Remediating Greenhouse Gas Emissions through Urban Greenspaces

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Executive Summary

With metropolitan areas driving emissions trends (Wang et al., 2021), investing in city ecosystems is essential in combating greenhouse gas emissions and their effects on human well-being. Urban greenspaces provide a wide range of ecosystem services that effectively remediate the impacts of climate change. To maximize the benefits of metropolitan ecosystems, city planners should tailor greenspace design to native species in their area, incorporate many plant types into their greenspace, and avoid high-carbon construction materials in parks.

A recent report from the EPA reveals that although greenhouse gas emissions in the U.S. fell in 2020, **carbon dioxide concentrations in the atmosphere remain 49% higher than their pre-industrial levels** (EPA, 2022). These emissions increase global temperature and play a key role in climate change. On the local level, they pose a significant threat to human health through their contribution to air pollution. Air pollutants, including greenhouse gasses, are linked to increased prevalence of chronic obstructive pulmonary disease, asthma, respiratory infection, and stroke (WHO, 2021). In 2016, outdoor air pollution was estimated to cause over 4 million premature deaths worldwide (WHO, 2021). Greenhouse gas emissions are not only a health crisis for our planet, but a health crisis for our people.

To address this emergency, city planners must direct resources to urban greenspaces, a long-term investment that will reap sizable returns. In New York City, it is estimated that **every dollar spent on tree planting and maintenance produces $5.60 in benefits, such as improved air quality and energy savings** (Peper et al., 2007). These benefits also include carbon sequestration, a process in which plants capture atmospheric CO2 through photosynthesis and store it in their bodies. While a young tree sapling today can sequester around one pound of carbon each year, in adulthood, that same tree can capture over 100 pounds of carbon annually, which equates to the carbon emissions from driving a car almost 150 miles (Groth et al., 2008; *Greenhouse Gas Equivalencies Calculator*, 2022). **Compared to the time of planting, carbon uptake increases 50-fold after 20 years** and 108-fold after 30 years for the average city tree (Park & Jo, 2021). Considering these long-term gains, it is imperative to invest in carefully planned urban greenspaces now, priming city landscapes to efficiently store carbon in the long-run.

To maximize the positive impact of their investment, city planners should strategize carefully, promoting many ecosystem services while minimizing the greenhouse gas emissions from the park itself.

Work with what you've got.

First and foremost, it's important to assimilate native ecosystems into the process of landscape design (Chon et al., 2014). Removing existing trees to plant new species, even those with more carbon uptake potential, requires machinery that burns fossil fuels and releases greenhouse gasses (Park & Jo, 2021). **Prioritize preserving existing plants**, and when adding to your greenspace, consider cultivating native plants rather than transplanting foreign species. In addition to improving the chances of survival, choosing local species reduces the greenhouse gas emissions from transporting saplings and supports native fauna (Park & Jo, 2021; Kendall & McPherson, 2012).

Think big, think evergreen

Researchers have found that evergreen trees have high average carbon sequestration rates compared to other species and retain that carbon through seasonal changes (Wang et al., 2021). In addition to mitigating a wide range of air pollutants, evergreens have low maintenance costs and provide optimal locations for birds to nest and forage (Wang et al., 2021).

Take a multi-layer approach.

Rather than designing urban greenspaces that separate plant types, consider densely planting many species, preferably those that are fast-growing and hardy in size (Jo, Kim, & Park, 2019). Species diversity will make your greenspace more productive and resilient to environmental changes. Research also shows that **multi-layered areas that overlap trees, shrubs, and herbs** demonstrate carbon uptake that is 60-times higher than that of single-layered planting areas (Park & Jo, 2021).

Grass isn't greener

Because grass requires frequent maintenance, it emits 2.7 times more carbon than it sequesters (Park & Jo, 2021). Prioritize plants with high carbon sequestration potential over new sod.

Opt for low-carbon building materials in your park.

As well as carefully selecting the plants in your greenspace, it is essential to consider the carbon footprint of your construction materials. For example, brick and concrete production emits 24 times more carbon than other materials (Park & Jo, 2021). **Choosing stones, soil, and biomass** will reduce your project's carbon footprint and may have other benefits like improved water percolation.

Chip away at your carbon footprint

If you're incorporating wood chips into your landscaping, consider using local felled wood to decrease the carbon emissions from processing and transportation (Park & Jo, 2021).

To fully address greenhouse gasses in city centers, collaborations between governmental departments, corporations, and other leaders in innovation are essential (Zhao & Sander, 2015). However, metropolitan ecosystems are central to these efforts because of the multitude of services they efficiently and cost-effectively provide. The course of action for urban planners is clear: expand urban greenspaces.

References

Chon, J., Eui Choi, Y., Jin You, S., Ji Lee, H., & Sun Seok, Y. (2014). Exploring low-carbon landscape design: Focus on an urban waterfront area. *WIT Press*. http://dx.doi.org/10.2495/EID140341

Greenhouse Gas Equivalencies Calculator. Environmental Protection Agency. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Groth, P., Miller, R., Nadkarni, N., Riley, M., & Shoup, L. (2008). *Quantifying the Greenhouse Gas Benefits of Urban Parks*. The Trust for Public Land. http://cloud.tpl.org/pubs/benefits_greenhouse_gases_and_parks_whitepaper.pdf

Jo, H.-K., Kim, J.-Y., & Park, H.-M. (2019). Carbon reduction and planning strategies for urban parks in Seoul. *Urban Forestry & Urban Greening, 41*, 48-54. https://doi.org/10.1016/j.ufug.2019.03.009

Kendall, A., & McPherson, E. G. (2012). A life cycle greenhouse gas inventory of a tree production system. *Int J Life Cycle Assess, 17*, 444–452 . https://doi.org/10.1007/s11367-011-0339-x

Park, H. M., & Jo, H. K. (2021). Ecological Design and Construction Strategies through Life Cycle Assessment of Carbon Budget for Urban Parks in Korea. *Forests, 12*, 1399. https://doi.org/10.3390/ f12101399

Peper, P. J., McPherson, E. G., Simpson, J. R., Gardner, S. L., Vargas, K. E., & Xiao, Q. (2007). *New York City, New York Municipal Forest Resource Analysis*. Center for Urban Forest Research, USDA Forest Service. https://www.milliontreesnyc.org/downloads/pdf/nyc_mfra.pdf

United States Environmental Protection Agency. (2022). *U.S. Inventory of Greenhouse Gas Emissions and Sinks: 1990-2020* [draft]. https://www.epa.gov/system/files/documents/2022-02/us-ghg-inventory-2022-main-text.pdf

Wang, W., Chang, Q., & Li, X. (2021). Promoting sustainable carbon sequestration of plants in urban greenspace by planting design: A case study in parks of Beijing. *Urban Forestry & Urban Greening, 64,* 127291. https://doi.org/10.1016/j.ufug.2021.127291

World Health Organization. (2021, September 22). *Ambient (outdoor) air pollution*. https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

Zhao, C., & Sander, H. A. (2015). Quantifying and mapping the supply of and demand for carbon storage and sequestration service from urban trees. *PLoS One, 10*(8). http://dx.doi.org/10.1371/journal.pone.0136392