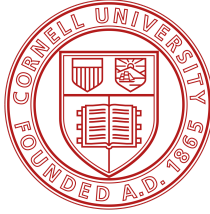


# Green Cities

Promoting  
Human Well-being  
and Quality of Life

Cornell University  
2021



# Cornell University

This book features students' projects from the "Green Cities" course

Cornell University Summer College, June 21 – July 9, 2021

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## About

Team chapters and individual research essays in this book are written by students in the Green Cities 3-credit online course offered by Cornell University in summer 2021. This year, the course focused on such aspects of green cities that promote human well-being and quality of life. Course participants were mostly pre-college students, and a few Cornell University undergraduate students, who came from the U.S., China, and several other countries.,

## Acknowledgements

Students and the teaching team would like to express their gratitude to everyone who supported this course. **Janna Dawn** and other staff at the Cornell University Summer College who helped recruit and support students. Several guest lecturers, including **Akiima Price, Emily Maxwell, and Ana Fisyak** have enriched students' learning by sharing their academic and practical expertise. Two former students from this Course, **Yuehuai "Golden" Gao** and **Ningyu Gao**, shared their ideas about higher education with participants of this course. **Suzanne Wapner** and **Colleen Kearns** have shared information and resources related to the Environment & Sustainability major at Cornell University. The teaching team is also grateful to **all students** in the Green Cities course who contributed their passion, hard work, experiences, and enthusiasm each day by writing the individual research essays and team chapters that are part of this book. Your research ideas, leadership, and environmental action will help us build more sustainable cities that improve the environment and contribute to human well-being and quality of life in cities. Thank you!

## Disclaimer

All ideas and opinions in this book are students' own, and may not reflect opinions of the course instructor, teaching assistants, or Cornell University. Students are responsible for correct citations, acknowledgment of others' work, and proper use of copyrighted materials.

## Suggested reference

Russ, A., Jorgensen, B., Dominguez Contreras, E. (Eds.) (2021). *Green Cities: Promoting Human Well-Being and Quality of Life. Students' projects from the Green Cities course*. Ithaca, New York: Cornell University.

# Student quotes

*Green cities are a result of so much more than an abundance of trees and plants; they encompass ideas from environmental justice to biophilic design to civic ecology. A true green city is sustainable, and ensures a high quality of life for all citizens.*

– Sophia Lopez

*Green cities are living systems that depend on decisions and care from planners, engineers, community members, and others. I've learned that the key to creating long-lasting green cities is fostering behavioral changes and community engagement among urban residents.*

– Emily Kerstetter

*A successful city must value sustainability. Our society cannot move forward if we do not collaborate with the environment around us instead of exploiting it. Whether we do it by supporting community gardens or conducting environmental education, creating stronger connections between individuals and nature is essential. Eventually, it benefits the environment and well-being of urban residents.*

– Aananya Lakhani

*Green Cities taught me that urban sustainability and wellness was not only about green technology and infrastructure, but also about quality of life.*

– Jayden Liu

*Designing a green city requires a close and interactive relationship between community members, experts, and the government. A green city should integrate nature, and provide safety and comfort for its citizens.*

– Jin Chen

*Green cities should include not only green infrastructure and visual harmony between humans and nature, but also social bonds among community members who recognize the importance of the environment and work together to improve their cities. Nature connection, sense of place, and environmental social norms help urban inhabitants play an active role in transforming their urban home into a more livable, sustainable, and green city.*

– Isabel Gardy

*Cities are defined by their inhabitants, cultures, and lifestyles. Planners and officials must prioritize residents' well-being, and encourage their participation in decision-making and environmental education. Such sustainable cities can serve the needs of all people.*

– Elena Schmidt

*Green cities are home to people who are knowledgeable and aware of the environment and nature around them. The core of green cities is not only green infrastructure or zero carbon emissions, but also the strong connection and codependency between humans and nature. I envision an urban future that shows a positive relationship between human development and environmental protection.*

– Lan Hai

*Nature can survive without cities, but cities cannot without nature. Having green spaces, wildlife, clean air, and potable water in a city is a privilege. As an aspiring urban designer and student of this course, I want to find how to equally share these privileges with all, and protect precious natural resources in cities for future generations.*

— Jens Slothouwer

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# Part I

**Ideas that help green cities promote human well-being and quality of life**

# Food security

Emily Kerstetter, Rebekah Robinson, Samantha Graves, Matthew Nagy

Access to quality food is fundamental for human well-being in cities. Residents of some urban areas experience food deserts, where access to fresh and healthy food is scarce. In addition, climate change threatens food supply and distribution globally. Locally sourced food options are gaining popularity but still account for only a small share of consumed food. Creating more secure food access is critical for urban sustainability and must be prioritized as urban populations grow worldwide.

Food deserts, which disproportionately affect low-income and minority communities, are linked to health risks and limit healthy, sustainable food consumption (Ghosh-Dastidar et al., 2014). Roughly 6% of the US population lives in food deserts. Food deserts lack supermarkets with fresh produce, thus families resort to accessible processed or fast food. Poor food options lead to obesity and high blood pressure, and often depend on long-distance food transportation (Ghosh-Dastidar et al, 2014). Public transportation may help urban residents overcome difficulties of food access, however economic factors have drastically limited the number of urban grocery stores. Implementing soon-to-expire food redistribution programs and increasing urban agriculture will combat food deserts by improving community food options.

One of the biggest threats to food security in urban areas is climate change. Cities are also large contributors to climate change. Since the early 1990s, climate change has caused extreme weather-related events to double, which has affected the yield of major crop production worldwide (Concern Worldwide US). Food production shortages and rising prices disproportionately affect communities of lower socioeconomic class, which cannot afford increasingly expensive food. As urban populations grow and food production faces environmental threats, food shortages are increasingly threatening cities worldwide. Addressing climate change is imperative for sustainable urban food security.

Local food systems, particularly urban food production and distribution, are essential to combating climate change. As of 2011, over half of local food sales went through commercial means, such as grocery stores, rather than direct-to-consumer methods like farmer's markets (Tropp, 2013). As demand for high quality and nutritious food grows, large retailers are selling more locally produced food. While many local farmers face difficulty producing food for mass distribution, regional food hubs help them scale up production by developing active relationships between farmers and sellers (Tropp, 2013). Making fresh food accessible goes beyond basic food security and provides sustainable, locally produced food to residents.

As urban areas continue to grow, food security is critical to maintaining desirable cities. Increasing access to locally sourced food is critical in maintaining community health, wellbeing, and increasing environmentally conscious practices that support urban areas.

References: (1) Ghosh-Dastidar, B., et al. (2014). Distance to store, food prices, and obesity in urban food deserts. *American Journal of Preventive Medicine*, 47(5), 587–595. (2) *How climate change threatens food security (and why we're all at risk)*. Concern Worldwide. (2019, October 23). (3) Tropp, D. (2013). *Why local food matters: The rising importance of locally-grown food in the US food system* (No. 1471-2016-120680).



Green Cities and

# Food Security

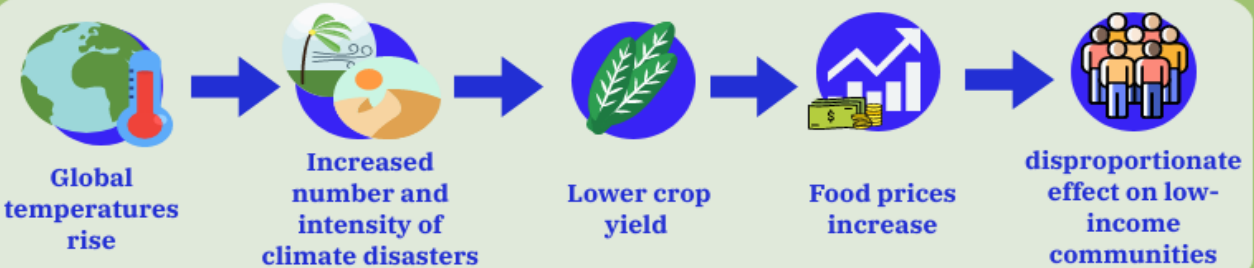
## Food Deserts

Food deserts in cities are urban neighborhoods without access to healthy, fresh, affordable food.

Food deserts are most common in low-income areas. They are linked to increases in obesity and high blood pressure.



## Climate Change



## Local Food Sources

Local food sources such as community gardens, farmers markets, and food hubs can combat climate change and improve community health.





# Connection to nature

Hibiscus Chen, Meiyi Chen, Hero Zhang, Ruhai Ding

Under the pressure of modernization and growing population, many cities lack opportunities for their residents to connect with nature. As addressed recently by the UK Environment Secretary, it is important to recover nature and compensate for the disturbances in cities in order to guarantee urban health (Briggs & Gill, 2021, para.5). Cities should increase their residents' connections with nature by providing vegetation, biodiversity and public green spaces.

Plants play an important role in our lives because they maintain a healthy environment for us. One of their basic and perhaps most essential functions is absorbing carbon dioxide and producing oxygen through the process of photosynthesis. In addition, due to their ability to remove carbon dioxide, they aid in reducing the greenhouse effect and global warming (CK-12 foundation, 2019). However, some people may cast doubt on the advantages of having plants in cities. For example, trees and bushes occupy a lot of the space in a crowded city. A solution may be increasing green roofs or walls to fit the plants in limited capacity. Another common objection is that the pollens produced by plants may cause allergy, yet it can be addressed by planting hypoallergenic plants.

Biodiversity is crucial in providing multiple ecological services such as regulating and cultural services. Some species help manage natural processes. For example, bees are significant in pollinating plants. Without bees, the urban flowers will vanish soon unless greater human care is invested, which results in more economic cost. The abundance in species can also provide education. The shapes and principles behind many species have inspired many human creations that improve life quality, including planes and helicopters that are designed after birds and dragonflies. Therefore, reintroducing biodiversity into the city can enrich human well-being.

Accessibility to public green spaces and natural environments is an essential element for human well-being. Detriments to mental well-being such as frequent distraction, mental fatigue, and mental illness, can be decreased by spending time in nature. Contact with nature can increase self-regulation positively (Hartig et al., 2003). Proximity to parks may also improve physical well-being by increasing exercise level (Kaczynski, 2007). Public open spaces such as playground areas, sports fields, hiking trails, even sidewalks and greenways for pedestrians and commuters, can help address obesity and social class disparities due to different privileges of accessing green spaces. Public green spaces also can enhance urban community connections. Green spaces with diverse plants, orderly arranged environment, and maintenance can stimulate people's enthusiasm to gather. These occasions could take place in community gardens, parks, pocket forests, or any green infrastructure. Thus, public green space can positively influence human wellness and quality of life.

Green infrastructures such as plants, wildlife, and green communal expenses can bring considerable benefits to cities. They are the best mediums to relax people from physical and social stress, especially in the current frustration of the pandemic.

References: (1) CK-12 foundation, (2019) *Importance of plants*. FlexBook. (2) Briggers, H., & Gill, V. (2021). *Green light for 'net zero' equivalent for nature*. BBC News. (3) Cynthia L. Ogden, et al. (2017) *Prevalence of obesity among adults, by household income and education*. CDC: Morbidity and Mortality Weekly Report (*MMWR*). (4) Bertram, C., & Rehdanz, K. (2015). The role of urban green space for human well-being. *Ecological Economics*, 120, 139–152.

## HUMAN WELL-BEING



- Health
  - Fresh Air
  - Space for Sport
  - Help Empower the Society
- Community



## PUBLIC EDUCATION

- Informing
  - Living Samples
  - Tangible Nature

## PEACE & FRIENDLY

## WILDLIFE CONSERVATION



- Peace For Animals
  - Food for Pollinators
  - Habitat Rebuild
  - Reduce Conflict



## BIODIVERSITY

- Condition
  - Help preserve species
  - Prevent Habitat Degrade

# Ecological footprint

Angelica Hsu, Lucas Lee, Michael Phelps, Xueqing Tsang

Ecological footprint measures a human's consumption of natural resources and depends on several factors. In a study where twenty-two explanatory variables on ecological footprints were evaluated, energy consumption was ranked second in efficacy of increasing ecological footprints (Fakher, 2019). Sustainable resource consumption is important for quality of life because overconsumption of resources can lead to environmental and social degradation. When the use of nonrenewable energy sources exceeds discovery of new sources, reliance on these sources cannot ensure long-term human well-being.

Renewable energy provides a feasible solution in sustaining future energy use, especially within dense areas such as cities. Carbon emissions and ecological footprint increase per capita, leading consumption in cities to be higher than in suburban and rural areas (Heinonen & Junnila, 2011). Therefore, it is critical that society develops more sustainable methods of acquiring energy such as solar, wind, geothermal and hydroelectric energy in order to promote quality of life and increase energy efficiency in urban areas.

Solar energy is the energy that is generated from the sun, and it can help reduce carbon emissions in cities by replacing the usage of the nonrenewable resources like fossil fuels. Also, the carbon emissions generated by producing solar panels is less than the manufacturing process for other energy-capturing equipment (Clemons, 2017). Wind energy is the second largest renewable energy source, and its usage shows that carbon emissions of wind farms is approximately 148, 73, and 128 times less than that of burning coal, natural gas, and oil, respectively (Liu et al. 2021). Wind power also has lower carbon emission intensities than other renewable energy sources. Geothermal energy, found in the heat of rocks beneath earth's crust, has significantly lower carbon emissions than fossil fuels and produces an insignificant amount of pollution (Brophy, 1997). Finally, hydroelectric energy is a renewable energy source that utilizes the flow of water, a generator, and a powerhouse. Currently, hydroelectric power represents about 17% of total electricity produced and has potential to grow in around  $\frac{2}{3}$  of all places in the world economically. Hydroelectric energy can reduce our ecological footprint through its minimal pollution and natural source of power (USGS, 2021).

Usage of renewable energy is one of many methods in maintaining a sustainable ecological footprint. With continued population growth in urban environments, depletion of Earth's resources beyond a sustainable level has become more possible. Therefore, beyond the transition towards renewable energy, it is also critical for cities to strategically manage their resource consumption.

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# CONTRIBUTIONS TO ECOLOGICAL FOOTPRINT





# Urban design

Yilin Du, Sophia Lopez, Elena Schmidt, Jinlin Zhang

Thoughtful urban design is key for the well-being of a city's inhabitants: the layout and details influence the residents' lifestyle. Such planning also creates a more sustainable city, which serves humans as much as it does nature. To make a city unique, cultured, safe, and prosperous, planners should consider the philosophy of planner Kevin Lynch: prioritizing the human perception and the pedestrian perspective over an aerial-view approach to design.

Public spaces promote culture and activity in the streets, contributing to the uniqueness of a city. While their purpose has evolved from being historically civic to being policy-related (Carmona et al., 2019), public spaces also provide important social functions: people can gather and appreciate the surrounding environment or use the area for cultural celebrations, fostering interaction and unity. Though ideal for gathering crowds, an open space does not always attract people; unsuccessful spaces are often too large, discouraging interaction among visitors, and lack adequate spots for pedestrians to rest and linger (Gehl, 2010). Hence, planners should make spaces more inviting by using the human scale to encourage people to spend time in public, interacting with each other and their environment.

Strategic street plans and efficient transportation promote human well-being through physical health benefits. Walkable cities, often characterized by wide sidewalks and narrow roads, prioritize the individual by entitling them to use the street as a public space to support their daily needs. By designing streets for the individual, cities can encourage inhabitants to lead healthy lifestyles by promoting walking and biking, lowering the number of car accidents through a decreased amount of vehicles on the road (Agyeman, 2013), and improving air quality by reducing carbon emissions. Finally, easy access to public transportation can further lessen the dependence on private cars, which mitigates climate change and its effects on human health (Lehmann, 2011). Urban designers can promote healthy lifestyles by reducing the need for private cars and encouraging active transportation.

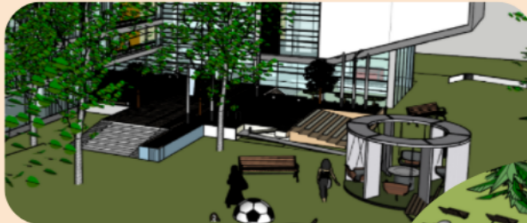
While vertical development can address a lack of space in high-density cities, city planners must also consider the safety and aesthetic implications of skyscrapers. Tall buildings in large sites make pedestrians on sidewalks feel unsafe and vulnerable (Beasley, 2019) as most human activity occurs within the buildings, leaving the streets empty; conversely, shorter buildings underuse precious vertical space. Therefore, developers should find a balance between high and low-rise buildings, such as through mixed-use zoning, to maintain pedestrian safety and make the most of limited space. Varied building height also creates a more interesting skyline, which pleases tourists and residents.

Urban planners can create a livable and enjoyable city by prioritizing the needs associated with human well-being. When they design the city for pedestrians, urban planners can enhance the residents' quality of life, while making the city more sustainable.

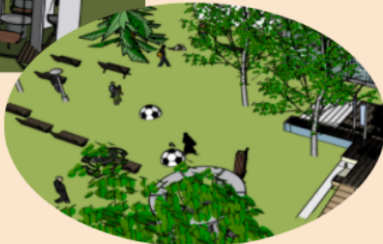
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# Features of Livable Urban Design

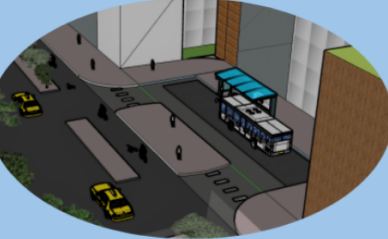
## Culture



Public Space,  
Seating

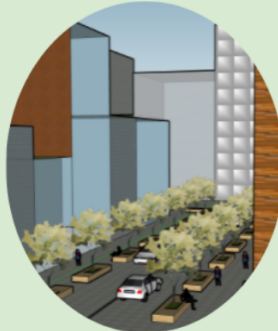


## Health



Active & Public  
Transportation

## Safety



Mixed-height Buildings

# Infrastructure

Aananya Lakhani, Jens Slothouwer, Mike Huang, Lan Hai, Jake Lee

City residents should be the center of a city's focus. Green infrastructures are an important feature of eco-friendly and liveable cities that serve citizens' needs. On the one hand, urban residents depend on infrastructure that provides a safe environment, food, water, and air. On the other hand, infrastructure provides opportunities for recreation, meeting other people, and enjoying urban life.

Urban agricultural infrastructure, for example, provides local food, increases urban resilience, and improves residents' mental health (Battersby, 2013). However, many cities lack sufficient urban agricultural infrastructure, creating food deserts, and increasing community vulnerability to environmental and social problems such as the urban heat island effect and a reduced sense of belonging (Specht, 2013). Thus, urban agriculture infrastructure can be implemented to provide local food, promote human well-being, enhance a sense of community, and increase urban sustainability.

Urban planners should also consider green infrastructure that saves and recycles water. Rain gardens can store stormwater runoff and solve water scarcity issues in many cities (Types of Green Infrastructure, 2018). By retaining rainfall from small storms and reducing stormwater discharges, these gardens also help reduce sewer overflows and lower capital costs for stormwater management. Other infrastructures that harvest rainwater differ in design and location, including infiltration basins, stormwater greenstreets, and blue roofs (Types of Green Infrastructure, 2018). Cities can reduce the risks of flooding or water shortage with water harvesting infrastructure.

Furthermore, green infrastructure can decrease air pollution. For example, vegetation can reduce ground-level ozone by filtering air pollutants and decreasing temperature, which can mitigate respiratory illnesses and premature death (Benefits of Green Infrastructure, 2020; Benefits of Green Infrastructure, 2020). The benefits of green infrastructure to human well-being can also guide interior planting and biophilic building designs in cities.

Strategic placement of green infrastructure reduces community "susceptibility to floods, fires, and other natural disasters," increasing resiliency (The Multifunctionality of Green Infrastructure, 2012). Infrastructure such as green roofs reduces the need for expensive water treatment facilities and frees up funds to make the city more resilient. This creates a positive cycle of GI, released funds, and increased resilience.

While cities experience environmental issues, green infrastructure is crucial to ensure human well-being. Imagine a city that respects the needs of the environment and fulfills the needs of its residents. Developing resilient green infrastructure that contributes to humans' food, water, and air necessities improves the resilience of communities and leads to greener cities with happier people. References: (1) Battersby, J., & Marshak, M. (2013). Growing communities: Integrating the social and economic benefits of urban agriculture in Cape Town. *Urban Forum*, 24(4), 447–461. (2) Specht, K., Siebert, R., et al. (2013). Urban agriculture of the future: an overview of sustainability aspects of food production in and on buildings. *Agriculture and Human Values*, 31(1), 33–51. (3) *Types of Green Infrastructure*. Types of Green Infrastructure - DEP. (n.d.). (4) Environmental Protection Agency. (2020, May 28). *Benefits of Green Infrastructure*. EPA.

<https://www.epa.gov/green-infrastructure/benefits-green-infrastructure> (5) DG Environment News Alert Service. (2012, March). The Multifunctionality of Green Infrastructure.

# INFRASTRUCTURE AND THE BASIC NECESSITIES OF LIFE

## Water



- rainwater harvesting
- water recycling
- effective distribution infrastructure
- irrigation methods
- reduction in chemical usage



## Air

- interior planting,
- urban farming,
- green roofs,
- tree barriers... can shade building surfaces and reduce urban heat island effects

Amongst millions of people,  
on a fraction of land,  
you stand,  
drinking water falling from the sky,  
eating food grown steps away,  
breathing air fresher than mint,  
residing in a haven of safety, health, and wellbeing.

A dream?

No.

The future.

Impossible?

No.

**Infrastructure.**

By Jens Slothouwer

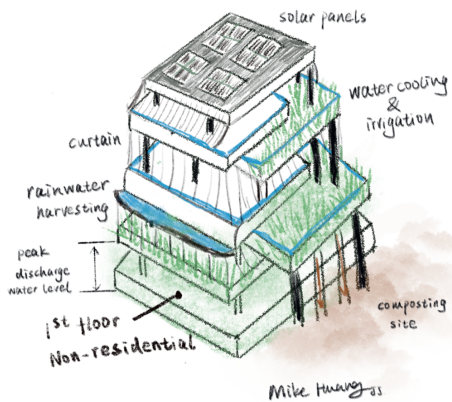


## Food

- Community gardens
- Vertical farms
- School gardens
- Rooftop gardens
- Community farms

*Provide:*

- Food security
- Improved mental health
- Sense of community
- Increased ecoliteracy





# Energy

Jayden Liu, Isabella Zeng, Reem Alhakeem, Sanghyeok (Aidan) Park

In urban development, no resource is as ubiquitous as energy, which provides lighting, heating, sanitation, and much more. Energy is costly thanks to high consumption and limited production, causing inequities such as energy poverty. Thus, the development of a sustainable city must start from its people and their extensions — buildings. A focus on building energy conservation (BEC) demonstrates how efficient energy usage supports sustainable development by creating higher resource utility alongside civic engagement and social equity.

BEC incentivizes more effective resource utility in urban communities. Cities that have applied efficiency-focused incentives have created more sustainable communities with lower energy expenses and less contribution to climate change. For example, building energy standards such as the IECC in North America incentivizes designing buildings for sustainability. In comparison, China has 90% clean mechanisms from abroad, which are expensive. To make up for this, Beijing certifies EC technology but not buildings, which was projected to increase its annual energy use by 6.69% in 2020. However, due to republic tradition, Beijing awards EC businesses, not EC customers, making BEC uneconomic. With a mix of centralized planning and purposeful incentives, urban resource efficiency can increase (Zhang, D. et al., 2019; Zhang, X. et al., 2008).

Building energy conservation also emphasizes the need for active civic participation by defining sustainability around individual actions. An enemy to energy conservation is excess consumption. For example, Saudi Arabia (KSA) has seen rapid increases in domestic energy consumption. Specifically, energy consumed by commercial and residential buildings has grown about 10% per year over the past five years (Krarti, 2017). Many countries rely on KSA's oil exports to stabilize their markets; more domestic consumption means less exports, with greater impacts for the global economy. Situations like these can be remedied by advocating for energy-efficient actions such as lower lighting usage, fostering civic engagement on the individual level by presenting preferred behaviors as social norms, influencing attitudes towards sustainability.

A focus on urban energy efficiency also has benefits for equity. High energy pricing can cause energy poverty for lower-income households. However, a combination of energy-efficient design, promotion of sustainable personal actions, and welfare policy can help raise accessibility. Reduced consumption increases budgets available for programs such as subsidized household solar panel installation, allowing for wider access to energy and supporting improvement in less-privileged communities and protecting people's right to free choices (Zhang, X. et al., 2008).

Urban sustainability must start from the ground up. When everyone understands the values and methods of conservation, together, great strides will be made to conserve the urban community.

