastrophe), temperatures would increase 0.6 degrees Fahrenheit by 2025 and by up to 1.6 degrees Fahrenheit by 2100. Second, if industrial activity continues at a more sustainable level (the scenario many people, including myself, are vying for) and CO_2 emissions are greatly reduced by 2050, then temperatures would increase 0.7 degrees Fahrenheit by 2025 and by 2 to 5 degrees Fahrenheit by 2100. Lastly, there is what I call the "doomsday scenario" in which industrial activity continues to grow as usual. This scenario would result in temperatures increasing 0.7 degrees Fahrenheit by 2025, and by an astonishing four to ten degrees by 2100.

These numbers may seem rather insignificant, but the disastrous effects of global warming have been and are being felt throughout the world. IPCC projections and modules show that in a warmer future climate there will be longer lasting heat waves, intense precipitation, rising warmer seas, and stronger cyclones. These effects have already been experienced. The most recent large-scale example of the effects of global warming is Hurricane Sandy. This category one hurricane struck the Northeast United States in October 2012. Also known as "Superstorm Sandy", this hurricane ravaged the Northeast causing millions of dollars in damages. Although some factors of the storm's

[2] www.ipcc.ch - see "AR4 Synthesis Report"

destruction were completely natural, it is without a doubt true that climate change strongly contributed to the storm's overall impact through higher sea levels and warmer sea temperatures. First, according to Ben Strauss[3] of Climate Central, the sea level in New York harbor is fifteen inches higher than it was in the year 1880. Strauss estimates that climate change is responsible for about eight inches of the total. Coincidentally, the estimated sea level rise seen since 1880 is also eight inches[4] affirming Strauss' scientific research. Adding eight inches to a hurricane's storm surge may not seem like a lot, but it is and has proven to be extremely dangerous. Along with the higher sea level was the water's temperature. According to NOAA's National Hurricane Center recordings[5], Sandy traversed sea surface temperatures that were far above average for the time of year. Warm water is to a hurricane what blood is to a vampire; warm sea temperatures fuel hurricanes making them more powerful. Hurricane Sandy was well above the threshold contour for temperature required for hurricane growth along most of the storm track, which allowed it to remain a hurricane and strengthen.

As seen in the IPCC's research and projections, scientific data concludes that at this point climate change is going to occur regardless. The goal is to reduce it as much as possible in order for current and future life to prosper on a healthy planet. Reducing climate change can come about through a variety of efforts from large-scale to small-scale and from various concentrations. The question "how can we reduce climate change and care for the natural environment while not compromising economic growth?" is asked continuously. The answer is simple: sustainability. Being sustainable means, at the

[3] http://www.climatecentral.org/what-we-do/people/ben_strauss
[4] ftp://dossier.ogp.noaa.gov/NCASLR/Publications/Church_White_2011_HistoricSLR_1880_2009.pdf
[5] http://www.nhc.noaa.gov/tafb/atl_anom.gif

simplest level, that a process can continue indefinitely. In regards to the environment and economic growth, "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[6]

I believe that cities can serve as models for sustainability all while successfully pursuing economic expansion. The first cities emerged about 6,000 years ago. The first city to reach a population of one million was Rome, Italy, in 133 BCE. Since then, the world has become increasingly urbanized. Today, half of the global population, and seventy-nine percent of Americans live in cities.[7] In addition to this, cities account for over seventy percent of global greenhouse gas emissions.[8] According to the Worldwatch Institute, urban populations occupy only two percent of the earth's land area, but consume about seventy-five percent of the world's climate changing CO_2.[9] Therefore, it is safe to say that cities have a large ecological footprint.

Currently, buildings account for a little over forty percent of all energy used in the United States, with industry emissions at thirty-three percent and transportation emissions at twenty-eight percent.[10] On the global scale, buildings are responsible for more than forty percent of global energy used, and as much as one-third of global greenhouse gas emissions, both in developing and developed countries.[11] Below is a figure from UNEP's Sustainable Buildings and Climate Initiative "Buildings and Climate Change", illustrating

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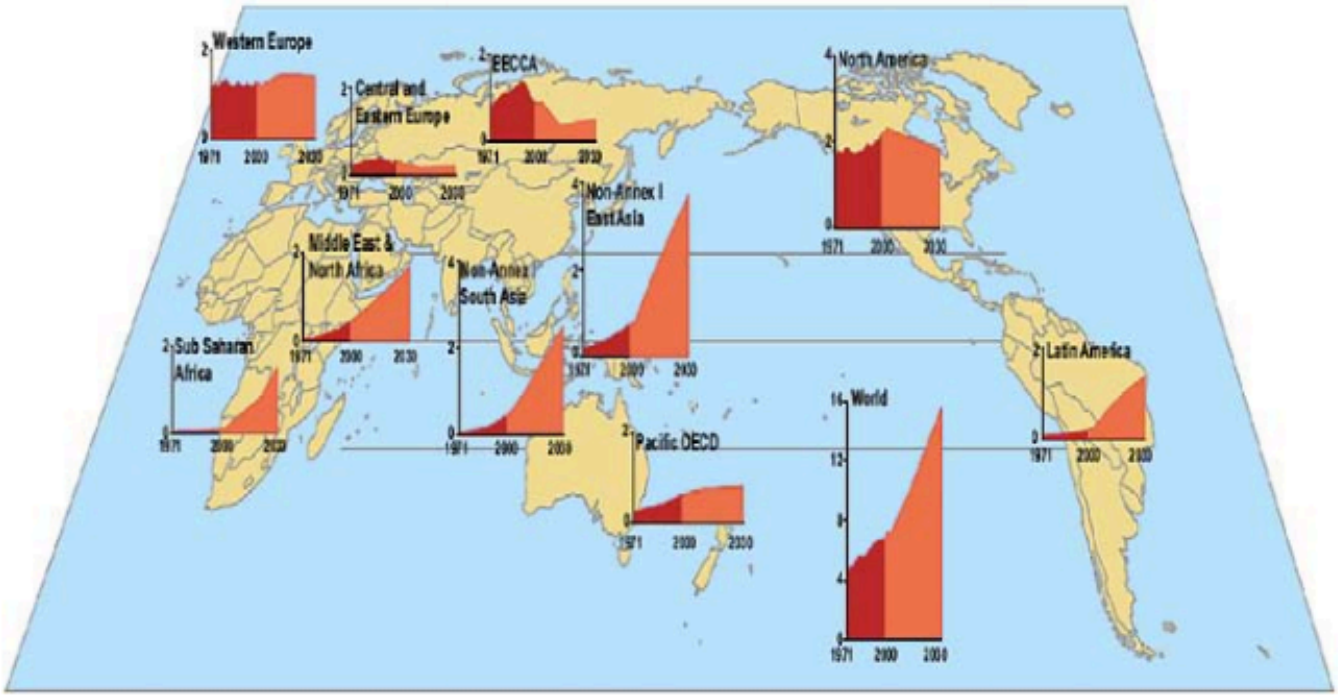
6 www.un-documents.net/wced-ocf.html
7 Tyler Miller Jr., G. *Living in the Environment.* 17th ed. Belmont, CA: Brooks/Cole, 2012.
8 http://www.ghgprotocol.org/city-accounting
9 Tyler Miller Jr., G. *Living in the Environment.* 17th ed. Belmont, CA: Brooks/Cole, 2012.

