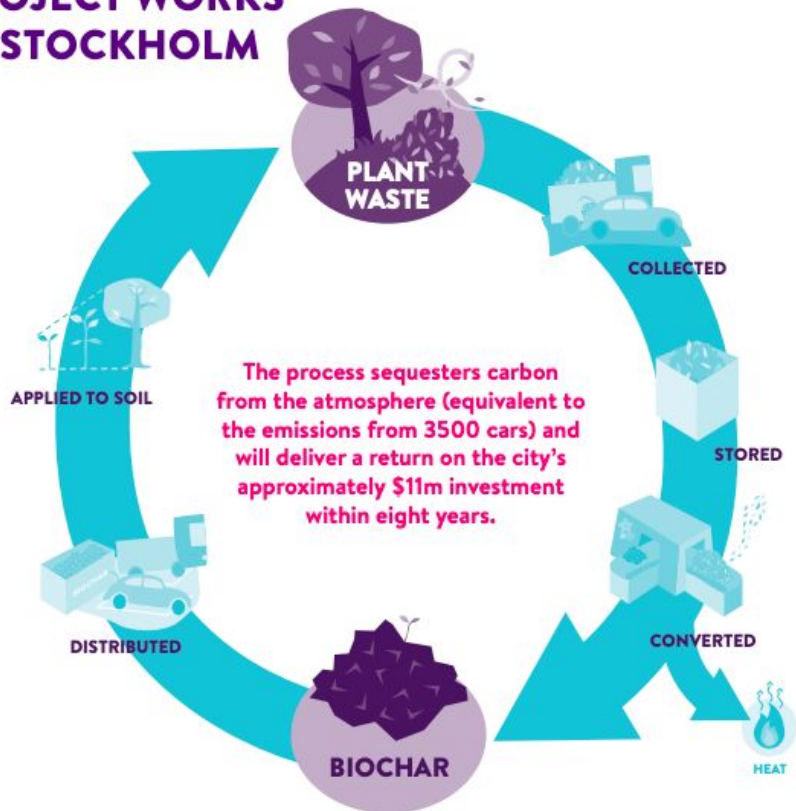


Developing Urban Biochar Systems

Stockholm Biochar Project

HOW THE PROJECT WORKS IN STOCKHOLM



COLLECTED

NO ADDITIONAL FINANCIAL OR CARBON COST

Both citizens and the city already deliver park and garden waste at a network of waste management centers across Stockholm.



STORED

NO ADDITIONAL FINANCIAL OR CARBON COST

These waste management centers already have plant waste storage facilities.



CONVERTED

HIGH ADDITIONAL FINANCIAL COST

The project requires an upfront capital investment, both to purchase the plant and prepare the site. Plant waste also needs to be chipped before it can be used in the plant.

NEW REVENUE

As well as turning plant waste into biochar, the carbonization process produces heat which is sold into the grid in order to heat local homes.



DISTRIBUTED

NO ADDITIONAL FINANCIAL OR CARBON COST

Citizens and city gardeners pick up biochar from waste management centers when they are dropping off their plant waste.

NEW REVENUE

Biochar is sold to the open market and to the city's traffic administration team (the department that manages the city's trees). It will be gifted to citizens.



APPLIED TO SOIL

NO ADDITIONAL FINANCIAL OR CARBON COST

City gardeners and citizens apply biochar to their parks and gardens in the course of their regular activity.

NEW CARBON SAVING

When planted with trees or plants biochar increases growth while sequestering carbon dioxide from the atmosphere.

Specific Uses of Biochar in Stockholm

- Tree cells in tight urban sites
- Tree planting in field/open soil conditions
- Amending planting beds
- Stormwater infiltration
- Urban gardens
- Giveaway to residents

Replicating the Stockholm Project Here

- Bloomberg Philanthropies was a supporter
- They want to see it replicated → RFP for city-wide biochar projects
- Cincinnati, Lincoln and Minneapolis selected among 10 cities in the world to participate
 - Technical assistance
 - Qualified to apply for matching financial support from Bloomberg
 - All 3 cities were successful in the financial award round

USBI Urban Biochar Task Force

- Cincinnati, Lincoln, and Minneapolis will be working together as a cohort to learn from one another and develop resources in common
- Leverage that effort as an opportunity to dovetail with the work of USBI and extend the network of learning, collaboration and implementation
- Build a coalition of cities working on common objectives

Goals and Activities

- Showcase models of urban biochar production
- Create partnerships for quantifying benefits and impact
- Develop focus areas to guide our efforts
- Develop best practices and fact sheets/usage guides for application
- Facilitate dialogue among cities
- Examine methods for creating urban-rural linkages for biochar creation and use in order to maximize carbon and soil health impacts regionally
- Raise awareness

Lincoln's Future Climate

The ways in which Nebraska's climate is expected to change are significant.