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# Energy and BEC

## Equity

## Resource Utility

- Accessibility
  - EC design
  - Personal action promotion
  - Welfare policy
- Right to make decisions
- Reduced energy consumption
- Increased extra budget
- Decision making rights
- Reduced consumption & increased available budget

- Incentives
  - Cost saving
    - Energy & Facilities localization
    - Tax relief
      - Business wise
      - Customer wise
  - Climate change mitigation
  - Innovation focus directing
    - Technology innovation
    - Construction extension
  - Standards
    - IECC
    - Certifications
      - LEED
      - China Green Building Label



## Civic Participation

- Domestic energy consumption
- Social norm
  - More of preferred Behaviors

# Community

Taylor Nguyen, Aidan Rosenthal, Tarini Ruia, Harrison Wang, Frank Wu

When people hear “urban green spaces”, they immediately think of cities paired with nature and the environment. What they often fail to consider is how communities interact with and benefit from such spaces. Communities within green spaces have positive social interactions that allow them to grow and improve. The same way greenness is an indicator of a healthy plant, a “green” city is one with healthy and happy communities. Underserved communities often experience poor environmental conditions. To address the environmental and socio-cultural challenges urban communities face, cities must incorporate sustainable living democratically.

Discrimination based on race, ethnicity, gender, sexuality, religious beliefs, class; these different aspects of identity in combination with environmental issues make for oppressive realities in many urban communities. Attempting to achieve social justice and income equality often come in conflict with growing economies and environmental protection. The best way to achieve all three objectives is to work towards sustainable development (Agyeman, 2003). In order to effectively coexist, urban communities must designate sustainable methods in which environmental and social-cultural aims are achieved simultaneously.

With communities being engaged, diverse, and equal, some of the world’s most prevalent environmental issues, primarily caused by large urban areas, can be mitigated. Communities that embrace these three principles are essentially democratic, and therefore are capable of transitioning into the usage of democratic local governance. Social scientist Xavier De Souza Briggs elaborates that democratic local governance includes norms and practices implemented and followed by the community, making it the key to problem solving urban environmental issues, as they set a path to forming regimes, or “governing coalitions that forge ambitious agendas of action...” (De Souza Briggs, 2008). Achieving this will bring sustainable living to all communities in favor of the transition.

The democratic ideal is deeply participatory. It can be achieved not only through acts of political participation such as voting and protesting, but also by fostering the values of inclusion, diversity, social capital, and self-efficacy in people. These values grease the wheels of a city, allowing the smooth functioning of the ‘invisible’ stakeholders: governments, councils, communities and people. Moreover, frameworks such as the urban metabolism model can be adopted to their fullest capacities, by eliminating socio-ecological injustices. To achieve this however, citizens must go beyond individual acts of engagement such as recycling and donating money (Russ et al., 2020); they must engage in community endeavours such as volunteering in non-profits and collectively expressing their opinions to policy-makers such as city councils, or even becoming council members themselves. People coming together to focus on problems is the solution to communal environmental justice.

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# Health

Isabel Gardy, Grace Martin, Leo You, Violet Ke

Liveable cities rely on a myriad of important elements that make up human well-being. One of the most salient of these factors is health, which is determined by a complex web of factors including environment, economy, lifestyle, and community. The creation of liveable cities requires that both physical and mental health take precedence, as they affect inhabitants on the most intimate level, and unite the city's wellbeing as a whole. By prioritizing human health and well-being among their citizens, cities become more liveable and ultimately, more sustainable.

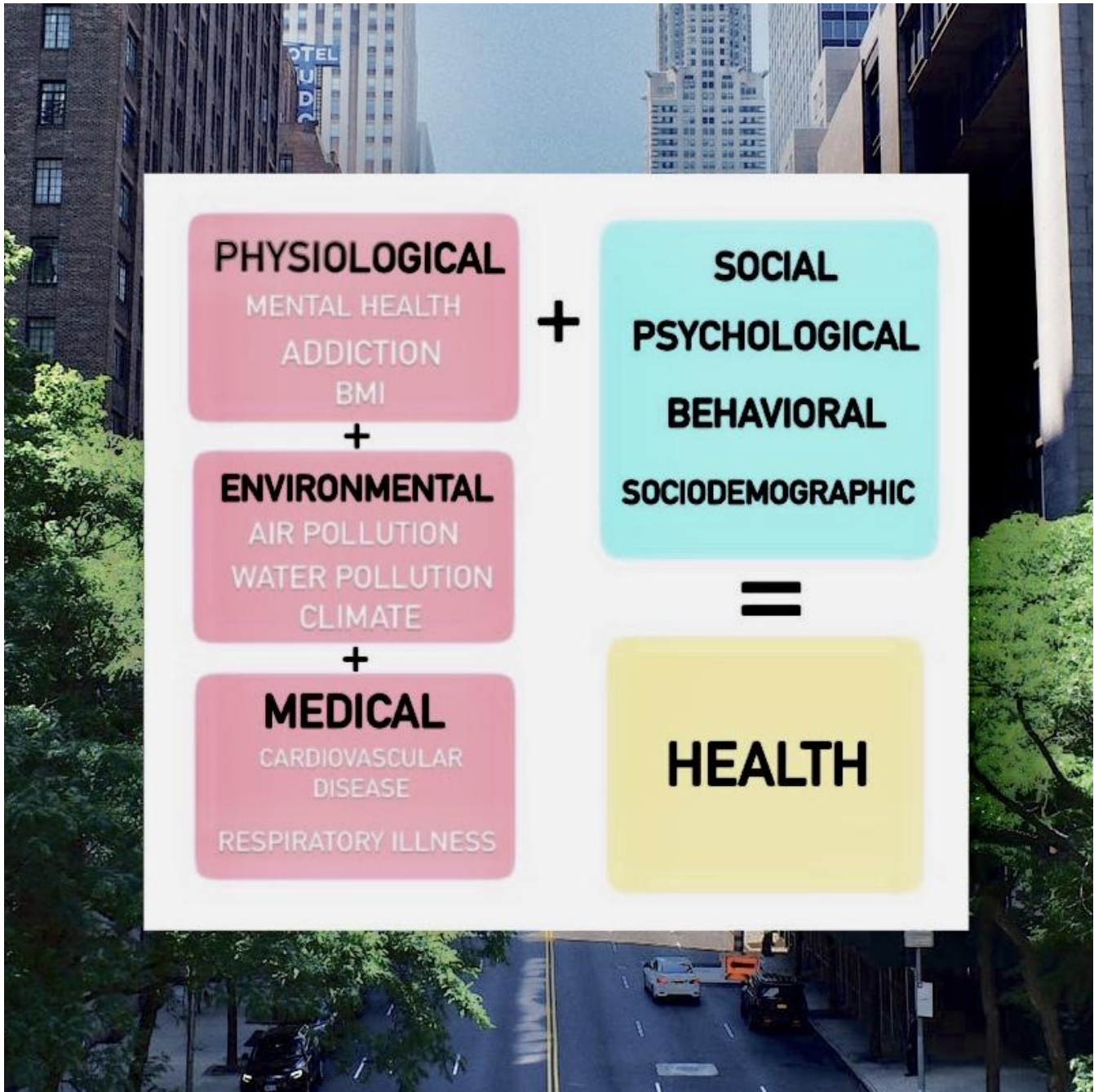
According to a human health framework called the Healthy Cities Approach, it is essential to create and improve physical and social environments within urban areas. By expanding community resources, cities strengthen their inhabitants' abilities to mutually support each other and develop their maximum potential (Glouberman, et al., 2006). Human health is a complex system, and it covers a wide range of conditions that contribute to the physical and mental health of inhabitants. Social, spiritual, economic, and political health are also key features of healthy cities (Glouberman, et al., 2006).

To analyze city health, it is important to use complex adaptive systems thinking; this is an approach that recognizes the multitude of factors that make up health in the urban setting. It includes physiological, psychological/behavioral, sociodemographic, social, environmental, and medical factors. Apart from the commonly recognized physiological variables of human health, such as body mass index, cardiovascular disease, or other medical conditions, human health in cities is also affected by social connection levels, stressful work environments, unemployment, and access to healthcare (Glouberman, et al., 2006). Individuals interact with their city in a variety of ways, and when discussing the health aspect of human well-being, it is important to view it through a complex lens that understands the many factors between community members and the world around them that make up a truly healthy city.

Many urban areas are already adapting methods of improving health in their cities, and one of the most common of these methods is green infrastructure, which can improve air quality and reduce stress levels, consequently lowering cases of respiratory and cardiovascular diseases within cities (Gomez-Baggethun, 2013). According to Maslow's hierarchy of needs, only when these physiological needs are met will city inhabitants have the ability to fulfill psychological needs such as love and belonging within their community. Therefore, it is important to provide inhabitants with access to efficient and sustainable green infrastructure that can aid physical and mental health while simultaneously building community strength and improving sense of place.

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*“Cities are enormously complex, and changes in one part of a city may produce unforeseen consequences in another. Human health, too, is a product of many factors, each of which interacts with the others and each of which is subject to change that may affect the overall health of an individual” (Glouberman, et al., 2006).*



# Lifestyle

Songru Chen, Morgan Cook, Vinh Nguyen, Hongmin Dai, Tengyue Cao

From exercising at a gym to working a 9-5 shift, lifestyle is a major indicator of human wellbeing within urban environments and should maintain certain features in order to achieve the highest quality of life for residents. A green urban lifestyle should work to incorporate sustainability, balance, and continuous civic engagement.

As the impact of humanity on the environment continues to escalate, advancements in sustainable aspects of urban lifestyle are becoming increasingly vital to maintain ecological balance and elevate human wellbeing. In order to fuel these advancements and positively impact urban quality of life, cities should dedicate resources to sustainable movements such as incorporating shared green spaces, investing in renewable energy, guaranteeing accessible public transportation, and exploring the production of urban agriculture. These transformations have proven effective in multiple cases. The city of Vancouver has demonstrated such, where sustainability goals and initiatives including the 'Greenest City 2020 Action Plan' have continuously labeled it the number one 'most liveable' city, with focus on residents' quality of life and Vancouver's green efforts (Walker, 2015).

Another key to a successful green city is allowing workers to enjoy balance between employment and recreation. It is often outside of working hours when citizens are able to interact with the city and give back. This can include volunteer work and enjoying aspects of the city such as parks. Leisure time also allows for more engagement when workers are at their jobs, meaning more employee motivation and involvement (Bataineh, 2019). City governments should allow workers to maintain this balance by implementing city-wide employment scheduling necessities such as time off and mandatory break periods. In this way, workers are in a better position, both physically and mentally, to give back to the city through efficiency within the workplace.

Civic engagement in green activities is an essential factor of quality urban lifestyle. Community activities such as civic ecology practices (park cleanups, for example) not only offer physical activity but also bond communities as residents communicate and become acquainted with one another (Cohen et al., 2012). These green activities must also be widely accessible as studies show that those with advanced access to green spaces tend to demonstrate higher mental health and cognitive performance (United States Department of Agriculture [USDA], n.d.). By allowing residents to continuously engage in collaborative green activities, cities promote residential happiness and unity and therefore uplift future city potential as a whole as residents are more familiarized and connected to their urban environment and one another.

In conclusion, by incorporating these characteristics of sustainability, balance, and engagement in green cities, urban lifestyle is able to cater to residents' well-being and allow ecological growth within successful urban environments.

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# URBAN LIFESTYLE

## Civic Engagement

### Balance between employment and recreation

- Time off and mandatory break
    - Volunteer work
    - Growing gardens
    - Enjoying parks
- 
- Higher engagement at work
  - Greater motivation
  - More involvement

- Community services
  - Exercises
  - Civic ecology
  - Civic environmental Stewardship programs



- Build trust and bond
- Practice openmindedness
- Health advantages

## Sustainability

- Green Infrastructure
- Renewable energy
- Public transportation
- Connection to nature
- Health advantage

## **Part II**

# **Urban social-ecological problems and solutions**

# Addressing plastic pollution

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Every second, 160,000 plastic bags are used globally for an average of 12 minutes (Theworldcounts, 2021)! Plastic, the wonder material used everyday in millions of products, is perhaps the most detrimental of trash found in the ocean today. Most plastics are composed of propylene, a chemical derived from petroleum. When propylene is heated and mixed with other chemicals, polypropylene (i.e PP plastic) forms. The chemical bonds are strongly linked with one another, which is the reason why plastic takes years to degrade (Bahti, n.d.), and then only breaking into smaller and smaller micro- and nanoplastics. With the growing global accumulation of plastic waste, plastic pollution has become a pressing concern to many. In fact, plastic pollution falls under the 12th Sustainable Development Goal (SDG) proposed by the UN, focused on responsible consumption and production. In addition, plastic pollution disturbs human well-being and the quality of life in cities by imposing threats to wild-life animals, humans' health, landscape, etc. To satisfy human well-being in cities, and for the safety of the upcoming generations, the issue of plastic pollution must be addressed through a series of interventions - such as polylactic acid plastics (PLA), environmental education in schools, and legislative restrictions on single-use plastics.

Through technological interventions, the issue of plastic pollution can be mitigated, such as the usage of PLA plastics to minimize plastic waste in cities. "Technological fixes are attractive because they bypass human behavior. They require that people do basically nothing" (Heberlein, 2012). We all know that plastic needs years to break down; in fact, when it does break down, plastic disintegrates into tiny pieces that are ultimately absorbed into the environment — in most situations becoming more hazardous than its first form. The biodegradable bioplastic industry is appearing as a bright solution to substitute fossil fuel-based polymers to remedy our concerns, specifically PLA. PLA, possessing the properties of petroleum-based plastics (eg., PET), is a type of biodegradable bioplastic used in many cities produced from organic waste substances such as banana peels, rotten tomatoes, moldy bread, etc. Unlike other types of biodegradable bioplastics, PLA hits two birds with one stone by: one, transforming excess food waste into a highly demanding product without the competition between food, energy and materials. Two, "creating value from zero, which is economically and socially attractive" (Qunfang, 2011) for cities. In fact, a study concluded that despite the "lower costs of PP, PLA has the highest E/E values indicating better environmental and economic sustainability" (Changwichan, 2018) which can overall achieve the bigger goal of improving quality of life in cities.

Recent years have seen a significant enlargement of research and technology advancements in the biodegradable bioplastics field resulting in its vital application developments in the food and agricultural areas. However, we should take a step back and examine how biodegradable bioplastics, specifically PLAs breakdown. The biodegradation of PLA occurs in particular environmental conditions: high temperature and humidity (i.e., when appropriate microbes are present). Indeed, PLA can entirely decompose into CO<sub>2</sub> and H<sub>2</sub>O in a large-scale composter at 50–60 °C in 90 days, but, globally, most municipal recycling programs don't accept PLA. This means that PLA will most likely end up in the ocean - just like other petroleum-based plastics (Qunfang, 2011). While PLA may be a good substitute for conventional plastic in some cities, it is certainly not the ultimate solution for plastic pollution; hence, there is an urgent need for government agencies, scientists, and health authorities to conduct more research on such a topic.

Society must be fully aware of the detrimental effects of plastic on human well-being and cities. Accordingly, environmental topics, specifically plastic pollution, should be incorporated into the school curriculum, and people should have access to environmental programs. Quality education is the basis of human well-being and acts as a critical aspect of society/cities. "Environmental education increases public awareness about environmental issues... it provides the public with the necessary skills to make informed decisions and take responsible action" (ETA, n.d.). The integration of plastics issues into the educational system has usually been neglected, presenting a significant hurdle to environmental awareness. Two vital elements for altering human action are environmental knowledge and attitudes. According to Dalu (2020), there is a striking discrepancy between people's attitudes and actual behavior. However, by providing the proper education system and non-profit environmental programs (such as Take3ForTheSea, OneMoreGeneration, etc.), people's attitudes could alter, changing their behavior. It has been noted that behavior change and educational interventions in New Zealand schools resulted in decreased amounts of plastic being brought into the school premises.

In order to combat pollution caused by plastic, government officials should enforce new laws by putting legislative restrictions on single-use plastics. Typically, single-use plastic items are formed of low-value material that makes them extensively obtainable but economically impractical to manage and recycle. Charging a fee and banning single-use plastic has proven to be effective in reducing litter and taxpayer costs. For instance, in less than a year of implementing a 10-cent fee on paper bags in San Jose, California, 58% of customers started using reusable bags and a 24% increase in customers not using bags. Furthermore, "the primary recycling collection company in San Jose cut the time spent untangling plastic bags from their machines nearly in half" (Surfrider Foundation, n.d.). However, the methods of developing policies differ from city to city, "depending on the politico-administrative system" (Shaxson, 2009). For plastic policies enforced by the government to positively impact human well-being, the policies should contribute to innovation and outstanding economic performance.

As plastic pollution is becoming a major concern worldwide; all nations, entities, and individuals must unite to protect flora and fauna, the quality of life for upcoming generations, and improving human well-being. This is only possible through the conjunction of modern technologies such as PLA plastics, environmental awareness and education, and enforcement of new laws by policy makers.

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# Social and ecological aspects of urban life

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Urban cities worldwide struggle with many social and ecological aspects that adversely affect urban dwellers. Some of the social elements affecting these cities include high population causing overcrowding, inadequate and ineffective education, increased cost of housing, increased traffic and increased crime activities (Atkinson & Dávila, 2019). On the other hand, ecological aspects of urban cities include urban agriculture and green infrastructure. However, some of these aspects are causing adverse effects in these cities, such as health problems to urban dwellers, aesthetic pollution, noise pollution, and thermal pollution. Metropolitan cities should embrace quality characteristics such as health, intelligence, livability, energy efficiency, and sustainability.

There are various health problems that arise from living in big cities such as obesity, overnutrition and other lifestyle diseases which would eventually cause chronic illnesses. For instance, hearing problems are due to noise caused by many vehicles in these cities and noise emanating from various industries located in these cities. Also, living in big cities as an urbanite can significantly toll someone's mental health, anxiety disorders, anger management disorders, mood disorders, and PTSD. As if that is not already enough, other psychological diseases such as schizophrenia and paranoia affect the urbanites more than those who live in rural areas (Rogers, 2020). According to psychologists, these diseases affect urban dwellers since urban living conditions tend to give their brains a workout that interferes with coping with stress. Additionally, living in a city can affect an individual's sleep quality, thus having a ripple effect on the physical health of such an individual. Lack of quality sleep causes traffic noise, which may interfere with sleep and living in brightly lit urban areas. Insomnia is also common to urban dwellers ("Insomnia and its causes," 2016). As such metropolitan cities should seek funds to ensure urban dwellers' health is adequately catered for by offering health insurance covers.

Another problem facing urban cities is aesthetic pollution. Aesthetic pollution refers to instances where visual images displayed in certain places are displeasing to many but not all people. There is no set agreement on what will be considered aesthetic pollution since one person may find a particular image to be aesthetically inappropriate. In contrast, another person sees the same picture to be aesthetically appropriate while another does not. In urban areas, due to the different cultures, there are bound to be aesthetic differences.

Additionally, another problem facing urban cities is increased inequalities. As the number of affluent individuals continues to grow in cities, the number of poor individuals also rises. The provision of resources and the ability to cope in the harsh environment in these cities is unequal between these two groups of individuals (Franzetti, 2018). If the widening gap between the haves and the have-nots is not checked and corrected, inequalities may destabilize the city and limit any urban development benefits. There is an urgent need for policymakers in urban areas to ensure that resources in their towns are shared equally among city dwellers. Such policies may draw from examples like Manchester City who have tried to equalize these two groups, although a lot still needs to be done.

Environmental pollution is another problem affecting cities around the globe. Environmental pollution includes noise pollution, water pollution, reduced air quality, and over-consumption. In developed cities, ecological pollution problems involving basic infrastructure and industrial production are reduced since these have adapted up-to-date technology and policies, which have primarily reduced pollution. However, underdeveloped cities have a long way to go to ensure that pollution is



diminished ( Florio,2018). Traffic problems and over-consumption problems have, however, increased in developed cities. Such is as seen in Nairobi, Kenya where city dwellers spend close to two hours while stuck in traffic. Cities produce increased amounts of emissions from cars and industries, which pollute the air in these areas. Water and waste pollution in Hotan,China are usually due to increased population in urban areas and industrial activities. Waste, water, and air pollution are the main environmental pollution in big cities.

Despite the challenges stated above, urban cities have a lot to offer. Urban areas provide job opportunities for young people and older adults. In urban areas, roads are of better quality, and the houses are well-built. Transport facilities such as cars, air transport, and railway transport are readily available, and it is faster to move from one city to another. Also, due to the availability of public transport, individuals can save money on a car (Eyaggelos, 2019).

Additionally, amenities such as banking facilities and entertainment opportunities are readily available. In healthcare emergencies, health facilities are readily available and operate twenty-four hours a day such as is experienced in Nairobi city. Cultural and ethnic diversity in these cities allows individuals to make new friends and meet new people (Maré & Poot, 2019) . Education in most urban areas is thought to be of good quality, and it is easier to access schools in urban areas.

In conclusion, urban areas have their advantages and disadvantages in terms of their social and ecological aspects. However, it would be advisable that the management of these cities develop strategies to curb and mitigate the stated problems. Some of the techniques that can be imposed include decentralization of resources so municipalities can access essential services such as quality healthcare and headquarters of organizations. Also, roads should be developed even in rural areas to facilitate more accessible transport services. In the same vein, rules and policies should be set to ensure that noise pollution, environmental pollution, and aesthetic pollution are curbed. When the above is done, there will be a ripple effect towards urban dwellers, and they will not experience health problems, and the cities will also be clean.

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# Urban adaptations to the changing climate

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Since the start of the industrial revolution, cities have modernized dramatically. Along with this, we have seen a dramatic increase in greenhouse gas emissions, resulting in climate change. Climate change, causing global warming and shifting precipitation patterns, seems distant to many urban dwellers, but it has already caused traumatic environmental and economic losses in some cities. In 2021 May, the notorious Yangtze storm killed 11 lives and affected 3000 more residents in Nantong, China. To prevent another catastrophe, cities should evolve and adapt to the constantly changing weather for the safety and comfort of the citizens by adjusting their infrastructures, horticulture, and public attitudes.

Buildings should be designed or modified to withstand potential natural disasters and ensure comfort for the users. Since different cities experience different climatic changes, buildings should be optimized to prepare for potential environmental risks locally. Environmental components like temperature, humidity, and surrounding geographic features, are essential to consider in architectural design so high quality of life can be ensured. For example, heat waves caused by global warming can cause increasing pollution, electricity issues, and droughts if cities are unprepared. Therefore, buildings that can adapt to the situation are necessary for the future. When planning for new buildings, materials with good insulation, high volumetric heat capacity, and good thermal conductivity should be prioritized to control the amount of heat that enters the buildings passively (Cao, 2019). Moreover, old buildings should also evolve by adding attachment structures such as horizontal louvers (Garvin, 2016). These window shades can effectively decrease the passive heat reception of buildings in an economic way. In addition, integrating vegetation into architecture is also a plausible solution. The greenery can increase cooling through evaporation, and they can filter pollutants from the air. Plants can be grown on horizontal roofs, known as green roofs, or on vertical surfaces installed with irrigated plastic modules, fabric pockets, or metal cassettes (Grant, 2021). These attachments can apply to new buildings as well as existing ones. By implementing features like shades and vegetation on buildings, citizens can be better protected from predicted natural hazards such as heat waves while decreasing the energy and associated greenhouse gas emissions needed for keeping buildings cool.

Since vegetation is one of the most important elements in reintroducing nature and regulating the city ecosystem, it deserves special attention to prepare for the changing climate. The changing climate may influence the city's temperature, hydrological regimes, number of pests, frequency of natural hazards, and more. Choosing plant species with higher adaptive capacity to the local weather will allow vegetation to thrive and better perform their roles in benefiting the city (Ordonez, 2016). For instance, many cities are in coastal areas for the geographic advantage of convenience to resources and trade, but this advantage is accompanied by increased flooding risks. In this case, it would be unwise to vegetate the cities with inland species, because they have low resistance to weather events such as tropical storms. On the other hand, floodplain species like mangroves are more appropriate because they have longer roots to grasp the soil, higher tolerance for salinity, endurance to submergence, and higher biomass production (Banach et al., 2009). These species not only can withstand the harsh weather but can also serve as a buffer as the waves approach the land. Therefore, choosing the suitable species of plants for city vegetation is important to keep the citizens from harm during hazardous weather events.