10 "Buildings Energy Data Book" www.buildingsdatabook.eren.doe.gov
11 http://www.unep.org/sbci/pdfs/SBCI-BCCSummary.pdf

CO_2 emissions from buildings globally

Figure 1. CO_2 emissions from buildings (including through the use of electricity) – IPCC High Growth Scenario.
Note: Dark red: historic emissions. Light red: projections 2001 – 2030. 2000 – 2010 data adjusted to actual 2000 carbon dioxide emissions. EECCA= Countries of Eastern Europe, the Caucasus and Central Asia. Source: Levine et al, 2007.

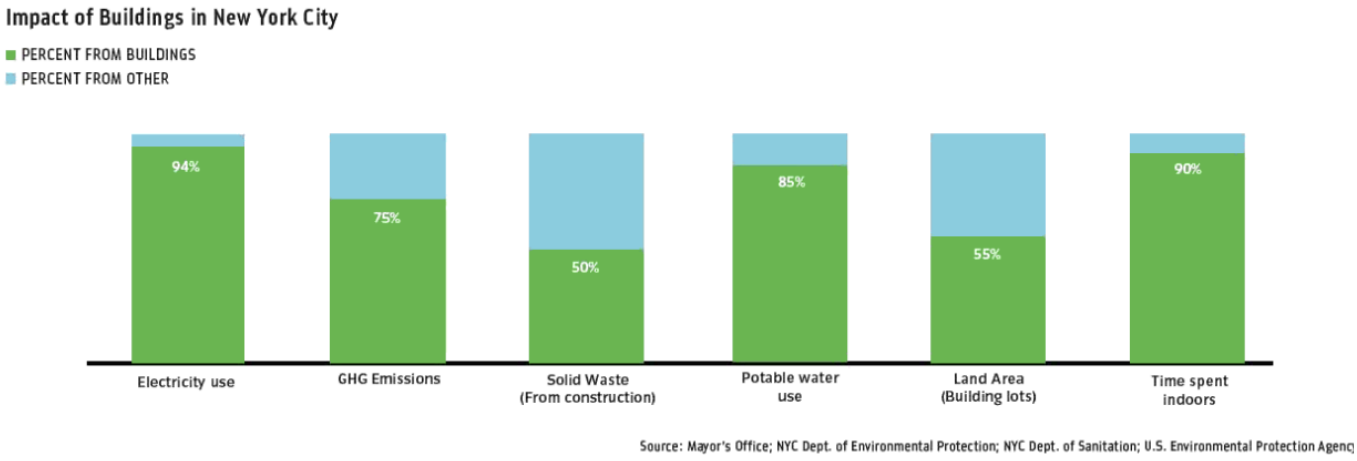


This graphs shows us that energy efficient, sustainable building construction and operation is key to reducing energy use, greenhouse gas emissions, and, ultimately, climate change.

Many countries and cities have taken green building initiatives in order to reduce climate change and their environmental impact. Given that every city has different needs, environmental concerns, histories, and policies, I have decided to focus my research on one, arguably the most influential, city: New York City.

When one thinks of New York City, buildings immediately flood the mind. Buildings are not only structures utilized for workspace, residential needs, and leisure; they represent different facets of history, each telling a different story. They are testaments to

the potential of human accomplishment through innovation and perseverance. New York City, a city of buildings, is implementing sustainable practices in its existing and new buildings in the hopes of building a greener, greater New York. In the city the electricity, heating, and hot water consumed by buildings account for seventy-five percent of the city's greenhouse gas footprint along with fifteen billion dollars per year in energy costs. In addition to greenhouse gas emissions, buildings impact the city in various ways. As is seen in the graph[12] below from the New York City Mayor's Office, buildings have a significant impact on New York City's urban and natural environment; therefore, having an impact on the entire world.



In order to further understand the current and potential impacts of buildings on the natural environment and climate, we need to examine how we have gotten to this state.

III. America, Urbanism, and the Environment: How Did We Get Here?

When Europeans first arrived in North America, the possibilities and resources seemed endless. The oceans, rivers, and lakes teemed with fish so plentiful they were said to slow ships down. Trees blanketed the landscape. Millions of bison grazed freely on the

[12] http://www.nyc.gov/html/gbee/html/about/about.shtml

Great Plains. Even early explorers described Manhattan Island as “sweet smelling”, teeming with diverse ecosystems and beautiful, lush forests. North America was so large that there was always another region, each different from the last, people could move to. During more than two centuries of exploration and development, the American frontier and its resources seemed endless. However, by the mid-1800s all this changed. Settlers had migrated into each corner of the country, exterminating entire forests and species. The roots of the environmental movement – preservation and conservation – were born from the cultural shift to capitalism catalyzed by industrialism.

Origins of Industrialism, Environmentalism, and Policy

Rise of Industrialism

The Industrial Revolution that has so greatly shaped American society and subsequently provided a model of outdated industrialism for all developing nations was not exactly planned, but it was not without a motive either. First, what is industrialization? At its most basic level, the process of industrialization involved the rise to prominence and eventual dominance of the industrial sector within an economy.

