# How Green Can We Grow?

Simulating NYC's Journey to 30% Tree Canopy Cover by 2035

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## Abstract

Urban tree canopy provides critical ecological, social, and economic benefits. This study simulates the efforts required for New York City (NYC) to achieve its canopy cover target of 30% by 2035, as outlined in the NYC Urban Forest Agenda. Using data from the 2017 LiDAR survey, species-specific growth models, and urban spatial constraints, the model estimates yearly sapling planting requirements to reach the target under varying growth and spatial scenarios. Results underscore the potential for strategic planting policies to meaningfully accelerate urban climate resilience through natural infrastructure.

## 1. Introduction

Urban forests serve as natural air filters, mitigate urban heat islands, enhance biodiversity, and contribute significantly to public health and quality of life. Trees sequester carbon, reduce energy use by providing cooling shade, and increase property values. In NYC, a 2017 LiDAR analysis revealed a tree canopy cover of 22.08%. To enhance urban resilience and livability, the "Forest for All NYC" coalition has targeted a 30% canopy coverage goal by 2035. While this initiative aligns with global trends in urban greening, achieving this target in NYC's spatially constrained environment requires a deep understanding of species dynamics, planting space limitations, and ecological growth patterns. Moreover, integrating simulations into urban planning enables evidence-based decisions for tree planting policies that maximize both coverage and ecosystem services.

## 2. Literature Review

Recent studies emphasize the interplay between urban canopy coverage and regional climate outcomes. For instance, Civerolo et al. (2022) demonstrated that increased urbanization in NYC significantly affects surface temperatures and air quality, linking vegetation loss with elevated ozone concentrations and boundary layer dynamics. These findings highlight the urgent need to counterbalance urban expansion with greening efforts. Complementary studies also explore simulation-driven strategies for urban forest expansion, particularly focusing on optimizing tree selection based on growth rates and environmental fit. These insights support the design of models like ours that simulate tree growth under species-specific and spatial constraints, reinforcing the feasibility of setting aggressive canopy targets through well-informed, location-sensitive afforestation.

## 3. Methodology

Our simulation consists of six iterative stages. Starting from the 2017 canopy baseline of 22.08%, it establishes a cap on the maximum number of trees that can be supported, reflecting NYC's limited planting space. Each simulated year, a predefined number of saplings is introduced, randomly selected from the five most common NYC species: Pin Oak, London Planetree, Honey Locust, Callery Pear, and Littleleaf Linden. These are chosen according to their documented urban prevalence. Species are modeled with age-diameter growth curves, using logarithmic interpolation based on real-world data. Growth is computed yearly, with canopy expansion calculated from species-specific diameters. The simulation ends when 30% canopy is achieved or the year reaches 2035. This modeling structure allows planners to adjust parameters like annual planting rates or maximum tree capacity and evaluate the outcome.

## 4. Tree Growth Modeling

Each species is encapsulated in a class object containing growth stages, maximum diameter, and maximum age. The canopy area is calculated from interpolated diameter assuming circular geometry (πr²), with diameter increasing annually based on species-specific interpolation curves. For example, the London Planetree reaches 70 feet in diameter by age 40, while the Callery Pear, though faster-growing, maxes out at smaller dimensions and a shorter lifespan. Growth curves are capped at biological maximums to prevent unrealistic simulation outcomes. These growth models are derived from empirical forestry data and refined to reflect conditions documented by NYC Parks Department and urban forestry guidelines.

## 5. Spatial Constraints and Planting Logic

Urban space in NYC is heavily constrained, leading the model to impose a `max\_trees` cap to simulate realistic afforestation ceilings. Each sapling added is counted against this cap. Planting ceases when the cap is reached. Additionally, planting occurs only if the simulated year is below 2035, reinforcing the temporal boundary of the study. This approach mimics real-world limitations like zoning, infrastructure competition, and land use planning constraints. Moreover, it allows testing of multiple policy interventions—e.g., zoning reform or vertical greening—that could potentially raise this cap.

## 6. Results and Interpretation

Simulations reveal that planting 350,000–400,000 trees annually from 2024 onward makes the 30% target feasible, provided urban planning supports optimal spacing and low mortality. Earlier and more aggressive planting schedules yield better outcomes due to compound growth effects. The fastest-growing species—like London Planetree and Honey Locust—contribute disproportionately to early canopy gains. Simulations also reveal diminishing returns as the canopy approaches its spatial limits. Incorporating real-world species behavior into simulations provides a realistic trajectory toward policy targets, empowering urban decision-makers to prioritize certain species and areas.

## 7. Discussion and Limitations

Although robust, the model abstracts many complex variables. It assumes no tree mortality or disease, uniform growing conditions, and simplified spatial distribution. These factors, along with unpredictable socio-political dynamics, may alter actual outcomes. Further research incorporating geospatial planting maps, heat-island mitigation models, and socio-economic overlays could offer a more detailed view. Despite these simplifications, the model provides a valuable scenario-planning tool for guiding urban greening initiatives and understanding how combinations of biological and infrastructural variables interact over time.

## 8. Conclusion

Achieving 30% canopy cover in NYC by 2035 is ambitious yet attainable. Strategic early planting, thoughtful species selection, and targeted policy reform can substantially close the canopy gap. The simulation framework presented here can serve as a decision-support system, enabling planners and policymakers to visualize outcomes, test strategies, and make evidence-based interventions. Urban forestry, especially in dense metropolitan areas, benefits greatly from such predictive tools that integrate ecological realities with spatial policy constraints.

## References

Forest for All NYC (2021). NYC Urban Forest Agenda.  
NYC Department of Parks and Recreation (2017). LiDAR Tree Canopy Analysis.  
Civerolo et al. (2022). Estimating the Effects of Increased Urbanization on Surface Meteorology and Ozone Concentrations in the New York City Metropolitan Region. Atmospheric Environment.