The technological fixes mentioned such as adaptive architecture and vegetation are not sustainable unless they are supported by the public. Thus, as a complementary cognitive fix, the public should be educated with related information so they want to support the transformation. Climate change is an “epistemological phenomenon”, or an assembly of knowledge, that includes many different aspects and issues. Its complexity and difficulty to control presents uncertainty, and this uncertainty result in some people believing climate change is not real. Nevertheless, an increase in environmental literacy, or acquisition of knowledge about the environment, may help correct this (Kagawa & Selby, 2010). Environmental literacy can also provide political and social motivations, other than environmental incentives, for city transformations. Understanding the risks of climate change, governments will react more efficiently by adopting relevant solutions and providing subsidies to modify the city, and the public will be willing to contribute their efforts. As redesigning a sustainable city is linked to the safety of the citizens and their properties, as public attitudes shift, both the government and the citizens will support retrofitting and climate adaptive architecture, even if it comes with an economic cost. The one time cost will address long-term issues and prevent future loss. Therefore, environmental literacy is crucial for gaining support for adapting a city for climate change and instructing citizens in ways to protect themselves and their quality of life.

Climate change is a major factor affecting human well-being in cities around the world. Confronting it requires city adaptations through architectural retrofits, appropriate vegetation installation, and public education. These adaptations are crucial in promising high quality of life for the long term. As the cities are prepared for incoming uncertainties, losses can be minimized while happiness is maximized.

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# Life line or death line

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Roadkill is one of the most severe problems threatening the lives of the wildlife in urban areas. Wildlife also face the issues of habitat fragmentation and disturbances from human activities at the same time. Victims of roadkill vary from reptiles like lizards to large mammals like pumas or mule deer. This must be solved not only for the sake of wildlife but also humans. The dead bodies after roadkill accidents are very hard to clean, they stink and are revolting to look at, and may spread bacteria and parasites after the bodies start to decay.

One way to solve the conflict is to stop wildlife from getting onto the roads. Animals will be attracted by noises or lights and walk up from their habitat to the roads. Also, reptiles will be attracted by the leftover heat on the roads at night. A way to help the wild animals is to repel them. Keeping them away seems to be cruel but this prevents them from losing their lives and shed blood on roads. Wildlife repelling includes chemical animal repellent and visual repellent, but visual repellent will be less harmful and easy to install. According to "Wildlife-Vehicle Collision Reduction Study: Report To Congress" by US Federal Highway Administration, mirrors (Deer Reflectors) are useful in getting large herbivores like deer, and the price is much lower than chemical repellent, but can only benefit a small area.

Another method is to set up signs. Lots of drivers would not recognize wild animals until it is too late to turn away. This problem made the tragedies inevitable. The solution is to set up bright colored signs where collisions happen frequently. Drivers will see these signs, and the price of installation is very low (18\$/year). However, the signs cannot help that much since it is a fixed post and cannot actively warn the drivers to stop.

The best way for wildlife conservation on urban roads is to build blockades and pathways designated for animals. A fenced area with under or above paths for animals to pass through can reduce disturbances of their original

Wildlife conservation is a win-win situation that is tightly connected to human wellbeing and the ecosystem. It is the responsibility of humans to figure out how to balance the conflict between their own community and animals' habitat. Collisions can be avoided by care and awareness.

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# From waste to energy: Biogas finds its way

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Because of the growing urban population, food waste disposal and accumulation in landfills in city areas are growing exponentially, which causes serious issues like soil and water pollution, land scarcity, and health problems. Meanwhile, air pollution, much of which comes from burning coal, is causing asthma, heart disease, and cancer leading to more than 7 million deaths each year worldwide (United Nations Economic Commission for Europe [UNECE], n.d.). These two environmental problems drastically decrease human well-being in cities. To simultaneously address the problem of food waste and air pollution while seeking an alternative for declining fossil fuels, the government should promote the use of biogas for cooking in cities, which may improve urban residents' quality of life by reducing landfill and air pollution, and by using a sustainable energy source.

The use of biogas for cooking can help mitigate food waste accumulation, which leaves more land for human use. Dumping food wastes in landfills or dumps is expensive and land wasting, and can cause severe environmental issues like soil, water, and air pollution due to the production of methane, carbon dioxide and other nuisances like flies and odor (Al-Wahaibi et al., 2020). Anaerobic digestion can be one way to turn food waste into biogases for use. According to EIA, biogas can be produced by anaerobic bacteria in landfill sites and then be burned directly as a fuel (U.S. Energy Information Administration [EIA], n.d.). Since one major raw material for biogas generation is municipal organic wastes, this energy generation method can effectively help clean up current landfills in cities (Wang et al., 2013). It is beneficial to human well-being not only because it retains the aesthetic value of nature by removing wastes, but also because it helps solve land shortages. In most areas where agriculture is the major income for the majority of the population, losing land means the loss of income and a reduction in living standard (Barbier & Di Falco, 2021). In urban areas, land shortage is also causing housing shortage, unemployment, poverty, and other social issues which negatively affect residents' quality of life. In this case, the clean up of landfills to generate biogas would render more land for human use, mitigating the effect of land shortages and contributing to human well-being.

In addition to cleaning waste in landfills, the use of biogas for cooking can also reduce air pollution rate, contributing to the enhancement of human health. According to the Environmental and Energy Study Institute, using stored biogas as cooking fuels in cities helps limit the amount of methane released into the atmosphere. More specifically, the reduction of methane emissions is equal to the annual emission of 11 million passenger vehicles in the U.S., which is a reduction of 91% relative to petroleum gasoline (Environmental and Energy Study Institute [EESI], 2017). As for carbon dioxide, a remarkable carbon footprint reduction can also be achieved by capturing carbon dioxide during the generation phase by means like water scrubbing, which lead to 95-98% reduction (Budzianowski & Postawa, 2017). These reductions in major greenhouse gas emissions improves the health of citizens in several ways. For example, it reduces the chance of getting headaches, difficulties in breathing, and increased heart rate by reducing both indoor and outdoor pollution. To sum up, switching conventional energy sources to biogases for cooking helps reduce air pollution rate by limiting the emission of greenhouse gases like methane and carbon dioxide, preventing people from getting related diseases.

Another benefit biogas brings is energy security, which contributes to urban sustainability. IEA defines energy security as the uninterrupted availability of energy sources at affordable price. To ensure sustainable development, it is vital to find a secure energy source. Biogas is a renewable



energy source as it qualifies under the U.S. renewable Fuel Standard Program and other standards (EIA, n.d.). Since renewable energy can be naturally replenished, it can be used continuously when properly regulated, thus providing an uninterrupted supply for future generations. Furthermore, biogas also has the lowest annualised costs among all the options, which made it more affordable for developing countries (Kammila et al., 2014). In this case, use of biogas helps improve human well-being since it provides people with affordable and reliable energy supply, which makes food more accessible for low income citizens.

A common disadvantage for biogas is that it might be less suitable for dense metropolitan areas. Obviously, the lack of land in cities for installing anaerobic digester equipment makes transporting waste to rural areas for processing the only option to generate biogas. If a city is densely populated, it will be energy burning and time consuming to collect all the waste, and there also may not be proper transportation methods for waste. Problems like poor collection and inadequate waste transportation thus cannot ensure a consistent supply of biogas in dense cities. Yet, since biogas technology is relatively new with only a little research, its development in the future may address these disadvantages and make it more suitable for cities.

Using biogas for cooking in cities has an immense potential for solving important environmental issues like air pollution and waste accumulation in landfills. Producing and using biogas will enhance human well-being and quality of life by mitigating land shortage, reducing pollutants affecting human health, and providing a secure energy source for future use. However, to reach its potential, it is important for governments and industry to keep investing in research projects to improve current biogas shortcomings.

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# Farming in underserved urban communities

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Urban sustainability is often thought of in terms of what a city can do to improve the natural world in and around it. However, as vital as this is in maintaining an overall healthier planet and minimizing the negative impacts of human lifestyle on the living world surrounding us, urban efforts to integrate more ecological methods of design also have the potential to create long-lasting impacts for city residents as well as the physical aspects of the city. In order to both minimize food deserts and strengthen low-income urban communities both physically and socially, city managers should invest in the design and creation of zero-acreage farming in lower income urban communities.

Firstly, with more investment into ZFarms, the number of food deserts in underprivileged urban communities would decrease. A food desert refers specifically to a physical area in a city environment where fresh foods are more difficult to acquire in comparison to other parts of the city as higher quality grocery stores flock to more affluent neighborhoods, where residents are more likely to afford such goods (Karpyn et al., 2011). With city managers and local legislature investing in zero-acreage farming by dedicating a proportion of their public service or environmental service budget to the task, families and individuals living in underserved urban areas will have access to easily accessible produce. Locally grown crops also promote healthier habits by dissolving the geographical barrier between underserved communities and fresh markets that only accumulate in higher income neighborhoods (Hallberg, 2009).

Implementing ZFarming through methods such as community gardens directly and positively impacts cities. Establishing areas of local food growth secures environmental benefits from reduced transportation miles and resource conservation (Specht, 2013). Saved resources detract from landfill buildup and limit greenhouse emissions precipitated by the transporting of produce into cities as well as emissions stemming from vehicles within cities as individuals travel in search of quality produce. Without the same amount of dependence on long-distance farms, physical costs of transporting raw materials also greatly diminish. Additionally, turning to local food production also contributes to the health of consumers, particularly those living in lower income communities who reap the benefits of zero-acreage farming. This includes the fact that rooftop gardens, a popular form of ZFarms, can reduce food contamination due to the physical distance between crop growth and roads (Thomaier et al., 2014). With ZFarming specifically requiring existing building space in order to function properly, there exists potential to physically benefit underprivileged communities by utilizing rundown or abandoned infrastructure to renovate into settings for ZFarming practices.

There are numerous social benefits stemming from investment into ZFarming in urban environments. Overall, a sense of community is built from having shared green spaces for residents to collectively contribute to and benefit from - offering the chance for individuals and families to gather, promoting social integration in underserved areas whilst simultaneously contributing to a positive image of the neighborhood (Thomaier et al., 2014). Additionally, the creation of such green spaces through rundown buildings in underserved communities carries educational potential as ZFarming is often used as an opportunity for students to learn local sustainability through food production and benefits of a healthier diet - weaning new generations into sustainable practices and encouraging youth to take roles in urban agriculture. These farming locations can be used as places of activity for all ages. With students contributing and benefiting from such establishments, the potential for schools to become more biophilic in communities involved in ZFarming is more of a reality.

Additionally, ZFarming can even work to minimize criminal activity in an urban setting. Studies show that the lack of ecosystem services available to underserved communities in cities can contribute to overall stress and disease, with higher levels of these factors as well as high crime rates found together in these low-income communities (Hribal-Kornilowicz, 2016). It has also been illustrated that the more vegetation present in a community (including that from urban agriculture such as ZFarms), the less likely crime is to occur. An inquiry into Chicago's underserved 'Ida B. Wells' public housing development revealed such when it was demonstrated that increased levels of vegetation present in the community resulted in lower levels of two crime categories: 'property' and 'violent' (Kuo et al., 2001).

However, some would argue that investing in renovating buildings in lower-income urban communities in order to create ZFarms is not worth the monetary contributions of taxpayers simply due to the hassle and seemingly minimal impact. For example, keeping ZFarms year-round means consistently maintaining certain indoor temperatures for the farms throughout all seasons of the year. Besides this, ZFarms alone will not be able to single handedly solve food insecurity. However, investment is necessary for progress, and only examining renovation costs of ZFarming ignores the abundance of short and long-term benefits of ZFarms in relation to lower-income communities and cities as a whole that are worth the expenditure - ranging from the educational benefits for youth to the environmental and physical benefits such as reduced crop contamination.

In conclusion, zero-acreage farming in low income communities carries with it many possibilities and immense power to contribute to the physical, social, and economic aspects of urban life. Being able to use resources and space already present in cities is vital to promote environmental justice and end food insecurity in low-income neighborhoods. With at least six of the United Nations' Sustainable Development Goals relating to environmental injustice, it should be noted that achieving these endgames means each of us taking on the responsibility of working towards civic ecology and creating a chain of positive change so that the underserved may be served in regards to environmental rights. A green city means green for everyone.

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# Household waste disposal

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Have you ever heard of how some cities deal with waste? They simply dig huge pits and bury these waste underneath the ground without categorization. These pits, known as landfills or dumps, result in contaminating underground water and soil, polluting the air, and increasing the likelihood of fires. In China, the rapid growth of the economy and population has caused increased amounts of waste, decreasing the availability of land for burying waste. Since 2000, Municipal Solid Waste (MSW) management has been a serious issue for a developing country like China. This essay focuses on the issue of household waste in China, which has exceeded 150 million tons per year (Lin & Kuang 2021). The rational disposal of household waste should be well regulated by policies established for citizens, including sorting waste and reducing daily waste by using reusable options to sustain a green and healthy environment.

Garbage sorting, so called Urban Garbage Classification (UGC), was introduced in recent years as an effective solution for household MSW. Several cities have launched the program of constructing a strong system of garbage classification. The implementation of UGC can establish awareness of the harm created by poor waste management by citizens while taking the first step toward proper management. TV channels and broadcasts in China adopted promotional videos regarding the importance of waste management in the previous years, foreshadowing the new policy of garbage sorting for recycling purposes among communities. Posters that provide knowledge of categories of waste are distributed to each household by community servicemen with the placement of corresponding community garbage cans. Once the citizens are well educated about the importance of waste management, they then acknowledge their position in the protection of the environment by simply sorting the waste they produce. Residents are encouraged to use several trash cans at home to remind themselves of garbage sorting.

Additionally, UGC allows cities to dispose of household waste by category effectively: waste that can be reused directly, waste that can be reused after certain processes, harmful waste and non-renewable waste. Some waste can be incinerated for energy rather than to be processed with the non-reusable waste which reduces the amount of waste disposal and processing equipment, benefitting not only the environment but also the economy (Liu Tong Liu 2020). Thus, waste that previously was buried with the harmful and non-renewable waste can be separated from the group of “waste” for its value of being used for other purposes.

Finally, the most obvious way to manage household waste is to reduce the amount of waste generated on a daily basis by choosing renewable sources to use. For instance, this could mean avoiding the use of plastic bags, which are composed of non-renewable sources. Paper bags or canvas bags, therefore, can be a better alternative. Restaurants should stop using disposable tableware and either encourage people to bring their own tableware or return to using reusable tableware washed onsite. Communities should consider establishing facilities for the collection of specific reusable waste such as boxes and paper and transporting them to factories for their next usage. Cities must popularize eco-friendly materials, stopping companies from producing non-renewable materials, and reducing the quantity of harmful waste. Hence, renewable energy sources can effectively reduce the amount of waste produced.

Household waste can be well managed by a strong system of urban garbage classification with corresponding policies for punishments and rewards, by a well educated community, and by paying attention to choosing reusable items for use in daily life. With the positive participation of citizens

under the ruling of the government with knowledge supported by expertises, harms caused by household waste would ameliorate to form a green city and benefit the well-being of humans.

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# The crucial “leftover” in cities

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A metropolis is not a strange presence in the modern world. Towering skyscrapers, prosperous commercial complexes with dazzling shops and entertainment, crowded streets with a booming population adding up; flourishing based on economic development is visible in every way. Yet, the impacts of urbanization on biodiversity ecosystems, human well-being, as well as the potential benefits of ecosystem restoration in urban areas remain poorly understood (McDonald and Marcotullio 2011). Climate change adaptation and mitigation, recovery of damaged ecosystems, active engagement of people, and community cohesion can be improved not only by exploring new aspects of cities but also by taking advantage of what we already have. To address these issues, city governments ought to adopt more green infrastructures, such as green roofs and stormwater retention, emphasize usage of vacant land, and conduct refurbishment and redevelopment of brownfields.

The implementation of green infrastructures plays a key role in the usage of the areas that are capable of utilization but sometimes ignored by people, in other words, the “leftovers”. Green infrastructures are resilient, cost-efficient, and provide various community benefits (EPA). Additionally, they are often not spatially occupied on a large scale. Infrastructures include green roofs, bioswales, community gardens or farms, stormwater harvesting, and more. Their contributions are embodied in many ways. A prominent case from the book *Biophilic cities* by Mr. Beatley, discusses the Ballard branch of the Seattle Public Library. It has a green roof that incorporates multiple ecological features, like extensively diverse plants, daylighting system, installation of photovoltaic panels, and the building itself is built out of recycled materials. The combination of these traits provides a favorable environment for someone inside or outside the library, and also promotes net-zero emissions by using renewable energy. Other than spaces on rooftops, green infrastructures can also be implanted in vegetation. Another mentionable case, sustainable Urban Drainage Systems (SuDS), utilizes vegetated land surfaces to help restore natural features within the urban environment landscape (Ellis, 2013). They attenuate flood impacts by storing stormwater and filtering the pollutants (L. Hoang; R. A. Fenner, 2015), providing temporary buffers in case of inundation. We realize that simple utilization of the plannings that are underestimated will create margins for potentials.

Focusing on vacant land development can further incorporate accessible areas and urban constructions. There is plentiful overlooked, underutilized land in our cities that can be extensively productive and has the potential to provide cities vital ecosystem services for urban residents (Timon McPhearson, 2012). For instance, one example would be converting vacant lots to community gardens, vineyards, or tree farms. Such uses foster provisioning services through urban agriculture, balancing consistency in local areas, and making the community more vibrant. A great example in Detroit, Lafayette Greens, fully depicts an ideal version of vacant lots accommodated in greenery. By padding in green infrastructures and necessities to an empty plaza, an edible garden, the lot now operates as a public institution landscape and is aesthetically appealing. (Philips, 2013) Non-profit organizations steward this garden while it is accessible for families, friends, or just pedestrians to engage and communicate. Some might argue that vacant lands are only capable of transformations relating to agriculture, but we may expand our imagination on aspects such as recreational areas and enterprise establishment, outdoor exhibits, and public green spaces.

Retrofitting brownfields is another important way to promote upgrading inside the city. When we visualize brownfields, they often relate to polluted landfills or industrial factories with

contamination. Envisioning more possibilities to reinvent these properties could make holistic contributions to facilitate job growth, existing infrastructure, and improve and protect the environment (EPA). A brownfields reinvestment program in Waterbury is helping the remediation of its core neighborhoods by repurposing underused industrial property that is adjacent to the city's train station and neighboring residential areas. Encouraging green, efficient land use, and businesses coupled with economic growth. It will also incorporate a riverfront greenway into all new developments for public access (WDC, 2014). There are many more successful examples, such as turning wasted industrial plants with important histories into modified walk-in parks. Visitors can go for a stroll, take pictures, and be immersed in a meaningful regional custom. Such projects offer comprehensive steps to spur new uses in urban centers and to promote sustainability, similarly, they demonstrate the great potential for ecosystem conservation.

In a review of the solutions presented so far, even though there are some inevitable circumstances that could impact their viability, nevertheless, it is clear these "leftover" spaces still have much to contribute. By fully exerting them, they could bring education to the populace of their effects. As more "urbanized" the city is, people are more focused on what actions should be taken in order to achieve a vibrant, resilient, sustainable--and most importantly, green city. By sensibly implementing green infrastructures, making use of vacant land, and brownfield rejuvenation, this goal is within reach and will be accomplished in the future.

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# Plastic pollution control

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Resulting from the rapid manufacturing of throwaway plastic items, plastic pollution has become one of the most urgent environmental concerns. A great deal of plastic pollution occurs in cities with poor waste management. Chemical additives used in plastics for strength, flexibility, and durability increase the time of decomposition of plastic items even after they become garbage. To make things worse, plastics are easily transported in oceans, rivers, atmosphere, soil, or even right next to you when you are walking on the street. Even when water, wind, soil, and sunlight break down plastics, microplastics still remain. It is almost impossible to retrieve those remnants once they have drifted throughout the open ocean or become released into the air as micro- and nanofibers. Plastic garbage accounted for 12 percent of all municipal solid waste globally in 2016, with 242 million tonnes of waste generated. This trash came largely from three regions: East Asia and the Pacific (57 million tonnes), Europe and Central Asia (45 million tonnes), and North America (35 million tonnes) (TIPW). In fact, plastic kills millions of creatures every year, including fish, birds, and other marine species. To avoid environmental damage from plastic and minimize the use of plastic materials in cities, municipal governments should use economic incentives, education, and policymaking to encourage citizens and manufacturers to switch to biodegradable materials.

First of all, depending on the advancement of technology and general support for the development, production, sales, and use of biodegradable material products, plastic pollution and consumption can be easily reduced and prevented. Biodegradable plastics have similar qualities as regular plastics, but their chemical structure can change under certain conditions, making the polymer decompose and assimilated by nature as non-toxic byproducts. Such plastic is manufactured from organic plant-based raw ingredients that allow decomposition, and these plastic kinds will eventually breakdown into compost. Significant progress has been made in the research and development of new plastics in China, and "green" substitutes made of starch, straw fiber, natural straw pulp, and other materials are being developed. New fast food cutlery made from paper, starch, and biodegradable materials without releasing toxic chemicals which can be easily broken down in relatively high temperatures has been used on some railway trains to reduce the amount of plastic pollution along the railway (Wu, 2013).

Further, the legislature should strengthen laws and other regulations, bring plastic pollution prevention and control under the purview of the law. The government should formulate and promote relevant national laws and regulations to prevent and control plastic pollution as soon as possible, and clarify the obligations and legal responsibilities of producers, sellers at all levels, and consumers to reduce the amount of plastic produced and used, and to create systems for appropriately recycling plastic waste. For each link in the chain of production, management, use, and disposal of plastics, the government should specify particular control measures and guiding policies, check the production of plastic packaging that is not easily recycled and encourage the improvement of the recycling systems for waste plastic. The government departments can introduce relevant policies and measures to restrict production and sales, calling on people to take action and use reusable options, such as cloth bags instead of the daily use of plastic bags. For instance, in reaction to apparent inactivity at the state level, Los Angeles approved a ban on free plastic bags beginning in 2010. Due to the implementation of a plastic bag ban paired with a \$0.05 tax in Los Angeles County, no plastic bags were provided by the 72 retail outlets causing plastic bag utilization to fall dramatically (Wagner, 2017). In China, the government ceased providing free plastic bags for shopping in supermarkets as

of June 1, 2008, according to a law that requires consumers to pay for them separately (Clapp, 2009). The introduction of this law resulted in the reduction and control of the use of non-biodegradable plastic products.

Furthermore, the government should strengthen the publicity of environmental protection and enhance public awareness of environmental health. The prevention and control of plastic pollution is a systematic process, which requires joint efforts of all industries and government departments, and the active participation of the public. The prevention and control of plastic pollution should be regarded as a key to the comprehensive improvement of the urban environment to build a green society. Forming environmental protection social norms is crucial to address plastic pollution and other forms of pollution. In addition, it is necessary to use various administrative units, organizations, news media, school education, and other outlets to gain extensive publicity and popularize relevant knowledge about the causes of plastic pollution and plastic hazards. Governments should improve public awareness of environmental health and social ethics and educate people to develop good environmental habits so people can actively participate in the repurposing of plastics (Silva, 2020). For example, in order to conserve the environment, the government has taken the first step in 2019 by banning the use of plastic straws and replacing them with biodegradable drinking straws in Kuala Lumpur, Putrajaya, and Labuan. By doing so, the public can not only comply with environmental protection laws and regulations but also actively set examples of good behaviors.

To prevent and reduce plastic pollution, relevant departments (including government, legislature, environmental protection agencies, and so on) should unify their thinking and understanding, strengthen management and focus on the development of technology. Governments should also advocate raising public awareness about environmental conservation (Matt, 2014). Plastic pollution not only affects the appearance of the city, but also harms the environment, human well-being, and animals. Government, businesses, and the public can work together to decrease plastic pollution while adapting the use of biodegradable plastic, thus lowering the contaminants in soil, water, and atmosphere, and improving human well-being.

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# Green roofing and human well-being

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Green roofing in urban settings provides a multitude of benefits, including a variety of regulating, supporting, and cultural services that increase the quality of life for inhabitants (Gomez-Baggethun, 2013). These benefits include, but are not limited to: climate regulation, enhanced city aesthetic, improved physical and mental health, strengthened sense of community, higher levels of social interaction, runoff mitigation and protection against flooding, and reduction of smog. Rooftop gardens in cities serve as urban food sources, providing community members the opportunity to form close connections with both nature and other community members (Gomez-Baggethun, 2013). Urban soil from rooftop gardens also mitigates noise pollution, a major issue for densely-populated cities, by absorbing, deflecting, refracting, and dispersing sound waves. Vegetation can aid urban areas with air purification by removing pollutants such as ozone, nitrogen dioxide, carbon monoxide, and particulate matter from the atmosphere (Gomez-Baggethun, 2013). One of the major environmental benefits of urban green roofing is mitigating something called the urban heat island effect. The urban heat island effect is caused by the abundance of dark surfaces within an urban area like asphalt and rooftops that absorb large quantities of heat from the sun compared to green surfaces (Yang, et al., 2016). This heat absorption can cause cities to be up to ten degrees warmer than surrounding rural or suburban areas. Along with the aforementioned environmental services green rooftops provide, a variety of social and community-based advantages exist, such as providing individuals with opportunities to get involved in the local environment, form social relationships with other community members, and improve mental and physical health. The complexities of green roofing as a tool to improve sustainable city life often originate in the possibility of unintended ecosystem disservices, such as attracting rodents or other unwanted organisms, which must be regulated to ensure the advantages of green roofing are maximized equally across the entire population (Gomez-Baggethun, 2013). Although green roofs provide many benefits, it is important to implement this method of green infrastructure in a manner that takes into account the human well-being of the entire city's population and caters to the needs of the people across all demographics. City governments can achieve this by taking the following three steps: careful prevention of ecosystem disservices, ensuring equal accessibility to all community members, and logical city-wide distribution.

