

Urban Ashes: Building a Circular UrbanWood Triconomy™

Project Team:

Anna Norman, Diane Simunek, John Pontillo, Justin Pryor, Molly Barstow

Project Advisor:

Andrew Hoffman

Client:

Urban Ashes - Founder/CEO Paul Hickman

A project submitted in partial fulfillment of the requirements for the
degree of Master of Science (Natural Resources and Environment) in
the University of Michigan
April 2022

Table of Contents

Executive Summary	2
Abstract	5
Urban Ashes Founding and Timeline	7
The UM-SEAS Team	12
Project Overview and Goals	13
LCA: Analyzing the Carbon Abatement Potential of the CUT Model	15
The Business Model: Driving Profits and Carbon Abatement in Municipalities	27
Urban Ashes' Market Success	33
Social Impact: Positive Externalities of the CUT Model in Michigan	34
Conclusion	41
Key Questions to Consider for Urban Wood Circular Economy Models Going Forward	42
Appendix	43
References	55

Executive Summary

Paul Hickman founded Urban Ashes (UA) in 2009, manufacturing wood products from urban salvaged wood. This process was inspired in the wake of the Emerald Ash Borer, which launched its devastating impact in 2002 near Detroit, Michigan. Within the United States, wood from urban trees and wood products from deconstructed buildings is seen as a burden by municipalities, and is largely handled as if it is a waste product. An estimated 64% of above-ground tree biomass in the state of Michigan is merchantable, and the financial, social, and sustainable benefits derived from a circular economic system are great. In the state of Michigan alone, these annual benefits are estimated to be: 1.7 million tons of lumber; 1.26 million board feet of lumber; 1.54 million metric tons of carbon sequestered; \$27.6 million USD; dozens of jobs, and many for returning citizens. Long before the concept of the triple bottom line became mainstream, Paul and Urban Ashes were marrying profit with deep-rooted consideration for, and prioritization of, people and the planet. This approach manifested as The Circular UrbanWood Triconomy™ (CUT) model, a business framework based on the triple bottom line that seeks to measure and improve outcomes related to social, environmental and financial ends. The CUT model is customized for the urban wood economy, and seeks to increase environmental sustainability, social equity, and economic diversity.

A key component of the CUT model is in comparing the business as usual (BAU) case of tree disposal and the CUT model of upcycling urban salvaged wood. A circular economy for urban wood, or CUT model, will reduce carbon emissions and landfill waste, and thereby, enable more robust action on climate change. To address this theory and quantify the impacts, LCA is employed, offering a comparison between business-as-usual (BAU) practices and the potential practices behind the CUT diversion model. After analyzing both cases, we conclude that Ann Arbor sees a reduction in its carbon storage capacity of 1,111 metric tons of CO₂ per year in the BAU management of its urban trees. This is a crucial conclusion in favor of the CUT model that Urban Ashes deploys. Another core aspect of the CUT model is the economic impact such a model delivers. The largest processors of fallen urban trees - cities and municipalities - tend to be constrained by budgets, which erodes incentives to invest in urban tree utilization. However, increasing opportunities exist for various economic opportunities associated with “upcycling” urban wood into lumber, furniture/handmade goods, biochar, or fuel pellets (Lumbercycle, 2020).

A key component in the success of the economic model is in differentiating its service offerings from competitors, as an urban wood circular economy business will need to highlight and leverage key partnerships to credibly validate the offering and facilitate speedy process alignment. For revenue optimization, an urban wood circular economy business will need to highlight and leverage key partnerships to credibly validate the offering and facilitate speedy process alignment. There are multiple possible revenue streams for an urban wood circular economy business, primarily based around consultancy and royalty models, in which a business would take a percentage cut of all wholesale wood or finished products sold in clients’ cities. Scaling this network to other small- and

mid-sized cities has lots of overlap across the three dimensions of the CUT model, while driving revenue growth for Urban Ashes.

On the social side, providing employment opportunities for returning citizens (or formerly incarcerated individuals (FIIs)) has been a cornerstone of the Urban Ashes business model. According to Hickman, returning citizens are “one of the most, if not the most, discriminated against labor pools” in the United States, and a significant opportunity exists to provide meaningful employment opportunities for individuals from this population, whereas in many instances, this group is shut out from society. The benefits of working with returning citizens are many, and can help develop skills among many who struggle to find employment, reinforce connections across social strata, and offer a sense of satisfaction from accomplishment and a job well done. While it’s a challenge for anyone who has been shut out of society to learn to trust institutional systems once again, it is a mutually beneficial arrangement with strong social impact.

This report seeks to highlight these benefits and make the case for the adoption of the CUT model in small- and middle-sized cities through a combination of analysis of work completed and actions taken by Urban Ashes, as well as positing models that have potential to drive outcomes related to the CUT Model.

Abstract

Paul Hickman founded Urban Ashes (UA) in 2009, manufacturing wood products from urban salvaged wood. The opportunity for this type of business arose in the wake of the Emerald Ash Borer, which launched its devastating impact in 2002 near Detroit, Michigan. This devastation to trees grew widespread quickly; as of 2013, the Emerald Ash Borer had spread to at least 15 states and two Canadian Provinces, and had destroyed between 50 and 100 million Ash trees across North America (Pacitti, 2013). This enormous influx of lumber from Ash tree removal demanded better utilization than simply entering our waste streams, where it decomposed and emitted carbon into our atmosphere.

Within the United States, wood from urban trees and wood products from deconstructed buildings is seen as a burden by municipalities, and is largely handled as if it is a waste product for simplicity's sake (Pitti, Espinoza & Smith, 2020). With an estimated 64% of above-ground tree biomass being merchantable, it is estimated that missed opportunities per year in the state of Michigan equate to the following: 1.7 million tons of lumber; 1.26 million board feet of lumber; 1.54 million metric tons of carbon¹; 27.6 million USD industry (Nowak et al., 2019). In addition to carbon storage and feedstock for wood products, trees offer significant value in terms of ecosystem services, such as leaf litter to support vegetation growth, reducing runoff into streams resulting in cleaner water, urban air filtering resulting in healthier urban air, cooling of urban heat islands which results in lower energy costs, and improved community mental health and well-being through the benefits of green spaces (Nowak et al., 2019)(City of Ann Arbor Forestry Public Works).

The model that Paul developed at Urban Ashes model merges this overlooked environmental value with supporting returning citizens and bringing high-value, locally sourced and manufactured end-products to the national retail market. At the time of Urban Ashes' founding, the main outputs were picture frames and furniture, manufactured from Ash tree wood and other species that would have otherwise entered waste streams. Paul worked as the main product designer and business manager, employing largely formerly incarcerated individuals and youth who have had contact with the justice system to perform manufacturing roles in the shop. A somewhat unique proposition at the time, Urban Ashes employed returning citizens and worked to be both a personal and vocational support system for individuals working to reclaim their lives post-incarceration.

Long before the concept of the triple bottom line became mainstream, Urban Ashes was marrying profit with deep-rooted consideration for, and prioritization of, people and the planet. This approach manifested as The Circular UrbanWood Triconomy™ (CUT) model, a business framework based on the triple bottom line that seeks to measure and improve outcomes related to social, environmental and financial ends. The CUT model is customized for the urban wood² economy, and seeks to increase environmental sustainability, social equity, and economic diversity. The CUT model generates several benefits across varied domains:

- It diverts valuable urban lumber from waste streams (such as landfills), reducing greenhouse gas (GHG) emissions
- It invests in high level organics recycling; it develops urban milling and manufacturing

¹ Assuming on average that lumber is 50% carbon by weight

² Urban wood is any wood that comes from recently fallen trees that came down for any reason other than their wood value. They can come from urban, suburban or rural environments.