Beginning in Britain in the mid-eighteenth century, the textile industry began to flourish and agriculture, the main occupation for centuries, rapidly declined. Peasants farmed while town guilds provided food and goods, and industry was made up of several skilled craftspeople working individually as a side project to farming. Within a short amount of time, the textile industry, which had traditionally been dependent on the craft of individual laborers for the output of small quantities of woolen cloth and cotton, exploded into a mechanized factory system that efficiently spewed out abundant amounts

of fabric. This drastic change was spurred by the emergence of new technologies. In the mid-1700s cottage workers spun thread on spinning wheels in their homes. In 1770, the spinning jenny was patented. This new device greatly increased the number of threads produced. Other mechanized equipment, such as the spinning wheel and the water frame, exponentially increased textile production.

Prior to industrialism, exported fabrics would primarily travel by sailing ships. This process was slow, unreliable, and vulnerable to piracy; in fact, it was astonishing that the cargo ever arrived at its destination. But this changed drastically with the rise of steamships and railroads. Such technology allowed products to be moved more quickly and farther distances. By 1840, factories had the means and motivation to produce an extraordinary amount of product in the pursuit of profit. Fabric workers eventually grew too busy to continue farming and moved into towns and cities to be closer to factories. Times were changing, the economy was booming, urban areas spread, and city populations increased dramatically.

Like all paradigm shifts, industrialism encountered resistance. Cottage workers in fear of losing work and Luddites would usually vandalize new technology and laborsaving equipment. Industrial production also provoked another response, one that touched on spiritual and imaginative life. In the 1850s, a small group of intellectuals articulated a counter-movement known as Romanticism. This movement is just as crucial to understanding the origins of environmentalism as the Industrial Revolution is.

Between 1750 and 1850, throughout the Western world, poets, painters, and writers began to view natural landscapes differently than they had before. They were no longer barren, desolate places that instilled confusion and fear of the unknown; they were

places of contemplation and self-reflection where one could go to escape social and economic stresses. Due to passionless logic of scientific thinking that came with industrialism, these artists yearned for a sense of possibility that they discovered in the natural world, untouched by the destruction and moral chaos of the modern world. In the wilderness, they experienced "the sublime": a feeling of awe and fear at the transcendent power of God. Unlike industrialists who viewed nature as an obstacle to overcome and subdue, romanticism advocated being in concord with nature. They articulated a contrary worldview to nature and human progress, one that gave no special importance to production or economic growth. But it was this worldview that simply could not and currently cannot hold its own in the modern world. Attempts to place romantic values over the forces of economic growth are doomed to fail.

In general, romantics portrayed industrialism negatively because it failed to possess any consideration for the natural world. Despite this dark and gloomy depiction, the overall spirit of industrialists, and many others at the time, was one of great optimism and faith in the potential of human progress. As industrialization boomed, other employment opportunities emerged that assisted its rise. Institutions such as commercial banks, stock exchanges, and the commercial press all opened further job markets for the new middle class and tightened the social network around economic growth. Furthermore, industrialism brought about luxuries that we regard as mostly commonplace today such as public transportation, cheaper products, water distribution, waste collection, sanitation, and safe housing, and made these conveniences available to more people with varying income levels. No longer did the leisure classes alone have access to all the comforts.

A perfect example of this industrial expansion is the car. In the early 1890s the automobile was custom built by skilled craftspeople slowly and carefully by hand to meet the customer's specifications. Usually factories would only produce about one hundred cars a year; they were luxury items. That is, until Henry Ford. Ford worked as an engineer, and a builder of race cars before founding the famous Ford Motor Company in 1903. He realized that in order to produce cars for the modern American, and not just for the elite, he would need to manufacture vehicles cost-effectively and in large quantities.

In the following years, different aspects of manufacturing combined in order to meet this goal, revolutionizing not only the car industry but industry across all sectors. First, Henry Ford centralized his factory's operations. In 1909, Ford decided that the company would only produce one product, Model T's, and the following year Ford moved his operations to a much larger, central factory. The most famous of Ford's innovations is the assembly line, which completely revolutionized the industrial sector. Prior to the industrial revolution, parts were assembled separately, then brought together for final assembly. Ford and his colleagues engineered a moving assembly line that carried materials to workers. This process enabled each worker to repeat a single operation, leaving less room for error and reducing labor time dramatically.

The assembly line and technological advances made possible the mass production of the Model T from a centralized location. In fact, this new method of industrial manufacturing pushed costs of the Model T down from $850 in 1908 to $209 in 1925, and business skyrocketed.[13]

The Model T basically epitomized the general goal of the first industrialists and industrialism – to produce a good cheaply and quickly that was also desirable, durable,

[13] "Cradle to Cradle" p. 23

and affordable. From the Industrial Revolution forward, new technologies were and still are aimed at improving the production process by increasing power, accuracy, economy, system, continuity and speed. As I mentioned previously, the Industrial Revolution was not exactly planned, but it had clear motives. At its most basic level, it was an economic revolution driven by the ever-growing desire for capital. The economic success of industrialism sparked current American culture where economic growth equals progress, and success is measured by consumption.

Post Industrial Revolution and the Environment

The aforementioned early industrial practices relied heavily on the misconceived notion that natural resources were endless. Ore, cattle, coal, water, land, crop, and timber were the raw materials necessary for manufacturing, and they still are today. These materials would enter facilities in massive quantities and, once inside, would be transformed into a finished product. The extraction of the resources necessary for industrialism caused great environmental degradation. The prairies were overtaken and stripped for agriculture. Great American forests were cut down for wood and fuel. In the spirit of efficiency, factories aimed to situate themselves near the natural resources necessary for production and near bodies of water, which they used for manufacturing processes and the disposal of waste. When these practices began, the state of the natural environment was not a widespread concern. Such concern was overshadowed by the exciting prospect of economic expansion and profit. Nature was perceived as “mother earth” who would absorb all things and continue to grow; resources seemed immeasurable.