Unintended adverse impacts from green roofing necessitate thought-out installation that anticipates a variety of ecosystem disservices on different demographics as well as the city's environment. Although green roofs are sustainable methods for urban flood mitigation, runoff from green roofs can contain high levels of nitrogen and phosphorus, which must be controlled in order to prevent water contamination, eutrophication, and other negative environmental and ecosystem consequences (Buffam, et al., 2015). Fertilizers used in rooftop gardens contain nutrients that stimulate and foster plant growth, such as phosphorus and nitrogen, but these compounds can cause immense damage if leaked into nearby bodies of water like lakes, streams, or rivers (Buffam, et al., 2015). Eutrophication is a chemical process in which plant nutrients leached into bodies of water stimulate excessive algal growth, depleting aquatic ecosystems of oxygen and light and killing aquatic organisms. When installing green roof structures in urban settings, it is important to take notice of this possible ecosystem disservice and ensure that no local bodies of water will be negatively impacted by the construction. Additionally, rooftop gardens and farms may attract a wide variety of organisms, some of which may be perceived as pests, calling for a thought-out approach to green roofing that



takes into account any animals and insects that may be lured by specific vegetation (Gomez-Baggethun, 2013). One of the most important elements of green roof implementation is ensuring that no one community will be disadvantaged by any ecosystem disservices that may arise following construction.

The wide range of benefits green roofing provides must be accessible to all demographics across city communities. One limitation many low-income urban residents face when making the decision to implement green roofing on community or privately-owned buildings is the financial burden of construction. Additionally, many green roofs and rooftop gardens in cities are located on private property and not open for public use, preventing a large portion of inhabitants from receiving the benefits green roofs provide for mental, physical, and spiritual health, leading to deepening inequality. According to a case study in Helsinki, Finland, private ownership benefits of green roofs do not usually cover the cost of construction, but when cities implement green roofing at a higher rate, the whole urban area sees tremendous benefits (Nurmi, 2013).

In order to ensure that the environmental and community services that green roofs bring forth are equally distributed, cities must examine the specific needs of each community and take into account different environmental and social conditions city-wide. Cities are complex systems, and a number of factors go into the specific needs of a large urban area. For example, higher-income neighborhoods within cities tend to have a significantly higher percentage of foliage cover compared to low-income neighborhoods in the same city (Shanahan, et al., 2014). This causes less affluent neighborhoods to feel the damages of urban environmental issues on a much more intense level, such as air pollution, noise pollution, and the urban heat island effect. Distributing green roofing to these low-income neighborhoods on a larger scale will ensure the communities who stand to benefit most from green roofing will have the support they need to get their green roofing infrastructure off the ground. By preventing ecosystem disservices and promoting financially feasible construction among all city neighborhoods, green roofing can be implemented equally across all income levels and given on a higher scale to specific urban areas that are in need.

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# Ecologically-based malaria prevention

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Malaria is a deadly and common disease that plagues every African country. In Ghana, Malaria accounts for 19% of all deaths across the country. The populations who suffer the highest mortality rates from malaria include young children, the elderly, and households living in extreme poverty. Not only does malaria have a large effect on individual well-being and quality of life, it also impacts community-level operations, as it has shown to decrease business revenue, impede economic growth, and increase health-related absenteeism in educational and professional settings. There have been large amounts of funding dedicated to malaria prevention, supporting programs focused on controlling and lessening the symptoms of malaria to decrease mortality rates. However, there is also increasing interest in making structural changes to how individuals interact with the environment and ecological system that will help prevent disease transmission. Malaria prevention organizations should focus on structural changes they can make in the environment, including strategies such as increasing the use of mosquito nets, improving waste removal procedures to limit mosquito breeding grounds, and restructuring housing to include extra protection from outside insects.

Malaria prevention tactics in Ghana have been extensive, and few have shown long-lasting effects on Malaria mortality rates in the region. One of the more recent malaria prevention tactics introduced in Ghana is insecticide-treated nets, which hang over individuals' beds to help prevent mosquito bites overnight. Studies show that the use of insecticide-treated bed nets can reduce national malaria cases in Ghana by 50%; moreover, if 75% of Ghanaian households used bed nets properly for an entire year, malaria could even be eliminated in the region (Agusto et al, 2013). These mosquito nets are effective in lessening Malaria infection by reducing the number of mosquitos that come into contact with individuals. Similarly, these nets also prove to be effective in killing large numbers of Malaria infected mosquitoes due to the strong insecticide spray used on the nets (Agusto et al, 2013).

Implementing this prevention strategy for Ghanaian citizens could have very positive effects for the environment. For starters, many individuals in Ghana who do not have access to bed nets instead use local herbs to create natural remedies to aid against Malaria infection. Not only are these herbal remedies ineffective, but the large amount of herbal uprooting that happens in these areas has a substantial impact on vegetation and farming (Aikins, Pickering, & Greenwood, 1994). Additionally, since Malaria has the biggest impact on lower income communities, it also has a large impact on farming. The most common profession for lower income individuals, or rural communities with little economic support, is farming. With Malaria being most common and most deadly in these rural communities that lack prevention measures and proper sleeping arrangements to protect them from mosquitos, Malaria mortality impacts individuals, families, communities, and also the rural agriculture system (Aikins, Pickering, & Greenwood, 1994). By providing bed nets to all residents of these rural communities, it not only helps reduce the gap between low and high income Malaria infection rates, but it also has an effect on the farming population, which helps provide food security and urban development.

While insecticide-treated bug nets prove to be effective in limiting Malaria exposure, these nets are only effective in communities that have properly structured housing. Although mosquito vectors for Malaria commonly have outdoor breeding sites, mosquitoes that are unfed begin host seeking within indoor spaces, which is why the most common place of Malaria transmission from mosquito vector to individuals is inside residents' houses (Ogoma, 2010). Most of the housing units in rural Ghanaian

communities consist of huts with mud walls and thatched roofs. This design leaves large open eaves between the roofs and mud walls that allow mosquitos entry. Research shows that housing units with closed eaves had 38% less prevalence of Malaria infected mosquito vectors than houses without (Ogoma, 2010). If organizations provided building materials to Ghanaian huts, it will help limit the amount of holes and open eaves in Ghanaian huts, which will have a large impact on decreasing rates of Malaria infection in rural communities.

Another indicator of high Malaria infection rates is unsanitary waste and sewage removal, which plagues many low income and rural communities throughout Ghana. In low income communities, it is common for people to dump their sewage and waste into drains and ditches that run alongside roads. These same ditches are used to help reduce flooding by having excess rain water flow through them. In communities with large amounts of waste blocking these drainage systems, it is common for stagnant pools of dirty water to form, which are primary breeding sites of Malaria infection mosquito vectors (Obisesan, 2015). The rate of Malaria infection is proven to be around 68% higher in low income communities with unsanitary waste removal and clogged drains (De Silva & Marshall, 2012). These unsanitary measures also have negative implications for agricultural trenches used for farming in rural communities, which are impacted by the dirty water that builds up within their drainage systems (De Silva & Marshall, 2012). Improving the waste removal system in these communities would help reduce mosquito breeding sites and help limit the amount of parasite infected mosquitoes within the community, further preventing the spread of Malaria.

Malaria prevention measures in Ghana have been a widely debated topic for years as researchers have gathered data about the factors that increase Malaria prevalence in certain areas. Making environmental structural changes to housing units, waste removal, and bed net usage will help reduce Malaria mortality in the country. This topic is very important to me, because I have personally been infected by Malaria while residing in a Ghanaian rural community. I will soon be starting a full time job position working at a non profit organization in the Volta region in Ghana, so I have a personal stake in reducing Malaria mortality for my community members.

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# Ocean plastic: Market-based approaches

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Every minute, it is estimated that around one garbage truck of plastic is dumped into our oceans (Campaign). And by 2050, there will be more plastic than fish in the oceans. Plastics that enter our food chain release harmful toxins, while microplastics entering the human body can lead to an array of serious health problems (Campaign). However, ocean plastic cleanup is costly, brings little economic return, and is ineffective at addressing the root causes of plastic pollution. Thus, government agencies and for-profit companies have little incentive to invest in ocean cleanup, and the plastic crisis continues to worsen as plastic production continues to increase. Models for ocean cleanup and protection that do not take economic feasibility into consideration may be hindered in their capacity to scale up and create substantive change. To reduce urban impact on ocean plastic pollution, cities should implement economically feasible solutions such as cost-effective alternative materials, market-based instruments (MBIs) for regulation, and marketable solutions for cleaning up existing plastic debris.

Reducing plastic use would require cost-effective green alternative materials that have the same functionalities. Given that plastics have found ubiquitous applications in all areas of life, abolishing plastic usage in an attempt to mitigate plastic pollution would be unreasonable. Despite the short term benefits, plastics are leading towards long term destruction as only 9% of all plastic produced has been recycled (Gibb, 2019). Current solutions include biodegradable bioplastics; however, most biodegradable plastics are biodegradable only in industrial composting facilities. Research conducted shows that the polymers polylactic acid (PLA) and polyhydroxyalkanoates (PHA) have the highest potential to replace traditional plastics as bioplastics. Although studies show that the global market price for synthetic plastics is \$1,000 higher than the price for PLA pellets, the polymers are not proven to be highly recyclable (Oliveira et al., 2020). Current technology does not support environmentally friendly, biodegradable bioplastics that are economically-viable at an industrial scale. Cities should support R&D in affordable biodegradable bioplastics, which contribute to increased resource efficiency in a circular economy system. By producing biodegradable plastics in developing economies that could benefit greatly from the additional job opportunities, they may be able to compete and eventually replace traditional plastics.

In addition to finding alternative materials to traditional plastics, implementing MBIs to provide polluters with incentives to reduce negative environmental externalities is also crucial in reducing plastic pollution. Maturity of production of alternative materials takes time, and regulations could slow down the increasing rate of plastic pollution and buy cities time. Regulatory frameworks for implementing sustainable measures have often experienced challenges, but a combination of regulatory and market based incentives can effectively reduce plastic use and pollution (Vince, J., & Hardesty, 2018). Research shows that an incentive of 5-10 cents cash for containers was effective in reducing beverage container waste (Vince, J., & Hardesty, 2018). The amount of beverage containers found in coastal surveys from states with incentives was also 40% less than in states without incentives (Vince, J., & Hardesty, 2018). This suggests that putting a price on traditional plastic could encourage consumers to embrace more environmentally responsible alternative materials. Putting a price on plastics or implementing other economic incentives for reducing consumption would likely be effective in recovering the material and reducing loss rates to the environment.

On top of prevention and regulation, cities should work towards cleaning up the large quantities of plastic debris remaining in the oceans, such as the Great Pacific Garbage Patch. Given

the sea transport costs of ocean cleanup, the economic result of landfilling or incinerating recovered ocean plastic waste yields a negative outcome (van Giezen, A., & Wiegman, 2020). To make ocean cleanup a viable process, it is important to develop a recycling chain that creates revenue” (van Giezen, A., & Wiegman, 2020). If the production costs of recycling plastics can be controlled to be less than the cost of plastic collection, profit could be made from ocean cleanup, which would greatly accelerate the path towards cleaner oceans. Companies such as Sea2see and NortonPoint sell glasses made from recycled plastics, and it is estimated that there is a yearly market for 100,000 recycled glasses (van Giezen, A., & Wiegman, 2020). Similarly, SAIL-E, a startup founded by high schoolers that modifies waste sailboats into remote-controlled garbage collecting boats also gains revenue from plastic cleanup (SAIL E PowerPitchFinal, 2021). Once mass produced, the profit gained from selling the collected plastic to local recycling terminals or companies such as TerraCycle can cover the travel and manufacturing costs (SAIL E PowerPitchFinal, 2021). If urban planners could implement more market-based ocean cleanup solutions and support cleanup companies, the ocean plastic problem could be greatly alleviated.

Despite the importance of economically feasible and marketable solutions to ocean plastic pollution, increased efficiency and decreased impacts on the environment may encourage consumerism, the driving force of the current interrelated socio-environmental crises. While focus on the market is needed to effectively mitigate ocean plastic pollution, excessive focus may sustain or even accelerate the current “infinite growth” market model. With this in mind, it is important for cities to recognize the need to shift to an economically-feasible circular economy approach instead of the linear economy approach of make, use, and discard (Vince, J., & Hardesty, 2018). The circular economy focuses on minimizing waste and repurposing, and does not support the infinite growth market model.

Although there may be many challenges to truly solving the ocean plastic problem, economically feasible approaches hold great potential in making fundamental change. There is no single solution that will resolve the complex nature of the ocean plastic problem. While inventing cost-effective alternative materials fundamentally solves the plastic pollution problem, implementing MBIs for regulation effectively slows down the acceleration of plastic pollution by buying time, and finding marketable solutions for ocean cleanup effectively cleans up existing plastic debris. A combination of the three economically feasible approaches may lead to healthy cities with plastic free oceans and a sustainable future.

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# ESG reporting and sustainability

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According to the definition from the U.S. Environmental Protection Agency, sustainability means, “Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment.” Living sustainably can improve our generations’ quality of life while also ensuring future generations have the same quality of life we do, or even better. However, we face major challenges balancing economic and social issues to achieve sustainable societies (Agyeman & Evans, 2003). One key part of achieving this sustainability is to shift priorities in the private sector. Current sustainability standards and evaluations are vague for many private sector industries and companies. To address this problem, Environmental, Social, Governance (ESG) reporting was created for evaluating sustainability. It also summarizes the resulting quantitative and qualitative information (Sphera, 2021). Although many companies want to achieve sustainability, they still don’t know anything about ESG. In this case, ESG reporting should be necessary for all companies for making connections for people and the environment, improving living quality, and to trigger others to also start to have eco-friendly goals and actions

Making connections for citizens and residents who are living in a specific city to the environment and businesses is crucial for achieving Sustainability. People have to be aware and educated about the environmental situation of their city to take action to make their city become a better place. Changes and fluctuations generated in two of the components of sustainability – social equity and economic growth – will affect the social needs of the residents. In other words, the citizens’ attitudes toward negative effects about their community and economy will also negatively affect the sustainability of the city (Agyeman & Evans, 2003). But usually at the first, the effects are potential, people wouldn’t know before the effect happens. Therefore, checking open information in ESG reports can help the residents to learn more about the potential risks of a specific business about their economy. Furthermore, as ESG reports provide residents and employees chances to help to supervise the business to maintain the current situation or to make changes to the businesses that are having bad impacts on sustainability. The residents who are interested in having investments in businesses or are stakeholders can also use this report as a reference to decide whether or not this company deserves investments from them (Murphy & McGrath, 2013). By having fewer investments, means that the money flow of the entire company will decrease. This can further cause the bankruptcy of the company. And those companies that have annual ESG reporting will have less risk of going broke. Because while in the recession stage of the economic cycle, the investors will select which company seems more sustainable and can overcome the current stage. In this case, the possibility for the businesses and companies that have ESG reporting will have a larger chance of getting more money flow (Sphera, 2021).

ESG reporting not only helps in making connections for the businesses and the residents, but it also helps with improving the quality of life for them. This also works in businesses and the labor force. For example, when unemployed workers want to find jobs, they can use the ESG report of that company as a reference for its sustainability. The Environmental, Social, and Governance Pillars will be transparent for all people which can also help with promoting liability of the company. In this case, this can help the unemployed workers to check about the potential risks and opportunities of that company. Moreover, the life expectancy and income of people are rapidly increasing in both developing and developed countries. To keep on this trend, checking ESG reports for sustainability is necessary. For example, the whole world faced COVID-19 in 2019 and 2020, and the global economy

went into a depression stage. But the countries with businesses that have annual ESG reports can avoid and prevent these kinds of negative effects. Although the effects of COVID-19 are inevitable and most of the companies had been negatively affected, most of the companies that have long-term planning such as scenario plans and communication with stakeholders and government did survive from the terrible depression (PricewaterhouseCoopers, n.d. ). In this instance, people could keep on living in high quality without huge fluctuations in income or price level.

ESG reporting can also help trigger other companies to start to achieve sustainability. It is impossible to make every company in the world have a sustainability goal, but it is better to persuade more of them to join to have ESG reporting. One way that ESG reporting can benefit businesses is that customers would check whether your company has ESG reporting or not when they are buying products. Customers are more likely to buy and appreciate products with ESG reporting to show their class inequality. Buying products from checking ESG reporting not only can show that they are customers that are considering the sustainability factor, but also can show that they are having a comparatively higher status by being responsible for our environment than other customers who buy products from companies without ESG reporting (Agyeman, 2013). From this perspective, companies that want to promote the consumption rate of their product will start to have ESG reporting as a marketing strategy.

As people are more considering sustainability as a reference for living quality and expectancy, we need to know more facts and information about the economic, social, and governance factors. And the easiest way of getting access to that information is to check the ESG reporting from the big companies. To conclude, ESG reporting should be the universal standard for all companies, and especially for companies that are involved in industries that directly impact the environment.

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# The potential of informal settlements

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Most regions around the world are becoming urbanized due to rural-to-urban migration. Such migration, together with inadequacy of both market and public response, reinforce the negative impacts of urbanization. Almost 1 billion people, or 32 per cent of the world's urban population, live in slums, the majority of them in the developing world. Even in High-income countries (HICs) like France (Bidonville), the rise of informal settlements is hindering development (Mangin, 1967). This is because along with the mushrooming of informal settlements, there will be delinquency, crime, and black market etc; a continuous influx of people from rural areas also gave rise to high dependency ratio regarding that the unskillful internal migrants are actually economic burdens. Though informal settlements are perceived as the dark side of a city's image, the shanties have become part of the city and there are different ways to view this urban issue. Aiming to explore the potential of informal settlements, structural and technological adjustments must be made, along with regional policies like altering tax rate. This can eventually make the whole area greener, bring more equity, improve the well-being, and improve the quality of life.

Structural measures can be usefully defined as improvements upon the survival strategies of informal settlements, especially the income-generation patterns. For example, how to make the poor become economically active is the biggest challenge on the way to revitalize the shanty towns (UN-HABITAT 2003). The government should first enroll the unemployed in state-funded training to help them find new jobs. In return for the training provided by the government, the newly-enrolled labour force not only decreases the dependency ratio but also improves the city's potential of development. Alternatively, informal settlements can be redeveloped into folk culture communities, instead of developing capital intensive manufacturing industries, which emit more greenhouse gases. In this way the area can attract tourists and bring extra economic benefits. Through generating income from their own efforts, people who live in informal settlements will gain a sense of belonging.

Technological improvements on informal settlements are highly recommended, as a more advanced means to gain potential positive spillovers. Green infrastructure tends to be costly, however there are still improvements that can be made upon the squatter settlements; greening rooftops and walls with vegetation can help mitigate the urban heat island effect. Solar energy panels can be placed on the rooftop of informal settlements as well, which provides alternative energy sources. In addition, transforming formerly discarded land would create space for composting sites or community farms to support the development of urban agriculture (Aubry et al, 2012). As a final point, to improve the poor's quality of life, both soft and hard engineering should be constructed along with informal settlements in order to protect the residents from natural disasters. These include flooding and mass movement, which are serious problems for coastal cities like Rio De Janeiro, where hundreds of casualties result from such disasters annually. In conclusion, technological advances will change the stereotypical image of informal settlements, and help build a more resilient city.

Coordinating social resources is also of great significance as the local government has the responsibility to provide fair governance and a healthy environment for all. When the poor are disincentivized by high living costs, they might be trapped in a vicious cycle (Ezzeddine 2021) and eventually become social liabilities. To tackle the problem, the 'site and service schemes' and the 'self-help schemes' provide diverse options for the government. The site and service schemes are popular in many regions, especially in Brazilian 'favelas'. Council provides land near places of work. The land is divided into building plots and roads are built. Electricity, water and sewage services are

provided. People can rent a plot of land and build their own house, slowly making improvements as they earn more money. As mentioned above, a collaborative framework between the government and individual on shifting resources turns out to be mutually-beneficial, which can help improve the people's quality of life. And most importantly, it defends human rights. The schemes also can be linked to the concept of civic engagement (Krasny, 2015). Only through promoting civic engagement, for example, self-initiated tree planting and community gardening, in improving the informal settlements can the government successfully enforce environmental laws to address long-standing urban issues, and foster psychological and physical well-being.

Government policies play an important role in realizing the potential of informal settlements. Taxation is a tool that the local government should fully utilize to help promote equality, especially for the poor. In the context of a disparity of development in urban areas, where most people live rough in informal settlements but the rich are living extravagant lifestyles, a progressive tax should be imposed. This means the burden will fall more on the rich, and therefore effectively redistribute the income. An increased government expenditure which is sourced from the tax revenue will be used to subsidize the poor, or directly invested in infrastructure, allowing vulnerable groups to improve their standard of living through enjoying amenities and social welfare.

Some may argue that redeveloping informal settlements has a huge opportunity cost, and it is not worthwhile to invest in an area that is subject to social-economic decline. Despite the problems, there is great potential among informal settlements: Mitigating climate change, boosting economic growth, creating a new income-generation pattern, increasing social stability etc. As the people who live rough expect things to improve, we should not neglect that voice. To conclude, rejuvenating informal settlements can make the city greener and improve the living standard for all urban dwellers. The whole world should move ahead with greater determination and knowledge in our common effort to help the world's slum dwellers to attain lives of dignity, prosperity and peace. (K. Annan, 2003)

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# Revitalizing infrastructure for an urban future

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Buzzwords like "green" and "sustainable" are easy to throw around without invoking any real meaning. As such, the phrase "sustainable infrastructure" can be difficult to understand on a deep level. But developing sustainable infrastructure is key to developing and maintaining cities as urban life becomes increasingly popular. With this urban boom comes the need to address the civil infrastructure that forms the backbone of modern cities. Civil infrastructure involves the physical systems that connect the built environment, from highways to parking garages to buildings themselves. It must offer residents a high quality of life for generations to come. In urban environments, civil infrastructure is used on a mass level every day and can have a massive impact on the environment. Although the challenge of revitalizing civil infrastructure for a sustainable future seems daunting, it can be achieved by understanding how it supports the life of residents, learning to customize it by location, and taking a multidisciplinary approach.

Sustainable infrastructure must maintain a high quality of life (QOL) among the people using it. Anthropological research shows that in both ancient and modern cities, "communities tend to be most concerned about the issues that threaten their survival or quality of life." (Fischer, 2011). The knowledge that QOL is a primary motivator for human behavior is critical to understanding why it must be included in infrastructure design. Humans also strive to better their living conditions through constant development: "sustainable infrastructure will promote human development, and it will thereby promote improvements in QOL" (Fischer, 2011). Quality of life can be measured in objective assessment of existing amenities or in subjective analysis of metrics such as environmental beauty or job satisfaction. These assessments must be used to inform infrastructure design.

Planners must implement sustainable infrastructure on a local level. Global warming will impact regions across the globe differently, and solutions that apply to farmers supplying specific cities in North America cannot be expected to work similarly elsewhere. Successful infrastructure plans require research that considers the specific conditions of all regions (Boyse, 2010). As with analysis of QOL, several models have been developed to inform such plans. The 'Average Annual Loss' (AAL) metric assesses the "social and economic 'riskscape'" posed to certain areas based on natural disaster. AAL presents regional analysis, which enables careful customized planning as climate change further distorts weather patterns. This will allow cities to plan for financial losses and future resilience (Sarkar-Swaigood, 2020). A recent analysis found that incredible investment in infrastructure is required to combat carbon emissions while building the foundations for future growth. Most of this investment should occur in the developing world, which tends to face new development and poor infrastructure. Failing to fully invest in new infrastructure threatens to "[lock] in high-carbon, polluting, and wasteful pathways if we build the new infrastructure in much of the same way as in the past" (Qureshi, 2015). Sustainable infrastructure should avoid these pathways and set the stage for new ones. While developed countries must retroactively change their infrastructure, developing countries will find that making large investments now establishes infrastructure that already meets sustainability goals.

