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# Reaching Climate Resiliency: The Challenge for Urban Areas

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**Abstract**

This paper explores some of the current challenges urban areas face in regards to climate change and the shifts that are necessary for urban areas to reach a state of climate resiliency. Chapter 1 uses the United Nations Intergovernmental Panel on Climate Change (IPCC) report on urban areas to understand the current and future challenges that urban areas will face in the years to come. Chapter 2 explores how New York City is working to address climate change. Chapter 3, explores the role that urban agriculture can play in moving urban areas closer towards a future of climate resiliency. Within this chapter there will be a variety of industries discussed. Chapter 4 explores how rethinking our business and economic models is necessary in reaching a state of climate resiliency. Chapter 5 solidifies the importance of what we learned in Chapters 1-4 and includes some policy recommendations on how urban areas can become more resilient.

Key words: climate resilience, urban poverty, doughnut economics, urban agriculture, green infrastructure

*Table of contents*

**Introduction**

Humans have flocked to cities for millions of years. City life offers an experience unlike that of a suburb or rural area. They are a meeting place for people, ideas, art, culture, business, and innovation. The cities of Ancient Rome were designed with the intention of shaping the individual's morals. During the Renaissance period, engineers, architects and artists collaborated to create cities with the intention of uplifting the public. Modern cities like New York have been built with those similar ideals. These hubs are so beautiful because they each have their own unique character that was formed from the work and lives of ancestors and are continually evolving because of the humans that live there. People, young and old, will endure close living quarters, noisy environments, and other less than favorable aspects of city life because of the opportunities urban life affords them.

This last year, a global pandemic has shaken the world: infecting and taking the lives of millions of people while also stressing global government, health care, and economic systems. Extreme weather events are not new but the frequency with which they can start occurring due to climate change poses a lot of challenges for cities.

More than half of the world's population currently lives in urban areas. Therefore today's cities must be prepared to grapple with modern problems.That means that much of the adaptation to climate change will need to take place in these urban areas. Cities around the world have already started to address the issue of climate change. The question is whether there are key solutions that cities are not focusing enough attention to.

This paper examines the threat that climate change poses for urban areas and how urban areas can work to achieve climate resiliency

Chapter 1 lays out quantitative data on the issue of climate change in urban areas as written out by the Intergovernmental Panel on Climate Change. Chapter 2-4 explores the current state of NYC's climate change plan and some key solutions that are not mentioned in NYC's plan yet are vital ways for cities to reach climate resiliency. Chapter 5 solidifies the importance of what we learned in Chapters 1-4 and includes some policy recommendations on how urban areas can become more resilient.

**Chapter 1: Climate Change and the Threat it Poses for Urban Areas**

The world population is constantly growing but unevenly in rural and urban areas. The United Nations (UN) projects that almost all of the population growth that will occur in the next 30 years will take place in urban areas particularly in low and middle income nations. With the various threats that climate change brings, all urban areas will have to adapt but those that are in low and middle income countries will need to do more to adapt despite their many constraints. (Revi et al.2014).

Since many studies show that a high proportion of the population most affected by extreme weather events is concentrated in urban areas, this study examines that threat in general with particular reference to New York City in the United States of America. The significance of the study stems from the understanding that urbanization changes the ecology of an environment underscoring the need to examine the threat climate change poses to urban centers that are rapidly becoming home to most of humanity. Since the early 1900s, urbanization has caused anthropogenic transformation of terrestrial biomes. Although urban areas only consist of 0.51% of the total land area, they have much higher ecological impacts. For instance, "the net ecological impact of urban centers includes the decline in the share of wild and semi-natural areas from about 70% to less than 50% of land area, largely to accommodate crop and pastoral land to support human consumption. This deficit has not only led to a decrease in biodiversity but also to fragmentation in much of the remaining natural areas and a threat to the ecological services that support both rural and urban areas" (Revi et al. 2014 ). If this trend continues, the more habitats lost lead to a decrease in biodiversity particularly in biodiversity hot spots. It will also lead to the loss of the green infrastructure that serves as buffers against climate change. Humans have altered habitats more rapidly and extensively in the last 50 years than at any other time in human

history, primarily to meet rapidly increasing demands for food, fresh water, wood, fiber, and fuel. As a result, there has been a significant and largely irreversible reduction in the diversity of life on Earth. Without biodiversity ecosystems services are weakened as is the case when there is a shortage of bees to pollinate the food crops that humans depend on. These ecosystem services fall under the category of supporting, provisioning, regulating, and sustaining cultural life. Hence, these services play vital roles in maintaining the well-being of life for humans and the environment as a whole.

Urbanization changes local environments through a variety of physical phenomena that can trigger local environmental stress. Local flooding, which can be intensified by climate change, and urban heat islands (higher temperatures, especially at night, in comparison to outlying rural locations) are two examples. Hence, there is often a relationship between the process of urbanization, local environmental change, and future climate change. Many large cities' compact existence has a significant impact on anthropogenic heat emissions and surface roughness, which are related to income, energy use, and micro and regional climate conditions.

In the interactions between urbanization, climate-related threats, and vulnerability, spatial settlement patterns are a critical factor. One example is density, which can range from dense to scattered, with most planned urban settlements having lower population density as they move further from the center. Changes in the dimensions of migration and material movements into and out of towns, as well as within them, are also correlated with urbanization. The degree to which these conditions increase (or, in some cases, decrease) produces a complex standard of risk in cities. The planners of cities that are rapidly evolving must strive to accommodate this growth through housing and infrastructure development while understanding what effect the developments will have on the environment and climate change.

The connection between urbanization and climate change has significant implications for ecological sustainability. Climate change has the potential to exacerbate ecological pressures in cities while also aggravating current environmental, economic, and political stresses.

Extreme weather events such as heavy rainfall, warm spells and heat events, drought, severe storm surges, and related sea level rise will become more common, intense, and/or last longer as a result of climate change (Revi et al. 2014). Cities are especially vulnerable to an increase in temperature. Increased water scarcity, energy shortages (where hydropower is a source), water-related diseases (through use of polluted water), and food prices and instability (due to decreased supplies) are all possible consequences of drought in urban areas. All of this may have a negative economic effect and lead to a rise in rural-to-urban migration. An estimated 150 million people live in cities where there is a perpetual water shortage, characterized as less than 100 liters per person per day of sustainable surface and groundwater flow within the urban area. Averages for all climate change scenarios, taking population growth into account, indicate a significant rise in this figure, probably reaching 1 billion by 2050 (Revi et al. 2014). This is a projection that policymakers should not take lightly.

Increased flooding poses a particular threat to cities with extensive port facilities and large-scale petrochemical and energy-related industries. With scenarios of socioeconomic development, sea level rise and heightened storm surge, and subsidence, it is expected that the vulnerability of major port cities to coastal flooding will change by the 2070s (Revi et al. 2014). Given the growing concentration of urban populations in coastal areas and low-elevation zones, sea level rise is one of the key changes in urban climate change risks. The latest Intergovernmental Panel on Climate Change (IPCC) forecasts for global mean sea level rise by 2100 range from 26 to 98 cm. Rising sea levels, related coastal and riverbank erosion, or

flooding caused by storm surge could have far-reaching consequences for people, land, and coastal vegetation and habitats, posing a threat to trade, industry, and livelihoods (Revi et al. 2014 ).

Heavy rain and storm surges are projected to flood urban areas due to climate change, resulting in property and public infrastructure damage, pollution of water supplies, water logging, loss of business and livelihood opportunities, and a rise in water-borne and water-related diseases, according to several reports. Research shows  that average changes in rainfall intensity at small urban hydrology scales vary from 10% to 60% from control periods in the recent past (typically 1961–1990) up to 2100, according to a study of the global impacts of climate change on rainfall extremes and urban drainage. These shifts in severe short-duration rainfall events could have a big effect on urban drainage and pluvial flooding. So far, the findings suggest that sewer sub-charging, sewer overflowing, and combined sewer overflow (CSO) spills are becoming more common(Revi et al. 2014 et al.  et al. ).

Climate change can affect future social and environmental determinants of health, such as clean air, safe drinking water, adequate food, and secure shelter, according to the World Health Organization and World Meteorological Organization (Revi et al. 2014 ). Temperature extremes (heat and cold) have been shown to have a negative impact on health, especially mortality rates. In a number of cities in subtropical, semiarid, and temperate climates, increased warming and physiological stress on human comfort levels are expected. Hot days are considered to have negative health consequences, which can be compounded by drought and high humidity. Extreme temperatures have been shown to have an effect on mortality in urban settings where infant mortality is high. Some jobs put people at greater risk when they are exposed to higher

temperatures for longer periods of time. When heat waves interrupt or impair income-earning opportunities, low-income households are more vulnerable.