Although, that is not to say that some notable environmental victories did not occur. The late 1800s saw the rise of the first two roots of the American environmental movement – the preservation and conservation movement. The preservation movement aimed to protect nature by setting aside wilderness areas that were not to be disturbed by human activity. A major victory for preservationists and the environment came in the year 1872 with the creation of America's first national park, Yellowstone National Park. The other early branch of environmentalism, the conservation movement, took a more pragmatic approach towards nature. Conservationists advocated the wise use of resources; they primarily opposed what they viewed as the indiscriminate waste from the extraction of resources. Humans were not protecting nature for nature's sake, but for humanity's sake. Their goal was to continue providing resources for the future.

Despite conservationist's good intentions many romantics, most notably John Muir, met them with opposition. Muir was a romantic writer who embraced wild places as warm and welcoming; this embrace opened a door for later environmentalists. In 1892, he founded the Sierra Club in the hopes of leading city people into the wilderness. The Sierra Club also suggested the collective action to protect natural landscapes – one of the primary strategies used in today's environmentalism. Muir and conservationists butted heads because conservation placed values on natural resources strictly for their economic potential further commodifying nature. The tension between Muir's romanticism and the conservation movement subsided with Muir's death in 1914.

Culture of Consumption

During the first half of the twentieth century, debates and concerns for the environment were overshadowed by economic success of the Industrial Revolution, World War I, the boom alongside the farm crisis of the 1920s, the Great Depression of the 1930s, and the entry of the United States into World War II in 1941.

During the war, the country had emerged from its economic slump. When the war came to an end in 1945, Americans were greatly encouraged by the government and businesses to become consumers again. They urged that doing so would help create jobs for soldiers returning to the workforce and build on the country's newfound economic prosperity. Consumption was promoted as a civic duty and a form of patriotism rather than an indulgence. So, Americans abided and consumed at an incredible rate. Americans were told that foremost on the list of items they needed was a new home, the ideal home according to the standards of the time. Single-family homes were mass-produced to meet demands and suburbia was born. With home ownership came the need for many items, but few had more effects than the car. With the majority of Americans living in suburbia, the ability to commute to work and shopping centers became essential; American car culture was born. Along with home ownership and cars was the television. The integration of the television into daily American life was one of the most important social, economic, and technological changes of the twentieth century. Just like Henry Ford's Model T, manufacturing the television was cheap and done in large quantities making it affordable enough for most American families; thus, hoping to blur the lines between social classes.

The aforementioned societal, cultural, and economic changes of the 1950s greatly increased the standard of living. As a result, the American culture of consumption flourished, engraving it into the Western way of life.

As politicians and business leaders celebrated the consumptive and affluent society, a new generation of thinkers began to reevaluate the Earth's capacity to sustain this new rise in consumption. Industrial society depends on natural capital such as the extraction of raw materials, farmland, forests, and oceans. The economy and industrial growth follow a pattern found nowhere else in nature – linear yet endlessly expanding. Between 1960 and 1974, the global population increased from three billion to four billion.[14] Growth advocates saw only progress in this population growth; environmentally aware individuals saw problems in these increasing numbers.

By the 1960s, a panorama of chemicals were being used in the production of plastics and pesticides – compounds that had never existed on Earth before – including dichloro-diphenyl-trichloroethane, or DDT. What humans came to discover was that animals stored DDT in their fatty tissues allowing the toxic chemical to be transmitted between predator and prey species, which threatens human health and the environment. In 1962, the modern environmental movement was galvanized by the publication of Rachel Carson's book, *Silent Spring*. Carson's research told readers that their own choices and decisions mattered in the larger world; that chemicals like DDT threatened to destroy all forms of life. Most importantly, Carson stunned the nation with the simple revelation that consumption in industrial society could deteriorate the very fabric of life.

[14] "U.S. Environmentalism since 1945"

Environmentalism proposed an alternative vision of growth, and by the 1970s, environmentalists employed politics and policy to reach their goals. Students from across the country went to work on holding an environmental teach-in, and on April 22, 1970 the first Earth Day was held. The federal government responded to this with a series of groundbreaking policies such as the Clean Air Act of 1970, the creation of the Environmental Protection Agency, the Clean Water Act of 1972, and the Endangered Species Act of 1973. Throughout the 1980s, many environmental organizations and groups, such as Greenpeace, were created. Also, many environmental justice issues regarding minorities and industrial waste were brought to the forefront during this time. Then, finally, in the 1990s came climate change awareness. In the last decade, climate change has emerged as the defining environmental issue of our time. The truth about climate change, its causes and effects, is a culmination of all past environmental problems. As I discussed before, industrialism and unsustainable manufacturing practices do degrade the environment greatly, but the ultimate and most dangerous outcome is global warming.

Clearly, our understanding of nature has changed. Early innovators never could have imagined the magnitude of the repercussions their pursuit of economic expansion would have on the ocean, the air, the mountains, the plants, the animals, and humans. But despite our new understanding, modern industries still operate according to paradigms that developed when humans had a very different sense of the world. Just like the industrial infrastructure of the early twentieth century, the infrastructure we have today is linear. It lacks awareness of natural systems and their delicacy, complexity, and interconnectedness. Although, it is important to note that the Industrial Revolution did

bring about a number of positive social changes. With higher standards of living came an increase in life expectancy. Education and medical care improved and were more widely available. Electricity and other advancements made life more comfortable and convenient. More importantly, the technological advances facilitated by industrialism brought developing nations enormous benefits in increased agriculture for growing populations. But, overall, there were fundamental flaws in the Industrial Revolution's design. They resulted in key omissions, and devastating consequences that have been handed down to us.

IV. The Green Apple

This is the main discipline I will be using to examine sustainable methods for cities and their green buildings focusing on New York City. I will begin by examining New York City with an emphasis on how the post-Industrial Revolution climate of the second half of the twentieth century and Robert Moses contributed to its grey infrastructure. Then I will delve into green buildings, particularly how New York City and its main inhabitants, buildings, play a crucial role in greening our environment through energy efficiency, green roofs, storm-water harvesting, heating and cooling, retrofitting and so on. Along with using my internship with the Urban Green Council as a case study, I will be evaluating their LEED (Leadership in Energy and Environmental Design) green building methods and incorporating their effectiveness into my research.