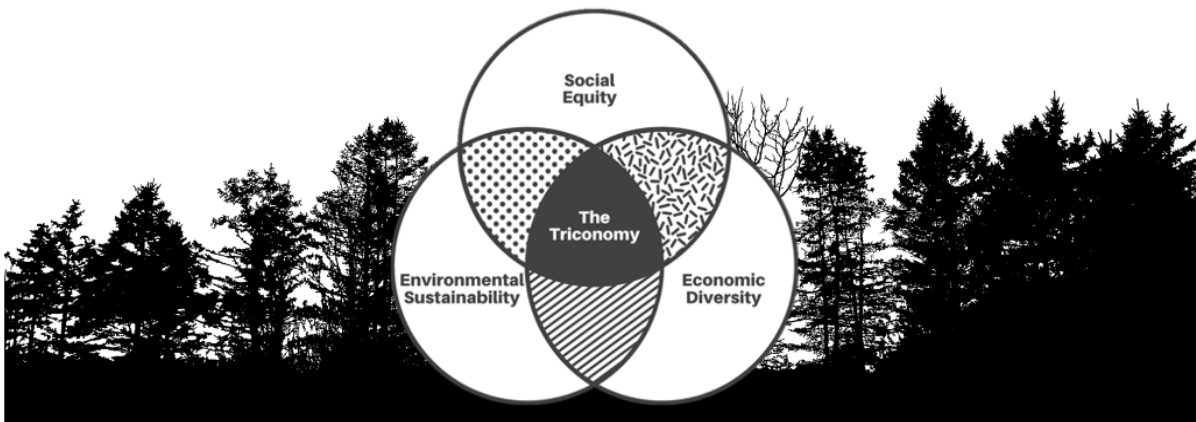
infrastructure

- It disseminates production expertise and best practices
- It expands tree planting and maintenance that creates opportunities for startups and local community support
- It reduces unemployment and recidivism for returning citizens while giving purpose and direction to youth who have had contact with the justice system (Hickman).

Selecting Ann Arbor as a hub in which to grow this model, Urban Ashes is uniquely positioned to create and scale its CUT model by consulting businesses and municipalities across Michigan and the US. Through his expertise, Paul and UA can help interested organizations divert urban wood from landfills and create a market for circular urban wood products in partnership with organizations that operate with a triple bottom line approach. Work streams for development and realization of the CUT model have been split into the three distinct features of the triple bottom line or Triconomy™ mentioned above: environmental sustainability, social equity, and economic diversity.

Building on the credibility of Urban Ashes' past as a national manufacturer and designer of urban salvaged wood products, this project team has worked with Paul to reimagine Urban Ashes 2.0 - a consultancy equipped to adapt and implement the CUT model with municipalities and private business owners across Michigan and the greater US.

Figure 1. The Urban Ashes 2.0 CUT Model



Urban Ashes Founding and Timeline



Credit: Janet Miller | For AnnArbor.com

2008

- Paul Hickman created the idea of Urban Ashes (UA) , building off of the successes of the Urban Wood Project he had co-founded in 2005, with the intention of creating a viable product to scale and increase the utilization of urban salvaged and deconstructed wood. The first products available were picture frames and various furniture pieces, which were to be crafted with a labor force focused on citizens returning to society from incarceration.

2009

- UA was established as a DBA under Paul M. Hickman Inc.

2010

- UA established partnerships with four local retailers, two frame shops, and two boutique gift stores.

- UA is based out of Paul Hickman’s studio with some contract labor help while Paul continues his design business. For these 2 years, Paul focused on R&D and market research to establish a solid product line with viable pricing.

2011

- UA partnered with Work Skills Corporation out of Brighton, MI to become the fabrication partner, supplying all the labor and shop space. UA provided training, major equipment, all moldings and all sales, marketing, and general management.

2012

- UA established a full brand identity and develops marketing materials
- UA launched outside of Washtenaw County, Michigan.
- By the end of 2012, they had partnered with over 100 custom frame shops and gift boutique stores across 15 states to sell UA ready-made, custom frames.

2013

- Introduced the ReClaim Frame™ collection for Holstee, establishing their presence in the OEM frame market.
- Awarded the first Big Leap Award by Think Local First, Washtenaw, MI.
- Exceeded partnership with 160 retail stores across 30 states.

2014

- Outgrew Work Skills capacity to produce and keep up with the rapid sales growth.
- Established the first UA fabrication shop in Ann Arbor. Hired the first four employees, three of whom were returning citizens that came over from UA crew at Work Skills.
- Secured first commercial furnishings contract to produce all tablespots for Manhattan-based Just Salad restaurants.
- Established a relationship with Michigan Works to help with workforce development and recruitment of individuals who were formerly incarcerated.
- Awarded the International Innovation Award by the Professional Picture Framers Association.

2015

- Continued successful expansion into the OEM product line for Holstee.
- Surpassed 220 retail partners in 42 states.
- Established a new pipeline of labor in partnership with an Ypsilanti after-school program for youth who have had contact with the justice system, providing job opportunities to individuals that had never been able to find employment outside of fast food in Ypsilanti.
- Participated in UA’s first job fair within a prison. One of the UA staff members who was previously incarcerated gave the closing talk to those currently incarcerated to a rousing ovation.

2016

- Outgrew the 2,500 square foot location in Ann Arbor and moved into a new 6,000 square foot shop in Saline, Michigan.
- Expanded contract furnishings business with Busch's Market producing a variety of tables for multiple grocery stores and cafes.
- Extended OEM market with Frank Lloyd Wright Foundation, Lake Art, White House Custom Color, and Michigan State University.
- Partnered with Leaders Quest to provide corporate training for AIG, Crédit Agricole, PwC, and Google.
- Established a relationship with the Washtenaw Juvenile Probation Office as another resource for youth labor.

2017

- Added the Detroit Foundation Hotel and University of Michigan as contract furnishings clients.
- Expanded OEM clients and volume orders with Lake Art, Muir Way, Artisan Bench.
- Established first large-scale contract with Ford for on-site, tree-to-table reclamation project, converting 2 semi-truck loads of logs removed from their construction site, and constructed into conference tables and giant wood sculpture walls.
- Facilitated and hosted a tour, including one-on-one interviews among six Google executives and incarcerated individuals at Jackson Parnell Correctional Facility. Led to Google donating \$2 million to the Michigan Prison System, in order to establish the first computer coding program within the prison. The program has now expanded to several other states.
- Established a program offering in-house workshops in partnership with the Washtenaw Juvenile Probation Office providing one-on-one training and mentorship, as well as group discussions facilitated by our Director of Community Outreach, who had been incarcerated as a youth and completed 24 consecutive years in prison.

2018

- Selected as the first ever Platinum Awardee of the Michigan Ross Center for Positive Organizations' Positive Business Project.
- Awarded Ann Arbor Spark's Fast Track Award, presented to companies with consistent and substantial records of growth.

2019

- After failing to raise the additional capital needed to upgrade machinery and systems to accommodate the robust growth or to find a viable suitor to acquire the company, Urban Ashes Founder and CEO, Paul Hickman chose to cease all production and sell off all assets.

- After accessing the 10 year run and what would be the next best steps to maximize the value of the UA brand and to continue the growth in the utilization of urban salvaged wood, Paul chose not to close down the brand of Urban Ashes but to reshuffle its focus.
- Paul began researching the national markets around urban wood utilization, reconnecting with the Urban Wood Project that had then become a national organization, the Urban Wood Network.
- Presented at one of the first Urban Wood Academies in Baltimore.

2020

- Continued research of the national market with extensive trips throughout California to establish more connections, while learning more from more established urban wood utilization operations.
- Overhauled Urban Ashes' products and services, switching to strictly a small consulting and design firm, focused on aiding municipalities and other businesses in maximizing their utilization of their fallen urban trees.
- Established the concept of Circular UrbanWood Triconomies™ (CUT), which promotes a circular business model focused on urban wood utilization.
- Secured commitment from the City of Ann Arbor to be the first test city to create the blueprint for the CUT model with UA.
- Established relations with Michigan DNR and Parks and Recreation to divert invasive Black Locust logs from the waste stream.
- Began working with Michigan DNR and various entities connected with Belle Isle, Detroit to establish an urban wood utilization program in conjunction with their restoration of the urban mill that had been on the island since the early 1900s but was abandoned in the 1980s.

2021

- Established the Michigan Chapter of The Urban Wood Network and became the Chapter Lead, a national steering committee member for UWN, as well as the co-chair for the UWN legal transition team.
- Joined NextCycle Michigan as a partner to help in the diversion of wood from the waste stream (see Appendix A).
- Cleared the first two rounds of review from those involved with Belle Isle to implement an urban wood utilization program.
- Secured a 5-person team of University of Michigan graduate students to aid in the design and implementation of the CUT model for the City of Ann Arbor (Appendix H)
- Through NextCycle, UA partnered with LilyPad Labs, an autonomous boat start-up to design and source urban salvaged wood for their boat decking.
- Through NextCycle, UA connected with an Israeli company, Daika to aid in product development and was awarded one of the first MICRO grants from NextCycle for a proof-of-concept project around the utilization of urban wood waste, sawdust, chips, and bark to

produce the first ever extrudable, castable and injection molded wood composite with zero toxic binders.

- Awarded admission into the first FLOWS track of NextCycle addressing the recycling of organics, with UA being the only entity addressing the recycling of wood beyond mulch or compost.
- Produced the first TEDxUrbanWoodNetwork video as part of TED Countdown.