Climate change has ramifications for city air quality, noise, and public health policies. The effects on urban air quality in specific cities are somewhat uncertain, and can involve both increases and decreases in such contaminants. Localized air pollution from transportation and manufacturing, as well as industrial and residential sources, has already harmed urban air quality as seen in cities like Beijing and New Delhi. Climate change-related rises in ground-level ozone exposures may have an effect on asthma exacerbation rates. Other pollutants can be affected as well, particularly in cities where PM10 and ozone levels exceed WHO guidelines. Pollen distribution, quantity, and consistency in urban areas, as well as the timing and length of pollen seasons, may all be affected by climate change (Revi et al. 2014).

The direct effects of climate change, both recorded and predicted, affect the risk exposure of city residents, buildings, infrastructure, and systems. Climate change will have a significant effect on a wide range of city operations, infrastructure, and services, while intensifying many current stresses. These effects can occur locally and extend to other cities and rural areas where a given city's resources are produced and extracted (Revi et al. 2014)

Tourism is a major source of income for many cities but the industry can be adversely affected by extreme weather events. When the weather becomes stormy or overly hot, urban centers that serve as major tourism destinations may suffer from inhospitable conditions, resulting in a loss of revenue. A vivid example would be Superstorm Sandy that hit New York City in 2012 and caused an estimated $19 billion in damages (Gibbens). Systemic and cascading climate threats will also have an effect on infrastructure. The National Climate Assessment project in the United States examined the effects of climate change on infrastructure, taking into

account the water, soil, and energy nexus, as well as a wide range of industries. These structural cascades may have both direct and indirect economic consequences, ranging from the built environment to public health in cities. To address infrastructure and service deficits in low- and most middle-income cities, significant additional investment is required. Without such investment, making the short-to-long-term trade-offs to build resilience can be difficult. However, this challenge presents an opportunity for "climate smart" infrastructure planning, which takes into account how to align pro-poor growth with climate change adaptation and mitigation. Cities like New York face more difficult challenges owing to their dense ageing infrastructure and related materials that may not be strong enough to withstand the stresses from climate change.. Such cities will need to incorporate climate factors into modern infrastructure decision-making processes while replacing outdated infrastructure (Revi et al. 2014)

Water and sanitation systems have an effect on household health and well-being, as well as urban economic activity, energy demands, and the fair distribution of water in rural and urban areas. Residential water demand and availability, as well as management, can be affected by climate change. Changed precipitation and runoff patterns of water in cities, sea level rise and resulting saline ingress, water supply and quality restrictions, and increased volatility in long-term planning and investment in water and wastewater systems are all expected to be impacted (Revi et al. 2014).

Local government agencies and utilities in charge of water supply and waste water management must grapple with these new climatic patterns and significant uncertainties in water availability, besides learning to adapt to complex and changing constraints.

Urban populations will be more at risk and vulnerable as a result of reduced groundwater and aquifer quality, subsidence, and increased salinity intrusion as a result of climate change.

Groundwater mining at high levels has resulted in severe subsidence issues such as building damaged, fractured pipes that consequently increase flood risk. As saline infiltration decreases groundwater quality and erodes infrastructure in coastal cities, the problem can become even worse. The effects of climate change on water resources will intersect with rising population, demand, and economic pressures in many rapidly developing cities, potentially heightening water stress and negative impacts on the natural resource base, with implications for water quality and quantity. With their growing middle-class and urban population, Caribbean countries, for example, are facing increased demand for water and the related challenges of managing runoff, storm water, and solid wastes (Revi et al. 2014). Water stress will be exacerbated by projected decreases in rainfall levels at specific times and in specific locations (Revi et al. 2014). As a result, climate change is expected to reduce water supply, and increase floods, groundwater salinization, and coastal subsidence in Shanghai (Revi et al. 2014) Besides, groundwater loss has exacerbated water stress and erosion threats in these already fragile regions, contributing to land subsidence.

Several reports have estimated how climate change will affect water users' relationships, exacerbating tensions and disputes between actors in residential, commercial, industrial, agricultural, and infrastructural sectors. The impact of flooding on well water quality in small and mid-sized African cities is a rising concern (Revi et al. 2014). Floods, droughts, and heavy rains have all had an effect on agriculture and urban food supplies, and they can intensify food and water shortages in cities (Revi et al. 2014). If attention is not paid to maintenance, the limited capacity of drainage systems in old cities, or the lack of drainage provision in most unplanned settlements and many urban centers, wastewater and sanitation systems will become increasingly overburdened during severe precipitation events. Uncontrolled city development

that builds over natural drainage channels and floodplains, exacerbates flooding. These issues are most noticeable in cities lacking solid waste collection services and drains or sewers to help deal with heavy rainfall.

Energy has a significant impact on economic growth, wellness, and overall quality of life. Any disruption or unreliability of power or fuel supplies as a result of climate change can have far-reaching effects for urban dwellers, industries and infrastructure. Disruptions also impact essential services including healthcare, emergency services, water treatment and supply, rail-based public transportation, and traffic. A study done by (Mideksa and Kallbekken in 2010) on climate change impacts on the energy sector in the United States and Europe, predicts lower water cooling performance for large power plants, changes in hydropower and wind power capacity, and shifting demand for heating and cooling (Revi et al 2014). These shifts could potentially lead to more power outages. Climate change would alter urban energy consumption habits, especially in terms of the energy required for cooling and heating. As a result of climate change, air conditioning demand will rise, resulting in higher energy demand the related costs. In most areas, projected rises in summertime electricity demand from climate change will outweigh potential decreases in winter energy demand. If water shortage and variability disrupt hydropower supplies, many cities' economies will suffer. Reduced hydroelectric production, for example, would have an effect on the economies of many Brazilian cities as well as neighboring countries (Revi et al. 2014). Declining water levels in the Hoover Dam have increased the prospect of Los Angeles losing a significant power source, as well as a drastic reduction in drinking water supply in Las Vegas (Revi et al. 2014). Brownouts or blackouts may occur during summer heat waves when demand for air conditioning spikes. On hot summer days, cities in Australia's temperate regions already experience frequent blackouts, owing largely to the use of

residential air conditioners (Revi et al. 2014) Because of the collapse of power lines and other infrastructure, any increase in the frequency or severity of storms may disrupt electric power systems.

Extreme weather events caused by climate change will have an effect on urban transportation and telecommunication infrastructure, including bridges and tunnels, highways, railways, pipelines, and port facilities, as well as data sensors and wire and wireless networks. Because of its critical role in providing logistical support for such activity, the loss of telecommunication connectivity during severe weather events will curtail disaster response and recovery efforts. Climate change presents significant challenges to ports, including exposed locations in coastal regions, low-lying areas, and deltas. It also affects the lifespans of key infrastructure and increases the vulnerability of trade, shipping, and inland transportation systems. Hurricane Sandy wreaked havoc on the New York area, forcing the closure of one of the country's busiest container ports for a week (Revi et al. 2014). In low- and middle-income countries, large parts of the urban population live in settlements without all-weather roads and paths that allow for emergency vehicle access and emergency evacuation. Hazardous sites, a lack of public transportation, and poor governance can all impede emergency evacuations in low-income areas.

Extreme weather events that disrupt vital public transportation systems, impede access to work, and increase exposure to health threats that can have a significant impact on low-income urban residents. According to some reports, urban women walk or use public transportation more than men (Revi et al. 2014); therefore, the gendered effects of transportation disruptions should be taken into account (Revi et al. 2014). Also, the Covid-19 pandemic has shown that women are

disproportionately affected by crises. This is illustrated by lockdowns that disrupt employment in the informal sector where most women in developing countries work.

Transportation networks face many threats as a result of climate change. Many transportation networks are already vulnerable to changes in precipitation, temperature, winds, visibility, and, in coastal cities, increasing sea level rises, which pose a risk of flooding and destruction (Revi et al. 2014)**.** Also, transport is extremely vulnerable to climate change and variability, yet the economic value of transportation networks has grown with the advent of just-in-time delivery methods, increasing the risk of losses due to severe weather (Revi et al. 2014) Cities need to ensure that bridges, railway overpasses, and other hard infrastructure are resilient to climate change during the period of their service , in addition to adapting to road transportation. Few studies have looked into the impact of climate change on railways, but high temperatures, icing, and storms are all known to cause rail system failures. Similarly, few studies have looked at the vulnerability of air and seaborne transportation and infrastructure, yet climate change could result in more and longer weather-related delays and disruptions (Revi et al. 2014).