You Can't Have N.Y.C. Without Moses

Between 1800 and 2008, the percentage of the United States population living in urban areas increased five percent to seventy-nine percent.[15] This population shift occurred predominantly during the rise of industrialism. The industrial revolution and the subsequent creation of the factory are largely responsible for the rise of the modern city, as massive amounts of workers flooded into the cities in search of employment. Consequently, New York City held the largest population of Americans during the golden years of the Industrial Revolution – 1840 to 1920.[16]

By the late nineteenth century when industrialism and its economic prosperity were in full swing, New York City and New Yorkers were considered the prototypes of the Gilded Age. Despite the more publicized elite benefits of such a shift in American culture and commerce, this era of social Darwinism plagued New York City with social unrest, class divisions, inequality, and illegal doings. Amidst the chaos, new artistic and social shifts, such as the Harlem Renaissance and Bohemian rebellion, found a voice in New York City. This time period affirmed the city's role as not only an economic capital, but also a cultural and social ferment by challenging social, racial, and artistic assumptions. The problems of the industrial city often overwhelmed people just as they do to this day. Fortunately, problems inspire innovation and efforts to better balance situations that are not working. Right on cue, Robert Moses stepped in hoping to fix the city's problems. Moses is considered to be the master builder of mid-twentieth century New York City – he recast urban planning with his bulldozing public policies. Essentially, he believed that automobiles were more important than mass transit, that

[15] Tyler Miller Jr., G. *Living in the Environment*. 17th ed. Belmont, CA: Brooks/Cole, 2012.
[16] http://en.wikipedia.org/wiki/Largest_cities_in_the_United_States_by_population_by_decade#1880

commercial buildings should replace factories, and that slum clearance should hold higher importance than community preservation. This approach to the social contract gradually applied to all other construction projects too. Moses' philosophy was quite straightforward: "When you operate in an overbuilt metropolis, you have to hack your way with a meat ax."[17] This has been the prevailing philosophy across all sectors throughout the expansion of New York City – innovation guided by short-term benefits and brute force.

Many scholars and historians argue whether Moses was the best thing to happen to New York City or the worst. Author Robert Caro even published a Pulitzer-prize winning book in 1974 titled *The Power Broker: Robert Moses and The Fall of New York*, in which Caro tells the story behind Moses and the shaping (and/or mis-shaping) of twentieth century New York City. Despite the controversy that will forever cloud Moses' name and legacy, New Yorkers must acknowledge that Moses' work played a huge role in shaping the city we know and love today. Kenneth T. Jackson, a New York City historian, puts it perfectly, "Every generation writes its own history. It could be that *The Power Broker* was a reflection of its time: New York was in trouble and had been in decline for fifteen years. Now, for a whole host of reasons, New York is entering a new time, a time of optimism, growth and revival that has not been seen in half a century. And that causes us to look at our infrastructure."[18] Luckily, New York City is doing exactly this. It's on the brink of a new industrial revolution where long-term benefits and being socially responsible coincide with environmental harmony and economic benefits.

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[17] Robert A. Caro, *The Power Broker: Robert Moses and the Fall of New York* (New York: Vintage Books, 1975)
[18] http://en.wikipedia.org/wiki/Robert_Moses#Legacy_and_lasting_impact

Green Building: The Movement

As I mentioned previously, sustainability addresses the challenges of balancing the needs of people with the needs of the natural environment. Through the lens of sustainability, we are beginning to understand the true limitations of our planet. Furthermore, this lens presents sobering news, telling us that we must begin to explore and apply alternatives to our Western, resource-gobbling ways. Generally, the mainstream media tends to focus on the doom-and-gloom side of our environmental concerns. While we cannot ignore this negative trend of environmental indicators, what is needed is a sense of hope and empowerment to energize people and leaders towards actions that make a difference. I believe that sustainable building offers that hope.

The world of green buildings is rapidly evolving. Until fairly recently, the modern-day built environment provided us with only a few grassroots examples of environmentally friendly buildings, and most of these have been considered anomalies or rather strange looking. Today, thousands of more mainstream examples exist, including college facilities to corporate headquarters to affordable housing even. Also, the growing success of the green building appears to be outpacing many other environmental movements. Many leaders, such as renowned geneticist David Suzuki, who was named one of the 2007 "Heroes of the Environment" by *Time* magazine, Al Gore, Robert Redford, and Wangari Maathai have expressed amazement at the adoption and progress of the green building movement's transformation of the marketplace, in comparison to many other environmental movements.[19] This success may be partly because green building differs from reactive environmental movements that orient solely around protest

[19] Athens, Lucia. *Building an Emerald City*. Washington DC: Island Press, 2010.

and political upheaval. It provides a proactive solution to a complex web of issues, long-term profitability, and a positive approach that the public can get behind. In addition, green building creates visible symbols and visceral experiences for how a sustainable world might eventually look and feel, further fueling the fire of inspiration in the movement.

Leaders in the field have devised ways to leverage their agenda within the building sector because of the tremendous resources already invested in design and construction activities. In fact, most of the building projects that end up becoming sustainable are development that is slated to happen anyway. With the correct tools, vision, and leadership, these resources can be applied and shifted to green rather than traditional building methods. Green buildings have the ability to be generators, rather than consumers, of energy and other resources. This turns the traditional paradigm for grid-dependent and minimal code-compliance building on its head.

i. The United States Green Building Council: LEEDing the Way

By definition, a green building is designed and constructed to minimize adverse environmental impacts and reduce energy consumption, while contributing to the health and productivity of its occupants. The goals of green building can be summarized in four basic points: 1) Highly efficient use of energy, water, and other resources. 2) Improved health, comfort, and productivity for the construction team and building occupants. 3) Reduced waste, pollution, and environmental degradation in both construction and operation. 4) Increased building system durability and performance. The achievement of these goals through green buildings can be accredited to various things: political

leadership, grassroots advocacy, technological development, and so on. But the most influential factor that has been propelling sustainable building forward globally is the United States Green Building Council's (USGBC) development of the LEED rating system.