The UM-SEAS Team



Anna Norman

MBA/MS: Sustainable Systems concentration
Previously: Supply Chain / Operations at Bosch
Favorite Tree: Red Oak



Diane Simunek

MBA/MS: Sustainable Systems concentration
Previously: Federal Management Consultant at National Parks Service
Favorite Tree: Birch



John Pontillo

MBA/MS: Sustainable Systems concentration
Previously: US Peace Corps - Mozambique; FSG, Inc.
Favorite Tree: Japanese Maple



Justin Pryor

MBA/MS: Behavior, Education, and Communication concentration
Previously: Marketing at PepsiCo.
Favorite Tree: Redwood



Molly Barstow

MBA/MS: Sustainable Systems & Environmental Policy and Planning concentrations
Previously: Community Programs Manager at Project Citizenship
Favorite tree: Sugar Maple (hello maple syrup!)

Project Overview and Goals

With Urban Ashes poised to transform from manufacturer and designer to consultant, the UM SEAS project team joined Paul along his journey at a pivotal moment. Founder and CEO, Paul Hickman, relied on the project team not only to conduct research and analysis, but also to help shape the future of Urban Ashes as it developed its new business model. The team’s research and analysis sought to uncover opportunities and risks for Urban Ashes as a consultant and mentor for municipalities and community businesses to achieve increased urban wood utilization. In pursuit of this goal, the team conducted iterative brainstorming and working sessions with Paul, his design team, the City of Ann Arbor, and University of Michigan faculty, to adjust the business model, perform the life cycle assessment analysis, explore new partnerships, and develop a theory of social change.

After an extensive ideation and development phase, our team came up with a three-pronged approach to understand the opportunities for Urban Ashes, as well as to arm Paul with analysis needed to support his model and expand his business. The team identified three workstreams in which to focus our efforts: (1) conduct a life cycle analysis of urban wood, (2) propose a new business model for Paul to proliferate the CUT model, and (3) analyze the social impacts of employing formerly incarcerated individuals, or returning citizens. In order to make the CUT model viable, the financial, environmental, and social benefits need to be demonstrated.

Figure 2: Strategic goals of the project team

Workstream	Topic	Description
Environmental Sustainability	Life cycle assessment of urban wood	Demonstrate the positive environmental impacts of diverting urban wood from landfill.
Social Equity	Analysis of benefits of employing returning citizens	Assess the positive social implications of providing meaningful work to returning citizens.
Economic Viability	Development of new business model	Create a roadmap for the new Urban Ashes business model that will enable Urban Ashes to spread the UrbanWood Triconomy model.

Environmental Sustainability

To make the sustainability case for Urban Ashes and the CUT model, the UM-SEAS team developed a comparative life cycle assessment (LCA) between a business-as-usual (BAU) case and the Urban Ashes CUT model in Ann Arbor. Research entailed collecting information on the following:

- Current BAU practices in Ann Arbor urban wood disposal
- City tree inventory and carbon storage potential
- Current scale of wood imports and sales in the city for small-scale wood manufacturing jobs
- Impact of Urban Ashes CUT diversion model on urban wood inventory and overall carbon storage.

Social Equity

Widespread CUT adoption means growing public and private support for and commitment to training and employing our justice system's returning citizens and youth who have had contact with the justice system. Our research involved analyzing the current situation for returning citizens through a combination of a literature review, interviews with key stakeholders, and interviews with returning citizens. Through understanding current incarceration and employment metrics in key locations, we have come to better understand how to contextualize the potential impact from supporting job opportunities for returning citizens in the UrbanWood Triconomy.

Economic Viability

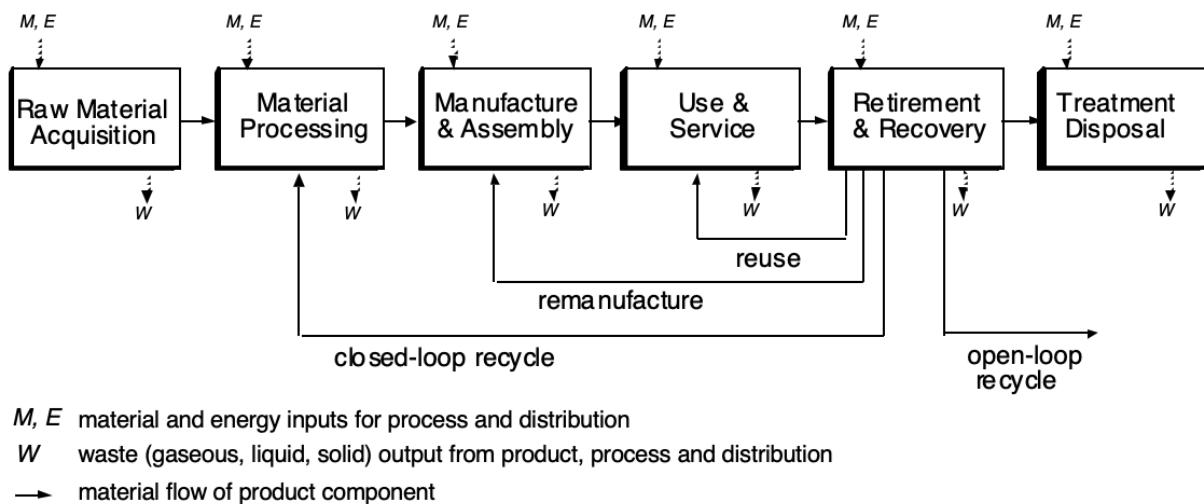
To launch the Urban Ashes CUT model, research was conducted by comparing similar business and consulting models and through a literature review. Given the unique nature of the CUT model, the consulting business has required significant analysis into the viability, profitability, and self-sufficiency of the model. The UM-SEAS team conducted research into the sustainability of such a business model, completed the value proposition, and explored future target markets for growth. Additionally, the team worked with Urban Ashes to synthesize the company's core values and vision to be used as a business overview and to evaluate market viability.

LCA: Analyzing the Carbon Abatement Potential of the CUT Model

Life cycle assessment (LCA) is a “compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its lifecycle” (ISO, 2006). One of many components in the International Standards Organization’s (ISO) Environmental Management Standards, LCA aids in establishing an environmental profile of a system.

Current and historic industrial practices have led much of our global economy to operate in linear fashion. As visible in the below Figure 3, the traditional product life cycle starts in nature with raw material acquisition and eventually ends with disposal, where material (despite its possible value) ultimately leaks from the system and is left to slowly decompose in a landfill. An alternative product life cycle, demonstrated below by the loops of *reuse*, *remanufacture* and *closed-loop recycle*, is circular with little or no material leakage from the system. This alternative to a traditional linear system is often referred to as the *circular economy*, a term that is championed today by the Ellen MacArthur Foundation (Ellen MacArthur Foundation). The Circular UrbanWood Triconomy (CUT) is the Urban Ashes model for creating a circular economy of urban wood, and LCA is a compelling tool for validating the carbon abatement potential of such a system.

Figure 3: The Product Life Cycle (Center for Sustainable Systems, 2021)



In addition to Urban Ashes’ business and social arguments for the CUT model, the company and its founder believe there is a compelling environmental argument. The theory is that a circular economy for urban wood, or CUT model, will reduce carbon emissions and landfill waste, and thereby enable more robust action on climate change. As cities, states, and nations look to set aggressive climate action targets, forestry and land use management in urban areas will need to be addressed more comprehensively (e.g., including urban wood utilization). To address this theory and quantify the impacts, LCA is employed, offering a comparison between business-as-usual (BAU) practices and the potential practices behind the CUT diversion model. The ISO 14040 framework was used for the LCA to divide the study into four phases: Goal and Scope Definition, Inventory Analysis, Impact Assessment, and Interpretation.