Housing should provide a comfortable, safe, and secure living environment for its inhabitants while also protecting them from accidents, damages, destruction, and displacement (Revi et al 2014). Many low-income households depend on home-based businesses to support their families, and housing is critical to safeguarding their assets and preventing income disruption. Vulnerable groups, such as babies and young children, the elderly, and those with disabilities or chronic health problems, all benefit from decent housing. Climate change will hasten the decay and weathering of stone and metal buildings in many cities due to increased climate variability, warmer temperatures, precipitation changes, and increased humidity. Recreational areas like parks and playgrounds may be impacted as well. These spaces are

classified as vital infrastructure in New York City yet they are often located in low-lying areas susceptible to storm surge flooding **(**Revi et al. 2014)

Changes in temperature and precipitation regimes, evaporation, humidity, soil moisture levels, plant growth rates (and allergen levels), water tables and aquifer levels, and air quality will influence ecosystem functions. Climate change will also demonstrate the importance of ecosystem services and green infrastructure in adapting to its impacts. Among the solutions is green infrastructure defined as interventions that maintain the functionality of existing green ecosystems (such as parks, forests, wetlands, or green belts) while also transforming the built environment through phytoremediation and water management techniques as well as the introduction of productive landscapes (Revi et al. 2014). Permeable surfaces used in stormwater management, green/white/blue roofs, coastal marshes used for flood control, urban agriculture, and total biomass production may all be affected by any changes in these ecosystem services.

Climate change would also have an effect on urban public services such as health and social care, education, law enforcement, and emergency response. Many low- and middle-income communities lack sufficient social and public service coverage, while higher-income cities are only just starting to include climate change in their health and emergency management strategies.

The projected disruptions to every aspect of life by climate change make it imperative for policymakers, business leaders and the public to adopt remedial measures and adaptation strategies as a matter of urgency. The next section examines the stapes New York City has taken to address this urgent need.

**CHAPTER 2: How New York City is Working to be Climate Resilient**

The capacity of a city or urban environment to withstand a wide range of shocks and stresses is referred to as urban resilience. As a result, climate change is seen as only one of the pressures that cities must contend with. Urban resilience research is based on a wide range of literatures that can be divided into four categories: (1) ecological resilience in cities; (2) urban hazards and disaster risk reduction; (3) economic resilience in cities and regions; and (4) resilience promotion by urban governance and institutions (Leichenko). A city is a complex system much like the human body. To improve the resiliency of a complex system like a city, one must understand how the city functions by analyzing how the infrastructure and institutional systems work and how they are interdependent upon each other. There must also be an understanding of how the infrastructure and institutions contribute to the economy, socio-political conditions, and even how they change the physical geography of a city.

New York City is a leader that other cities look to for inspiration in times of crisis. In this section, I give an overview of how the city plans to address climate change. In 2015, Mayor Bill De Blasio's administration launched the OneNYC 2050 plan. The strategic plan aimed at creating "a strong and fair city" by addressing issues of economic equality, social justice, and environmental sustainability by 2050.

By setting a goal to achieve carbon neutrality by 2050, New York City is aiming to produce net-zero greenhouse gas emissions in all of the sectors it monitors, including

net-zero emissions in the construction, electricity, transportation, and waste sectors, at the very least. Carbon neutrality is critical for future generations to limit the effects of climate change on water and food shortages, living conditions, and human health. It also provides a huge opportunity for the cities and others like it to become more fair and sustainable. As a result of a

ne-zero economy, urban residents will have better health and life expectancy, enhanced air quality, increased efficiency, job growth, more walkable and livable communities.

To achieve carbon neutrality, a transition to renewable energy from a variety of sources is needed, including rooftop solar energy generation and utility-scale renewables, as well as building and grid-scale energy storage. Natural gas, as well as nuclear, hydropower, and wind and solar energy from upstate areas, are used to fuel New York City today. While half of the electricity is produced within city limits, electricity generated outside the city is transported to the city through a network of high-voltage transmission power lines, the majority of which pass through the city's northern section.

The City needs to construct more transmission lines into New York City in collaboration with New York State, the New York Power Authority, and the New York Independent System Operator in order to open up the city's grid to traditional power sources and new renewables. The City will continue to expand renewable generation on a local level by making energy storage more accessible while speeding up the deployment of solar on rooftops across the region. Since 2014, the city's renewable solar energy has increased over sixfold but has a long road ahead. By 2030, the City wants to see a grid that is 50 percent renewable. To this end, the city would need to bring in large-scale renewables from beyond the city limits, including solar, hydropower, and on- and offshore wind. Besides, the City will initiate a new transmission investment in order to gain access to large-scale Canadian hydropower at a reasonable price, resulting in a carbon-free energy supply for City government operations.

To further promote the development of energy storage, the City has committed to approving all small and medium-sized buildings in less than 12 months by 2020. It also plans to continue to encourage solar and other forms of distributed energy generation. More solar and

green roof installations will be needed on new constructions in the city, and they'll extend accelerator services to help building owners with renewable energy projects and the solar installation process. The City will continue to work with utility and business partners to incorporate demand response measures into load management tools. As of December 2020, Con Edison (Con Ed) which is New York City's utility provider, had agreed to its largest energy storage contract to date.

Since 2015, NYC has been making strides towards reducing GHG emissions in residential and industrial buildings, with the Retrofit Accelerator and Community Retrofit NYC projects assisting over 5,000 privately-owned buildings, resulting in a reduction of the equivalent of 95,000 metric tons of carbon dioxide. On the other hand, buildings still account for about 70% of the city's GHG emissions; and in order to reach carbon neutrality, the owners of both old and new buildings will need to adjust significantly. Along with requiring new construction to have zero carbon emissions, the city will extend its efforts to promote deep energy retrofits in virtually every building in the city and implement a cap-and-trade program, where buildings can accumulate credits for exceeding 20% energy savings before 2030.The city's local legislators understood that voluntary action was insufficient in 2017, and proposed some of the most ambitious energy efficiency laws in the country, while also putting into law the need for a long-term energy plan by 2019. The New York City Council passed the New York City Climate Mobilization Act on April 18, 2019 which included a wide range of solutions aimed at strengthening energy efficiency and reducing carbon emissions. The bill which was later signed into by law Mayor Deblasio, (1) requires all new buildings and buildings undergoing major roof renovations to be covered with solar panels, green roofs, or some combination of the two, (2) mends the ranges for how energy efficiency grades are calculated as required by Local Law 33 of

2018, (3) authorizes a Property Assessed Clean Energy (PACE) program in the City to fund upgrades to building energy and water efficiency, (4) requires all buildings larger than 25,000 square feet to meet ambitious carbon reduction targets. The implementation of carbon emission caps under Local Law 97 is estimated to impact up to 50,000 of New York buildings' which make up 60 percent of the city's floor area and building emissions. Although the new law is seen as aggressive, John Mandyck, CEO of the nonprofit Urban Green Council believes the policy's goal is meant to influence the city's worst emitters first. The city is now working with the City Council to put in place regulatory provisions for buildings larger than 25,000 square feet to drastically reduce pollution. Local Law 32 of 2017 established performance-based stretch-energy codes, which mandate that new construction meets the most recent energy efficiency requirements.

In addition to handling building emissions, the OneNYC plan also addresses the emissions created by treating 1.3 billion gallons of wastewater daily.According to the OneNYC plan, emissions from the water and wastewater system are responsible for nearly 20 percent of City government emissions and wastewater treatment accounts for 90 percent of that. To achieve net-zero energy for wastewater treatment by 2050, the City will continue to introduce deep energy-saving initiatives, increase the production of renewable gas from wastewater and organic waste processing, while producing renewable electricity. A critical piece in addressing the city's 14 wastewater treatment plants (WWTP) will be the use of cogeneration systems. WWTPs utilize the digster gases processed at the plants turned into the facilities' electricity and heating source. The introduction of cogeneration systems in the city's WWTPs is a potential solution that can be transferable to other major urban centers' waste treatment systems.

