Improving Air Quality
Northeast US

This document is a collection of abstracts with citations compiled by Drexel University highlighting research around green roofs' ability to improve air quality in the Northeast United States. This is not a comprehensive literature review but is intended to be a first stop for a green roof researcher. These abstracts were compiled by Tenaya Hubbell-Wood and Korin Tangtrakul, under direction of Dr. Franco Montalto of Drexel University. Contact Korin for more information: krt73@drexel.edu

This document will be updated periodically to include the latest research. It was last updated in February 2020.

Scaling of Economic Benefits from Green Roof Implementation in Washington, DC

Niu, Hao; Clark, Corrie; Zhou, Jiti; and Adriaens, Peter. (2010). Scaling of Economic Benefits from Green Roof Implementation in Washington, DC. Journal of Environmental Science & Technology. Vol 44. Issue 11. 4302-4308. DOI: 10.1021/es902456x.

Green roof technology is recognized for mitigating stormwater runoff and energy consumption. Methods to overcome the cost gap between green roofs and conventional roofs were recently quantified by incorporating air quality benefits. This study investigates the impact of scaling on these benefits at the city-wide scale using Washington, DC as a test bed because of the proposed targets in the 20-20-20 vision (20 million ft(2) by 2020) articulated by Casey Trees, a nonprofit organization. Building-specific stormwater benefits were analyzed assuming two proposed policy scenarios for stormwater fees ranging from 35 to 50% reduction for green roof implementation. Heat flux calculations were used to estimate building-specific energy savings for commercial buildings. To assess benefits at the city scale, stormwater infrastructure savings were based on operational savings and size reduction due to reduced stormwater volume generation. Scaled energy infrastructure benefits were calculated using two size reductions methods for air conditioners. Avoided carbon dioxide, nitrogen oxide (NO(x)), and sulfur dioxide emissions were based on reductions in electricity and natural gas consumption. Lastly, experimental and fugacity-based estimates were used to quantify the NO(x) uptake by green roofs, which was translated to health benefits using U.S. Environmental Protection Agency models. The results of the net present value (NPV) analysis showed that stormwater infrastructure benefits totaled $1.04 million (M), while fee-based stormwater benefits were $0.22-0.32 M/y. Energy savings were $0.87 M/y, while air conditioner resizing benefits were estimated at $0.02 to $0.04 M/y and avoided emissions benefits (based on current emission trading values) were $0.09 M-0.41 M/y. Over the lifetime of the green roof (40 years), the NPV is about 30-40% less than that of conventional roofs (not including green roof maintenance costs). These considerable benefits, in concert with current and emerging policy frameworks, may facilitate future adoption of this technology.

The heavy metal budget of an urban rooftop farm

Harada, Yoshiki; Whitlow, Thomas H; Russell-Anelli, Jonathan; Walter, M Todd; Bassuk, Nina L; Rutzke, Michael A (2019). The heavy metal budget of an urban rooftop farm. The Science of the total environment, ISSN: 1879-1026, Vol: 660, Page: 115-125. DOI:10.1016/j.scitotenv.2018.12.463

Urban rooftop agriculture is a growing enterprise in the US with the goal of providing high quality, healthy, locally grown produce for city dwellers. However, air pollution abatement and the purification of stormwater are among the ecosystem services emphasized in studies of conventional green roofs. If rooftop farms actually capture pollutants, then accumulation of heavy metals in the soil could pose a problem over time. This study reports the heavy metal concentrations in soil, atmospheric deposition, and drainage output of 8 metals from the Brooklyn Grange Navy Yard Farm, rooftop vegetable farm in New York City, USA. Drainage of Pb and Mn were 6% and 14% of atmospheric bulk deposition, respectively, meaning that the Grange could be a net sink for Pb and Mn. Although there were small scale hotspots in the soil, farm-wide averages for heavy metal concentrations never exceeded guideline levels, and relatively low concentrations of Pb and Ba in the soil suggest that rooftop soils may be less vulnerable to contamination related to traffic and construction. In comparison to the growing seasons, we found relatively high concentrations of Pb and Cr in the soil during fallow periods when the soil was bare. To reduce the atmospheric deposition of heavy metals to soil, it is important to cover the soil with mulch, and discard the used mulch and unmarketable portion of vegetables, instead of recycling them via composting for soil amendments.