5 degrees

warmer than now

The mean average temperature in Lincoln is projected to increase from 52°F (1990 average) to 57°F (2050 average).¹⁰



44 days

annually with a heat index over 100°F

Lincoln will see a 340% increase in the number of days where the air temperature and relative humidity will yield a heat index over 100°F. Of those, 26 days will be even hotter – they'll have a heat index over 105°F.¹¹



10%-16%

winter and spring precipitation totals will increase

Winter and spring precipitation totals will be 10-16% higher than current conditions, while summer precipitation will decrease by 4%.¹²

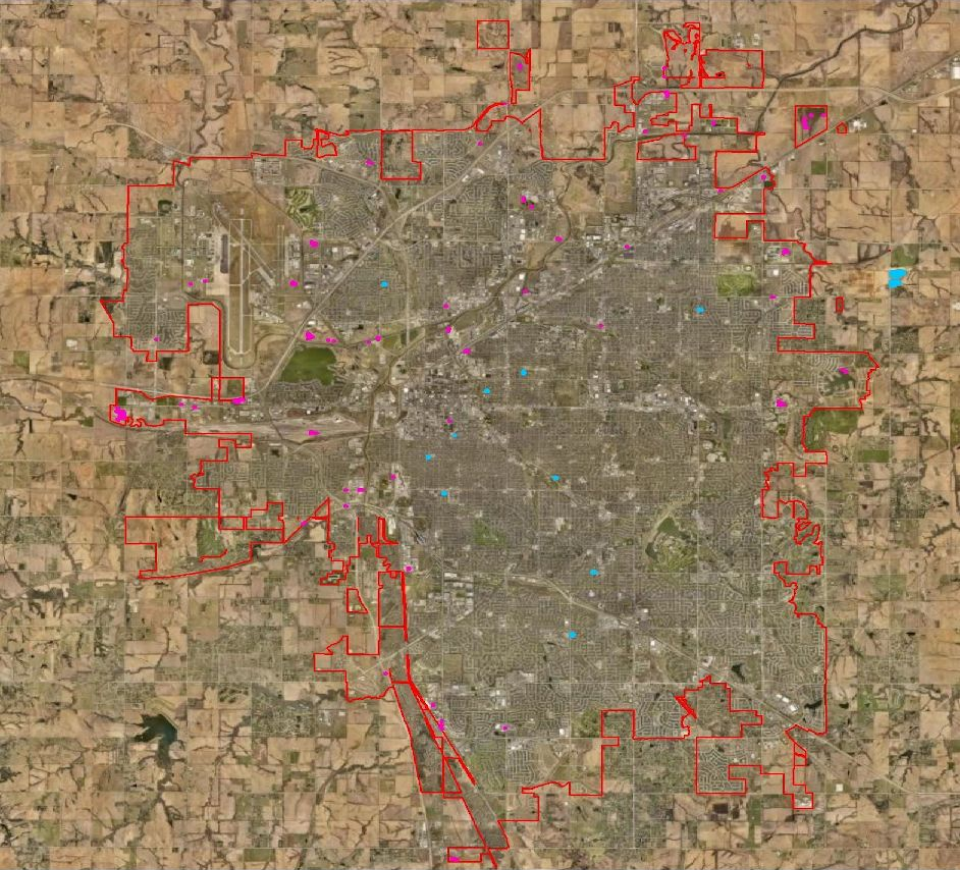


15% to 30%

increase in heavy precipitation days statewide


Heavy precipitation days in Nebraska are projected to increase 15% to 35% by 2050. Furthermore, multi-day extreme precipitation events will increase in severity.¹³





 Area boundary (Lincoln city limits + surrounding parks and city ag land)

 Urban agriculture sites (www.communitycrops.org): estimated 17 acres

 Barren Land (NLCD class 31).