The city's transportation sector, which encompasses private vehicles, freight, and mass transit (subway, commuter rail, and bus), produces roughly 23 percent of the city's emissions. To achieve a carbon-neutral transportation system, NYC must reduce its reliance on automobiles and ensure that all transportation needs, including but not limited to commuting and freight, are met with more environmentally friendly alternatives. By 2050, the City must achieve an 80% sustainable mode share for commuting — trips done by walking, biking, or public transportation — and reduce or eliminate pollution for the remaining trips by widespread adoption of alternative-fuel vehicles. This will necessitate the expansion of electric charging networks for all forms of cars, a reimagining of streetscapes to facilitate more changes away from single-occupancy vehicles, and collaborative transportation management with major employers and organizations.

The City will create a network of quick charging stations on City-owned land to increase the number of publicly accessible EV chargers across the five boroughs in order to promote EV adoption. The city is also working to improve the performance of its municipal fleet by using renewable diesel fuel, hastening the transition to electric and hybrid vehicles, and increasing fleet efficiency. In 2020, under Governor Andrew Cuomo, New York state has planned to spend up $701 million in EV infrastructure and other related initiatives in the "EV Made Ready" program. New York City's EV plan will significantly benefit from this program especially as the Governor has set a goal to have 10,000 EV charger stations by the end of 2021 and 850,000 zero-emissions vehicles by 2025. The program also has addressed issues of environmental justice by allocating funding for solutions that help communities that have been underserved and heavily affected by climate change. Waste constitutes a large part of NYC's GHG emissions with roughly 25,000 tons of residential, business, and institutional garbage every day generated daily. Unfortunately,

only 15.4 percent of the garbage collected by the City ends up recycled.Through partnering with the City Council to create mandatory organics recycling citywide, the City hopes to extend the country's largest organics management program, which includes curbside collection, drop-off locations, and funding for neighborhood composting. Around half of New Yorkers' recyclables are thrown away, and textiles and other items account for 10% of the waste stream, which could be put to better use. Through education and outreach, the City intends to provide equitable access to services that will divert people from non-recyclable materials and inspire New Yorkers to use renewable goods. An innovative and potentially scalable city program called Zero Waste Schools has students and teachers of New York City's schools participate in creating programs in their schools and communities related to recycling, sustainability, reuse, gardening or cleanup. The Department of Education and GrowNYC (formerly known as the Recycling Champions Program) provides cash prizes to exemplary school-led programs that move the city closer to its OneNYC goals.

The City also says they will take a leadership role in transitioning the City towards a circular economy by pushing brands and product producers to plan for returnability, reusability, repairability, recyclability, and compostability by using the power of legislation, advocacy, procurement, and regulation. A recent strategic partnership between f New York's Department of Sanitation, New York City Economic Development Corporation and the Ellen McArthur Foundation lead to the #WearNext campaign which had large fashion brands like ASOS, Gap, and H&M promote sustainable fashion to reduce the amount of clothing that reaches New York's landfills. Another example is the Circular Economy Initiative that brings together representatives from the city's government, businesses and civil society to create recommendations that will get New York City to reach its 2050 targets.

Nevertheless carbon neutrality necessitates individual and organizational teamwork, hard work, innovation, and imagination. To achieve a just and accessible carbon-neutral future, the City will need to collaborate with current and new partners from communities, businesses, and all sectors of civil society. They continue to build on the progress made so far and extend effective efforts to help New Yorkers engage in the transition to carbon neutrality. The creation of a NYCgo website that highlights sustainable attractions and businesses for locals and tourists is a step in the right direction to grow awareness amongst the community and to build an eco-friendly economy. Similar to Zero Waste Schools mentioned above, the expansion of programs like GreeNYC, a program that encourages residents to adopt emission-reducing habits supporting programs that aim to teach students about climate change and sustainability.

To foster resiliency and mitigate the most harmful and disruptive climate impacts, New York City is making physical improvements to its environment. This includes hardening stormwater, wastewater, and other vital infrastructure to withstand climate impacts,in addition to advancing nature-based solutions to stabilize shorelines, minimize flooding, act as carbon sinks, and alleviate urban heat island effects, through the restoration of wetlands and forests. Areas like lower Manhattan because of its high population density and complex infrastructure have been forced to utilize outdated techniques like sandbags near the city's port.

Coastal programs will be implemented by the city to protect vulnerable coastal areas. By 2100, 20 percent of Lower Manhattan streets will be subjected to frequent tidal flooding, and storm surge will continue to be a widespread and serious danger.The City is investing nearly $500 million in flood-risk-reduction programs in the Two Bridges area, The Battery, and Battery Park City as a result of this report, which covers 70 percent of Lower Manhattan's shoreline. Land-based adaptation initiatives were found to be physically infeasible in the low-lying and

highly restricted Seaport and Financial District, which comprise the remaining 30% of the Lower Manhattan coast. The City is pushing forward with an ambitious proposal to expand the shoreline into the East River to protect these areas from sea level rise, coastal storms, and other climate threats. This will result in a new piece of land with high points equal to or greater than 20 feet above sea level. A comprehensive public participation process will assess the exact extent of the new shoreline, as well as the design and implementation of this groundbreaking flood control system.Additionally, the city will work with local utilities to protect their energy and telecommunications assets from the effects of climate change, and to ensure that climate risks are factored into systems planning and design. In order to provide essential services in the face of climate change, the City will also strengthen transit services, wastewater treatment plants, and sewers. Through stormwater management, coastal defense, and heat reduction, the City will improve the health and resiliency of green and natural resources that provide essential services.

Individuals, community groups, civic organizations, and businesses will be able to prepare and plan for climate change as New York City builds capacity and provides the required resources and knowledge. The city is creating opportunities for property owners and landlords to better understand their flood risk and invest in flood mitigation to respond to climate change and create resiliency. Flood insurance is a vital tool for ensuring financial resiliency as the City's flood risk rises. To boost flood insurance enrollments, the city will work with FEMA and community groups. It is critical that the City continues to engage New Yorkers in extreme-heat preparedness as the summers get hotter. Coating roofs white and maintaining street trees and green infrastructure are two examples of how the City plans to accomplish this.

The Covid-19 Pandemic did have an impact on some of the city’s initiatives. The GrowNYC Compost Program, which began in 2011, aims to make composting second nature for

all New Yorkers by running residential Food Scrap Drop-off sites and collaborating with community composting facilities to produce compost locally. During spring of 2020, DiBlasio cut the Department of Sanitation's budget by $106 million.  Consequently, the food scrap drop-off sites and curbside composting services were suspended. In addition to the composting program being suspended, other programs run by the NYC Department of Sanitation were cut including GrowNYC's zero waste program (Crunden).  After the budget cuts were announced, NYC residents started stepping. Vivian Lin created a private composting service and people in Astoria, Queens, and Greenpoint, Brooklyn, began volunteering at homespun drop-off sites (Nierenburg).

## Chapter 3: The Need for  Urban Agriculture

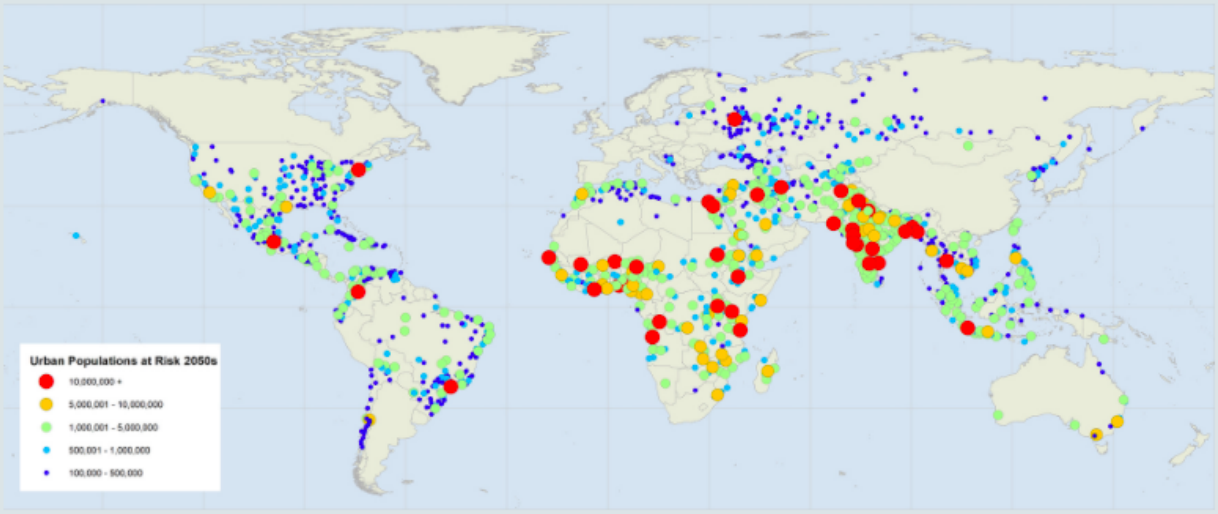
The threat that climate change poses to cities is easier to comprehend when viewed through the lens of food security. Food security is described as the ability to obtain and consume sufficient quantities of healthy and nutritious food. Food security is described as "having physical, social, and economic access to enough, clean, and nutritious food to meet ... dietary needs and food preferences for an active and healthy life at all times," and it affects people through both under- and overconsumption. Food security necessitates that food is (1) available—that it exists in a specific location at a specific time, (2) that people can obtain it by economic or other means, (3) that people can use the food that is available and accessible to them, and (4) that each of these components be stable over time. Food insecurity can be caused by restrictions in any of these components. Climate change is likely to have a negative impact on global, regional, and local food security by affecting food supply, reducing access to food, and making food use more difficult(USDA).