Goal and Scope Definition

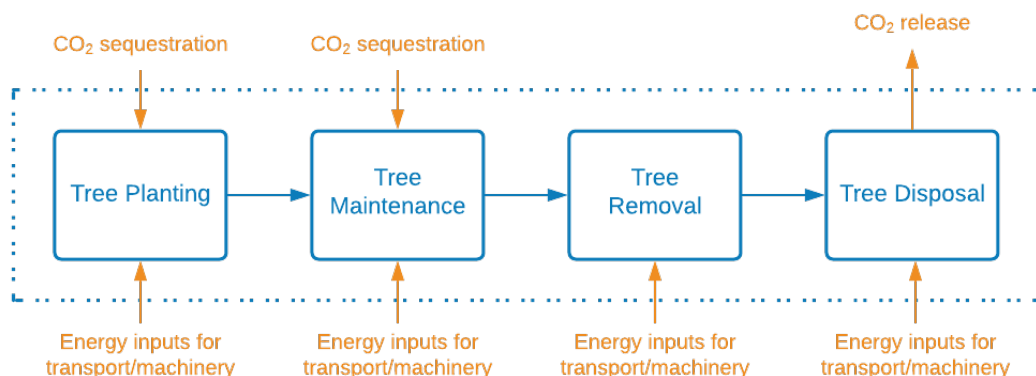
The objective of this comparative LCA study is to understand the carbon abatement potential of high urban wood utilization (CUT model) relative to a BAU scenario of very low urban wood utilization in the city of Ann Arbor, Michigan. The CUT model is hypothesized to deliver the following benefits:

- Divert urban salvaged trees from the landfill, burn, mulch, or biomass piles;
- Support public / private initiatives to replant and maintain trees (such as the A2Zero 2030 plan, see Appendix B for excerpt), thereby enabling continued carbon sequestration and development of future feedstocks;
- Deliver human health and economic benefits through environmental sustainability, i.e., preservation and regrowth of urban forest areas and localized economies around urban wood.

Regarding the scope, this LCA seeks to compare management practices for a natural resource - urban trees. The function of both systems is largely service-based: to properly manage the life cycle (planting, maintenance, end-of-life) of the public urban trees in Ann Arbor. Regardless of whether each system offers different levels of carbon storage, both systems must continue to perform the function of proper tree management. However, the success of the system from a life cycle impact perspective will be measured by each system's ability to preserve carbon pools and abate GHG emissions. The functional unit of the system is tree management throughout the life cycle occurring over the course of one year in Ann Arbor. Tree planting, maintenance and removal data is based on actual numbers in Ann Arbor in 2020. It is assumed that activity levels in 2020 will be consistent through 2030 (the horizon for Ann Arbor's Climate Action Plan).

The system boundary for this LCA surrounds the core activities in cradle-to-grave tree management: tree planting, tree maintenance, tree removal, tree disposal. Relevant and in-scope inputs to the system include CO₂ (via sequestration) and fossil energy used in transport and machinery. System outputs include the release of CO₂ in the tree disposal process (via decomposition) and the embodied emissions from the burning of fossil fuels for the necessary inputs of transport and machinery. Figure 4 outlines this system boundary (in blue) and the corresponding inputs/outputs (in orange).

Figure 4: The System Boundary of Urban Tree Management



Inventory Analysis

The basis for the life cycle inventory analysis is a tree inventory completed in October 2020 by Davey Resource Group (DRG) for the City of Ann Arbor (Davey Resource Group, 2020). This summary report presented to Ann Arbor's Urban Forestry & Natural Resources Planning Coordinator, Tiffany Giacobazzi, provides an update to the city's tree inventory in public spaces (parks and street rights-of-ways). Trees are accounted for and categorized by size, species and condition. This data was used to quantify the size of the carbon pool (based on tree size and species), understand which types of trees were likely removed in the course of one year (based on tree condition), and how those removals over the course of one year impacted the carbon pool (based on tree size, species and condition). In short, there are approximately 51,010 trees in Ann Arbor's public parks and street rights-of-ways and they can be characterized by the following:

- The overall condition of the tree population is Fair;
- Most common species: *Acer platanoides* (Norway maple), 10%; *A. saccharum* (sugar maple), 8%; *Gleditsia triacanthos inermis* (honeylocust, thornless), 7%; *Malus* spp. (apple), 5%; and *A. rubrum* (red maple), 5%;
- The majority (52%) of the urban forest is rated as young, having a diameter of 0–10 inches;
- 70% of the population is recommended for tree pruning, 24% is recommended for a Training Prune, and 6% is recommended for removal.

Appendix C shows a series of detailed breakdowns of the number of trees across age (i.e., size), species and condition. A core assumption of the inventory analysis is that there is an equal distribution of young - mature across species. This was a necessary assumption given that the DRG inventory did not provide sub-breakdowns by both size and species.

With this data on Ann Arbor's tree inventory, the next step is understanding how this inventory is impacted over the course of one year (the functional unit size) by activities in the urban tree management life cycle: planting, maintenance, removal and disposal. Through a series of interviews, the following information was collected from various sources:

Figure 5: Inventory of Ann Arbor urban tree management activities

Interviewee / Source:	Information Provided:
Tiffany Giacobazzi, Ann Arbor Urban Forestry & Natural Resources Planning Coordinator	FY2020 Work Plan consisted of the following: 4,829 trees (street) pruned (maintained) 575 trees (street) removed 595 tree stumps removed Trees > 23" DBH ³ sent to biomass pile Trees ≤ 23" DBH sent to chipper/mulching
Matthew Waldsmith, Tree Maintenance for Ann Arbor	3,000 - 4,000 street trees pruned (maintained)/year Type of trucks and machinery used, but no detailed activity data on usage
Scott Spooner, Ann Arbor Parks and Recreation Services Deputy Manager	40 - 50 park trees removed /year
Bob Paris of Davey Tree Expert Co., service provider for tree maintenance in Ann Arbor	4,000 - 5,000 street trees pruned (maintained)/year 1,000 - 2,000 park trees pruned (maintained)/year 10 - 12 park trees removed / year
Barry Margolis of Margolis Nursery, service provider for tree planting in Ann Arbor	~1,000 street trees planted per year New trees watered every other week in the summer, no maintenance provided

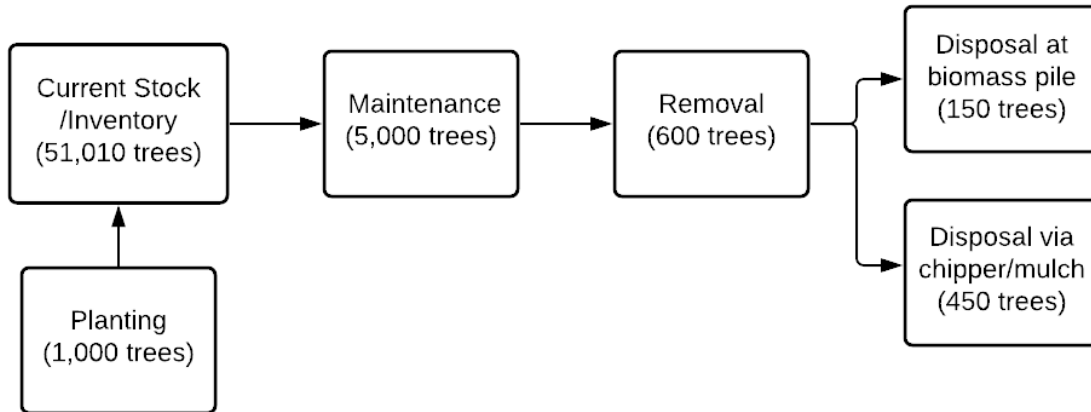
Based on the aggregation of this information, the following information was used for the LCA inventory of activities in one year:

- 1,000 trees planted annually (public only)
- 5,000 trees maintained annually in parks and streets
- 600 trees removed annually in parks and streets (see Appendix C for breakdown by species and age)

Equipped with data on the tree inventory (including species, age, condition) and annual activities along the urban tree management life cycle, the following Ann Arbor process flow diagram was developed:

³ Diameter Breast Height (DBH): diameter of a tree at breast height of the measurer, indicates tree age

Figure 6: Ann Arbor process flow diagram for functional unit



*Note: Disposal inventory going to biomass pile vs. chipper determined by Davey Tree Inventory tree condition and age then rounded (see Appendix C: 446 dead trees < 20” and 141 dead trees > 21”)

The inventory of Ann Arbor’s urban trees can also be measured in terms of above ground biomass. To translate tree species and size in the Midwest climate zone into above ground biomass, USDA’s Tree Carbon Calculator, developed by the US Forest Service Center for Urban Forest Research, was used. The inventory finding was an above ground biomass of 32,050 metric tons of dry weight in Ann Arbor currently (in 51,010 trees), with 472 metric tons of above ground dry weight being removed annually (in 600 trees)(USDA). Above ground biomass is important and the driver of economic value when we start considering felled trees.