Community Crops Farmer Training Program

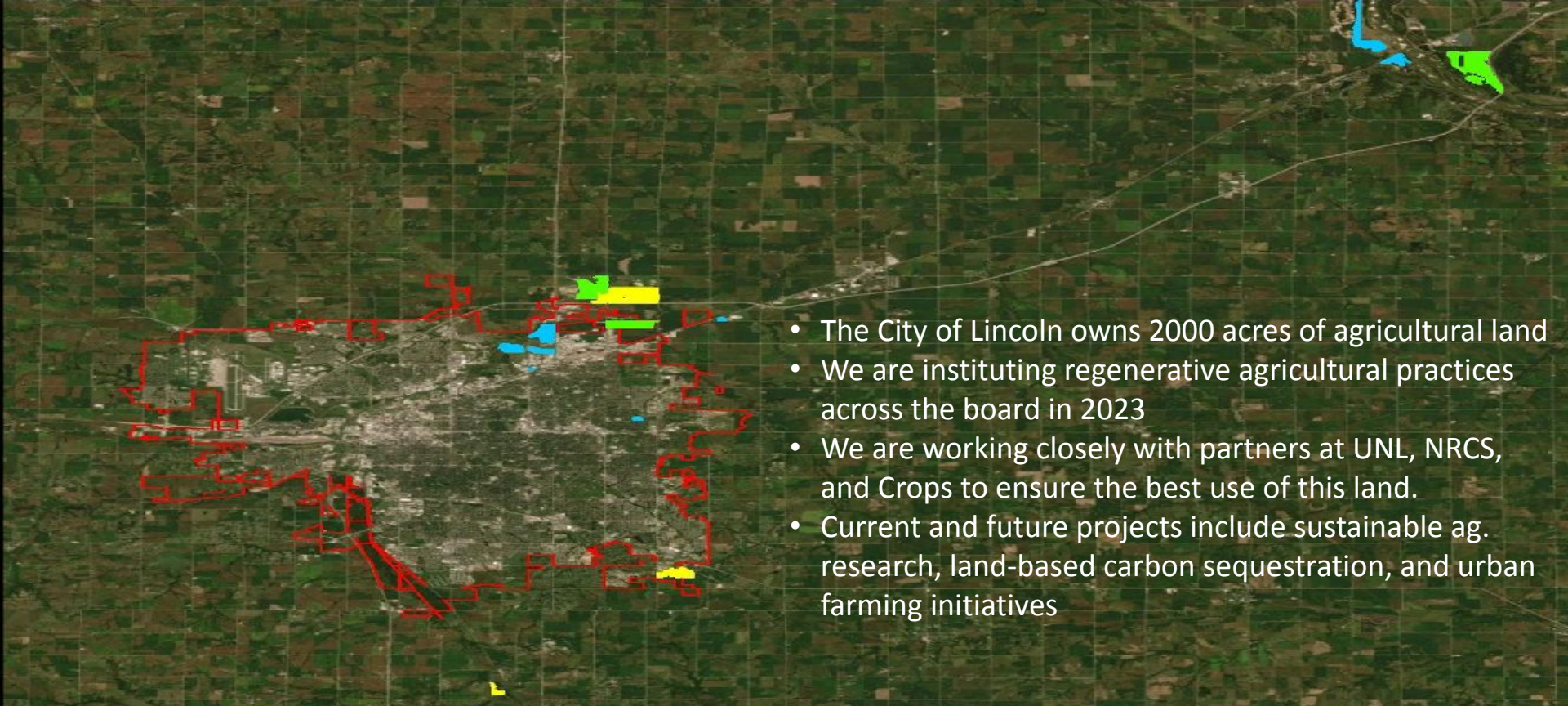
- They work primarily with refugee farmers from Iraq
- This field frequently had standing water and was declared unusable last season
- 2.5 tons of biochar have been integrated
- Future plans include integration into their 17 acres of urban ag. sites, biochar education classes, and urban biochar



Urban agriculture in the Hawley Hamlet

- 1 city block in the heart of Lincoln
- Formed through neighborhood partnerships over more than a decade
- “Our focus is growing community through food.” –Tim Rinne
- ~1.5 tons of biochar have been integrated






- The City of Lincoln owns 2000 acres of agricultural land
- We are instituting regenerative agricultural practices across the board in 2023
- We are working closely with partners at UNL, NRCS, and Crops to ensure the best use of this land.
- Current and future projects include sustainable ag. research, land-based carbon sequestration, and urban farming initiatives

 Area boundary (Lincoln city limits + surrounding parks and city ag land)

 City-owned farmland: crops (Thien Farm Management)

 City-owned farmland: crops and hay (Thien Farm Management)