Urban food supply systems must prepare for a variety of climate disruptions that can easily lead to food shortages in a world where climate change can have more severe and uncertain impacts everywhere, and where competition over water supplies, diminishing harvests, and the balance between domestic consumption and agricultural exports will increase. Food staples may become unaffordable due to shortages, which in turn push up prices. The urban poor are especially vulnerable to supply disruptions and the resulting increases in food prices. According to studies, extremely poor households in developing countries spend between 48 and 85 percent of their income on food. Millions of people living in cities across the world have such low incomes that any increase in food staple prices jeopardizes their health and nutritional status (C40 Cities).

According to The Future We Don't Like, if emissions continue unabated, agricultural outputs would decline for 2.5 billion people living in over 1,600 cities. In the countries where these cities are located, yields of at least one of the big four crops – wheat, maize, rice, or soy – will decline by more than 10% by 2050(C40 Cities) .

**Figure 1 – Agricultural decline**

National Yield Decline in Maize, Rice, Soybean, and/or Wheat in the 2050s




*Cities that are located in countries where national rainfed yield of maize, rice, soybean, and/or wheat is projected to decline by at least -10 percent below current*

Source: C40 Cities

If crop yields fall, as predicted by The Future We Don't Want, residents and local governments will be faced with a major challenge. At the same time as climate change threatens food production, urban populations are expected to continue to grow in many parts of the world, especially in developing countries. According to estimates, agricultural production would need to increase by around 50% by 2050 in order to have enough food. Not by a tenth of a percent. It is important that urban areas begin thinking about long-term food security now in order to ensure that rising populations in cities have enough to eat in the future (C40 Cities).

The Covid-19 pandemic has brought attention to food resilience in cities, as well as the need to reconsider the desired level of food self-sufficiency through urban agriculture  yet the climate plan of New York City does not focus on this sector. At the height of the pandemic, it's estimated that up to 26 million Americans lacked enough food to eat. In New York City alone, 1.5 million residents found themselves unable to purchase enough food, which led to hour-long lines at food pantries around the city. By October 2020, 12 million visits had been made to New York City food pantries, a 36 increase from the previous year (Steward & Heisler).

The failure to include agriculture if the climate plan of New York City was a missed opportunity worth pursuing. In the five boroughs of the City, there are many initiatives worth building on in a more coordinated manner to expand access to healthy food and to improve the environment through schools, businesses and communities. Among the many opportunities to build on are the many agricultural activities located in residents' backyard gardens, community and gardens and a small but growing number of commercial agricultural undertakings. Besides, students and other residents maintain hundreds of farms on land provided by schools and local communities. Commercial agriculture is taking root on indoor farms while hydroponics, and aquaponics are also used to produce food by those utilizing new technologies to benefit from urban agriculture.

During the implementation Covid-19 mitigation measures, the initial strict lockdown regarding access to urban agriculture to support local livelihoods were quickly softened in most cities, mostly unnoticed by the media (Langemeyer et al. 202) Cities in the global north, including New York, have not seen the importance of implementing local urban agriculture into crisis mitigation strategies.

The financial crisis of 2008, as well as the food crisis that ensued, was the most recent global scale stressor for urban food resilience (Langemeyer et al 2021). While global food prices doubled, many cities experienced significant social upheavals and protests as a result of food scarcity.

Due to a lack of agricultural production to fall back on during times of wage reductions, employment losses, and rises in food prices, the urban poor are especially vulnerable (Langemeyer et al. 2021)**.** This is true mainly, but not exclusively, for urban poor in the global south, as shown by COVID-19-related poverty in the United States. Beyond times of crisis, urban agriculture plays (and has always played) a significant role as a "survival strategy for the urban poor" in improving food security and good nutrition for the most disadvantaged members of urban society (Langemeyer et al. 2021)**.**

It's too early to say how the current Covid-19 crisis would impact urban food supply (UN, 2020), but Covid-19 should serve as a reminder that when preparing urban futures, unexpected scenarios of transition must be taken into account.

The fear of hunger has haunted cities for centuries (Langemeyer et al. 2021), and even in the global north, food insecurity should not be ignored especially in regard to urban climate resilience. Vulnerabilities in urban populations (including all of their sub-groups) need more careful thought when making communities fit for future challenges, which is currently lacking. This is not only for reasons of urban food resilience, but also in the face of sustainable global food development;  urban resilience priorities must be in line with global development goals and urban agriculture needs to be bolstered because of the food insecurity issues it can solve.

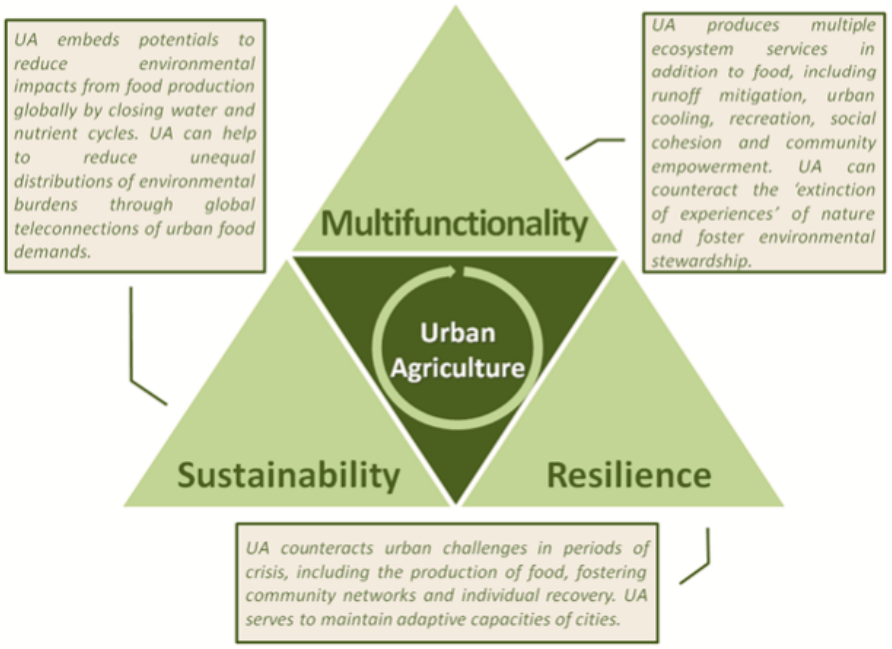



**Fig. 1.** Urban agriculture triad: Resilience, sustainability and multifunctionality.

Cities are typically situated in the most productive world regions due to their historical reliance on local agricultural production. This means that urban expansions, which have been occurring globally since the massive acceleration of urbanization, are affecting the most fertile soils (Langemeyer et al. 2021).