Impact Assessment

For this LCA, impact is measured in terms of CO₂ sequestered and released, calculating a net impact over the course of one year in Ann Arbor. CO₂ impacts were identified using two sources:

- Tree Carbon Calculator developed by the US Forest Service Center for Urban Forest Research (USDA)
 - Source used to calculate kg CO₂ stored per tree based on climate zone (Midwest), tree species, and DBH from the Davey Tree Expert inventory
 - See Appendix D for total CO₂ stored in Ann Arbor trees, CO₂ stored in removed trees, as well as a screenshot of a sample output for a 15” Norway Maple from the Tree Carbon Calculator
- Urban Forest Project Protocol developed by the Climate Action Reserve (Climate Action Reserve, 2010)
 - Source used to estimate the emissions from transportation and machinery used per project tree that is planted, maintained, removed and chipped, given that primary

data was not available from the City of Ann Arbor

- 4.17 kg CO₂ is emitted per project tree from municipality activities

Starting with the current stock of carbon stored in Ann Arbor’s 51,010 trees, the year will then see ebbs and flows to the carbon storage as trees are planted and removed. Additionally, CO₂ will be released by transport vehicles and machinery during planting, maintenance, removal, and chipping.

Figure 7: CO₂ sequestration and release impact by activity

Activity	Inventory	CO ₂ sequestration impact	CO ₂ release impact
Planting (of new trees)	1,000 trees	Negligible due to tree size	4.17 metric tons ⁴ CO ₂
Current Stock/Inventory	51,010 trees	75,399 metric tons ⁵ CO ₂	N/A
Maintenance	5,000 trees	N/A	20.85 metric tons CO ₂
Removal	600 trees	Lost carbon storage stock (-1,111 metric tons ⁶ CO ₂) & future carbon sequestration potential	2.5 metric tons CO ₂
Disposal (at biomass pile)	150 trees	N/A	739 metric tons CO ₂ over residence time of decomposing log
Disposal (via chipper/mulch)	450 trees	N/A	372 metric tons CO ₂ over residence time of decomposing mulch

As you can see illustrated in this table, Ann Arbor sees a reduction in its carbon storage capacity of 1,111 metric tons of CO₂ per year in the BAU management of its urban trees. This 1,111 metric tons of CO₂ will be released back into the atmosphere over the course of many years as the logs and mulch naturally decompose. Additionally, the city emits approximately 28 metric tons of CO₂ annually through the usage of transportation and machinery to plant, maintain, remove and chip trees.

Key Insight
Ann Arbor sees a reduction in its carbon storage capacity of 1,111 metric tons of CO ₂ per year in the BAU management of its urban trees.

⁴ 1,000 project trees in planting phase multiplied by 4.17 kg CO₂ emitted per project tree from municipality activities = 4,170 kg CO₂ or 4.17 metric tons CO₂ released annually from planting activities by municipality/service providers (Climate Action Reserve, 2010)

⁵ See Appendix D for Current Stock of Carbon Stored in Ann Arbor trees (USDA)

⁶ See Appendix D for Annual carbon storage lost from tree removal in Ann Arbor (USDA)

Interpretation

The goal of this LCA was to understand the carbon abatement potential of high urban wood utilization (CUT model) relative to a BAU scenario of very low urban wood utilization in the city of Ann Arbor, Michigan. The BAU scenario currently results in an annual reduction in carbon storage stock of 1,111 metric tons CO₂, as well as reduced future carbon sequestration potential, and 28 metric tons CO₂ annually from associated tree management activities.

None of the removed biomass is converted into long-term carbon storage in the form of furniture grade lumber and durable wood products. However, the City of Ann Arbor does still have interest in preserving and enhancing the local tree canopy, as a means to increase carbon sinks. The A2Zero Plan estimates that tree planting efforts can reduce overall GHG emissions by 450 metric tons CO₂e by 2030. New tree planting is vital to sustaining the urban forest, but this plan fails to account for the lost carbon storage each year of over 1,000 metric tons CO₂ from tree removals and little-to-no utilization of the wood. **At this rate of tree planting versus tree removals, the city will see more emissions from decomposing trees by 2030 than from added carbon sequestration from new trees.** A cradle-to-grave approach must be taken to properly assess the impacts of various decisions in urban tree management.

Key Insight

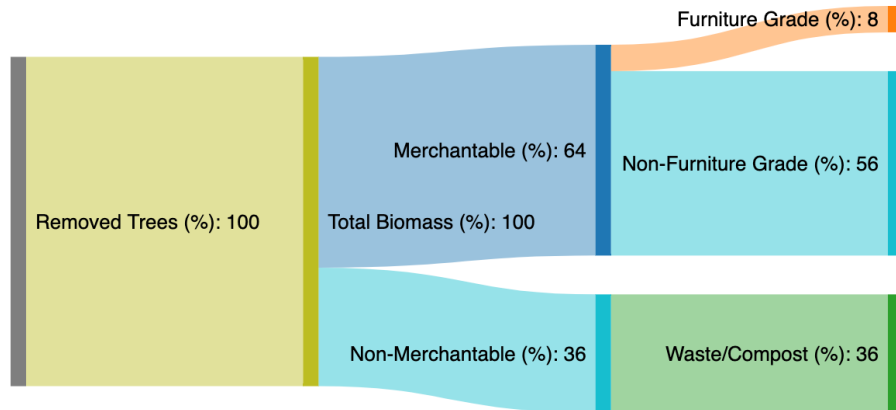
At this rate of tree planting versus tree removals, the city will see more emissions from decomposing trees by 2030 than from added carbon sequestration from new trees.

Employing a cradle-to-grave, triple bottom line approach, the CUT model seeks to keep at least some of the annual reduction in carbon storage (1,111 metric tons CO₂) out of the atmosphere by converting the biomass of the removed trees into products capable of long-term carbon storage. Although low levels of urban wood utilization (e.g., mulching) are already being used by the city for trees smaller than 23" DBH, activities to support longer-term carbon storage via high urban wood utilization are not taking place. In order to evaluate real potential carbon abatement impact of the CUT model, we must assess how much of the removed biomass is merchantable and, specifically, furniture grade.

Again by analyzing the Ann Arbor tree inventory through the US Forest Service Center Tree Carbon Calculator, we can see that the total annual biomass removed is equal to 472 metric tons (dry weight) of above ground biomass per year. Naturally, much of this biomass is non-merchantable or not high-value as it contains much debris, not just logs. Until a circular urban wood economy is established in Ann Arbor, we won't know the exact percentages of merchantable, furniture grade lumber available for the manufacture of durable wood products, however, we can start to analyze carbon storage potential and processing emissions based on different levels of merchantable material. Key to maximizing the capture of furniture grade lumber is identifying and prioritizing potential furniture grade trees immediately to ensure they are brought down in a timely manner, as well as ensuring proper cutting and handling. As a potential proxy for Ann Arbor, this assessment looked at the existing circular urban wood economy in Baltimore, Maryland. An interview with

Shaun Preston⁷, a practitioner and subject matter expert in Baltimore, uncovered the following pathways of urban wood merchantability specific to Baltimore:

Figure 8: Sankey diagram of typical usage levels/grades of removed urban wood biomass in Baltimore, MD (Preston, 2022)(Nowak, 2019)



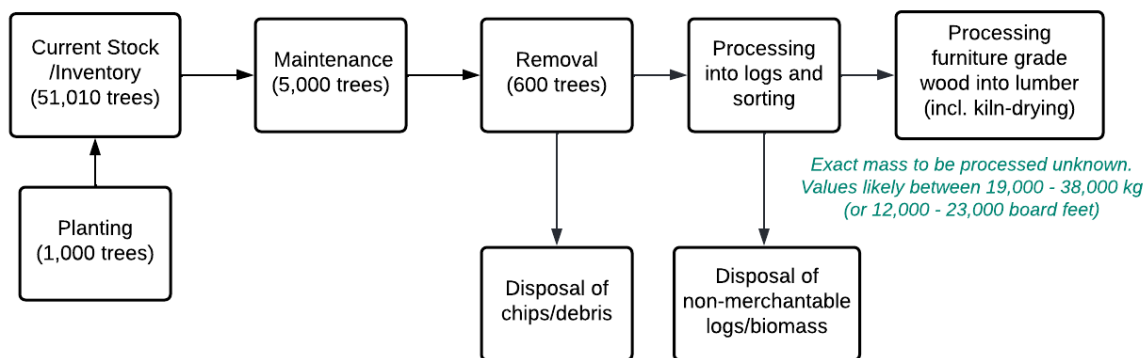
Baltimore’s furniture grade levels are currently constrained by a backlog in tree maintenance and removal, resulting in potentially furniture grade trees standing dead too long or subject to improper cutting and handling. Currently in Baltimore, of the removed biomass, it is typical for just 4- to 8-percent to be considered furniture grade, and thus capable of longer-term carbon storage. Non-furniture grade merchantable wood is typically in the form of wood chips and firewood where the stored carbon is released back into the atmosphere throughout usage, or in the form of pallets or other industrial uses where product lifespans are short before disposal (Nowak, 2019). If Ann Arbor were to reach similar levels of furniture grade lumber as Baltimore, the annual removed biomass consists of somewhere between 12,000 and 23,000 furniture grade board feet.⁸ The carbon stored in this volume of furniture grade lumber is between 44 and 89 metric tons of CO₂. These numbers will only increase if Ann Arbor is able to quickly identify and prioritize furniture grade trees, then ensure proper cutting and handling.