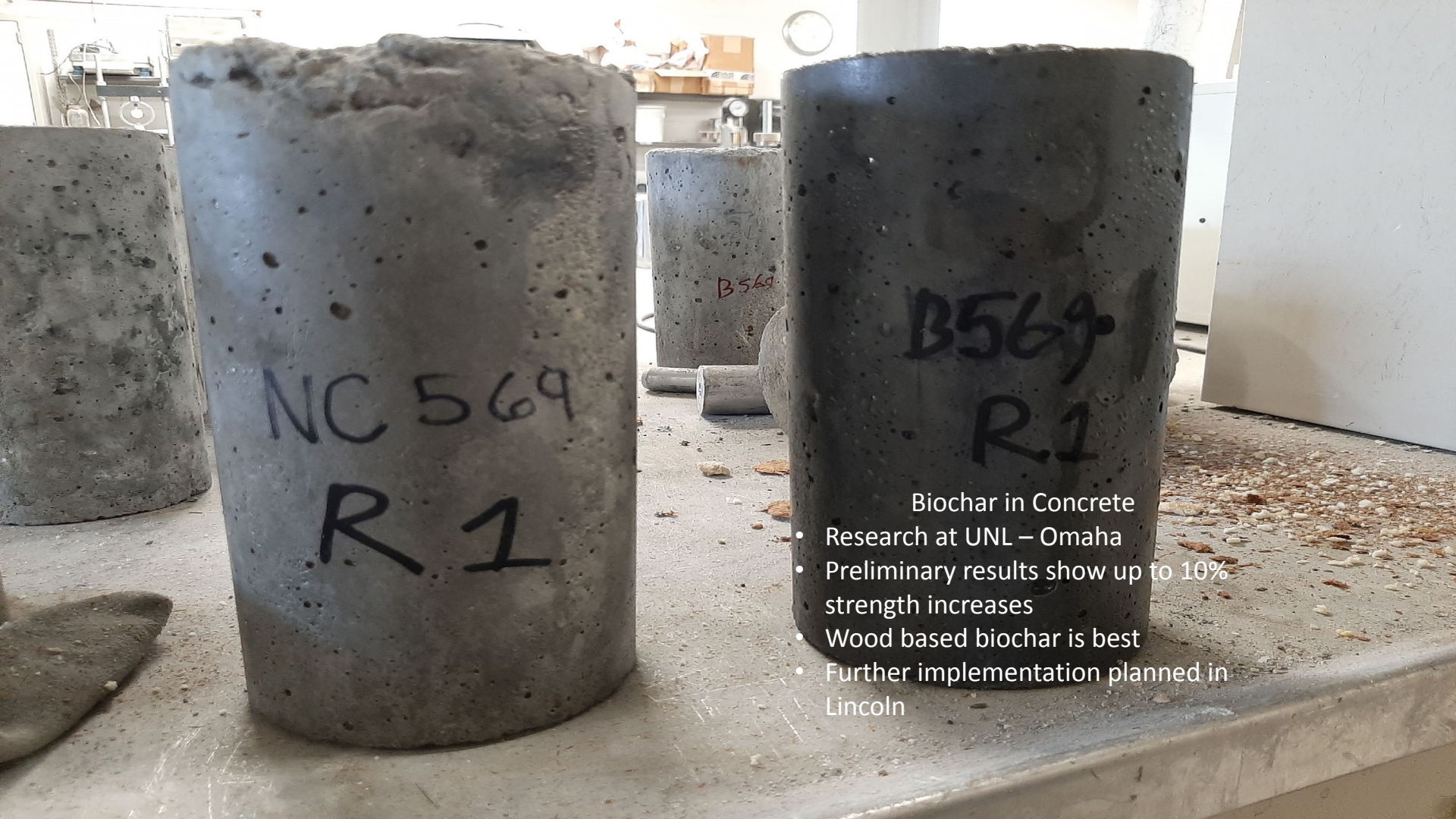
 City-owned farmland: hay (Thien Farm Management)

Total city-owned crop farmland: 1147 acres
Total city-owned hay farmland: 759 acres



Land Based Carbon Sequestration

- Experimentation with large scale application of biochar on agricultural lands
- Urban ag is Lincoln's priority, but the research of larger scale applications is a vital step for future carbon sequestration opportunities

The image shows several cylindrical concrete test specimens in a laboratory. The specimens are arranged on a concrete floor. The most prominent ones are in the foreground, with two labeled 'NC 569 R.1' and 'B569 R.1'. A third specimen labeled 'B569' is visible in the background. The specimens are dark grey and show signs of wear and small holes. The background includes laboratory equipment and a white wall.