When fertile soils are taken up by expanding cities, farmers are left with less fertile soils which they work with adverse effects on the environment. The heavy use of mineral fertilizers, which already accounts for about half of global food production, is one major concern of increased agricultural production on less fertile soils (Langemeyer et al. 2021). For example, approximately 20 million metric tons of phosphorus are extracted each year to meet global fertilizer demand (Langemeyer et al. 2021), and it has been estimated that mineral fertilizer supplies would only last a few hundred years at current consumption rates (Langemeyer et al. 2021) Mineral fertilizer processing is highly energy intensive accounting for around 5% of global food production's carbon footprint — about 575 megatons of CO2eq per year  This is important

because agriculture accounts for one-third of global GHG emissions (Langemeyer et al. 2021).Nitrogen-based fertilizers, in particular, are a concern, and the IPCC has identified them as a major source of global N2O emissions, a potent greenhouse gas (Langemeyer et al. 2021)**.**

For example, urea provided 58 percent of the world's agricultural nitrogen fertilization in 2017, with a total of 78 million tons used in agriculture alone (Langemeyer et al. 202), resulting in a CO2eq increase of 160 to 400 mega tonnes in 2017. Although transportation has been found to be a minor source of carbon emissions from food imports other distant food production externalities are embedded in urban food imports (Langemeyer et al. 2021).

An increase in urban agriculture  will greatly reduce food losses caused by the long supply chain associated with importing crops from thousands of kilometers away. Research shows that an annual total input of around 638 Mt primary food commodities results in approximately 129 Mt (about 20%) of food waste produced along the food supply chain in the EU, with fruits and vegetables experiencing the highest losses (Langemeyer et al 2021). Shortening the food supply chain by improving urban agriculture, especially for the latter products, would allow for lower food production volumes and, as a result, lower environmental impacts and surface requirements.

Agricultural irrigation already consumes about 85% of the world's water; but, as the world's population grows, so will food and, consequently, water demands. By switching from importing food to local urban agriculture processing, water costs elsewhere are avoided (Langemeyer et al. 2021). Although it would be naive to expect urban agriculture to be introduced without cost to the ecosystem, the effects can be greatly reduced by integrated urban water management strategies **(**Langemeyer et al. 2021 ). In arid climates like Khartoum, for example, rain water harvesting and reuse will cover 18 percent of irrigation needs (Sudan)

Fostering local food production via urban agriculture has significant potential for avoiding a slew of negative environmental and social consequences that are often overlooked in urban land-use planning. The deployment of highly efficient and optimized urban agriculture systems could unlock this ability. From community run outdoor gardens to tech-driven vertical farms, the produce from these farms can have a tangible impact on eliminating food deserts and provide more nutritious dietary options to poorer communities. Urban agriculture's recent integration in municipal policy in cities like Toronto, Detroit, Boston and San Francisco show a rise in recognition of the potential benefits that can be achieved.

Beyond its potential to improve urban resilience and foster global sustainability, urban agriculture's potential multifunctionalities or the provision of multiple ecosystem services beyond the food supply that urban agriculture provides, should be given more attention in urban land-use planning . In the context of urban green infrastructure and nature-based solutions, particularly in Europe and North America, ecosystem service assessments are on the rise (Langemeyer et al. 2021). For example, the United States Geological Survey's (USGS) has created various tools like the Social Values for Ecosystem Services (SolVES) application, which is designed to assess, map, and quantify the perceived social values of ecosystem services. Because it is open-source, SolVES has been used on almost every continent, enabling decision makers to access quantifiable data on the social values of ecosystems and better equip them to understand the tradeoffs among different ecosystem services. Green infrastructure approaches highlight the multifunctionality of urban agriculture, particularly in the global south, which lacks adaptations to urban realities **(**Langemeyer et al 2021)**.** Although there is a new green fashion in urban planning that involves the construction of avant-garde urban agriculture rooftop gardens, it is less trendy to retain existing urban agriculture on larger scales **.** However, improved food

security and decreased environmental impacts can only be achieved if urban agriculture accounts for a significant portion of urban consumption, which necessitates a certain degree of intensification. This introduces trade-offs and limits urban agriculture's multifunctionality (Langemeyer et al 2021).

Due to the fact that extreme heat events are expected to be one of the most serious and lethal consequences of global climate change in cities, urban microclimate control should be highlighted as another core capacity of urban agriculture (Langemeyer et al. 2021). Plant evapotranspiration raises air humidity, which may help to mitigate the effects of the urban heat island effect. Larger vegetated areas have been recorded to cool cities by up to 7 degrees Celsius whereas smaller areas like green roofs can cool cities by up to 3 degrees Celsius (Langemeyer et al. 2021).

Based on the experiences New York City has accumulated during the Covid-19 pandemic, the City would do well to include urban agriculture to its plans for building back better after the pandemic. This would require taking stock to identify vacant plots that city dwellers can use to grow food crops especially in poor neighborhoods. Rooftops and other spaces could also be utilized for the same purpose while restaurants and hotels are encouraged to buy locally produced food to reduce the emissions caused by importing foods from distants farms. Schools can play a critical role in boosting urban agriculture by including it in their curricular.

## Chapter 4: Rethinking How Business is Done

Cities serve as economic hubs due to the diversity of businesses that flock to them. Because businesses use many resources in cities, it is important that businesses also play a part in addressing climate change. Many commentators call for improved collaboration between businesses and cities in solving problems posed by climate change.

In 2021 Larry Fink, the CEOof BlackRock, published his annual letter addressed to CEOs of Fortune 500 companies. Fink as an advocate for sustainability writes:

"As an asset manager, BlackRock invests on behalf of others, and I am writing to you as an advisor and fiduciary to these clients. The money we manage is not our own. It belongs to people in dozens of countries trying to finance long-term goals like retirement. And we have a deep responsibility to these institutions and individuals – who are shareholders in your company and thousands of others – to promote long-term value.

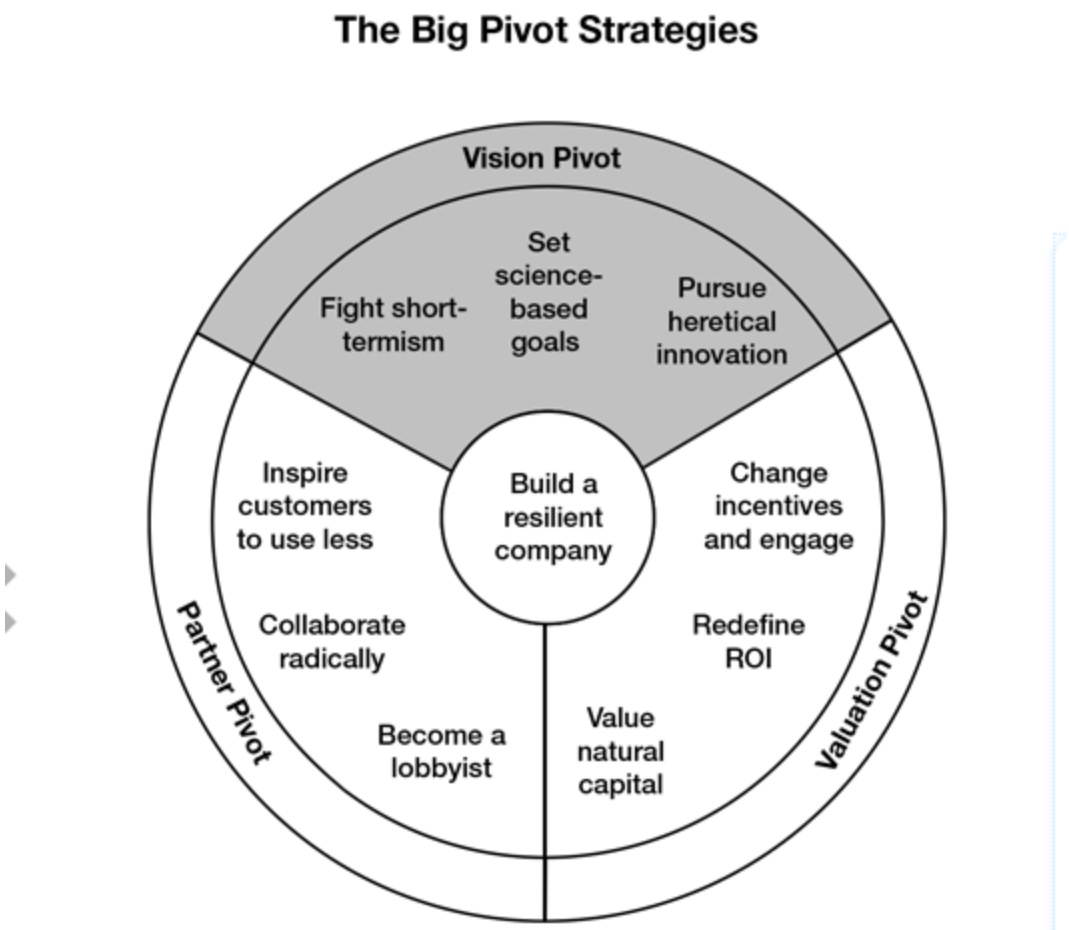
Climate change has become a defining factor in companies' long-term prospects. Last September, when millions of people took to the streets to demand action on climate change, many of them emphasized the significant and lasting impact that it will have on economic growth and prosperity – a risk that markets to date have been slower to reflect. But awareness is rapidly changing, and I believe we are on the edge of a fundamental reshaping of finance. The evidence on climate risk is compelling investors to reassess core assumptions about modern finance. Research from a wide range of organizations – including the United Nation's Intergovernmental Panel on Climate Change, the BlackRock Investment Institute, and many others, including new studies from McKinsey on the socioeconomic implications of physical climate risk – is deepening our understanding of how climate risk will impact both our physical world and the global system that finances economic growth.``