If under the business-as-usual processes in Ann Arbor the annual reduction in carbon storage is 1,111 metric tons CO₂, then whatever embodied carbon in the biomass deemed as furniture grade (whether 8% like Baltimore, or higher) can be held and not released back into the atmosphere. In order to allow for urban wood to be sold on the market as furniture grade lumber and durable wood products, additional processing is needed beyond removal and transportation (see Figure 9 for process flow diagram of CUT model). This processing can be both carbon- and cost-intensive. In order for the CUT model to be viable, the additional carbon emissions associated with further processing must be less than the marginal benefit of carbon storage in the wood products.

⁷ Shaun Preston is the Recycling Coordinator of Camp Small, Baltimore city’s urban wood recycling program that is part of the Urban Forestry Division

⁸ Above ground biomass (kg) converted to board feet using a lumber weight calculator per species (inchcalculator)

Figure 9: Process flow diagram for CUT model / high urban wood utilization in Ann Arbor



In September 2020, four members of the USDA Forest Service conducted a study entitled: *Life Cycle Assessment of Lumber and Slab Production from Freshly-Cut Wood from Urban Forests*. The main goals of this study were to: (1) “develop a cradle-to-gate (see Appendix E for system boundary) LCA model for lumber and slab production from urban forest resources” and (2) “understand environmental implications of producing high value wood products” from US urban forests (USDA Forest Service, 2020). The results of this study are critical inputs to understanding the net carbon abatement potential in Ann Arbor if the CUT model and high urban wood utilization were to be established. Detailed studies in both Baltimore, MD and Milwaukee, WI revealed that total cradle-to-gate emissions from lumber and slab production could range between 114 and 268 kg CO₂e per 1 cubic meter of wood, with the vast majority of emissions coming from the kiln-drying process and based on the fuel type used (electric vs. natural gas vs. non-fossil) (USDA Forest Service, 2020). While the kiln-drying process is quite carbon intensive, this localized form of wood sourcing and processing is overall less carbon intensive than traditional lumber which involves greater treatment processing and likely high emissions associated with transportation. Based on these findings from the USDA Forest Service, we can estimate between 3 and 15 metric tons of CO₂e will be emitted to process Ann Arbor’s 12,000 - 23,000 board feet of furniture grade wood (see Appendix F for calculations). The carbon storage potential of this 4- to 8-percent furniture grade wood (44 - 89 metric tons CO₂) outweighs the added carbon emissions associated with further processing (3 - 15 metric tons CO₂e), offering support for the CUT model’s environmental benefits.

The above values for carbon storage potential versus added carbon emission from processing assume that somewhere between 4- and 8-percent of Ann Arbor’s removed above-ground biomass can be transformed into furniture grade merchantable lumber. However, as stated earlier many factors, from level of tree care to tree species, can impact that percentage. Thus, a more dynamic sensitivity analysis of the net carbon abatement potential based on the percent of furniture grade biomass is shown below in Figure 10:

Figure 10: Sensitivity analysis of net carbon abatement potential in Ann Arbor based on percentage of furniture grade wood (ranging from 1% to 10% of total above ground biomass)

% furniture grade wood	1%	2%	4%	6%	8%	10%
Equivalent board feet	2,919	5,838	11,676	17,514	23,352	29,190
CO2 storage (metric tons)	11.1	22.2	44.4	66.7	88.9	111.1
CO2 processing emissions ⁹ (metric tons)	1.3	2.6	5.3	7.9	10.5	13.2
CO2 net gain in storage (metric tons)	9.8	19.6	39.2	58.8	78.3	97.9

For every additional 1% of furniture grade merchantable lumber, the city of Ann Arbor can gain approximately 10 metric tons of net CO₂ storage/abatement. If making the investment to increase urban wood utilization and invest in the necessary infrastructure/partnership for lumber processing, the city should focus on maximizing the capture of furniture grade lumber.

Key Insight
For every additional 1% of furniture grade merchantable lumber, the city of Ann Arbor can gain approximately 10 metric tons of net CO ₂ storage/abatement.

Relative to the BAU scenario of low urban wood utilization in Ann Arbor, application of the CUT model poses a significant opportunity to reduce the city’s emissions from land use change and forestry. If the city invests in infrastructure and partnerships to convert furniture grade wood into durable, high value wood products, then some of the carbon that would have been released in the BAU scenario can be stored long-term. Once this process for increased urban wood utilization is established and localized, the city will have a vested interest in preserving the health of the urban forest and maximizing the percent of capturable furniture grade lumber. From there, the benefits of localization will be cascading - spilling over into other ecological, social and economic co-benefits:

⁹ Assumes an average between processing emission findings in Baltimore and Milwaukee = 191 kg CO₂e per 1 cubic meter wood (= (114 + 268)/2)

Figure 11: CUT Model Direct Benefits and Indirect Co-Benefits

SOCIAL & ENVIRONMENTAL & ECONOMIC BENEFITS OF THE CUT MODEL ARE DEEPLY INTERWOVEN

Direct Benefit:	Indirect Co-Benefits:		
Carbon storage	Reduction in future climate mitigation & adaptation costs	Improved human health through reduced contribution to global warming	
Increased urban tree cover	Healthier air through urban air filtering	Lower energy costs through cooling of urban heat islands	Increased soil nutrients through leaf litter
Job creation (w/ focus on formerly incarcerated)	Community-wide reduction in unemployment	Economic contributions of successfully reentered citizens	Job creation is in the "green / clean economy"
Creation of market for local wood products	Residents able to enjoy locally sourced / produced goods	Reduction in transportation emissions from importing wood products / lumber	Inspiration for new business ventures in the urban wood economy

Current State and Next Steps

While the carbon abatement case for the CUT model is strong in Ann Arbor, there are also barriers to its potential success. Despite the city’s aim to “preserve and enhance the local tree canopy” through the *Living Carbon Neutrality Plan: A2Zero*, a recent study demonstrates that the current state is less than ideal with respect to the health of the local tree canopy - which is critical for its ability to sequester carbon dioxide from the atmosphere (City of Ann Arbor, April 2020). Using data from a Freedom of Information Act request and personal assessment of hundreds of trees in Ann Arbor’s 5th Ward, Ann Arbor resident Danny Maier identified that of the 1,100 trees planted in his ward over the last five years, “62% were not thriving - with 32% in critical condition or dead, 11% in poor condition and 19% in fair condition” (Stanton, 2022).¹⁰ Compared with the results of the most recent city-sponsored tree inventory conducted by the Davey Resource Group (DRG), these findings suggest that the young, newly planted trees are in worse condition than a 2020 baseline. In the DRG inventory, nearly half (48%) of all young trees (0 - 10” DBH) were found to be in good to excellent condition, with only 9% categorized as critical condition or dead (Davey Resource Group, 2020). Given that tree quality decreases with maturity (i.e., only 14% of mature trees > 30” DBH are in good to excellent condition in Ann Arbor), we can anticipate that fewer trees will survive and grow to the necessary size and quality for future furniture grade lumber.

In order for increased carbon sequestration and abatement in the CUT model, urban trees need to be cared for, enabling healthy growth. The current poor state of Ann Arbor’s tree planting and maintenance poses a supreme threat to the efficacy of a circular urban wood economy. For this reason, the CUT model aims to divert disposal fees from the BAU scenario back into planting and maintenance efforts - thereby reducing the high mortality rate of young trees and aiding to increase

¹⁰ The City of Ann Arbor has yet to verify if Mr. Maier’s analysis is accurate, thus they have not yet validated nor refuted these findings.

the size and quality of logs when they are eventually removed and processed. This investment in Ann Arbor's urban tree management will help to bring the most change and benefit on the back-end of high utilization.