To bring together the many fields involved in a successful urban system, a common definition of sustainable infrastructure must be established. There are three main pillars of sustainability: environmental, economic, and social (Fischer, 2011). In order to achieve the "sustainable" elements of "sustainable infrastructure," each of these needs must be met. Additionally, "short-, medium-, and long-term thinking at varying scales is also needed to understand the complex social systems that



drive and develop infrastructure systems and protect the environmental systems which provide many of society's resources" (Boyse, 2010). Consideration of each of these factors expands the responsibility of civil infrastructure design beyond engineers alone. Defining sustainable development is made more difficult because "the primary objectives of one community relative to sustainable development may be very different from those of another...[and] objectives may also change over time for the same community" (Fischer, 2011). The understanding that development goals will vary by location establishes the need for social and community experts as well. These definitions demonstrate that sustainable infrastructure must be approached from multiple angles.

This multifaceted definition of sustainable infrastructure makes clear the importance of experts, including legislators, sociologists, economists and engineers, collaborating to thoroughly design infrastructure plans. Researchers identify a connection between "the 'ultimate end' of sustainable, equitable and prosperous wellbeing and the intermediate means of the economy and society, and the ultimate means of the environment" (Costanza, 2016). These relationships highlight the importance of considering environmental, economic, and societal disciplines in the development of sustainable infrastructure. Communities will achieve sustainable goals more quickly than under the status quo by understanding infrastructure as a multifaceted system and combining efforts across disciplines (Fischer, 2011). Such collaborations will foster the innovative solutions required to enact system-wide changes.

Consistent growth of cities suggests an urban future even as the threat of climate change continues to grow. As the backbone of the built environment, civil infrastructure is key to a future that accommodates both the popularity of urban living and the need to protect the environment. If done correctly, infrastructure will be key to establishing a sustainable future by aiding in climate change mitigation and showing adaptation is possible (Qureshi, 2015). The future of human life on earth, particularly in cities, is increasingly threatened by climate change. However, hard work and dedication to reforming civil infrastructure with a systems-minded and interdisciplinary approach may allow for a sustainable urban future that has yet to be imagined.

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# Air quality control and health advancement

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Clean air and access to adequate oxygen is a fundamental need for everyone on our planet. Despite this common knowledge, many major cities worldwide face issues of air quality to the point where individuals must wear masks to protect their lungs and wellbeing. Poor air quality is a result of industrial revolutions. While these revolutions have helped countries develop, they have also cast carbon emissions into the air around us. This particular issue is present in my city, New Delhi, India. The initial causes for air pollution came from industrialization, but air quality continues to decrease in my city because of industry and harvest fires. Moreover, it reaches a point where my classmates and I must wear pollution masks all day in school. Which is why, to improve air quality, governments must implement structural and technological fixes, such as promoting public transportation, providing incentives and alternatives to the farmers conducting harvest fires, and encouraging the public and the industry to invest in sustainable energy sources.

Air quality in New Delhi can be improved by promoting public transportation. Transportation accounts for more than half of the nitrogen oxides in our atmosphere and contributes to the emission of greenhouse gasses (*Cars, Trucks, Buses and Air Pollution*, 2018). Many studies have shown that breathing in the pollutants released from fossil fuel burning can cause harmful effects on nearly every organ system in the body (*Cars, Trucks, Buses, and Air Pollution*, 2018). The ideal solution would be for everyone to stop using vehicles altogether. However, this is not possible. Motor vehicles have become a large part of our daily lives. Travelling cannot be halted completely, but it can be made more sustainable. In New Delhi, there is a very intricate metro system that can travel to any part of the city. Yet, many people choose not to use it because of personal convenience or the low quality of travel the metros provide. While the Delhi Metro is efficient, it is not hygienic and is very crowded. For the government to promote the use of the metro, they must renovate the metros to make them more spacious, prioritize safety, and place stricter fines. This will help improve quality and provide an incentive for more individuals to travel by metro.

Another solution is to provide incentives and alternatives to the farmers conducting harvest fires. This is one of the major causes of poor air quality in Delhi. The peak season for paddy harvesting is usually during October and November, and this is when there is a spike in particulate matter PM2.5 in Delhi (Choudhary, 2018). On some days, the air pollution levels are 20 times higher than the threshold for safe air as defined by WHO, resulting in harmful consequences for individuals (Choudhary, 2018). The farmers of India engage in harvest fires because it is an easy and cost-effective way to prepare for their next season of crops. For the government of India to stop this, they must place stricter laws and a fine on crop burning. Since the farmers do not earn much money, they will consider the consequences of their actions more carefully. It may even be necessary for the government to provide more incentive for the farmers by offering to buy them farming equipment they may need to clear their land for a new harvest so the farmers don't resort to burning. Farmers must follow a strict cycle of rice-wheat planting throughout the year to maintain India's food security (Bhowmick, 2020). This is because the sowing of rice requires much water. This causes the areas the rice is sowed into to experience droughts, so the farmers must plant their rice during the monsoon season (Bhowmick, 2020). The rice is then harvested in early November, and the wheat planting must begin mid-November (Bhowmick, 2020). This gives the farmers little time to prepare for the new crops. Hence they must resort to harvest fires to maintain India's food security. The government must

find alternative methods to renew farmland. If not, India's food security along with air quality will deteriorate.

Lastly, air pollution can be resolved by encouraging the public and industries to invest in renewable energy sources. Many individuals in New Delhi drive private vehicles, and many industries use fossil fuels for their production, resulting in high emissions of greenhouse gases. "In 2014, approximately 78 percent of US global warming emissions were energy-related emissions of carbon dioxide. Of this, approximately 42 percent was from oil and other liquids, 32 percent from coal, and 27 percent from natural gas" (*The Hidden Costs of Fossil Fuels*, 2016). These greenhouse gas emissions cause air pollution and global warming. Along with this, exposure to PM 2.5 from burning fossil fuels has caused around 8.7 million deaths globally in 2018 (Chaisson, 2021). To eradicate these consequences, the government must enforce laws and regulations requiring industries and corporations in India to get at least 20% of their energy from renewable sources. This will help slow down the emission of greenhouse gases in our city.

The solutions presented in this essay can help solve air quality issues. However, these solutions have their limitations. One might say encouraging the use of public transportation does not help decrease air pollution as public transport is also partially responsible for air quality issues. While this is true, using private vehicles is much more harmful to the environment, and public transportation is a reliable alternative. In addition to this, some might argue that regulating the farmers may not be effective as the government cannot monitor all the farmers, but even some of them not burning crops to start the new harvest will help decrease the issue.

In conclusion, poor air quality is an issue many developing cities face, my city of New Delhi included. These environmental issues can reach the point where it affects our everyday lives, such as having to wear a pollution mask just to step outside, which is why, governments must implement structural and technological fixes, such as promoting the use of public transportation, providing incentives and alternatives to the farmers conducting harvest fires, and encouraging the public and the industry to invest in sources of sustainable energy. We cannot always come up with the perfect solutions but implementing a solution that may not be entirely successful is more effective than not implementing a solution at all.

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# The untold truth about construction

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Do you think the concept of construction is beneficial? If you said yes, did you consider the full process of construction, or only its results? The concept of construction is more than a change to a building. Construction is a complex, significant, and rewarding series of steps. It begins with an idea and culminates in a structure that may serve its occupants for several decades, even centuries. Like the manufacturing of products, building construction requires an ordered and planned assembly of materials. The way construction has impacted the world, especially large cities, is largely due to its negative impact on the environment. Changes in CO<sub>2</sub>, pollution, waste, fossil fuels, wildlife, and energy can all be effects of construction. Thus, to address the negative consequences of construction, city governments must implement policies such as reforming the construction companies, properly disposing of waste, and eco-friendly building designs in places adequate to limit the detrimental effects of construction and fully realize its benefits.

Construction is everywhere and people cannot refuse its changes; but, it is necessary to adapt its steps before its negative outcomes become irreversible. Cities need to redefine how the construction industry does its job as it seems that even though some measures are taken, they do not go far enough in mitigating construction's impacts on the environment's future. One way in achieving the goal of a sustainable green city is through the reformation of construction companies and the industry as a whole. To do so, companies should learn to take time to look around their site and take into account multiple factors. Some factors include the type of vegetation on site, how much of it should be cleared, and if the project will end up benefiting the environment in some way (Palmer, 2020). Cities can build more green infrastructure through this and limit the harmful outcomes of construction. However, how can city government officials ensure that companies follow the precautions when starting a project? Though there is no simple answer, officials could start by requiring these steps before workers proceed with the project. With the addition of these reforms, the construction industry would be on the brink of change, creating a new view on the impact of construction.

In addition to creating reform, officials could take action by properly disposing of waste. The effect of waste on the environment is large. "According to new research by construction blog Bimhow, the construction sector contributes to 23% of air pollution, 50% of the climatic change, 40% of drinking water pollution, and 50% of landfill waste" (Sikra, 2017). Sustainability cannot be achieved with environmental issues as substantial as this, meaning that a policy of waste management is needed. Sadly, the issue of waste management is not only an example of harm to the environment but also to human well-being. Once human well-being is endangered, is it necessary to look at how it could be solved, and properly disposing of waste seems to be a solution. There are many steps to take into account when trying to limit waste. First, companies need to avoid creating waste in the first place. Second, organize the materials when on site. Lastly, recycle or reuse salvageable materials. By avoiding creating waste, there wouldn't be any unnecessary waste/left-overs after the job is complete. Second, organizations would reduce confusion for workers on which materials are salvageable or recyclable. Lastly, recycling or reusing salvageable materials would assure they don't end up in landfills (Zafar, 2021). City officials could use these guidelines for workers to reduce our carbon footprint, especially in heavily populated areas with environmental issues.

Lastly, having eco-friendly building designs in suitable places would alter construction's impact in cities trying to become green. Construction isn't typically associated with green ideals; however, if

they were, there would be many benefits. When companies start the process of building, they should consider natural building materials and renewable energies. When using natural materials, the manufacturing process produces less CO<sub>2</sub>. Similarly, when using renewable energy, energy will be preserved. Solutions like solar panels and rainwater collection systems would be types of renewable energy technologies implemented into building design (Weatherly, 2020). The ability to construct both a functional and green building is fundamental for the future with construction's current issue: being one-sided. Using these designs could spark change in construction and its proposed placement in some type of policy. Officials have been working to create green/eco-friendly buildings, and implementing a policy like this would only further this type of behavior. Becoming green, especially in cities, is a trend and if city officials find a way to make it appealing to both companies and residents, the projects would be more expandable and beneficial.

However, even though these all seem like feasible solutions, there will always be a problem. First, changing a whole industry will take time and lots of effort. It will take a movement of not only the officials but also residents, for construction companies to change their ways. This may take years or even decades. Also, education will interrupt the reformation of the companies, especially the workers. Since the workers don't have much say in the execution of the process, it will be difficult to break their typical habits and incorporate green ideas into them. Nevertheless, the benefits of green construction will outweigh the harmful effects of non-environmentally friendly construction.

In conclusion, when talking about the effects of construction, realizing its impact on the environment and how both officials and typical people can create change is important. Therefore, the topic of construction can be defined as both beneficial and harmful; however, city officials have the power to implement policies such as reforming construction companies, properly disposing of waste, and eco-friendly building designs to lessen the degree of the effects of construction and experience its benefits. Even though some may argue that these won't be achievable due to time, effort, and education, it only takes one person's effort to get involved and start the change to a more green and sustainable city.

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# Remedying traffic with structural policies

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During an average weekday rush hour, traffic in Washington DC and its metropolitan area easily piles up into a sluggish mess. Over 600,000 people are employed within the city alone, and this places incredible strain on transportation systems, leading to work commutes that can take beyond an hour. Furthermore, 60% of these commuters are single-occupant drivers, showing just how inefficient these systems are (Berkon, 2020). Traffic congestion on similar scales, especially for work commutes, is a major problem for many urban centers worldwide, with significant negatives for human welfare. Exhaust pollution and time loss from congestion lead to impacts on both physical and mental health as well as economic productivity, not to mention other indirect health impacts such as noise pollution and contribution to carbon emissions. In order to mitigate the risks created by traffic congestion while avoiding the expenses of total infrastructure overhaul, city governments can use policies to promote structural change and create broad social benefits by incentivizing carpooling, encouraging smart growth, and implementing telework.

Policies encouraging drivers to carpool can reduce traffic congestion while socially benefiting communities. For example, implementing high occupancy vehicle restrictions on heavy-traffic roadways can encourage commuters who previously drove separately to carpool, thus reducing vehicle density. Given the connection between congestion and workplace commutes, it may be further suggested to make employers hold some of the responsibility for these incentives. A 2007 case study on traffic congestion in Delhi, India, concluded that incentivizing carpooling would lead to visible benefits for traffic, not only decreasing average commute time but also reducing air pollution and fuel expenses, further indicating that this could be aided by mandating employers to implement company policies favoring carpoolers, such as free parking or subsidized car insurance (Dewan & Ahmad, 2007). This has added benefits to the urban community beyond reducing congestion, as carpooling has also been shown to increase equity for lower-income neighborhoods by increasing transit opportunities with less costs (Shaheen et al., 2018). This allows for residents of such neighborhoods to find transportation without personally owning a vehicle or using public transit, which may not be easily accessible in terms of location. With proper incentives, carpooling is a proven way to reduce the health impacts of traffic congestion and build social equity.

Smart growth planning is another avenue to decrease congestion. Smart growth policies advocate designing communities which are more densely structured and make use of mixed commercial and residential development in order to accommodate public transit and walkability. This combination has been found to reduce both automotive travel demand and traffic congestion, while also promoting other urban benefits such as preservation of green space and social equity through emphasis on accessibility and diversity. This is supported by a comparison of congestion in denser mixed-use neighborhoods versus suburban sprawling neighborhoods in Phoenix, Arizona; the former were shown to experience less congestion due to their higher accessibility (Litman, 2021). Though the implementation of smart growth policies can certainly take longer than other policy-based responses due to the need for infrastructure development, their creation of more connected and accessible urban communities make them essential considerations for not only congestion relief but also future guidance in sustainable urban growth.

Finally, implementing telework can also reduce traffic congestion. Telework enables employees to work from home, which directly benefits work-hour commute traffic by reducing transportation demand. In doing so, telework eliminates traffic-related stress and productivity loss while also further

benefiting mental health by allowing greater schedule flexibility and time management, positively satisfying professional-personal work-life balance. A separate social consequence of telework is a decrease in unemployment among “vulnerable people” such as those with disabilities, which helps promote societal equity by providing more work opportunity (Dima et al., 2020). Policies supporting company and business adoption of telework will have positive impacts on traffic congestion, benefiting both personal wellness and societal equity.

Concerns are often raised about the effectiveness of telework, mainly that it is inefficient at guaranteeing productivity. However, productivity loss from telework has been shown to be minimal, especially after worker training, and can even lead to net positives by accounting for productivity losses from traffic (Dima et al., 2020). Thus, productivity impacts of telework may largely depend on the responses per employer. While this shows that additional management may be needed to ensure and maximize the benefits of telework, it still remains a beneficial solution to traffic congestion due to its larger benefits for human well-being in the forms of accessibility, opportunity, and mental health.

As the effects of climate change become increasingly visible and the world grows increasingly urbanized, addressing traffic congestion is more urgent than ever. By incentivizing ridesharing, more compact but more accessible urban planning, and using telework, municipal governments can reduce both risks to human health and urban contributions to global warming, and develop more cohesive urban communities, all with comparatively less cost.

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# Healing hospitals: Biophilia in hospital design

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Hospitals are often viewed as stark, cold buildings that house the ill and injured as they recover. However, recent studies have begun to question conventional hospital design, advocating for a more patient-centered approach based on the philosophy of biophilia – humans' innate tendency to connect with nature. Biophilic design is quickly gaining popularity and can be observed in other aspects of the city such as schools, office buildings, and shopping malls. Hospitals, however, lag behind (Abdelaal & Soebarto, 2019) and are not taking advantage of nature's healing qualities. Thus, applying biophilia to healthcare facility design can prove especially useful in hospitals located in high-density cities where open green space is limited, as compared to semi-urban and rural hospitals. To contribute to patient well-being, architects and developers should turn to biophilic principles to design spaces that provide visual connections to nature, have a good presence of water, and pay close attention to the type and amount of light used.

Visual connections to nature have therapeutic, restorative effects on people (Browning et. al, 2014); benefits include reduced stress, improved concentration, and increased happiness, all of which are beneficial for patients and hospital employees. Visual natural connections can be provided by constructed natural spaces, such as a hospital garden, or by representations of nature, such as a photo of a forest. While constructed nature is more effective than simulated representations in providing therapeutic benefits, simulated nature is better than no nature (Browning et. al, 2014). Patients who recuperated with a window view of trees from their hospital room recovered faster than those with a view of a brick wall, implying that the quality of views should be considered when designing the hospital (Ulrich, 1984). This can be done by designing rooms with large windows facing inward, towards a courtyard with various elements of greenery like tall trees, to give all patients access to rooms with views of nature, supporting their recovery. Courtyards can also benefit employees, as viewing nature ten minutes before being exposed to a mental stressor, such as performing an operation, balances the nervous system, making the individual more resilient to stress (Brown et al., 2013). By incorporating views of nature into hospital design, patients and employees can reap the psychological and physiological benefits, leading to increased well-being.

A calming presence of water can also increase patient wellbeing (Browning et al., 2014). Photographs of landscapes with higher percentages of water features increased the perception of tranquility, compared to photographs filled with people (Pheasant et al., 2010). Thus, if actual water cannot be incorporated into a space, images with rivers, waterfalls, streams, lakes, the ocean, or pools can be used instead. At the same time, water's calming and stimulating effect also depends on its sound, proximity, and accessibility (Browning et al., 2014). In other words, architects must take into account water's visual attributes, as well as its auditory and tactile attributes, as they all strengthen human wellbeing. Natural sounds of a fountain and tweeting birds elicit pleasant feelings (Alvarsson et al., 2010), and being in green spaces with water improves self-esteem and mood (Barton & Petty, 2010). While most urban hospitals do not have access to natural bodies of water, constructed elements such as courtyard fountains or waterfalls where patients can linger, can stimulate multiple senses, enhancing their sense of peacefulness and tranquility.

The careful consideration of light in hospital design promotes healthy sleep patterns, decreases length of stays, reduces depression, and relieves pain (Browning et al., 2014). Patients in daylight-filled rooms recover faster, with a study reporting patients exposed to morning light had stays of around 3.67 less days than similar patients in rooms exposed to afternoon light (Benedetti et al.,

2001). Another study of surgical patients found that those exposed to more sunlight in the bright side of the hospital reported “less perceived stress, marginally less pain, and took 22% less medication per hour” compared to similar patients with rooms on the dim side (Walch et al., 2005). Thus, the east facade of hospitals should be prioritized for patient rooms, to allow for a reduction in patient stress and pain. However, in areas of the hospital that do not receive ideal amounts of sunlight, circadian lighting can be used to simulate the natural lighting conditions that change over time (Brown et al., 2010) to give all patients a healing environment. Achieving a balance between serotonin, from the blue light at midday, and melatonin, from the absence of blue light at night, allows for better sleep quality, which is essential to faster healing.

Though some may argue that biophilic hospital design calls for excessive spending, hospitals must be willing to introduce natural elements in their design to contribute to patients’ wellbeing. The integration of these elements in hospitals reflects a commitment to promote faster recoveries and serve a larger number of patients, supporting them in all aspects of the healing process. If more hospitals embrace biophilic design, it will become a common practice in the healthcare industry, making the connection between humans and nature the norm.

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# Sustainable consumption in cities

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In the majority of cities across the world, unsustainable food consumption is a pressing issue that has myriad negative impacts both locally and globally (Arosemena, 2017). Consumption is considered unsustainable when it has adverse effects on the natural environment and depletes nonrenewable resources. Many urban diets consist largely of meat and dairy products, which use land sinks and other natural landscapes that are essential to carbon sequestration (Drawdown, 2021). Agriculture takes up about 50% of the world's habitable land, and of that 50%, 80% is used for livestock agriculture (Ritchie, 2017). Livestock grazing also decreases biodiversity, which is essential for earth's ecosystems. Unsustainable farming practices also pose a large threat to the soil, as it can exhaust the soil of its nutrients thus increasing the need for fertilizers. Unsustainable consumption is a problem that must be addressed in many cities, as it has effects in the cities where it occurs and in locations where the food is produced. Fortunately, though, there are many solutions. Sustainable and responsible practices can be achieved in cities through cognitive fixes such as education on plant based diets and other ways to consume sustainably and the implementation of farmers markets and community gardens that sell locally produced and sustainably grown produce at prices that are affordable for all.

Educating the urban public on the importance of a sustainable diet by informing them and drawing on communities' social norms are effective ways of spreading knowledge and awareness (Drawdown, 2021). One of the indicators of a biophilic city is "priority given to environmental education" (Beatley 2011). Information can be spread in a multitude of ways. According to The Resources Department and the Centre on Global Health Security, there are three main levels of intervention when it comes to education on sustainable diets: "Inform and Empower, Guide and Influence, and Incentivize Discourage or Restrict" (Bailey, 2015). While inform and empower would require a shift in the public's mindset, it would be the most effective long-term, because the urban public are transitioning to a more environmentally conscious diet on their own terms. This information and empowerment could take the form of environmental information on food products, public information campaigns, or advertisements for sustainable products. Providing information such as "emissions could be reduced by as much as 70 percent through adopting a vegan diet and 63 percent for a vegetarian diet" (Drawdown, 2021) could inspire the public to move towards a plant-based diet. In addition "plant-based options must be available, visible, and enticing, including high-quality meat substitutes" (Drawdown 2021) in order for a shift to a more plant-based diet to be reasonable. Social Norm Theory can also be helpful when attempting to get people to change their behavior. Descriptive norms are defined as "a person's perspective of how people typically behave in a given situation" (Stern, 2018). If a sign was posted in a grocery store that read "The majority of shoppers at this store buy plant-based and organic products", other shoppers would be more likely to do so as well, because they know that is what most people do.

Another way to encourage the public to have a more sustainable diet is to provide opportunities to purchase sustainably and locally grown produce (Payne, 2000). Farmers markets are places where consumers can access sustainably and locally sourced produce. Farmer's markets are able to provide "high-quality fresh produce at a price comparable to that found in grocery stores" (Payne, 2000). By selling produce from local farmers, they minimize transportation of goods which creates less pollution and support small farmers who use more sustainable practices than large farming corporations. They are seen as "keystones for rebuilding local food systems" (Brown, 2004),



as they support local businesses and provide sustainably and locally produced goods. However, just because something is from a farmer's market, does not guarantee that it's grown sustainably or locally. Some markets will sell produce that's out of season or grown with pesticides. (Molly, 2018). Because of this, it is important to do research on the practices of the farmers that you purchase from. Farmers markets are also a "place for social activity and promoting a sense of community" (Brown, 2004), which is essential for improving quality of life in urban areas.

A common excuse to avoid switching to a plant-based diet is that vegetarian and vegan diets are very costly. While pre-made meat alternatives like veggie burgers can be more expensive, fruits and vegetables are cheaper than buying meat. (Peta, 2021). Although produce is more cost effective than meat products, purchasing enough fruits and vegetables to sustain a plant-based diet can still be a strain on some families' budgets. Fortunately, there is a solution; Community gardens are a way to provide low-cost sustainable produce while also building community and providing environmental education. In these gardens, lower-income residents who may not have the means to buy large amounts of produce can grow and harvest products, giving them access to fresh fruits and vegetables (Phillips, 2013). An indicator of a biophilic city is the "Number of community gardens and garden plots" (Beatley, 2011). Community gardens provide green-space where community members can come together and be in nature, while gardening to grow produce that can be consumed. In Oakland, California, a group of community members came together to create City Slicker Farms. The produce from this farm is distributed at a local farmstand. The market accepts donations, but they are not required, "ensuring that none are denied access to healthy food" (Phillips, 2013). City Slicker Farms also allows lower-income households to grow their own food in the garden space. This is a prime example of how lower-income residents can have access to sustainably grown produce.

Although unsustainable diets are a dire problem in the majority of urban areas, this doesn't mean that there aren't solutions. Educating the public, implementing farmers markets, and providing structural fixes are all ways to encourage urban residents to transition to more sustainable diets. Even for low-income residents who may not be able to afford traditional plant based diets, there are still options; community gardens can provide these residents with access to sustainable grown produce to help them shift to plant-based eating. Although it takes some hard work by both urban residents and larger corporations and governments within cities, it is possible to reduce the carbon footprint of cities through consuming sustainably.