He goes on to pose questions : Will cities be able to afford their infrastructure needs as the demand for municipal bonds is reshaped by climate risk? What would happen to the 30-year mortgage, a crucial financial building block, if lenders are unable to predict the effect of climate risk over such a long time horizon and there is no viable demand for flood or fire insurance in affected areas? What happens to inflation, and therefore interest rates, if food prices rise as a result of the drought and flooding? How will we forecast economic growth if emerging markets' productivity falls as a result of extreme heat and other climate-related factors?

Fink acknowledges that investors are grappling with these issues and realizing that climate risk is an investment risk. Climate change is the most common problem that clients from all over the world bring up with BlackRock. Investors all over the world are wondering how they can change their portfolios. They want to know about both the physical threats of climate change and how climate policy can affect markets, costs, and demand across the economy.

These concerns are causing a major rethinking of risk and asset values. Global business will see changes in capital allocation more rapidly than we will see changes in the climate itself, because capital markets pull potential risk forward. There will be a major reallocation of capital in the immediate future much earlier than most people expect.

From Fink’s letter it is clear that business is shifting towards investing in a more sustainable future.




Both city governments and companies must play a role in achieving urban climate resilience. Many jobs would be created as a result of adopting a greener economy that safeguards sustainable production and consumption. However, companies need to adopt new strategies if they are to succeed in a radically changing business environment. Before the COVID-19 Pandemic, the world economy was characterized by growing demand for goods and services by a rapidly expanding middle class and increased scrutiny of business operations by the public owing to growing concerns for the environment. These trends are likely to continue after

the pandemic underscoring the need for businesses to prioritize sustainability in their current and future operations.

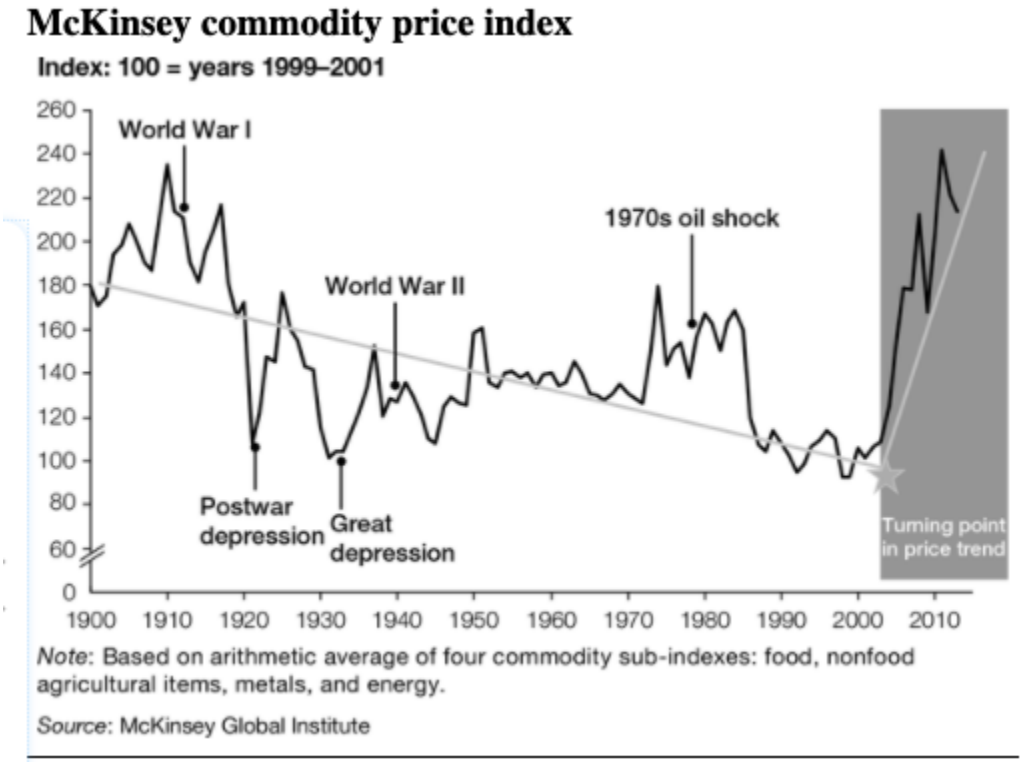
According to a report produced by the International Labour Organization, five million people now work in the renewable energy industry, and a greener environment would generate tens of millions of jobs over the next decade (Winston). Many countries are actively pursuing this massive, job-creating opportunity by investing huge amounts of money in new efficiency technology, water infrastructure, the "smart grid," renewable energy, high-speed rail, and other areas including electric vehicles.

The belief that renewable resources are scarce and costly is the clearest and least debatable "burning platform" for progress in the industry. Companies that are most directly dependent on food, for example, are facing increasing input costs, resulting in frightening food shortages for many millions of citizens.

For businesses, the big issue is whether higher rates are here to stay. All of the facts and figures point to the answer being a resounding yes. Long-term commodity prices have been studied by Jeremy Grantham who maintains that commodity prices fell on average in the twentieth century, with significant volatility around world wars. Second, since the early 2000s, prices have been steadily rising.

According to McKinsey, we wiped out all of the previous century's productivity growth and price declines in the first ten years of this millennium (Winston). Prices are now higher than they have ever been in real terms. The open-innovation toolkit can be extremely beneficial in addressing mega-challenges. “The planet is using up its natural resources at an unprecedented pace, and this has triggered a permanent shift in their value,” Grantham wrote in a quarterly

report to investors. We must all adapt our actions to this new situation. It would be beneficial if we could finish it quickly" (Winston). Such warnings have become more common.




Climate change is changing water patterns all over the world, rendering some places drier while others become wetter. In human development, population growth, and business operations, water supply has become a critical limiting factor. Companies like Coca-Cola, Pepsi, Nestlé Waters, and SABMiller, for example, depend on the resource for agriculture and water-based goods. These businesses have been working hard to fix what has become a critical problem. In certain areas, their ability to work is contingent on how they handle water(Winston).

Winston urges businesses to make a "major pivot," which would necessitate corporations and executives to abandon old, preconceived ideas of how to deal with social and environmental issues by adopting strategies that favour sustainability.

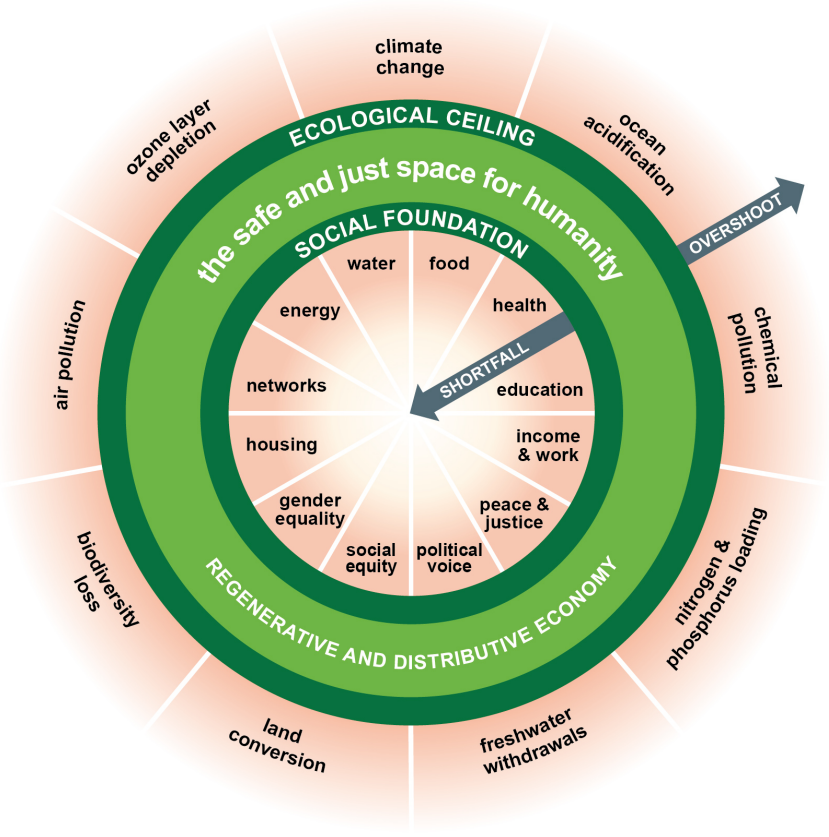
By definition, the term "sustainability" refers to the ability to continue doing what you're doing in a way that safeguards the interests of present and future generations. Is this a? justification for investing in initiatives that enable companies to keep operating? Or is it the encouragement of tactics that promote creativity and help businesses become more risk-averse and resilient?