Moving beyond Ann Arbor, Urban Ashes plans to replicate this life cycle assessment approach to analyze the carbon abatement potential of the CUT model in other cities. Many cities across Michigan and the U.S. have already expressed interest, with Traverse City and Grand Rapids, Michigan already being incorporated into another pilot study. Data availability will be the driving factor in determining and adjusting the LCA methodology, however the target outcomes will be the same: to evaluate the environmental benefits of high urban wood utilization, and justify the investment in necessary processes, infrastructure and partnerships. The following data availability should be considered in determining the proper LCA methodology:

- Detailed tree inventory, including age, species and condition
 - If unavailable, assume standard values of carbon storage, above ground biomass, and mortality (Nowak, 2020), using resources such as iTree to assess impact where in-depth inventories are missing
- Emission factors and activity data from municipality activities of tree planting, maintenance and disposal
 - If unavailable (as with the city of Ann Arbor), assume standard emissions per project tree (Climate Action Reserve, 2010) and per unit volume of lumber production (USDA Forest Service, 2020)

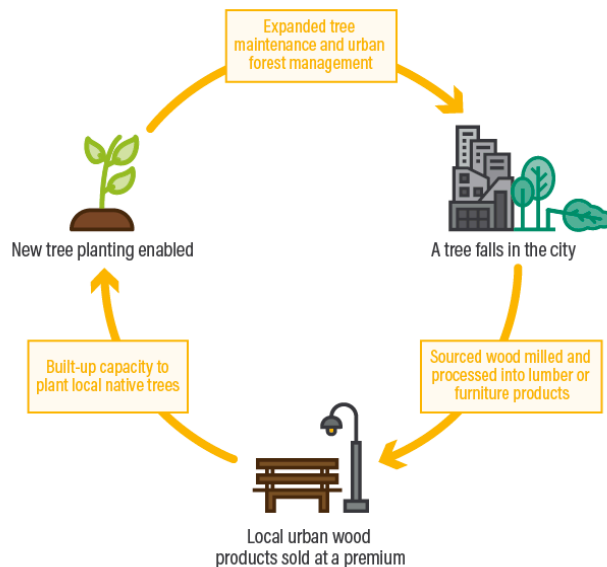
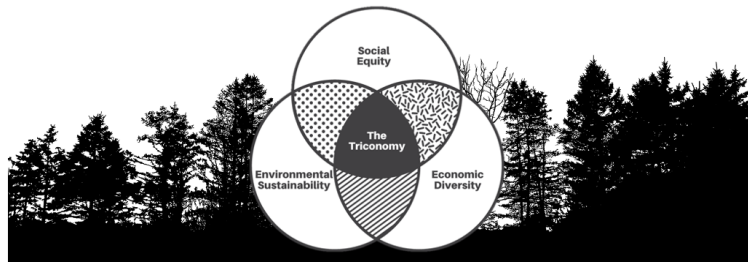
As cities, states and nations look to set aggressive climate action targets, forestry and land use management in urban areas will need to be addressed in a more robust and exhaustive manner. LCA is an effective tool to measure the climate benefits of a circular urban wood economy at various levels. For this case study of Ann Arbor, the carbon abatement benefits, as well as other co-benefits, are apparent and significant.

The Business Model: Driving Profits and Carbon Abatement in Municipalities

Overview

In naturally woody or unpopulated areas, fallen trees, classified as coarse woody debris (CWD), are often left to decompose without human interference. While the “time course of carbon release from CWD is not well understood,” this natural process does not unnecessarily accelerate the carbon release experienced when the ~36 million trees that fall each year in urban areas are burned, mulched, or placed in mixed waste landfills - described hereafter as the business as usual (BAU) scenario (Harmon, 2020). In addition to the carbon impact, the urban wood BAU scenario incurs financial costs related to the equipment, personnel, time, and space required to process the fallen trees through existing or standalone methods. This, combined with longstanding social inequities in employment, create opportunities for the **Triconomy** or “**Reforestation Hub**” circular economy models that are founded on the simple concept that the majority of fallen trees in urban areas are disposed of in ways that are environmentally, economically, and socially inefficient.

Figure 12: The Triconomy and Reforestation Hub Models (Repka, 2022)



Key Insight

Triconomy or “Reforestation Hub” circular economy models are founded on the simple concept that the majority of fallen trees in urban areas are disposed of in ways that are environmentally, economically, and socially inefficient.

The largest processors of fallen urban trees - cities and municipalities - often experience shrinking budgets and are measured by their ability to shrink costs, which erode incentives to invest in urban tree data collection or BAU scenario evaluation. However, academic studies and city-sponsored reports now increasingly highlight the economic opportunities associated with “upcycling” urban wood into lumber, furniture/handmade goods, biochar, or fuel pellets (Lumbercycle). For example, one assessment prepared for the city of Pittsburgh found that “by centrally aggregating and processing urban wood waste, the City could capture up to \$403,111 in lost economic value from removed trees annually while reducing fees paid for wood waste disposal” (Reforestation Hub Assessment). Such positive incremental economic benefits could, if sustained over an appropriate length of time, potentially allow for long-term financial breakeven in covering the costs associated with the setup and ongoing operation of a circular economy urban wood model - the specifics of this timing will vary greatly based on the size, tree canopies, and operational capabilities of the associated city or municipality.

As of October 2020, “slightly less than half of large U.S. cities have established GHG reduction targets” (Markolf, 2020). Many of these cities have goals set 20 to 30 years into the future, and few have tangible short- and mid-term pathways to achieve ambitious carbon reduction goals. While an urban wood circular economy model would itself not fulfill these goals, it is a tangible, short-term method to achieve progress against them. Based on our analysis, 4- to 8-percent of carbon captured in urban wood can be held in merchantable, furniture grade lumber - which offers significant opportunity to capture economic value from this wood while also locking up any carbon dioxide that otherwise would be released back into the atmosphere it left to rot. Further, long-term environmental and biodiversity benefits will follow from the increased frequency and maintenance of tree stock.

Social Benefits

A critical element of Urban Ashes’ model is ensuring employment opportunities for returning citizens. Returning citizens are a vastly underutilized labor force, to the tune of a lost \$78.1 to \$86.7 billion per year, according to the Center for Economic and Policy Research (CEPR, 2016). Providing employment opportunities for returning citizens, in addition to its positive economic implications, is an important way to reduce the likelihood of recidivism (Greater Baltimore

Committee). Businesses that take a triple bottom line approach have the opportunity, and arguably the responsibility, to create new economic opportunities for returning citizens.

Customer Segments

The primary audience for an urban wood circular economy business model are the 225 cities and municipalities with populations between 100k and 225k people (List of US Cities by Population). These cities are primary targets because a significant number of large cities have made fully established GHG reduction pledges (the smallest being Richmond, VA, with a population of 227,000 people), but it's much rarer for smaller cities to make similar pledges (Markolf, 2020). Therefore, impact is readily available in small mid-sized cities.

Ann Arbor, Michigan (with a population of 123,000) has an opportunity to more quickly and easily adopt a new, circular wood cradle-to-gate process with minimal disruptions and costs to existing operations. For example, Ann Arbor already has the necessary machinery to collect fallen trees as well as the space to sort the different types of trees. This can facilitate easy wholesale to local finished product producers. Additionally, cities of this size often have smaller “public works” (or similar) offices that are given broad authority over decisions regarding how to manage a city's waste, recycling, and compost, making the transition to a new system fairly seamless. Ongoing customer acquisition will rely heavily on the ability to demonstrate successful project implementation, quantified economic and environmental benefits, and social benefits (if/when applicable).

After gaining a foothold in the primary customer segment, a secondary market within existing geographies is a logical next step prior to casting a wide economic net. Secondary market targets include large campuses (such as universities or large corporate offices), land developers, and private landowners. It is assumed that by this stage, processors (processing and manufacturing), specifiers (architects and designers), and finished goods partners and capabilities have been identified through working with the primary segment, and the new wood supply can be easily woven into existing and validated, integrated processes.

Key Activities

To successfully grow an urban wood circular economy business, the organization must communicate and sell its key activities (“how it gets done”) related to selling and implementing this new process, including:

- Environmental value assessments that quantify carbon sequestration vs BAU
- Economic value assessments that quantify new revenue generation and/or cost savings vs BAU
- Social value assessments that highlight the potential benefits to be gained by including the employment of returning citizens.

- Client business model generation and process implementation
- Connections to urban wood industry experts
- Grants or private funding identification and application support
- Introductions to key political stakeholders and decision makers
- Assistance in setup of manufacturing and/or process facilities
- Finished product design expertise
- Connections to local and national finished goods retailers
- General circular economy expertise and thought leadership

On a longer time horizon, this should also include the certification of carbon credits generated through carbon sequestration or new tree planting. These credits could then be retired to further GHG reduction goals or sold on existing exchanges as an additional revenue source.