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# New urbanism: An innovative solution

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Our population is shifting to urban lifestyles, and this trend isn't going away anytime soon. The global population is rapidly moving to urban habitats, and 2007 was believed to have marked the switch of the first time more people in the world were living in urban areas than rural areas (Ritchie 2018). This explosive increase in popularity of urban cores has led to many desirable urban centers becoming financially-inaccessible and overcrowded, creating further urban sprawl and suburbanization across metropolitan areas. In an effort to reduce suburbanization, one practice we can begin to widely adopt in our cities is New Urbanism. New Urbanism is centered around the idea of mixed-use neighborhoods with an urban design, which are typically developed in suburban areas. This allows for residents of these developments to have multiple aspects of their lives, from a plethora of public amenities, restaurants, and shops, all within proximity of their homes. New Urbanism is an innovative solution towards dealing with the socio-ecological issues of today, as the design fundamentally promotes socioeconomically-inclusive, environmentally-sustainable, and healthy lifestyles for residents.

The adoption of the New Urbanism concept is an efficient way our society can address current socio-ecological issues due to its intrinsic inclusion of a diverse socioeconomic range. New Urbanism communities contain a transition of zoning between commercial and residential, which in turn grants a variety of housing options to be readily available. This can include apartments above commercial areas, to rowhomes and single-family dwellings further from the commercial center. This variety of properties allows for an unusually wide-range of socioeconomic diversity in a singular neighborhood, as compared to a traditional suburban neighborhood that may only be made up of single-family homes of similar size. According to a 2013 study reviewing socioeconomic segregation, "indirect exclusionary displacement is relatively common due to the state orchestrated sale and liberalization of social rental dwellings and steep price increases in the private rental and owner-occupied sectors" (Van Gent 2013). Due to the diversity in the types of housing in a New Urbanism community, exclusion of socioeconomic groups because of a price gouge will be very limited compared to other suburban communities with homogenous housing offerings, which may be financially-inaccessible to many socioeconomic classes due to the capitalist nature of the housing market. In addition to the fact that diverse housing options can lead to more diverse socioeconomic backgrounds, New Urbanism communities are also a great option for low-income residents who may not be able to afford a private automobile as their primary method of transportation, as other options such as walking and cycling are available and effective.

Another significant benefit of the New Urbanism concept relating to socio-ecological issues of today is its promotion of an environmentally-sustainable lifestyle. The high-density, mixed-use spatiality of New Urbanism communities encourages walking and cycling as alternative modes of transportation to the automobile. As environmental sustainability efforts are increasing globally, New Urbanism eases the environmental footprint of residents compared to a suburban lifestyle, as suburban households are estimated to drive 31 percent more than their urban counterparts (Iravani 2019). Living in an urban environment encourages walking due to the smaller distances needed to travel, making walking reasonably competitive with an automobile. Besides the alternative modes of transportation offered by New Urbanism, the urban planning design's fundamental trait of high-density allows for more preserved parkland and green spaces while retaining the same quantity of buildings developed. In Kentlands, a New Urbanism community in suburban Washington, D.C., an exceptionally

greater tree canopy can be observed from satellite view compared to the surrounding sprawling suburban developments. Furthermore, the neighborhood was designed with guidelines to preserve green spaces and natural habitats at about 16% of the property of the development parcel, while many of the surrounding suburban developments do not have guidelines to protect nature at all (Arkin n.d.). The set guidelines for ensuring the preservation of green space and natural habitat is a concept that is unique to New Urbanism neighborhoods, and not widely-practiced in traditional neighborhoods.

The high-density and mixed-use attribute of New Urbanism design is very appealing due to the issues this concept can resolve regarding the health of citizens. New Urbanism is most renowned for its ability to give residents the ability to walk from their homes to commercial spaces and local amenities. According to the Congress for New Urbanism, “studies revealed an association between land use and physical fitness in a study involving the 13 counties of the metropolitan Atlanta region, and concluded that the likelihood of being obese reduces as the mix of land use increases” (Iravani 2019). Having the ability to walk to a diverse range of amenities in one’s lifestyle promotes convenient physical activity that citizens in traditional suburban developments do not have proximal access to. Additionally, the maximization of preserved green space does more than benefit the environment. Urban green spaces provide a refuge and escape from household confinement, and are believed to reduce stress and provide relaxation (Samuelson 2020). Not only does this give access to natural amenities that many urbanites are devoid of, but also gives this green space in an equitable way. Regardless of one’s socioeconomic income, this green space is available to every citizen.

Comprehensively, New Urbanism is an optimal model for future development due to its inclusivity of socio-ecological factors. The implementation of mixed-use properties bridges the socio-economic divide present in most suburban development, all the while promoting increased health by walkability and reducing the environmental footprint through sustainable development initiatives. New Urbanism creates a variety of homes that provide accessibility, diversity, and quality development to all.

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# Education and empathy at the forefront

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Despite existing on stolen land, black, indigenous, and other people of color (BIPOC) are consistently subject to environmental racism without getting their justice. Recently, the Grassy Narrows First Nation of Northwestern Ontario had been targeted and later neglected after a Dryden paper mill dumped mercury into the Wabigoon-English River system. The native group's water source has since been contaminated (Scharper, 2016). The Grass Narrows disaster is an occurrence all too familiar amongst BIPOC communities. Such communities are identified as areas for hazardous installations such as landfills, incinerators, and coal-fired plants. Major corporations and politicians identify these communities as vulnerable targets since they are marginalized and continue to do so because of the lack of accountability. Understanding how environmental racism, especially against women of color, destructively impacts the environment will educate and encourage people, but especially legislators, to create policies that protect marginalized communities and the environment.

Environmental racism prevents communities from achieving social justice but also allows damaging environmental practices to continue being performed. As established previously, BIPOC communities are often ecologically neglected. A famous example is the water crisis in Flint, Michigan, a predominantly black community. Flint's water was lead-contaminated by corroded pipes but the local government disregarded residents' concerns. This ignorance was only exposed once the situation gained media attention as well as the support of scientists and medical professionals (Frey, 2019). Listening to those who are racially oppressed is one way to educate oneself on the prevalence of environmental racism. Anti-racism is also examined in modern movements such as the critical race theory, which examines how USA law creates inequalities and evaluates different approaches to racial justice. Getting justice means working towards a more equitable and environmentally-conscious future.

Combatting environmental racism with ecofeminism allows for a more holistic mindset towards creating change. Women of color, who often interact with the environment due to domestic duties, are specifically targeted by environmental racism. Ecofeminism understands the connection between female oppression and the environment. Especially in developing countries, households demand the most energy for both cooking and heating. Women are often responsible for maintaining the household and yet they are the same people who are left out of the conversation. Although once viewed to possibly reduce poverty in a South African community, a blindly-implemented sustainable development practice, solar water heaters, resulted in increased domestic labor, worsened existing privacy, and invisible costs (Fakier, 2018). If women were included in early-on consultations, it would have been revealed that the heaters went against privacy concerns and were inefficient for the specific domestic activities the women performed. Because women's interactions with nature play a major role in the environment, their voices are essential to possible solutions. An efficient solution to environmental racism requires empathizing with those that are being silenced.

Education is a unifier and catalyst for change. With greater understanding of environmental racism and misogyny, politicians are able to construct legislation that takes accountability and represents modern values, resulting in increased well-being and protection of the environment. Asheville, North Carolina, a state infamous for its enslavement of African-Americans, unanimously passed a resolution that gave reparations to the black community in acknowledgement of the city's inexcusable past behavior (Agyeman, 2021). The resolution came after dedicated education around anti-racism and effective combative strategies. Education and change can take place on a local level

like in Asheville but can span to a national level such as the Canadian Urban Institute did when hosting a roundtable discussion on how to best respond to “anti-Black racism in urbanism practices and conversations” (Agyeman, 2021). With anti-racism and ecofeminism in mind, legislators are able to progress towards a sustainable way of life that serves the needs of all, not just the select elite.

Some may say that environmental education is inaccessible or not popular enough to garner feasible change. This may have been true twenty years ago, but since the rise of the Internet, education is closer than ever. Having become even more accessible in recent years, the Internet unlocks education on a variety of environmental topics but more importantly, on a variety of opinions which formulate more holistic solutions to environmental issues. For better or for worse, social media has also gained momentum in the past decade. Social media has been a major proponent in consolidating support for environmental issues. The youth is on the forefront of directing social media. School Strike for Climate, a movement demanding political action to mediate climate change, engaged students and received global attention as it spread from Great Thunberg in Sweden to all corners of the world. It is the youth’s future that is threatened by environmental issues. Therefore, it is time to unite as a more educated, more empathetic whole in order to create political change.

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# Sustainable solution for air pollution

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Responsible for 4.9 million deaths globally in 2017 (Boogard, Walker & Cohen, 2019), air pollution is severely harming both human health and the environment. Unfortunately, our efforts in mitigating air pollution have worsened many other aspects of the environment, and this domino effect is most visible when we consider the impacts of air filter media waste on plastic pollution, as most commercial and industrial air filtration systems incorporate synthetic filtration materials. Considering the interconnection between aspects of the environment, this approach of resolving air pollution with no regard to other types of pollution is rather ineffective and ultimately worsen air pollution itself. Cities across the globe must mitigate air pollution without significantly worsening other causes of climate change by establishing a sustainable ecosystem centered around nature-based air filters.

As the threats from air pollution to the environment and society quickly grow in both range and seriousness, humankind could not rely entirely on the slow and painstaking process of reducing air pollution generation, but also have to directly capture and process airborne pollutants, which effectively reduce the concentration of air pollutants. Unfortunately, the majority of current air filtration systems are composed of synthetic materials such as TiO<sub>2</sub>, rare earth materials, and fine glass fiber (Wang et al., 2019), whose production, operation and disposal process require a significant amount of energy while using materials that are not disposable or renewable, yet hard to be recycled. This means further utilization of current air pollution solutions would further worsen other causes of environmental deterioration such as fossil-based energy consumption or plastic pollution. Thus, future efforts in mitigating air pollution should be centered around nature-based filters, considering that these products create significantly less ecological footprint throughout their lifetime: the production process utilizes natural materials that actually improve the environment, the operation process does not require any external toxic chemicals, and the disposal process can be handled much easier when multiple organic compounds were presented in the waste product.

Yet blindly producing or using nature-based filters, such as massive deforestation to provide planting space for filters' material or unsystematically dispose depleted filters in waste dumps, will bring forth detrimental consequences, namely loss in biodiversity or rediffusing of air pollutants. Thus, to ensure the effectiveness, sustainability, and synergy of each stage of the filters' life cycle, a sustainable ecosystem of activity stages and corresponding facilities must be developed. Activity-wise, such a sustainable ecosystem would consist of three main stages: design development, manufacturing, and service. Within each stage, constituent phases would be performed and progressively construct the air filter, with five key phases were focused in-depth: strategic planning, detailed design, production, storage, and retire recycle (Vila et al., 2015). These five phases greatly determine the planning activities and product development - controlling elements of environmental impacts and stages' efficiency - thereby play key roles in the filters' formation of sustainability.

Multiple organizations, research and technologies have been established with similar mission and vision regarding sustainability are concrete evidence and reference for the feasibility of constructing this sustainable ecosystem for practical purposes. International organizations such as the OECD, UNEP, and ILO is capable of providing extended support on multiple aspects for sustainable development programs across the globe, while sustainable product design tools and partial sustainable product design tools such as life cycle assessment (LCA) or multi-aspect quality function deployment for environment (QFDE) are useful for developing and evaluating the sustainability of filters at different stages (Ahmad et al., 2018). Sustainable production models utilizing lean and

environmental tools to measure additional values of product were studied by Aguado, Alvarez and Domingo (2013), which would provide a helpful foundation for production process development.

This systematic approach in developing and employing nature-based air filtration would bring forth great benefits. Production costs would be greatly reduced by utilizing natural materials and reducing unnecessary chemical treatments. Widespread usage of such a sustainable and environmentally friendly product would also provoke environmental movement and understanding among the citizens. Waste treatment process and waste storage would also be greatly simplified, as the majority of excess materials from nature-based filters are organic compounds which can be easily decomposed naturally. And most importantly, this sustainable air filter system would continuously elevate air quality, indirectly reduce respiratory diseases and problems such as bronchitis, emphysema and asthma, thereby improving human well-being, especially the health aspects (Mabahwi, 2014).

It is important to point out several difficulties in actualizing this ecosystem. One might be concerned that such a complicated system is not worthy to be established, as its value deteriorates as soon as air pollution is resolved. Although the actual time that air pollution would persist is greatly unidentified, the need for such an ecosystem to maintain balance in ambient airborne chemical concentration is definitely necessary, not to mention the potentials to repurpose as green cities' infrastructure. Another problem that requires consideration is the fact that this ecosystem revolves around natural materials, which would become increasingly scarce as the effects of climate change worsen. Instead of demotivating the actualization process, this reality would motivate citizens and governments to dedicate resources to these ecosystems when nature is still lively.

In essence, although air pollution is an urgent problem that heavily damages humans and the environment, we must resolve this problem without worsening other pressing environmental issues by developing and establishing a sustainable ecosystem centered around nature-based air filters. Given the current conditions of humanity and natural resources, it is vital to take actions as soon as possible, because society would soon reach the point of no return.

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# Environment-friendly cars = EV cars?

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Behind the world's economic growth and development over the past few centuries was the discovery of oil and internal combustion engine vehicles, which allowed for mass mobility. However, recent rise in oil prices and engine vehicles' direct impact on environmental pollution have given new attention to green growth and environmental protection. In the post-oil era, electric vehicles (EVs) are attracting attention as an effective means of transportation for the future. EVs provide three major advantages over its combustion engine counterpart in terms of 1) emitting fewer air pollutants and greenhouse gases, 2) providing superior fuel efficiency and 3) rendering tangible economic benefits to consumers.

Electric vehicle cars drive electric motors with electric energy stored in batteries; hence, the emission of air pollutants and greenhouse gases is much less significant than combustion engine vehicles. Others who oppose the above statement cite Life Cycle Assessment (LCA), which provides data that carbon dioxide and pollutants are inevitably emitted throughout the life cycle of automobiles - from manufacturing, processing of powered material and batteries, transportation and distribution, use, recycling, and final disposal. However, it is important to acknowledge that the scope and criteria for automotive LCAs may vary depending on the research authority, and regional deviation exists due to the difference in power generation energy sources by country. A counterargument to LCA is provided by a 2019 Dutch paper, "The Underestimated Potential of Battery Electric Vehicle to Reduce Emissions," which argues that the results are due to the overvaluation of carbon from battery manufacturing, the undervaluation of battery life, and the assumption that power source composition will not be decarbonized, and the unrealistic application of energy consumption measures to exclude greenhouse gas emission from fuel production (Hoekstra 2019). In addition, transportation and Environment (T&E), an NGO specializing in European transportation, announced that electric vehicles in the European Union generate about three times less carbon dioxide than internal combustion engines regardless of which electricity was used. The average carbon dioxide emissions of electric cars are 90 grams, but diesel cars emit 2.6 times and gasoline cars 2.8 times. Thus, electric vehicles are more eco-friendly than internal combustion locomotives that emit smoke during operation even in the worst case of high carbon dioxide emissions. Also, eco-friendly can be improved through various methods. Using renewable energy in the battery and body manufacturing process reduces emissions to the processing process. In addition, technologies such as extending battery life and recycling are rapidly evolving, reducing the amount of carbon generated in the battery production process. The de-carbonation of electricity, such as de-coal, which is the fuel for heavy electric vehicles, must be combined to ride the most environmentally friendly electric vehicle.

Furthermore, the motor of an electric vehicle has a level of efficiency that is far superior to the engine of an internal combustion engine. The energy efficiency of electric vehicles is determined by the charging and discharge efficiency of electric energy. Because there is a 9.5 percent energy loss while charging, EV cars, once charged, around 70 percent to 85 percent of their electric energy can be used (Lovell 2020). On the other hand, the majority of the energy in gasoline cars is dissipated as heat energy. In other words, even though it is more expensive, gasoline is less efficient with a thermal efficiency of just 20%. As a result, it can be concluded EV cars are more eco-friendly not only because EV cars' fuel costs are lower than internal combustion cars' but also EV cars have better fuel efficiency.

Lastly, because electric vehicles have fewer components than internal combustion engines, it provides economic benefits to customers. Electric vehicles are not completely maintenance-free, but maintenance is much simpler and easier compared to that of internal combustion engine cars. For EV cars, there is no replacement of engine oil and oil filters, which often require the most frequent maintenance use by the customer. Since there is no absorber, it is also unnecessary to change intake filters and manage exhaust, including the number of elements of diesel, and replacement of engine plugs and coils corresponding to gasoline. There is no transmission, so there is no replacement of clutch pads and transmission oil. In particular, the maintenance charge for a Tesla Model X electric vehicle that had driven 640,000 kilometers was only approximately \$500 for every 10,000 kilometers. (Tracy 2020) In addition, electric vehicles actively utilize regenerative braking, so the cycle of exchange of braking-related consumables is very long. Such semi-permanent brakes also benefit the environment since it reduces the air pollution coming from brakes. In addition, while it's not a feature of all-electric cars, Tesla has the advantage of being relatively less frequent to visit because it remotely connects to the car when something goes wrong, identifies the problem, and sends mobile services home if necessary. (Tracy 2020) In conclusion, electric vehicles are not impossible to operate for a long time without any maintenance, but they are at least much easier and simpler than internal combustion engine cars; therefore, EV cars are an appealing option for customers as well.

The essential thing is that people are attempting to minimize carbon emissions in any case, and it is noteworthy that carbon emissions are steadily dropping in relation to energy output, albeit slowly. As a result, decarbonization in the power generation sector is developing more quickly than in the final consumption stage, making the use of electric vehicles an ultimately smarter choice for the environment and customer.

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# Not just a walk in the park

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There are a variety of factors that lead a city to flourish, one of which are the physical and mental health of city residents. However, obesity is a widespread issue across the United States and can lead to many serious health problems. Moreover, recent research indicates that the prevalence of overweight or obese adolescents is higher in urban areas (17%) than in rural areas (13.5%) (Nurwanti et al., 2019). Physical health remains a serious issue for urban areas and promoting healthier lifestyles and physical exercise will be crucial for introducing a better quality of life for city residents. Nonetheless, cities can promote healthier lifestyles for city residents by renovating park facilities that target physical activity and distributing parks to ensure convenient access to parks and facilities for exercise; famous parks such as Central Park in NYC, USA demonstrate that parks not only encourage physical activity but also serve to strengthen the economy, protect the environment, and support the community.

In order to promote physical activity and health, cities can renovate urban parks by building or improving facilities targeting physical fitness. In a study conducted by Deborah A. Cohen and her colleagues, the researchers observed that of all park users in the 8 public urban parks that they tracked, 19% were found walking and 16% were engaged in vigorous activity (Cohen et al., 2005). While the interviewees identified the park as the most common place they exercised, a majority of park users were still observed sedentary. In order to increase the physical activity in a park, cities can employ a structural fix in which they renovate or build multipurpose fields, athletic fields, playgrounds, or walking paths since those park facilities were observed to engage the most physical activity from park visitors. By investing in and implementing better facilities that target physical fitness, park visitors will be encouraged to participate in more physical activities and thereby promote healthier lifestyles for park visitors.

In addition, cities should effectively add and distribute parks throughout the community in order to maximize access to parks and their facilities for city residents. In the same study of the previous paragraph, Cohen and her colleagues observed that the further a resident lives from a park, the less often the resident will visit the park. Of the observed park users, 43% lived in residences within a quarter-mile to the park in which they visited and 64% lived within a half-mile. On the other hand, only 13% of observed park visitors lived over a mile away from the park (Cohen et al., 2005). This finding makes logical sense because having a park close by makes it more convenient to visit and increases the frequency of visits for nearby residents. Therefore, ensuring that city residents have convenient and easy access to nearby parks is critical as it will increase visits from park users and increase access for city residents to utilize facilities in which they can exercise and have healthier lifestyles.

In addition to promoting physical activity and health, urban parks such as Central Park in NYC demonstrate that they have the ability to strengthen the economy of an urban area. Central Park is filled with vendors, park employees, numerous park facilities, and real estate surrounding the park. The Central Park Conservancy, the organization responsible for maintaining Central Park, reports that it had 453 workers on its payroll, 81% of whom are full time employees (“The Central Park Effect”, 2015). Central Park supports hundreds of employees and businesses through the necessity of the park for maintenance, landscaping, and construction. Moreover, concession stands and cafes located in Central Park generated over \$91 million in Central Park during 2014 alone, supporting even more New York City businesses and employees. Additionally, Central Park helps to beautify New York City, attracting investments and higher property values on the boundaries of the park. For example, high

end apartment rooms on fifth avenue facing central park have a premium of \$1,239 per square foot, a 75.6% higher rate compared to rooms facing away from the park. Central Park significantly stimulates economic development and demonstrates the ability of urban parks to strengthen the economy by supporting jobs, businesses, and investments.

In addition to providing economic benefits, parks such as Central Park contribute and support the environment and a stronger community. Today, Central Park is filled with natural settings including meadows, ponds, and dense plantings as envisioned by the co-designer Frederick Law Olmstead. The park serves as a home to diverse wildlife, including squirrels, turtles, ducks, fish, and more than 240 species of birds. The landscapes and biodiversity found in Central Park both protects the natural environment and allows city residents to interact with nature from within the city. Moreover, Central Park hosts more than 18,000 trees, all of which cool temperature, provide shade, capture air pollutants, and filter rainwater (Sain-Baird, 2017). In addition, Central Park serves to strengthen the community of New York City by hosting large fundraising events such as the Making Strides Against Breast Cancer charity event with over 60,000 participants and numerous music festivals. These large events and activities found in Central Park unite and bring city residents together, helping to establish a stronger city. Overall, Central Park has strengthened both the community and environment of New York City, demonstrating the potential impacts that urban parks can have on their communities.

Although many urban areas do not have the available space to build large parks such as Central Park, smaller urban parks can implement some aspects and designs of Central Park to help strengthen the economy, protect the environment, and support the urban community. Parks have the tremendous ability to promote physical health and improve quality of life for city residents: therefore, ensuring easy access to urban parks is critical to the success of them. Additionally, park designers can specifically build athletic facilities and walking trails within parks to further promote physical activity in the fight for better health. After all, investing in urban parks seems valuable, as they do not only serve for walks in the park.

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# Green transportation justice

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As urban populations grow, it is necessary to look at who has access to affordable and reliable transportation and who does not. Transportation injustice has profound impacts on low-income areas, minority communities, children, and the elderly. It can make access to education, employment, healthcare, healthy foods, and social organizations expensive and time-consuming, lowering overall wellbeing. From an environmental standpoint, transportation is the largest sector of greenhouse gas emissions, accounting for 29% of global GHG emissions (US EPA, 2015). Connected, affordable, and efficient transportation networks can simultaneously support transportation justice and lower air-pollutant emissions. To alleviate transportation injustice, state and community actors need to prioritize green transportation infrastructures such as bike-sharing services, restored sidewalks, connected bike lanes, and affordable public transit.

Green transportation infrastructure can increase resident wellbeing in underserved communities by connecting residents to jobs, resources, and services. A recent Harvard study determined one of the most significant factors for escaping poverty is commuting time (Chetty & Hendren, 2018). As urban growth causes housing prices to increase, low-income residents and people of color are increasingly pushed out of urban areas and away from employers (Criden, 2008). Bike-sharing services, restored sidewalks, and connected bike lanes all increase walkability and biking opportunities, decreasing time spent on commuting. Investing in connected, reliable, and efficient transportation helps overcome commute time. Transportation time is also an obstacle for reaching other destinations. Human wellbeing is largely affected by access to healthcare and healthy food. While increasing transport accessibility does not solve other systemic issues preventing access to these resources, it will eliminate one of the existing barriers. Being able to access resources is essential to living a healthy and meaningful life.

As cost is another factor limiting transportation justice, decreasing public transit costs will ensure that public transit is accessible and affordable. The cost of public transit creates an added burden for low-income families already struggling with financial constraints. A Center for Transit-Oriented Development report found that low-income households can spend upwards of 55% of their income on transportation costs (Netter, 2013). Affordable public transit is also essential for creating a transportation network available to everyone, as many people with disabilities and the elderly cannot walk or bike. Establishing a public transit system that is affordable to everyone can help mitigate socioeconomic disparities.

Green transportation infrastructure can decrease environmental hazards in low-income communities. Because low-income and minority communities are more likely to live in high-traffic neighborhoods, they are often exposed to more significant environmental hazards such as air, water, and solid waste contamination, as well as higher noise pollution and traffic accidents (Blumenberg, 2017). As the percentage of the global population that lives in urban areas increases, the carbon emissions for transportation will also increase. Establishing green infrastructure that will decrease these emissions, specifically in the regions that traditionally experience environmental burdens, is essential for establishing a just and sustainable future. Electric vehicles have become of increased interest within green transportation for their lack of emissions, but they increase congestion within an increasingly dense urban area. Infrastructure that promotes walkability and biking reduces emissions and congestion.