The USGBC is a 501(c)(3) nonprofit organization committed to a prosperous and sustainable future for our nation through cost-efficient and energy-saving green buildings. It is made up of tens of thousands of member organizations, chapters, students and community volunteers that are moving the building industry forward in a way that has never been witnessed before. This diverse group is made up of professionals from all fields – builders, environmentalists, corporations, nonprofits, teachers, lawmakers, and so on. Currently, they hold 77 chapters, 13,000 member organizations and 196,000 LEED certified professionals that share the same vision of a sustainable built environment for all within the next generation.[20]

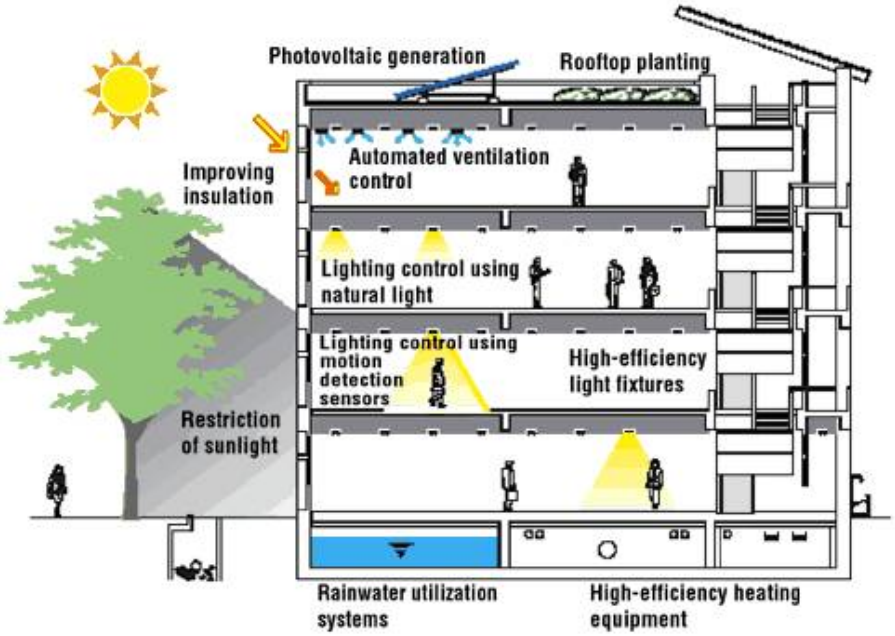
The Urban Green Council is the New York Chapter of the USGBC. The Urban Green Council was established in 2001. It is funded by contributions from foundations, its 900+ members, and over forty corporate sponsors. Urban Green offers a wide range of educational and networking events for members and the green building community at large, conducts research, and advocates for change that will make cities more sustainable. Urban Green's mission is to lead the advancement of sustainability in the urban built environment, and to serve as a model for other cities through education, advocacy, collaboration, and research. Their vision is to see cities that coexist in harmony with their natural environment and contribute to the health and well-being of all.

[20] http://www.usgbc.org/leed

I was fortunate enough to intern for the Urban Green Council in the Spring of 2013. During my internship, I mostly edited green building manuals, researched green building case studies, researched and edited LEED categories and initiatives, and created green building diagrams. In the following section, I will be utilizing my internship experience as I apply and analyze their LEED green building methods.

LEED Building Categories and their Application

LEED is the most widely recognized and widely used green building program across the world. It certifies 1.5 million square feet of building each day in 135 countries. Currently, more than 52,000 projects are participating in LEED, comprising more than 9.9 billion square feet of construction space. The categories that make up LEED in new construction – which I worked with the most in my internship – are sustainable sites, energy and atmosphere, indoor environmental air quality, water efficiency, materials and resources, and innovation and design. The first five are geared towards addressing environmental issues. The sixth is provided for innovative design measures as a bonus.



Conceptual Drawing of Green Building

LEED® for New Construction

Total Possible Points**	110*
Sustainable Sites	26
Water Efficiency	10
Energy & Atmosphere	35
Materials & Resources	14
Indoor Environmental Quality	15

** Out of a possible 100 points + 10 bonus points*

*** Certified 40+ points, Silver 50+ points, Gold 60+ points, Platinum 80+ points*

Innovation in Design	6
Regional Priority	4

Above is a very basic conceptual diagram of a green building that has implemented all the LEED categories.[21] Below that is a chart of the potential points in each category. As you can see, based on the total points achieved a building can be awarded Certified, Silver, Gold, or Platinum. The LEED system takes a whole-building approach to

[21] http://www.usgbc.org/leed

sustainability. As a result, each of the categories above include prerequisites that establish a minimum threshold of performance which must be met for a project to be eligible for certification.

Taken together, these categories cover a full range of potential green design measures and construction practices. They are the basis for the LEED rating system, but they also do an excellent job of defining the primary areas that require attention even when a green project isn't seeking LEED certification. As such, they provide a guide for defining and recognizing good practices in any situation where sustainability alongside profitability is a goal. With keeping the above illustrations in mind, let us delve into the separate aforementioned LEED categories as they apply to green buildings.

Sustainable Sites

The goal of the sustainable sites method is to locate new buildings on sites in ways that enhance the existing, surrounding neighborhoods, transportation networks, and urban infrastructures. This is done so that the negative environmental impacts of buildings on local ecosystems is limited. This is because buildings affect ecosystems in complex ways. Many of the goals of the sustainable sites category are important in order to maintain a commitment to sustainability. Some of the needs addressed are conserving open land area, locating buildings to maximize public transportation, avoiding encroachment on existing natural habitats, protecting local water bodies from stormwater runoff, reducing heat absorption from buildings and paved surfaces, and limiting light pollution to the night sky.

Water Efficiency

The goal of the water efficiency category is to protect and conserve natural water sources by reducing he volume of water that is required for occupant use, building operation, and site maintenance as well as the amounts that require sewage system delivery and treatment. In essence, the aim is to do more with less without sacrificing comfort or performance.

As socially and environmentally aware members of society know, water is a finite resource. As communities grow, the quality and amount of fresh water continues to diminish. Additionally, the water that conventional buildings use to convey waste is harmful when discharged back into the environment. This category conserves water; thus, this helps in the near and long-term because it minimizes the depletion of our fresh water sources, limits the discharge of waste water back into local water bodies, reduces building maintenance and life-cycle costs to owners and occupants, reduces consumer costs for municipal supply and treatment facilities, and creates jobs in the installation of water-saving devices.

Energy and Atmosphere

This category is the most important when it comes to reducing climate change. Its goal is to minimize the effects of atmospheric pollution associated with energy generation and use by reducing the amount of energy required to operate buildings and by promoting less-polluting forms of on-site renewable energy power.