Companies do not have inexhaustible financial or human capital to devote to all issues. And, ironically, their economic theories suggest that the world's physical resources are infinite. Slowly but steadily, the truth of what sustainability really entails is infiltrating leading companies' plans, and they're moving away from the outdated business case debate that Green business isn't about making money but about "saving the world."

There is a need for businesses to ask the right questions to address issues as large as climate change and resource scarcity. Businesses must seek a higher degree of creativity that questions their own long-held assumptions on how things function.The size and interconnectedness of mega challenges including climate change and resource constraints require businesses to approach these issues holistically, recognizing the mechanism they are a part of and collaborating with others to solve them.

Besides Wiston, many other commentators have advocated for sustainability in business operations. The model for a doughnut economy has been developed by the British economist Kate Raworth in a report for Oxfam entitled A Safe and Just Space for Humanity. The central argument is that social and environmental sustainability must be guiding principles for economic policy in the 21th century and together direct economic behaviour. There is no triple bottom-line: social and environmental sustainability are in the lead, the economy follows. Figure 1 below

depicts this model. It has a small circle in the middle and a large circle on the outside. The smallest circle represents the minimal social objectives (basic-needs) that apply to each country. The large circle represents the self-sustaining capacity of the planet. The Doughnut of social and planetary boundaries envisions a world in which people and the planet can thrive in balance – in other words, it offers a compass for guiding 21st century prosperity. The Doughnut's social foundation, which is derived from the social priorities in the UN Sustainable Development Goals, sets out the minimum standard of living to which every human being has a claim. No one should be left in the hole in the middle of the Doughnut, falling short on the essentials of life, ranging from food and water to gender equality and having a political




voice.

Figure 3: A visual of Kate Raworth's Doughnut model

The Doughnut's ecological ceiling comprises nine planetary boundaries, drawn up by Earth-system scientists in order to identify the Earth's critical life-supporting systems and the global limits of pressure that they can endure. Humanity must live within these ecological boundaries if we are to preserve a stable climate, fertile soils, healthy oceans, a protective ozone layer, ample freshwater and abundant biodiversity on Earth. What these repeated crises tell us is that we're deeply interconnected with each other and that the crises that are emerging are actually resulting from the very systems that we've created and that these shocks are deeply disruptive to human well-being, destructive of our collective resilience and for many they are an existential risk. We urgently need a new vision of progress that is fit for the century ahead of us. Doughnut Economics is a compass for human prosperity in the 21st century. The goal here is to leave nobody falling in the hole in the middle of the donut by falling short on the essentials of life like food, water, healthcare, housing, political voice and social equality.

People want more of everything as countries become wealthier. They crave for cars, food, buildings, clothes, insurance, banking, holidays, and so on. This incredible rise out of poverty provides an incredible opportunity for companies to meet new demands, as well as an enormous demand on shared capital. To react, businesses will have to make the Big Pivot to new ways of working (Winston). This calls for measures to ensure that goods satisfying rising demand are produced in a sustainable manner. For this to happen, Winston calls for workplaces that are more accessible and inclusive, with motivated workers working for a common goal. They'll be developing, creating, and delivering goods and services that avoid leading to our own demise and, in some cases, even rebuild our planet, making it a better place for future generations of people and businesses.

He argues that even as businesses redefine profit, the leaders would be more successful in every way. Redesigning the built environment, transportation networks, and energy systems, as well as reworking usage, and what constitutes a decent quality of life, would be multi-trillion-dollar endeavors with huge pots of gold for those who find the greenest ways to do it. Corporations will establish a new position in society as a force for real change by helping to create a more resilient, antifragile, sustainable world, guiding our ineffective governments to stronger, more productive, market-based outcomes. Governments will no longer be seen as the only entities capable of marshaling the common will of business leaders.

The way to get the job done according to Wiston is redefining meaning within an organization and innovating new ways, freeing ourselves up to pursue more exciting and satisfying endeavors. This requires investing and implementing technology and business models that will make people healthier and less dependent on risky, inaccessible, and costly resources that pose a security threat to the planet. As we create a circular economy, our economy will decouple itself from material use by treating all healthy resources as "nutrients" that can be recycled indefinitely. Most importantly, renewable energy will power our environment, delivered in a distributed manner from every building and home. Building a more just, inclusive society that is also in line with nature's boundaries, using the plentiful, renewable sources of energy all around us, would be a bet on people and our future.

**Chapter 5:Policy Recommendations**

From *Chapter 1: Climate Change and the Threat it Poses for Urban Areas*, we are given a broad overview of how climate change is set to affect cities and various sectors of urban life. It is clear that almost every aspect of life will be impacted by climate change; policy makers must therefore understand the issues at hand and prioritize remedial or adaptation measures that are most pressing or most strategic.

For example, the threat that extreme weather events pose to health and key infrastructure, needs to be a priority consideration amongst policy makers. As mentioned previously, after Superstorm Sandy hit New York City in 2012, many people died and the city incurred an estimated $19 billion in damages and much of that damage was done to homes. Cities especially in low and middle income nations need to be prepared to deal with the consequences of unexpected extreme weather events. Making sure that people living in vulnerable locations are safe and investing in infrastructure that protects vulnerable people and areas is important.

From *Chapter 2: How New York City is Working to be Climate Resilient*, we see how one of the most populated cities in the world is trying to address climate change. Policy makers around the world should notice how New York City's climate plan is bold and is part of a larger strategy that aims at addressing issues of economic equality, social justice, and environmental sustainability by 2050.

NYC is taking aggressive steps to reach carbon neutrality by 2050. As said in this chapter, reaching carbon neutrality is critical for future generations; it allows us to mitigate the effects of climate change on water and food shortages, living conditions, and human health. The City is taking steps to move its most carbon intensive sectors (buildings and transportation) to transition to renewable energy. With transportation, there have been millions of dollars invested

in electrical vehicle (EV) chargers which will make clean transportation options more accessible to residents and those who visit NYC. Policy makers should follow New York's example in examining where most of their carbon emissions come from and work to transition to renewables as well as making cleaner transportation options accessible. For cities in low and middle income countries that are just developing, there should be efforts to only rely on renewable energy.

From *Chapter 3: The Need for Urban Agriculture*, we examine the threat that climate change poses to urban areas through the lense of food security. Climate change is likely to have a negative impact on global, regional, and local food security by affecting food supply, reducing access to food, and making food use more difficult. Policy makers need to implement policies that address the issue of urban food supply. Urban systems must be prepared for a variety of climate disruptions that can easily lead to food shortages in a world where climate change can have more severe and uncertain impacts. The failure to include agriculture in the climate plan of New York City was a missed opportunity worth pursuing. Investment in urban agriculture should be a major part of climate change plans.

From *Chapter 4: Rethinking How Business is Done* we learn that businesses must be part of the solutions to the threats that climate change poses. Doing so will require abandoning outdated ideas of viewing sustainability as being unprofitable. Before the Covid-19 pandemic the economy presented many opportunities characterized by rising demand for goods and services by a rapidly expanding middle class. Such opportunities are likely to return as the pandemic recedes but business operations are coming under increasing scrutiny due to concerns about the environment. This shift means that business leaders need to partner with governments in caring for the environment especially in the cities where they conduct business.

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