A combination of state and society actors ensures that projects have the power and community recognition needed to succeed. Transportation projects require public capital investments and the use of laws and regulations that are facilitated by state actors (Karner et al., 2020). Although transportation projects need the resources provided by state-centric approaches, they rarely prioritize equity and community voices (Karner et al., 2020 and Stacy et al., 2020). Traditionally, there has been a lack of opportunities for meaningful public involvement within underserved communities leading to a lack of improved outcomes (Karner & Marcantonio, 2018). Community organizations prioritize procedural and recognition justice that empowers and organizes community needs. The knowledge and experience of both areas are needed to ensure that transportation projects are influential, represent the community, and are just.

Increased green transportation infrastructure that prioritizes walkability and biking is imperative for transportation justice. Establishing bike-share programs, restoring sidewalks, connecting bike lanes, and affordable public transit can help promote community wellbeing and decrease carbon emissions. As the world becomes more urban, the inequalities that affect low-income and marginalized communities need to be addressed to create livable and sustainable cities.

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# Transgenic bioluminescent plants light cities

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New York City consumes an annual average of 143.2 TWh of electric power (Department of Energy, 2016). There are a multitude of issues that have followed such electrical usage, including massive power outages and great amounts of light pollution. It has become common for cities around the world to use massive amounts of electrical power, contributing to an immense quantity of greenhouse gas emissions. To sustainably reduce the amount of electricity usage, power outages, light pollution, and carbon emissions in large urban areas, cities can introduce transgenic bioluminescent plants, or genetically engineered plants that include specific enzymes and genes which result in the expression of bioluminescence during a period of darkness (Hudkins, 2006), to replace current street lighting systems.

Transgenic bioluminescent plants can be used to offer a sustainable replacement for the current electric lighting systems in cities' streets. Architect and Environmental Designer Olympia Ardavani (yr) studied how bioluminescent plants can assume the role of exterior lighting in urban and suburban areas located in the mediterranean. Ardavani found that the amount of bioluminescent plants that are required to properly light streets is 40 plants per side. Her results showed that areas using transgenic plants experienced reduced amounts of energy consumption (Ardavani, 2020). Transgenic bioluminescent plants are successful in lighting cities in a sustainable way.

Not only would the introduction of transgenic bioluminescent plants lessen the amount of electricity used by cities, they would also help contribute many ecological services to cities. Photosynthesis in transgenic plants is just as other typical photosynthetic plants in that carbon dioxide, heat energy, and water is absorbed. Putting transgenic bioluminescent plants alongside streets would not only eliminate the need for electrical streetlights, but would also contribute to the several key ecological services listed by Per Bolund, a Natural Resources Manager. These include air filtration, micro-climate regulation, noise reduction, and rainwater drainage (Bolund, 1999). Hence, introducing bioluminescent plants in order to reduce the amount of energy used by streetlights in cities also results in several ecological services that help to mitigate some of the world's largest urban and environmental problems.

The installation of transgenic bioluminescent plants would make cities more resilient to power outages. It's currently understood that massive power outages in cities are often caused by extreme overload of energy and electricity usage. The effects of such large-scale blackouts can be anything from inconvenient to life-threatening. Some inconveniences people may face include loss of internet connection and communication, loss of visibility, and the loss of other electrical services. Although these are serious issues, they are temporary and typically repaired within the day of the outage. However, outages could also cause more serious issues regarding human health. Christine Dominianni, a New York City Environmental Epidemiologist, analyzed the impacts such power outages have on the health of New York City residents. Dominianni found that stresses and/or injuries contribute to greater respiratory hospitalizations, renal disease hospitalizations, and cardiovascular disease hospitalizations during city outages (Dominianni, 2018). Massive power outages could also result in food spoilage and water contamination. Clearly, power outages in cities can have detrimental effects on people's lives, thus generating a poor quality of life and human well-being for the affected residents. The implementation of transgenic bioluminescent plants could help reduce the amount of power outages that occur, as they'd be replacing streetlights, thus reducing the need for electricity. The plants could also be helpful for peoples' vision during blackouts, as their lighting process wouldn't

be affected by an electrical outage. Introducing transgenic bioluminescent plants would contribute to a greater quality of life and human well-being through reducing both the frequency and the effects of urban power outages.

Additionally, the replacing of streetlights with transgenic bioluminescent plants would reduce the massive amount of light pollution typically produced by cities. Cities contribute a large amount of light pollution by releasing artificial light which interferes with the natural patterns of light and dark. P. Deda, an environmental scientist and researcher, has found that light pollution has harmful effects on the natural processes conducted by animals and plants, contributing to the lessening of the biodiversity of cities' nearby ecosystems (Deda, 2007). Light pollution also interferes with our vision of the night sky and its astronomical contents. So, by eliminating the light pollution produced by streetlights through using bioluminescent plants, city residents can enjoy a nicer view of the night sky, boosting their well-being and quality of life with a sense of happiness and serenity.

Some may argue that transgenic bioluminescent plants are insufficient in generating a strong enough light source to brighten cities' streets compared to streetlights (cite). While it is true that streetlights do produce a significantly greater amount of photons per second than the current transgenic bioluminescent plants produce, these plants are effective in being bright during dark, and at brightening their surroundings. Because these plants have been genetically engineered relatively recently, it can also be predicted that scientists will improve the brightness of the bioluminescent properties of these plants.

To summarize, in order to tackle the enormous amount of electricity usage seen in cities around the world, along with its numerous effects on the environment and society, transgenic bioluminescent plants could be placed throughout streets by replacing streetlights. This change could lessen the frequency and effects of power outages, reduce light pollution and its effects, provide numerous ecological services, and ultimately bring city residents a greater quality of life and well-being.

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# Polycentricity: The key to rising sea levels

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Polar bears stranded on melting sea ice; forests engulfed in blistering flames; drought-stricken cracked earth. These are images we have seen all too often. In fact, ending the days of climate armchair activism through a cognitive fix is well in the past. The scary reality is that the highest level of officeholders remain 'seated' while islands are practically disappearing into thin air due to rising sea levels. The existing regime of monocentric governance, defined as "an approach in which the state is the centre of political power and authority, exerting complete control over society, economy, and resources", has failed to build a climate-resilient and idealistically liveable world (Rhodes, 1997). Hence, the following question arises: why are the bureaucratic issues of monocentric governance hindering progress when several parties are ready to act? The policy-makers of coastal cities should mitigate the rise of sea levels by adopting a regime, in which polycentric governance allows multiple governing bodies such as volunteer groups and city councils to help cities adapt to environmental changes.

Every citizen of this biosphere is an indispensable stakeholder when it comes to climate change, therefore, equitable representation is key. This can be achieved by tailoring governance to the specific circumstances of rising sea-levels: socio-ecological vulnerability (SEV) assessments, projections of future exposure, accommodating diverse biophysical responses, and ecosystem based adaptation, to name a few (Rogerson, 2020). These projects require decisive action from numerous bodies, ranging from multilateral associations such as 'The Intergovernmental Panel on Climate Change', to domestic organisations such as 'Mission Mangroves' in Mumbai (Lekhraj, 2017). Hence, the visualisation of SEV is an easy task when it comes to the impacts of rising sea-levels, especially at the grass-root stage. Through a polycentric approach, coastal cities will be equipped with the tools to identify SEV and execute environmental adaptation at every level.

When power is concentrated at the centre, in the monocentric approach, it results in maladaptive outcomes and institutional fragmentation (Huitema, 2018). The term 'institutional fragmentation' refers to the growing diversity and challenges to coordination among private and public norms (Zelli, 2013). The primary reason for this is that higher-level authorities usurp the functions of lower-level authorities by declaring them "incapable" due to a lack of resources (Mudliar, 2020). In reality, it is the lower-level bodies that supply the centre with resources such as volunteers, equipment, creative liberty and social networks. Thus, the dissolution of bridges between these levels greatly hampers information-sharing, conflict-resolution mechanisms, accountability and functional cross-linkages (Jordan, 2018). When power is not shared among decision centres, it intensifies conflicts and competition between them. Resultantly, the mitigation of rising sea levels is adversely affected as its policy domains are further fragmented; domains including infrastructural adaptation and preservation of biological diversity are compromised in monocentric governance (Huitema, 2018).

Although rising sea levels are linked to important issues such as the loss of biodiversity and critical habitat, it also impacts people's well-being. Polycentric governance allows for a more inclusive, happy and equitable society; by almost 'over-sharing' services, polycentric systems ensure that no one is left behind (Dewulf, 2010). The presence of multiple decision-making centres also plays a role in building social capital; the norms of reciprocity, levels of trust, reputation, and networks of relationships are fostered among bodies focused towards creating climate resilience. Physical well-being is addressed through this regime as well, because pertinent issues related to rising sea

levels such as water availability and temperature stress can be regulated in a systematic and collaborative manner (Jordan, 2018).

The solution to the governance gap in mitigating sea-level rise and coastal flooding in the San Francisco Bay Area, perfectly illustrates the power of 'polycentricity' (Lubell, 2019). The establishment of elevated wetland habitats, through green infrastructure and "living shoreline" solutions was imperative for several reasons: absorbing wave energy from high tides, providing habitats for sensitive species, water quality benefits and non-point source solutions (Lubell, 2019). However, through the process of wetland restoration, it became clear that centralized approaches pushed towards uniformity and 'one-size-fits-all solutions'. This led to difficulty in adapting to heterogeneous local contexts and discovering innovative strategies. Hence collaboration became a necessity, requiring cross level relations - regional actors "downscaling" information, resources and authority to local actors, and local actors "upscaling" information to regional actors. This concept was furthered by recognising the importance of local participation; gleaned from online records of membership, civic engagement flourished. In this manner, cost-effective pathways were found for achieving resilience in the San Francisco Bay Area (Lubell, 2019).

While polycentric governance offers a multitude of benefits in the mitigation of rising sea levels, it does have certain limitations and challenges for application. It poses a high risk of uncoordinated or, even contradictory, policies and actions, (Jordan, 2018). It also tends to disregard the key role of traditional powerful actors of climate change governance with legitimate legal and financial competence (Paelin, 2019). The approach also leads to contested accountability and confusion with regards to jurisdiction in coastal cities. Thus, a question arises: everybody is involved, but who is in charge? The aforementioned critique, however, can be addressed through proper structuring and building in of checks and balances for power sharing. Furthermore, polycentric governance engenders trust, due to which units experiment with new approaches and learn from each other instead of focusing on the semantics of contradiction. It also creates a more robust system: if one domain fails, others can step in (Ostrom, 2010).

Through polycentric governance, disadvantaged communities might no longer be disproportionately vulnerable to rising sea levels. Moreover, the multifaceted issue of rising sea levels would be tackled in a manner stretching far beyond the technicalities of "green" and "grey" infrastructure: invisible gaps in governance and social structures could be bridged as well. In essence, polycentric governance accommodates the three core "dynamics" of collaboration: principled engagement, shared motivation, and capacity for joint action, which, in turn, facilitate environmental adaptation to mitigate rising sea levels.

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# Enhancing sense of place through civic ecology

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A sustainable city is defined not only by green infrastructure and net-zero technology, but also by the feeling of community and well-being. People must engage with each other and their environment to enhance their sense of place. Sense of place reflects the values that residents associate with local places and a feeling of belonging to the community (Russ, 2017). In all communities, including underserved ones, it is important for neighbors to find their sense of place to help each other thrive, because their surrounding community greatly affects their values and connection to society (Massey, Gross & Eggers, 1991). Improving individuals' sense of place promotes human wellbeing by connecting people to a network beyond themselves, and is achievable through civic ecology practices. Civic ecology entails the interaction among neighbors, local institutions, and the surrounding ecosystems through environmental stewardship programs (Krasny, 2015). Participation in civic ecology activities enhances one's sense of place by creating positive memories and promoting leadership and awareness of local and global issues, including social and ecological issues, which impact urban sustainability. Furthermore, civic ecology can nurture participants' sense of place by promoting inclusive practices that encourage communication and collaboration. To foster a stronger sense of place among urban residents, local leaders should organize recurring environmental community-based events, including neighborhood meetings, hands-on activities, and virtual public engagement.

Regularly occurring neighborhood meetings on civic ecology programs enhance the local residents' sense of place by encouraging input from participants regarding the environmental projects (Jones, n.d.). These meetings, open to all residents, should serve to set environmental goals and mobilize civic ecology projects for the community, the specifics of which will be particular to the given neighborhood. However, because a neighborhood profoundly affects its residents' values (Massey, Gross & Eggers, 1991), it is important for many neighbors to adopt an enthusiastic mindset to impact the entire community, since it is likely that only a small subset of residents will be interested at first. The meetings to plan civic ecology activities can foster community-oriented social norms, and influence residents' environmental attitudes and behavior through injunctive normative messages (Stern, 2018). Such a shift towards community-oriented social norms is achievable by using meetings to focus on positive development, discussing the communal achievements and recognizing individual households for their engagement (Jones, n.d.). As the residents become more enthusiastic through regular, positive discussions, they develop a stronger attachment to their neighborhoods. By organizing regular meetings to discuss civic ecology projects, local leaders enhance the participants' sense of place within the community because the individuals feel valued and heard as they contribute to the discourse and planning of civic ecology practices.

The ecological projects planned in the meetings should result in hands-on environmental activities, as establishing a connection to nature through such actions can improve the residents' sense of place (Krasny, 2015). Numerous studies demonstrated that civic engagement improves quality of life by reducing crime and strengthening trust among community members (Ferguson, 2006). By integrating civic engagement with urban nature, civic ecology activities allow people of all ages to learn about ecosystem services while taking ownership in the improvement of their society and keeping a vested interest in maintaining it. Projects like community gardens, trash cleanups, upcycling workshops, and tree-planting initiatives are hands-on projects that build interpersonal trust through collaboration. This, in turn, can create bonds among people that strengthen their attachment

to the neighborhood (Putnam, 2000; Krasny, 2015). By engaging the community in civic ecology activities, local leaders help participants establish a connection with nature and each other, elevating their sense of place through the accomplishment of improving the surrounding environment.

As local socio-ecological improvements become tangible, leaders of the community projects can promote virtual public engagement to showcase the work done and inspire other communities to adopt a similar approach, strengthening people's sense of place throughout the city. A virtual platform, like social media, can encourage further local participation through the sharing of images that demonstrate the progress made, allowing the entire community to reflect on its achievements. These shared reflections can motivate further civic ecology actions, thus creating a positive cycle of community improvement (Krasny, 2015). While this beneficial feedback loop may exist in some neighborhoods, sense of place has been declining in many locations that lack civic participation (Putnam, 2000). Thus it is important to raise awareness of the socio-ecological benefits of civic ecology to encourage residents of other communities to foster a sense of place, as well. By sharing communities' success stories virtually, local leaders can cultivate their neighbors' sense of place while inspiring others to adopt a similar approach for their own neighborhoods.

Local leadership that organizes civic ecology practices can benefit community residents by strengthening their sense of place. Many cities today are in social, economic, and environmental crisis. In order to resolve these problems, urban residents must collaborate. The solutions that ultimately help neighborhoods thrive will likely be more complex than this general framework. Still, residents can take small steps, the first of which is improving their sense of place, to enable future community progress. Meetings foster valuable communication, activities promote collaboration, and public platforms promote reflection and inspiration. Taken together, these approaches benefit individuals by sparking a strong connection to nature and to the community, ultimately enhancing the residents' sense of place.

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# “C” in commute for ~~cars~~ cycling

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Everybody knows it: cars pollute, disturb, obstruct. Yet most daily commutes to work in American cities are made by this means of transportation. Reasons for this are well-known: convenience, urban sprawl, distance. Solutions have been long understood: density, public transportation, carpooling (Sloman, 2006). But even so, cars account for 76.4% of commutes made to work in the United States of America (McKenzie, 2015). Commuting on a bicycle proves to be an interesting alternative. While freeing up roads, creating no noise pollution and having no emissions, cycling also leads to improved physical and mental health (Pucher et al., 2012). For American cities, and in general all car-centric cities, to become welcoming to commuter-cyclists - and be freed of the car's many negative environmental and urban impacts - cycling highways need to be built, public transportation needs to be made more accessible to bicycles, understanding and awareness between road users needs to be enhanced, and bicycle use for commutes needs to be incentivised.

Cycling highways are special cycling lanes designed to enable cyclists to travel larger distances while using the same amount of energy. Although not defined by a single set of definitions, cycling highways are usually separated from other types of infrastructure, designed to increase cycling comfort (e.g. smooth pavement, street lighting) and wide enough to let cyclists pass each other. For these features, cycling highways are a major part of the solution towards getting people to commute by bicycle. In Munich, Germany, for example, the construction of a cycling highway through a low-density suburb showed a considerable increase in commutes made by bicycle, while a reduction in car travel was also observed (Rayaprolu et al., 2018). These results can be attributed to the fact that, as with cars, one doesn't commute by cycling through neighborhoods, since it is time-consuming and inefficient. With the construction of cycling highways, this problem can be overcome by providing direct and cyclist-only traffic arteries, thus creating efficient and safe cycling links between home and work, and even between city and city.

A major reason for why by far most Americans commute by car is distance. The average commuting distance in the 96 largest metropolitan areas of the United States ranges from 4.7 miles in Stockton, California, to 12.8 miles in Atlanta, Georgia (Kneebone et al., 2015). Although some of these distances can be covered by cycling highways, others will need to be complemented by other alternative modes of transportation; making public transportation more accessible to cyclists and their bicycles is the most effective way to bridge this gap. Integrating cycling with public transportation can be done through several ways: bicycle storage or renting facilities should be placed near train stations and bus stops, accommodations for bicycles on trains, metros, streetcars, and buses should be put in place, and bicycle routes (i.e. bicycle highways) should be aligned with public transportation stops (Pucher et al., 2012). Doing so will allow cyclist-commuters to travel further, breaking a barrier that used to prevent many commuters in car-centric cities from switching their cars for bicycles.

Improvements in infrastructure cannot be the only solutions to popularize commuting by bicycle, however: a cognitive fix is required as well (Heberlein, 2012). Firstly, an increased understanding between road users (i.e. cyclists and motorists) needs to be established, mainly through education, to ensure that everyone feels comfortable cycling to work. In the Netherlands, a “fietsexamen”, or cycling exam, is conducted in grade 5 or 6. Children learn, both theoretically and in practice, how to safely navigate traffic, and carry this knowledge with them for the rest of their lives. Understanding of cycling also comes from the other side, however: cyclists and how to deal with them needs to be covered extensively in automobile driving tests. Moreover, this education can be used to

create awareness on commute-cycling. 19% of American youth experience obesity, and an additional 16% is overweight; teaching these children the benefits of commuting by bicycle - of which achieving the recommended 30 minutes of exercise per day is one - could ensure that they grow up to become commute-cyclists themselves, with all its mental and physical benefits (Sanyaolu et al., 2019).

Lastly, employees can be convinced to commute-cycle through incentives, provided by either their employer or their (local) government. In the Netherlands, for example, it is common practice for companies to cover half of their employee's bicycle costs if they agree to cycle to work. In addition, incentives can be provided in the form of a bicycle sharing system: companies could cover the costs for a subscription to such an existing system, or could set up a sharing system amongst their employees themselves through the use of company bicycles. Local governments could also provide incentives, using the same methods. With the financial risks and/or barriers reduced, a previous disadvantage turns into a benefit, possibly leading to an attitude change of the employee that will make it more likely for them to commute by bicycle (Stern, 2018).

Although reducing the cost of bicycles through incentives will promote their accessibility, some might still argue that commuting by bicycle on a regular basis is not feasible for a large share of the working population, due to mental and physical disabilities or limitations. Improvements in cycling technologies have largely removed, or at least significantly reduced, these obstructions, however. E-bikes, for instance, allow the elderly or unfit to cover large distances within their physical capacity.

As mentioned before, the problems related to commuting by car are well-known, and so are the reasons for why it's so popular. There are solutions, however: through the construction of bicycle highways, an improved integration of bicycles with public transportation, an enhanced understanding between road users and an increase in cycling incentives, commute-cycling in car-centric cities can be normalised, and even standardised. But above all, these solutions will contribute to a happier, healthier, more sustainable lifestyle, one that is only four steps away, in the form of two wheels.

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# The brown-to-brightfield initiative

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“Brownfields — or contaminated postindustrial property — environmental justice scholars have found, are overwhelmingly found in low-income and minority communities” (Bryson 2012). The advocacy of human well-being in urban settings requires that communities of all incomes live within similar qualities of life, especially in terms of environmental accessibility. Therefore, the quality of life and environmental healthiness that is experienced by middle to high-income families should be a standard that is also reachable by lower-income families. A proposed way to delegate more exposure to nature in over-densified low-income communities is to redevelop brownfields into brightfields, or green spaces. This method is achievable even with limited land area, as brownfields are a pre-existing portion of the urban environment, therefore, displacing people is not necessary. Beyond that, not only are brownfields vacant land making up approximately 12.5 to 25 percent of U.S. cities, but they are also areas which, if given the effort of being managed strategically, can provide considerable potential in enhancing the biodiversity and ecosystem services in low-income environments (Goddard 2016). As a result, the greening of brownfields through specific methods such as biochar application and local involvement can become a viable solution in enhancing overall quality of life in low-income communities, especially within regions limited by urban land area.

Not only can reclamation of brownfields improve quality of life in terms of natural aesthetics, but it can also physically improve the environment by removing soil contaminants, health hazards that are detrimental to human well-being. One way of enriching brownfield soils is through the application of biochar, a type of charcoal produced by the thermal decomposition of waste biomass under hypoxic conditions. Application of biochar can provide two beneficial processes at once: brownfield soil remediation, and storage of heavy metals and organic pollutants. Application of biochar is akin to coal mining in reverse, instead of extracting materials from the Earth, biochar application restores soil fertility, enhances microbial activity, and improves water retention by reintroducing healthy biomass (Ritter 2013). Biochar activation is also a multi-functional process. Tang et al. (2013) proposed that through the use of steam activation, not only can biochar be applied, but surrounding plants will also experience accelerated nutrient retention and uptake, promoting the process of renewed growth. The negatively charged reaction of biochar application in the soil also attracts heavy metals with positive charges, such as Cu(II), Pb(II), Cd and Zn. In a study that explored the capability of biochar to retain Cd and Zn from a contaminated model brownfield, biochar application was shown to have reduced the concentration of Cd and Zn by 300- and 45-fold, respectively. As a result, biochar has both the potential to sequester heavy metals and to enrich brownfield soil for further development.

Involvement of local communities in the redevelopment process is key to ensuring the success of the brown-to-brightfield initiative. Local residents have the best understanding of their current living conditions and therefore will provide insightful advice on what to prioritize first within the remediation and use of brownfields. Brownfield redevelopment planning must work to protect both infrastructure and social aspects of the community. Beyond improving the environmental and infrastructural aspect of low-income communities, the developmental process should also build the adaptive capacity of vulnerable residents to future changes and gentrification. Through training and hiring local residents to take part in the remediation of brownfields, not only will public opinion be heard regarding urban intervention within communities, but social and environmental resilience within vulnerable residencies may also be improved (Anguelovski et al. 2019).



Apart from benefitting the residents, unique habitat mosaics formed on unmanaged brownfield sites can also provide microhabitats valuable to many specialist species, which poses an issue on whether to prioritize the residents or the natural inhabitants of certain sites (Connop & Nash 2018). Though unmanaged brownfield sites act as vacant land for low-income communities, it also provides habitats for endangered and specialist species. In unmanaged brownfields, especially dry ground sites previously occupied by large industrial buildings, the lack in fertile soil discourages growth of fast-growing plants, therefore allowing an abundance of growth in wild flowers. This naturally-occurring nutrient-poor land has provided specific contributions in promoting invertebrate biodiversity (Hunter 2014). Therefore, when considering the brown-to-brightfield initiative, a trade-off exists between improving the quality of life for low-income communities or preserving the unmanaged habitats of previously inhabiting invertebrates and other specialist species. In order to improve human well-being while also preserving biodiversity, strategic management of the developmental process must occur. This means to keep a portion of the land unmanaged, acting as wild space for the preservation of preexisting species, while redeveloping land to also satisfy residential needs.

The brown-to-brightfield initiative builds upon one of the sectors of Drawdown's three connected areas that call for action – supporting sinks, by engineering sinks through the use of degraded land. As brownfields exist as unproductive land within metropolitan areas, the repurposing of these environments allows for the bypass of limited land area constraints typically present when considering development of urban green spaces (Ritter 2013). In many urban areas, especially in developed nations, limited land area has been a growing concern coupled with continued urbanization and densification of cities. Beyond promoting equity in living standards for low-income communities, brownfields have also become more attractive economically for new development in the overall aspect of urban environments.