As discussed before in detail, buildings consume a lot of energy. Substantial amounts of this consumption are due to inefficiencies in building operations and design.

Along with reducing climate change through the reduction of greenhouse gas emissions, this category addresses other concerns such as reducing the cumulative and negative air-polluting impacts of fossil fuel usage, limiting the adverse environmental effects of fossil fuel extraction, refining, and transportation, reducing building operation and maintenance costs, improving equipment performance and lifetime energy performance, and creating jobs in the production and operation of renewable energy technologies.

There are four fundamental strategies that increase energy performance. First, reduce loads and demand for energy. This can be accomplished by optimizing building form and orientation, and by reducing loads through envelope insulation and daylighting (strategy that promotes natural lighting through building orientation thus reducing the need for electrical lighting) improvements. Second, simply increase efficiency. This is easily doable by having more efficient lighting, hot water, and HVAC (heating, ventilation, and air conditioning) systems. Third, recover waste energy. Methods of doing so include recovering the heat from exhaust air and waste water. As well as utilizing co-generation systems in order to capture waste heat from on-site electricity production and use it to heat water or space heating. Fourth, harvest free energy. Why pay for fossil fuel burning electricity when you have the planet's most powerful and free energy sources all around you? These free resources include using daylight, solar heating and power, and wind energy. These sources can satisfy electricity needs for space conditioning, water heating, and overall power generation.

Materials and Resources

Buildings are responsible for twenty-five percent of the world's wood harvest and forty percent of the total waste stream in the United States.[22] In addition, many of the harvesting and manufacturing procedures for common building materials are highly polluting and damaging to the environment, human health, and atmosphere. Basically, the aim of this category is to protect and conserve the Earth's natural resources and habitats through construction strategies, building materials, and occupant recycling programs that reduce waste. More importantly, implementing the practices of this category lessen the need for environmentally damaging processes related to the extraction, processing, and transportation of materials and products.

Indoor Environmental Air Quality

Americans spend an astonishing average of ninety percent of their time indoors.[23] The level of pollutants inside a building can range from one to two hundred times more than outdoor air pollution levels. The goal of this category is to provide healthy indoor environments for occupants and construction workers by using materials that release fewer, and less toxic, chemical compounds. Some examples of this include using paints and sealers that are water-based, rather than solvent based, and recycled carpeting.

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[22] United States Green Building Council (GPRO). *Fundamentals of Building Green*. New York: Urban Green Council, 2010

[23] United States Green Building Council (GPRO). *Fundamentals of Building Green*. New York: Urban Green Council, 2010

Innovation and Design Process

Finally, the last category is geared towards promoting innovation in green building. As sustainable strategies evolve and new technologies are introduced to the marketplace, it is important to support the industry's efforts to integrate these innovations. Also, it is key that the individuals responsible for sustainable building design fully understand LEED standards and are able to coordinate with all the stakeholders. Simply stated, this category aims to provide incentive and recognition for innovative building features and green building knowledge.

Overall, the LEED system provides a comprehensive means for guiding green building design in accord with good construction and operating practices. Understanding these categories helps us further understand the larger picture of green building. Also, alongside these categories and methods that push the sustainable building movement forward, there is another key player that must be held to the same priority: policy. With the combination of these easily implementable green building practices and policy incentives, green building can and is reaching new heights, all while proving that ecofriendly is profitable.

V. Green is Gold

Few entities hold more power to transform the face of the urban built environment than do city governments. Government has a clear mission as steward of the communal well-being and trustee of ecological systems, energy and water sources, public health, and thriving urban environments. Not only do we expect the government to protect our health and safety, but we also expect it to lead the way. I will use the Environmental

Politics and Economics discipline in order to research how politics and incentives help move sustainable development forward, specifically in regards to New York City's sustainability plan titled "PlaNYC." Furthermore, I will tie together the sustainability practices discussed in the previous section and use the Empire State Building as a case study in order to bring home the point: green is economic.

PlaNYC: A Model of Sustainability

In 2007, the Mayor of New York City, Michael Bloomberg, put forth an unprecedented policy initiative known as PlaNYC. The plan's goals are to prepare the city for one million more residents, strengthen the economy, combat climate change, and enhance the quality of life for all New Yorkers. The plan brings together over twenty-five City agencies to work toward the vision of a "greener, greater, New York." PlaNYC specifically targets ten areas: affordable and sustainable housing, parks and public space, brownfield cleanup, waterways, water supply, sustainable transportation, energy efficiency, better air quality, reduced solid waste, and reduced greenhouse gas emissions by thirty percent to combat climate change. Interwoven in these ten goals are numerous cross-cutting initiatives that include elements of green building, highlighting the key role of buildings in making New York City sustainable.

PlaNYC and Green Buildings

One major green building initiative is to strengthen the construction codes of New York City. The construction codes are like the DNA of buildings. They control how new buildings are built and how renovations are completed. The City explored LEED

requirements, but found that it wasn't exactly what they were looking for; they needed a green building system that was more regulation-intensive. Therefore, the City asked the Urban Green Council to convene a task force of more than two hundred experts to recommend changes within the City's codes to make buildings more sustainable. This task force came to be known as the Green Codes Task Force. The proposals they set forward are by far the most comprehensive effort of any U.S. city government to green the codes and regulations that impact buildings. The result was 111 proposals that cover a wide range of areas. The first group of proposals speaks to fundamental issues, such as enhanced code enforcement, and changing the fundamentals of building code to include environmental protection along with health and safety. Others address specific issues, such as water and resources, which follow categories that are similar to those of the LEED system. A large number of proposals address energy and carbon. They are divided into three sections: "Fundamentals", "Energy Efficiency", and "Operations and Maintenance." The first lays the groundwork by clarifying the underlying codes and ensuring that buildings require smaller energy systems. The second sets requirements making those energy systems more efficient. And the third seeks to ensure that these energy systems are run properly.