NC 569
R.1

B569
R.1

Biochar in Concrete

- Research at UNL – Omaha
- Preliminary results show up to 10% strength increases
- Wood based biochar is best
- Further implementation planned in Lincoln



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GREEN CINCINNATI PLAN



BUILT ENVIRONMENT



EDUCATION & OUTREACH



ENERGY



FOOD



NATURAL SYSTEMS



RESILIENCE



TRANSPORTATION

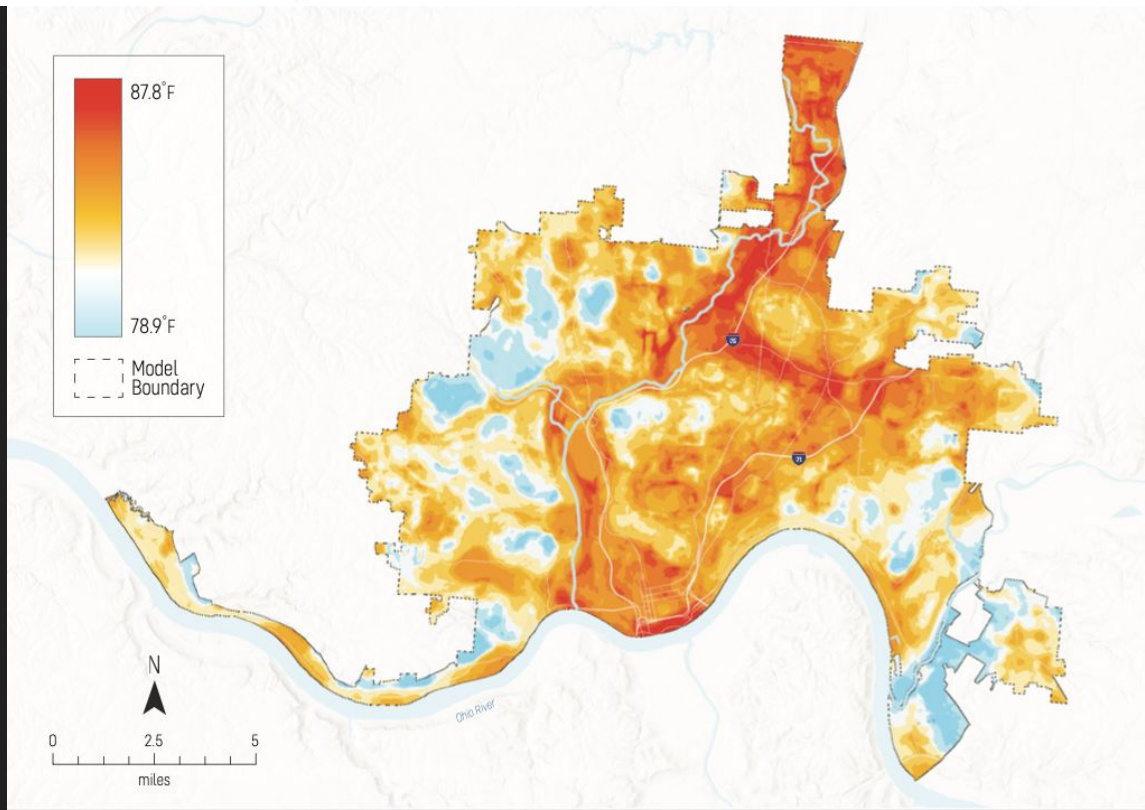


WASTE

80 Strategies to reduce carbon emissions 80% by 2050.

Sustainability. Equity. Resilience.

Cincinnati's 'Heat Islands' Disproportionately Affect Lower-Income Neighborhoods and Areas with Larger Black Populations

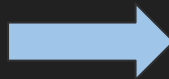


The Cincinnati Vision

- The City of Cincinnati wants biochar
- A strategy for meeting the goals of the Green Cincinnati Plan
 - Urban canopy (especially in low-income neighborhoods)
 - Emissions reduction
 - Stormwater management
 - Green infrastructure
 - Local food production, urban gardens
 - Climate resilience
- Key Principle- Turning waste into Resource, Revenue and Resilience

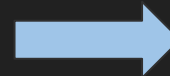
1

INPUTS



2

PRODUCTION




3

USES


- Wood chips from Parks Dept and tree companies

- Biochar Production (Private operator)

- City Use
- External Sales



ARTi Biochar Pyrolysis Systems



- AUTOMATED**
Simple, efficient pyrolysis trains
- INTEGRATED**
Modular Designs
- SCALE-UP REACTORS**
Up to 5 pyrolysis train per container

Sidebar production opportunities

- Utilizing heat
- Generating electricity
- Capturing syngas, wood vinegar

Bloomberg Philanthropies



Anticipated Uses for Biochar in Cincinnati

Trees

Parks

Gardens

Private land

Stormwater Management and Green Infrastructure



**CARBON
HARVEST**

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