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# Using green roofs in cities

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Urban cities tend to suffer from poor air quality and a lack of green space (Dominici et al., 2002, Lin et al., 2015). Parks in cities have undeniable benefits, including improving health and community relations (United States Department of Agriculture, 2018). However, cities may not always have enough space to add more parks, and green roofs would be more efficient as they can be converted into parks. Adding green roofs to cities would help solve both poor air quality, a lack of green space, and would also bring many other benefits.

One effect of green roofs is that they provide environmental benefits. For example, green roofs improve storm-water management and reduce temperatures during the summer (Oberndorfer, 2007). Statistics show that green roofs can have 66% to 69% of rainfall retention with more than 10 cm of substrate. Reducing rain runoff can also reduce environmental pollution, as less contaminants are picked up by the water. Additionally, green roofs can reduce annual heat gain as much as 95%. Green roofs can also reduce the cooling load for the entire building during the hottest time of the year, by 25%. Reducing the cooling load also saves energy consumption significantly. Finally, a city with 50% green roof coverage can reduce temperatures as much as 2°C in some areas.

To solve the problem of poor air quality, green roofs also can reduce ozone concentrations (United States Environmental Protection Agency, 2018). A study (Fallman et al., 2016) has also shown that green roofs resulted in a 5% to 8% reduction in ozone concentrations. By absorbing harmful pollutants, green roofs will improve air quality in cities and the overall well being of citizens. Additionally, urban cities also lack green space, and the addition of green roofs would not only save space but increase the green space per city.

As stated in the introduction, parks have many benefits. The first of these benefits is improving the physical health of citizens. Many Americans don't have access to public parks (Lakhani, 2020). In addition to a lack of public parks, people of color and people in low-income households lack easy access to parks. A green roof converted into a park could solve this issue, especially in urban cities. In apartments, parks on the roof could be used to provide green spaces to everyone equally. Parks provide an opportunity for urban residents to walk through nature, improving their physical health.

In addition to physical benefits, parks can also improve mental health and community relations (Swierad and Huang, 2018). Parks provide an easy way for communities to organize events to interact socially, and social interaction has been shown to improve mental health. Especially since green roofs can be used as parks, it provides an equal opportunity for everyone. Parks on apartment roofs also can lead to a closer local community with neighbors. Another option is to host a community garden on green roofs, which can also improve community bonding. Green roofs would be accessible for everyone, not just people of a certain income. These green roofs would be owned by the owner of the building, and so while it might be expensive, the benefits far outweigh the cost.

While gentrification could be a major problem with green roofs, if green roofs are added to every community, there would be no reason for wealthier residents to move in just for the green roofs. Additionally, green roofs shouldn't increase living costs significantly enough for residents to move out. There is also the possibility of the government creating a contract to prevent the landowners from increasing prices significantly just because of the addition of green roofs.

Overall, green roofs provide a variety of benefits in urban cities. These benefits include improving air quality, increasing green spaces and parks, as well as improving community relations and health. Green roofs are a good alternative to green spaces on the ground, as they save space. In

addition to improving air quality, they also reduce temperatures, which can save energy, and reduce rainwater runoff, which reduces contaminants in the environment. Green roofs can also have the same benefits as parks, but are more convenient, especially for low-income neighborhoods, as they most likely live in apartment complexes, and a green roof on top of their complex would be easily accessible.

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# Sponge city concept

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Urban expansion has changed the surface of our planet. Urban impervious surfaces –, such as buildings, roads, and squares – are changing the original natural ecosystems and hydrological characteristics. This factor reduces infiltration and increases surface flow – in some cases the peak flow of surface runoff could rise by 1.5 to 6 times when the watershed becomes urbanized (YongJiang, et al, 2018). Thus cities' ability to absorb precipitation is reduced. As a result, during rainy months, large cities are often burdened with the problem of stormwater treatment. Therefore, improper storm management in cities leads to waterlogging, flood formation, urban water scarcity, soil erosion, rain water waste, and water body pollution (Hamidi, et al, 2021). In recent years, the Sponge City concept, an urban planning concept, has been implemented worldwide to address the problem of pluvial flooding caused by extreme rainfall. The sponge city concept addresses stormwater management through increased infiltration, detention, storage, treatment and drainages (Hamidi, et al, 2021) . Therefore, sponge cities can be implemented to mitigate pluvial flooding and benefit cities in both social and ecological ways, increasing the cities' resilience and positively influencing the well-being of people.

Sponge city concept can reduce the risk of flooding. Through the construction of green infrastructures, such as green rooftops, artificial water bodies, green parks, and permeable pavement, cities absorb precipitation rather than letting it travel to the surface in the form of runoff. Green rooftops, one of the most familiar concepts of green infrastructure, is capable of retaining and utilizing rainwater that falls on the tops of buildings (YongJiang, et al, 2018). Artificial water bodies such as man-made ponds and reservoirs (Japan has underground reservoirs to help control flooding) serve as containers for excess precipitation. Permeable pavements, roads built of porous turf, permeable clay, and porous asphalt, or designed into a unique structure as that of interlocking concrete pavement, enhance infiltration, reducing the amount of water on surface (Scholz, et al, 2007). Government may establish policies to upgrade drainage systems and build parks. All these elements of sponge city can contribute to the ability of cities to absorb and retain water, mitigating flooding.

Through the construction of sponge cities, pollution of urban water bodies can be reduced. Runoffs that come in contact with drainage surfaces such as roads and impermeable paved surfaces, building materials and structure surfaces, and green areas may all carry pollutants like litter, toxic chemicals, or feces (Müller, et al, 2020). Eventually, polluted runoff will either enter the sewer or flow directly into urban waterways. However, with the help of sponge city construction, runoff can be largely reduced . Upgraded drainage system can collect and direct the polluted water into water treatment plants. In this way, pollution of urban waterways can be alleviated and polluted water can be collected and purified (Scholz, et al, 2007).

Beside the benefits mentioned above, sponge city can also provide opportunities for people to efficiently utilize rainwater to enhance the well-being of people. One of the most important benefits of sponge city is related to the utilization of rainwater. According to news reports, some cities in China managed to retain and reuse 70% of rainwater (Biswas, et al., 2017). These rainwater can be later used to irrigate plants or purified for other purposes. This is a solution to water shortage. For example, in some southern Chinese provinces, the supply of freshwater per capita is still limited although it does not lack rainfall and surface water. This is due to uneven distribution of water, pollution, and dense population. Furthermore, green parks and rooftop gardens, components of the sponge city, creates recreational opportunities for residents, allowing them to enjoy the physical and psychological

benefits brought by nature. Perhaps the concept of biophilic cities (Beatley 2011) can be combined with sponge cities to create a place where we can call an “ideal green city”.

Although sponge cities can bring a lot of ecological and social benefits, there could also be concerns. First is that the city itself, along with its parks and other biological components are actually consumers of water, competing with people for water resources (Köster, 2021). Second, global climate change leads to more extreme weather and drought may occur (Köster, 2021). This casts doubt on whether the city’s ability to retain and store water is sufficient enough to cope with the effect of drought. If it fails, then the city will lose its functions. However, there are still great potentials for technology and policy developments to address these concerns. In addition, there is no future city without a clear and distinct reference to water. Especially with regard to climate extremes, climate change can certainly be defined as a “water issue”: either there is too much or too little water in the city. Urban water services actually should be improved under climate change conditions and should not undergo a deterioration, as it is often predicted (Köster, 2021).

The Sponge City concept is one possible solution to address the problem of flooding in urban areas, not mentioning the social and ecological benefit it brings. With the help of government policies and technologies, it should hopefully achieve its designated effect of mitigating pluvial flooding in large cities and enhancing the well-being of people in cities.

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# Urban water pollution

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Water is a precious and increasingly scarce resource. It is critical for ecosystem functions (as both habitat and resource) and equally essential for humans (Milà i Canals, 2018). Although a large amount of the earth's surface is covered by water, approximately 70% (Oki, 2006) of it is covered with salty water, which cannot be drunk or used without being treated. There is very little water that can be directly used for production and domestic purposes. Accessible freshwater resources are rivers, lakes, and groundwater, accounting for about 0.28% (Oki, 2006) of the earth's total water storage. Global water shortage and imbalanced regional distribution have become a rising concern. With the rapid expansion of population, it is estimated that water shortage will affect 3 billion people in the world and 40 countries and regions (Oki, 2006). Therefore, dealing with the issues of water pollution, especially in urban areas, is crucial. In order to address the problem of urban water pollution in my hometown, it is important for the government to upgrade technology, strengthen supervision, and ensure public education.

Firstly, upgrading technology to deal with urban water pollution is essential. In the city where I live, some sewage treatment plants often have the issue of low treatment efficiency, which leads to the sewage often flowing into the river on rainy days, causing the river to be dirty and smelly, affecting the lives of nearby citizens. An intuitive solution is to improve the technology of sewage treatment plants to treat sewage more effectively. For example, the sewage treatment plant can use the activated sludge method to separate and precipitate the pollutants in the sewage through microbial metabolism, and finally discharge them in the form of sludge. On the other hand, the issue can also be addressed by promoting the automation of water resources monitoring. The government can provide automatic monitoring equipment for river water data in each sewage treatment plant, so as to realize the full-automatic water quality monitoring process updated every four hours. In this way, the government can respond to the pollution in time and send more people to solve the pollution problem accurately.

Secondly, for the government, it is necessary to strengthen the supervision of both individual businesses and large enterprises to make sure that they do not illegally discharge sewage into the rivers. People often think about their own interests. For some businesses and enterprises, secretly discharging sewage can help them save a lot of money. They therefore prefer to sacrifice the environment to reduce spending. To prevent such a situation from happening, the government should not only improve its own ability on supervision, but also encourage more citizens to participate in it. The discharge of urban domestic sewage needs daily supervision and management, and the government is sometimes short of manpower, which will lead to the problem that the supervision of sewage discharge of many businesses is not in place. However, if the government can apply water quality monitoring automation and the use of mobile apps to achieve convenient management, it can effectively improve efficiency, greatly improving the ability of pollution investigation and reducing the pressure of the government. At the same time, many citizens have a strong sense of responsibility and are concerned about the issues of water pollution. By disclosing the specific information of river regulation, the government can increase the participation of the public, which can not only help the government relieve the pressure, but also sometimes help to find the problems that the government did not realize before.

Thirdly, and maybe most importantly, the government should ensure public education on water protection. For all sorts of environmental problems, education is the most common solution

(Heberlein, 2012). In order to enhance public awareness, the government should carefully consider the role of education. The government can carry out education from different aspects. It can show the impact of water pollution on the daily life of residents through examples. It can also teach the public how to report the issues, such as calling the government hotline, leaving messages on the website and so on. Understanding these can increase the enthusiasm of the citizens to participate in the supervision and management, and public opinions can also help the government supervise the illegal discharge of sewage. In addition, increasing the scope of education can also enhance public awareness. The education can not only take place in schools but also in places with large flow, such as offices, traffic stations, various communities, and so on. Only when education is everywhere in people's daily lives, can the concept of water protection be infiltrated into the lives of residents to the greatest extent. Moreover, the government can adjust the form of education appropriately. Nowadays, most people like to participate in educational activities by themselves. Therefore, the government can carry out more activities such as river patrolling and visiting sewage treatment plants, so that people can clearly feel the most real situation, and have the will and confidence of self-discipline and heteronomy. At the same time, the preference of different age groups will be different. The government can carry out different ways of education according to different groups, for example, using comics to teach younger kids, to receive the best results.

To sum up, when solving the issue of urban water pollution, the government should consider the three aspects: technology, supervision, and education. Xi Jinping, the General Secretary of the Chinese Communist Party, once said: "We prefer green water and green hills to golden hills and silver mountains, and green water and green mountains are mountains of golden hills and silver mountains" (Zhou, 2017). Today, with the rapid development of society and the increasingly advanced modern science and technology, we should always think about the harmonious coexistence between human and environment, promote the sustainable development of the economy and ensure the far-reaching interests of the world.

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# Providing equal & sustainable access to cars

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Waves devouring coastlines, smog clogging our lungs and dizzying brains, forest fires destroying wildlife habitat; insecure, loneliness, climbing desire and material lacking... Massive climate change disasters are accusing careless human activities causing them, and the hopeful urbanization is depicting cities of separation and inequality. One promising solution is sharing economy: a habit by which villagers increase property usage and enhance community dynamics. Analogously, Person-to-Person (P2P) car sharing helps car owners to rent their cars to others. City governments should set educational and engineering programs to reintroduce P2P car sharing in cities, in order to reduce pollution, enhance community coherence, and save time and money.

P2P car sharing can be designed to largely reduce carbon emission. In Lesmes, Germany, successful car-sharing has saved the city 1,600 tons CO<sub>2</sub> a year. P2P car sharing changes people's decisions by influencing social norms. Study shows car sharing in Switzerland reduced on average 44% mileage and 22% environmental influence. In fact, eco-economic efficiency can rise 2.34-2.92 times after sharing (Xia et al., 2006). Car owners tend to remain cars free for load, which profits them and provides them a fulfillment. Economically, having shared cars, less renters will buy cars, which reduces car ownership and stimulates renters to walk short distances instead of waiting for shared cars. Alleviating traffic jams cuts off the unneeded commute time and prevents drivers from closing and opening the engine during the jam, both of which reduce carbon dioxide. Hence there will be less car carbon emissions. In fact, every sharing action instead of car payment reduces 0.84 tons car emissions annually (Martin et al. 2011). Targeting 47% carbon reduction in European cities (Fyson et al., 2020) and assuming twice the former's responsibilities in major emitter countries, (Salvia et al., 2021), the whole globe is far behind this Paris Agreement proposal (2015). While public transportation and electric vehicles (EVs) are broadly encouraged, their max influences are still not enough (Ferrero et al., 2016). In such occasions, P2P car sharing becomes significant.

Car sharing also enhances the sense of community within modern cities, and increases energy efficiency through it. Nowadays, busy citizens are losing interest in community socialisation. As a side effect, people aren't fond of sharing resources like they did in suburbs (Cheng et al., 2021). However, the P2P car sharing encourages people to drive in the presence of other people. Sometimes, people who rent a car share the trip with others in the same destination. Those who can't drive would ask no-car drivers in their workplace who live near them for a ride, and on the way home, community members again have the chance to sit together. P2P sharing also makes car trips effective. Only 10% of time is a private car used now. Take example of Beijing, that percentage equals 100 billion yuan of car resources wasted each year, while more than 20 million people are still unable to meet their car demand (Li et al., 2021). P2P car sharing stimulates people to fully utilize the private properties by renting them at rest, which improves the energy utility.

Once systematized, the car sharing economy can save one's time and money. Systems shall include location Based Services, license verification and feasible parking and maintenance rules under proper supervision, in the form of app. The app can also create economic incentives for EVs, which further in the The direct contact between two ends can lower 30%-50% rental price than other contacts like Business-to-Customer (B2C), mainly from reduced demands for media such as professional drivers or storing/purchasing procedures (Xia et al., 2006). The car sharing helps save the time of the customers, too. All public transportation systems have been somewhat complained about. Cities, especially the old ones, sprawling toward the vicinity, have to extend as population rises,

so new and old mix, and more conjunctions appear in where more cars emerge. Since cars have no schedule, nor routine, car sharing has better automobility than buses. As shared cars can be rented in groups, poolers spend less on them than taxis, which increases its accessibility to the poorer (Tesla, 2020). It also updates easier than that of the railway or bus routine, as the update of later requires the change in roads, etc. Considering taxis and B2C car sharing get inadequate drivers, P2P car sharing is a promising solution to promote public welfare and to perfect transportation systems.

However, people may not be happy to share their cars with others, and safety issues can hold one back too. The P2P car sharing requires car owners to hand over the cars to strangers. What if the car is stolen, or damaged? Understandably drivers who don't own the car will be more careless about scratching while driving, try to park at the easiest place to park, etc. even unconsciously. But this can be solved by education and laws that increase credibility between people, shown in the education systems of countries like Finland and the USA. Stronger concern is from the owner who has deep attachment to their cars. However, both problems have a precursor: house sharing. For instance, Airbnb and laws make a good team. The P2P house sharing app Airbnb has 150 million customers and 4 million hosts, closely related to regulations that credifies the app (Airbnb Statistics 2020). Professional teams gain customer's confidence, but still costs less in total than sophisticated B2C norms.

Cities and citizens had just got to know each other, looking for better ways to interact. Remembering some traditional core values, such as the sharing economy, always fixes it. As we focus on EVs and technology, some buffers are useful. So we need car sharing as a societal way to mitigate carbon emission. To create a green city, on the other hand, we need the essence of people (Lynch 1960), and car sharing supports the atmosphere of humanity in the communities, right to take care of that. Although people may feel less comfortable at first due to cultural or historical reasons, and that critics will alert on security, there's every reason to believe in the possibilities of P2P car sharing.

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# Restaurants food packaging

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We all have taken food from restaurants, perhaps a bowl of noodles or some hamburgers. However, we rarely recognize the complimentary packaging products that come with ordering and takeaways: plastic bowls, chopsticks, toothpicks, tissues, plastic bags, order slips, and more. Companies often overpackage food to protect them, but packaging generates significant environmental concerns for the sheer size of the wastes. According to the US Environmental Protection Agency (EPA, 2021), containers and packaging materials account for 29.9% of municipal solid waste each year, which is equivalent to 80.1 million tons. To reduce food packaging wastes from urban restaurants, the government should establish policies that eliminate the use of plastics nationwide, implement creative plans to reuse, reduce, and recycle wastes, and educate people to become more responsible.

In order to reduce packaging waste in cities, the nation must first limit or ban plastics - the most threatening packaging waste material. This must be done on a national level because city governments simply cannot control the influx of plastics. In a 2018 report called *Single-use Plastics: A Roadmap for Sustainability*, the United Nations classified policy tools to reduce plastic consumption as either regulatory instruments, economic instruments, or a combination of both (United Nations, 2018). Regulatory instruments function at the top of the supply chain where the government bans the production of plastic. Several nations have already implemented policies like this. For example, since 2004, the government of Luxembourg has replaced the country's single-use plastic bag with the Öko-Tut, an eco-sac reusable bag. The use of the Öko-Tut bags resulted in an 85% drop in plastic consumption in the first nine years of the initiative. This has cut down on the use of 1.1 billion single-use plastic bags, dramatically decreasing the impact of plastic wastes. Meanwhile, countries like Jamaica and Bangladesh banned plastic bags from consumption, and restaurants have since switched to reusable bags, biodegradable paper straws, and cardboard boxes (Pritchett, 2020). To reinforce this, governments should also utilize economic instruments to levy taxes on restaurants that purchase plastic. In the UK, the Chancellor announced that a plastic packaging tax will come into force in April 2022. The policy will tax £200 per ton of material for businesses whose products and packaging have less than 30 percent recyclable material. The UK government also implemented a tax that applies to plastic packaging produced in, or imported into the UK that contains less than 30% recycled plastic (Ville, 2020). By doing so, the UK is discouraging plastic use nationwide and slowly transforming into a plastic-less society. In its most effective form, a country uses both instruments to minimize plastic packaging waste, just like the UK.

In a Chinese study of a random sample of 1000 individuals who purchased food delivery service, 66% received single-use plastic boxes for their food; 21% received foam containers; 12% received degradable lunch boxes, and only 1% received completely paper-made containers (1421 Consulting Group, 2017). It becomes blatant that restaurants should reduce, reuse, and recycle the food packages. For smaller restaurants without significant funding, policies on decreasing the intensity of packaging by eliminating double wrapping and double bagging can be useful. There should also be policies for the restaurants to ask customers the number of spoons and chopsticks needed, making sure they are not wasted. Governments should tax restaurants for not following food purchasing policies. These might include a "just in time" purchasing system where restaurants only order what is needed when it is needed, ensuring minimal food spoilage and waste, which in turn reduces the

amount of food packaging wastes from both deliveries and takeaways. Larger restaurants should develop creative programs that encourage reusing the packages. For example, when purchasing for delivery services, consumers have to pay a few extra dollars to the online platform as deposits. After people finish their food, they need to return the packages to a self-service recycling machine to retrieve their money. Essentially, the system allows consumers to rent for but not buy the food packages while also providing the restaurant a reason to not purchase more packaging materials. In the end, it encouraged the consumer to have healthy and good consumption habits and garbage recycling awareness, too.

Government policies should also educate citizens to make smart and green decisions regarding food packages. These start with students. Schools should educate students about waste management, for instance identifying types of packaging wastes: glass, steel, plastic (EPA, 2021). The city of Newcastle has such educational programs that include topics on recycling, reducing food consumption, and landfills. Facts like “In Newcastle, around 30% of our red lid general waste bin is food waste” and “We throw away an average of 2.6kg of food waste per household per week” can encourage students to take small actions to minimize food and packaging waste, such as reusing their food packages as a temporary shopping bags or refusing to order food when meals are available (City of Newcastle, n.d.). Governments should also target the general public for reducing consumption. During quarantine, our city had daily TV programs that discussed quarantine-related issues, one of which being food ordering. Due to our limited outdoor activities, many families switched from conventional food shopping to food deliveries. In 2020, 7.6 billion orders for food delivery were made here in China, totaling 52 billion USD in sales. More than 100 million plastic containers are used every day just for food delivery (Big Data Research, 2021). The TV program designed by the government encouraged individuals to order from one restaurant instead of many. This is a minor yet effective way to reduce packaging wastes as two ordering from two places will essentially double the amount of wastes.

Food packaging has lots of benefits: slowing product deterioration, extending shelf-life, and, most importantly, increasing the quality of food. Thus, it is important to have them around. By replacing, reducing, recycling and educating, we can minimize delivery packages’ ecological footprint effectively, if and only if the society works together, top to bottom.

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# Solution to the recovery of ozone layer

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In recent years, human communities have been exposed to many kinds of environmental issues, and they impact people's lives in different ways, including people's physical health as well as the health of communities. Ozone depletion has been a problem that scientists have been concerned about for decades. Since the discovery of the ozone hole over Antarctica in 1985, people started to be aware that this might be a serious problem if they don't take any action on it. In 1985, Montreal protocol decided to forbid many of the chemicals that will deplete ozone layer, and I think they are on the right track, but there is more that we could do (U.S. Department of State, 2021).

The ozone layer is found in the lower part of the stratosphere, about 15-30 kilometers above the earth's surface (Environmental Protection Agency, 2018). It acts as a protective barrier that prevents ultraviolet radiation from entering the atmosphere. Unprotected exposure to this radiation can cause serious injuries and permanent illness, such as genetic mutations, skin cancer and eye damage. However, anthropogenic pollution has weakened the ozone layer, resulting in an ozone hole, which could set life on earth in danger (National Geographic Society, 2012).

Currently the biggest threat to the ozone layer is refrigerants. Various appliances, including air conditioners and refrigerators, produce vast amounts of chlorofluorocarbons (CFCs), and the chlorine atoms in these CFCs come off in the atmosphere to form chlorine ions. These negatively charged ions are unstable, therefore they break the oxygen in ozone molecules and combine with the oxygen ions. After this process is done innumerable times, the ozone molecules decrease and lots of them are broken into oxygen that we breathe (Union of Concerned Scientists, 2008).

Humans have already started to protect the ozone layer four years after the hole was discovered. In 1989, the Montreal Protocol had prohibited the use and production of many ozone-depleting substances, by then the amount of chlorine ions in the atmosphere was drastically reduced (NASA, 2018). However, this is only the first step, and we can definitely take steps further, solving the problem more thoroughly. For example, turn off the air conditioners during summers. They not only use up a lot of electric power, but also transfer viruses from the atmosphere to people's rooms, making them more vulnerable to bacteria and easy to get diseases (Amira Hassan, 2019). In addition, there are currently two alternatives to chlorofluorocarbons, hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs). On one hand HCFCs have chlorine atoms in their composition, so they have the potential to damage the ozone layer, but the extent is much less compared to CFCs. HFCs on the other hand, do not contain chlorine atoms, therefore it seems to be the best environmentally friendly refrigerant on the market, and in recent years the popularity of HFCs has grown dramatically. However, nothing is really perfect, as overusing HFCs could aggravate the effect of global warming (U.S. National Library of Medicine, 1996). Consequently, I think that people alternate the use of refrigerants back and forth, which could significantly reduce the extent of the issue while raising no extra environmental issue.

In summary, the ozone layer is depleting due to the overuse of CFCs in the refrigerants. When these chemicals decompose in the earth's atmosphere, they turn into ozone-damaging substances. Thus, by reducing the use of refrigerants, the ozone could recover naturally, when oxygen molecules interact with UV-light.

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