Two examples of green building policy incentives implemented by PlaNYC are the Solar Panel Tax Abatement and the Green Roof Tax Abatement. Unbeknownst to most, New York City is one of the twenty-five major U.S. cities designated by the U.S. Department of Energy as a Solar America City. Recognizing the environmental and economic benefits, New Yorkers are leading the nation in adopting solar energy technology. This rise in solar energy technology is due in large part to the Solar Panel

Tax Abatement. This incentive is a four-year tax relief of about five to eight percent of solar panel-related expenditures, approximately up to $62,500.[24] Another technology becoming very common in green buildings throughout the City is the green roof. Green roofs, which are roofs covered in vegetation, benefit property owners in numerous ways. They improve quality of life, increase property values, and beautify a property for occupants. Moreover, while there are up-front installation costs, green roofs eventually pay for themselves since they reduce energy and maintenance costs by protecting rooftops from excessive sun exposure during warmer months and increase heat retention during cooler months. Additionally, they filter and retain rainwater, filter oxygen to provide cleaner air, and provide habitat for wildlife. Recognizing these benefits, the City provides a one-year tax relief of $4.50 per square , up to $100,000.[25]

These proposals aim to do more than merely save energy and cut greenhouse gas emissions. They also save New Yorkers a lot of money by reducing the cost of energy, improving public health with better air quality, and make the City's buildings more resilient.

Greener, Greater, Buildings

New York City realized that in order to achieve its aggressive PlaNYC sustainability goals, it would need go beyond just improving new construction and renovations. It has to proactively address energy waste in existing structures, a problem that is difficult to take on given that the City has almost a million buildings. However, it turns out that the city's square footage is concentrated in less that two percent of its

[24] http://www.nyc.gov/html/gbee/html/incentives/solar.shtml
[25] http://www.nyc.gov/html/gbee/html/incentives/roof.shtml

properties; thus, translating into 15,000 properties over 50,000 square feet, which is about half of the City's square footage.[26]

Consequently, New York City enacted an effort known as the "Greener. Greater, Buildings Plan (GGBP)." The policy promotes cost-effective steps to create significant economic and environmental impacts. In regards to green buildings, this application of new technology and sustainable building methods to already existing, older buildings is known as retrofitting. Along with improving the environment, this package is projected to create 17,800 green jobs, stimulate the economy, and save money since sustainability pays for itself in the long-term. A prime example of the GGBP in action is the retrofit of one of the world's most iconic buildings – the Empire State Building.

The Empire State Building: A Retrofit Case Study

When it first opened in 1931, the Empire State Building was not only the tallest building in the world, it was a shining exemplar of the mechanical age. But the majesty and grandeur of a building does not exempt it from the effects of time. Recently, the landmark has begun to show its years. In 2006, Anthony Malkin, the owner of the building, was faced with a decision: sell the iconic structure or take on a massive infrastructure upgrade likely to cost half a billion dollars more using conventional methods. Eventually, he decided to take the riskier path and pursue a turnaround while making the building an energy-efficient model of the current green age. As mentioned many times before, buildings and their operations account for the largest share of greenhouse gas emissions, making them the most important contributor to climate

[26] http://www.nyc.gov/html/gbee/html/plan/plan.shtml

change. Also, unlike other greenhouse gas emitters, such as cars, buildings are an enduring capital investment. As Anthony Malkin points out, "If you want to turn back carbon emissions, you have to deal with existing buildings."[27]

Beyond retrofitting the building for environmental and economic benefit, Malkin hoped to do more – he wanted to create an easily replicable model for all existing buildings worldwide that will lead to significant reduction in greenhouse gas emissions, and promote sustainability in existing buildings. So, the team quickly got to work. Of the nearly seventy energy-saving measures considered, only eight were chosen. These eight LEED-based interactive projects would save the building a lot of money, paying for itself in just three short years, and reduce its energy consumption by 38.4 percent. The eight projects included: 1) Remanufacture existing glass units within the building's approximately 6,500 windows to include suspended coated film and gas fill, saving $410,000 per year. 2) Install more than 6,000 insulated reflective barriers behind radiators, saving $190,000 per year. 3) Reduce lighting power density in tenant spaces, install dimmable photosensors, and provide occupants with a plug load occupancy sensor for their personal workstation. This results in a savings of $941,000 per year. 4) Retrofit four industrial electric chillers in addition to upgraded controls, saving $676,000 per year. 5) Replace existing constant volume units with variable air volume units using a new air handling layout, saving $703,000 per year. 6) The installation of CO_2 sensors for control of outside air introduction to chiller water, saving $117,000 per year. 7) Provide tenants with access to online energy and benchmarking information as well as sustainability tips and updates, saving $387,000 per year. 8) Additional overall upgrades to digital controls,

[27] http://harvardmagazine.com/2012/03/a-green-empire

saving $741,000 per year. The project began in the autumn of 2009, and took twenty four months to complete. Overall, the Empire State building is saving approximately $4.4 million dollars a year and a minimum of 105,000 metric tons of CO_2 over the next fifteen years. In September 2011, the building was awarded the LEED-Gold rating.

The Empire State process is currently being replicated in cities across the world, from Los Angeles to Melbourne, Beijing to London. Businesses and buildings need economic incentives to be green, and sustainable building provides exactly that – a green synergy between money and nature. Creating bike parking is nice, but green building is what's going to change the world.

IV. Conclusion

Throughout this Thesis, I have delved into the promise of green building by examining the threat of climate change, our current culture of consumption, green building methods, and the benefits of implementing sustainability into our infrastructure; thus, proving my main point – by utilizing green building strategies, and altering the way we think and design, we can dramatically alter the health of the urban and natural environment while prospering economically. Thus, I believe that the current policies and initiatives in place with PlaNYC and LEED are comprehensive and effective. Although it is a great victory when the federal government adopts sustainable building polices, these types of policies are best implement through local government since the needs of individual cities and regions vary. This is seen through the effectiveness of PlaNYC and the previously mentioned green building strategies. The adoption of these integrative methods has reduced citywide greenhouse gas emissions by twelve percent below 2005

levels and are on track to achieve the goal of a thirty percent reduction in citywide emissions by thirty percent by 2030. More importantly, these policies leave room for growth and development as our understanding of climate change, the Earth's systems, and urban environments grow.

With a vision of sustainability and green buildings, renewal and resilience can become our new models for creating quality of life. I, for one, feel confident that we as a global community have enough imagination, ingenuity, and integrity to use the tools already at hand to create a healthy planet for generations to come.

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