Key Partners

To differentiate its service offering from competitors, an urban wood circular economy business will need to highlight and leverage key partnerships to credibly validate the offering and facilitate speedy process alignment. For example, Urban Ashes has existing relationships with the Urban Wood Network (individuals and entities “dedicated to building urban wood businesses since the early 2000s and united to promote and demonstrate urban wood utilization”), the University of Michigan, local Michigan wood product manufacturers, A Brighter Way (an organization “dedicated to reducing recidivism rates in Washtenaw County by providing programs, resources, advocacy, and creating a supportive community for our friends and family returning home from incarceration”) and national furniture retailers (Urban Wood Network)(A Brighter Way).

A holistic list of partnership “offerings” should also include: large equipment manufacturers, LCA experts, grant writers and editors, geographic survey experts, local ecological professionals, carbon credit certifiers, and local/national companies seeking carbon credits. Finally, access to advanced software tools to create customized LCAs and track progress against BAU scenarios will allow customers to monitor progress independently after the initial engagement.

Revenue Streams

There are multiple possible revenue streams for an urban wood circular economy business, primarily based around consultancy and royalty models, in which a business would take a percentage cut of all wholesale wood or finished products sold in clients’ cities. For Urban Ashes, we would recommend employing a “usage fee consultancy model” be used, given the varied nature, expertise, capacity, and depth of engagement required from the primary customer target (cities and municipalities). Market trends would suggest a \$50-125 range for hourly rates. However, certain model considerations, including a one-time selection fee (e.g., menu of options) or contractor model, does not make sense

in this context, given the nuanced ways of working and varying departmental models of each individual city that will have a direct effect on the number of hours (and overall quantity) of work requested. As such, negotiating terms and project deliverables will be crucial during the initial stages of any engagement and for final revenues.

Grants and traditional private funding sources will continue to play a role in project funding. However, this revenue will go directly to offset costs incurred by customers undertaking the new circular economy business model. Additionally, speaking engagements at conferences, universities, industry events, or community organizations will help to raise brand awareness and supplement ongoing income streams as expertise and network effects grow and deliver further opportunities.

Porter's Five Forces and the Urban Wood Market

The urban wood circular economy industry is not a commonly discussed or well established industry globally or in the United States, but its potential for growth is high as there is an abundance of wasted urban wood in our society and an increased desire to salvage mismanaged waste. To better understand the opportunities available to companies like Urban Ashes entering the urban wood repurposing industry it is helpful to have a deeper grasp on the market they will be entering.

Michael Porter's Five Forces framework serves as an excellent tool to evaluate the attractiveness of a given market and help develop a strategy to enter. The components of the five forces framework includes analysis of new market entrants, threat of substitutes, industry rivals, suppliers, and buyers. Each of these components are reviewed to assess their strength within the selected industry to paint a more clear picture of the challenges a company faces either entering the industry or strengthening its existing position.

While the urban wood circular economy is not a traditional industry and thus may not cleanly align with all of the components within the five forces framework there are still many insights that can be garnered by reviewing the individual sections.

New Market Entrants

Medium - The urban wood circular economy industry can be seen both as difficult and easy to enter depending on the existing infrastructure and equipment within the city or municipality that is being assessed. Barriers to entry are largely based on the knowledge gap that exists between the systems required to set up the circular urban wood economy. Capital investment costs will vary based on location and economies of scale will have a capacity after which they cannot grow, but have not yet been reached. Establishing an urban wood circular economy heavily depends on the willingness of stakeholders to develop partnerships and work together, without the willingness to participate new organizations cannot work.

Threat of Substitutes

Medium - Substitutes in the urban wood circular economy industry can largely be categorized as the business as usual scenario for a given city or municipality. In many cases this is as simple as sending the removed wood to a chipper or to a landfill. Any treatment of urban wood that does not recreate benefit to the community or the economy can be considered a substitute to an organization helping to establish a circular urban wood economy.

Industry Rivals

Low - Competition within the urban wood industry is fairly limited and fragmented at this point in time given the relatively new nature of the idea and concept. Of the companies that do currently operate within the urban renewal market, most of them are focused on a particular state or region, and have not expanded further geographically. Within the regions that do have companies operating in the urban wood revitalization there are rarely more than one company per region. Thus the competition is fairly low, especially when looking into new geographical markets to enter.

Suppliers

Low - The urban wood industry does not have traditional suppliers as you may find in other industries that are continuously dependent on their services. The suppliers within this market could be defined as the companies that sell the necessary machinery or storage space for the wood. In many ways the trees themselves are a needed input to this industry which makes the suppliers the city or municipality that carry jurisdiction over them, however they can also be considered as the customer.

Buyers

High - Buyers within the urban wood industry are numerous and, like suppliers, are not the traditional buyers that are seen in a more typical industry. Buyers can include woodworkers, artists, furniture manufacturers, or anyone commissioning a fine wood product. However, in addition to those that use the wood, buyers are also the cities, municipalities, large landowners that are purchasing the services provided by the urban wood revitalization companies to help them establish the circular economy. The complexity of stakeholders does make operations within this market more difficult, because all parties need to be in agreement and willing to work together to make the economics work. Overall the buyer power within the industry is very high, because it is easy for cities and municipalities to ignore the social, environmental, and economic benefits of adopting an

urban tree revitalization program and continue their operations as is. While the impacts of this change are positive, there are no legal pressures to adopt this change.

Urban Ashes' Market Success

When assessing the success of Urban Ashes entering the urban wood circular economy it is important to look at each of the forces individually. New market entrants overall have medium power, however if limiting the scope to just the offerings Urban Ashes can provide then this power is closer to low. Urban Ashes has extensive industry knowledge and expertise unparalleled and not easily replicated by competitors. The threat of substitutes is medium strength given the ease at which a municipality can choose the business as usual option for their operations. While increased interest for more sustainable practices is driving customers to switch to more innovative solutions, like Urban Ashes, at this time there is no imminent pressure to do so. The strength of industry rivals is low given the unique offering that Urban Ashes is providing. Very few companies are operating in the urban wood circular economy industry, and those that are have shown less knowledge around the industry than Urban Ashes. Supplier strength is low in the urban wood market because urban wood recycling is a ubiquitous problem. Finally, buyer power is currently high considering how new the Urban Ashes offerings are in the industry. Urban Ashes will require significant marketing to convince their customers of the value of their product.

Social Impact: Positive Externalities of the CUT Model in Michigan

Urban Ashes' Social Impact History

Since Urban Ashes began in 2008, providing employment opportunities for formerly incarcerated individuals (FIIs) has been a cornerstone of the Urban Ashes business model. Paul was first introduced to the idea of employing FIIs by a fellow member of the Urban Wood Project. He had previously been unaware of the plight of this marginalized group but came to believe that they were “one of the most, if not the most, discriminated against labor pools,” and therefore wanted to provide meaningful employment opportunities for individuals from this population. Through his close relationship with Ann Arbor Recycle, a nonprofit recycling organization, Paul was able to connect with various organizations that worked with those facing barriers to employment, including returning citizens. Through his network, he made more connections and eventually created a workshop through a partnership with Work Skills in Brighton, MI, that had a long history of working with both returning citizens and those with disabilities. In this partnership, Work Skills provided space and labor, and Urban Ashes provided materials, training, and general support.

In addition to working with formerly incarcerated individuals, Paul also came to realize the value in working with young people who had had contact, or were at risk of contact, with the justice system. The summer of 2015 or 2016 (Paul can't remember which), Urban Ashes had a particularly busy season and needed help for a limited amount of time. At the time, his son had been volunteering at an organization in Ypsilanti called Educate Youth. Paul got in contact with the Executive Director, Gail Wolkoff who helped Paul to recruit 5 teens to work at Urban Ashes for the summer. According to Paul, almost all of these teens had had some level of interaction with the justice system. Some of Urban Ashes' adult workers who had formerly been incarcerated mentored these teens in order to help them avoid a similar fate. After a successful summer of working with these young students, Paul continued to seek out opportunities to work with youth. He got in contact with a Juvenile probation officer, Steve Hall, who would occasionally bring in teens for a few hours in the shop to help make picture frames and to have a discussion about what was going on in their lives, which was facilitated by an Urban Ashes employee and returning citizen, Aurelio Dorris.

Paul aimed to employ approximately one third returning citizens, one third youth who have had contact with the justice system, and one-third individuals without barriers to employment at any given time. While the reality fluctuated, over the years Urban Ashes worked with approximately 50-60 returning citizens and 30-40 high school students, by Paul's estimation. At any given time, there were at most 15 Urban Ashes employees, and the composition of employees was closer to 8-9 returning citizens, 1-2 high school-aged students, and 1-2 workers without barriers to employment. When asked about turnover rates of members of the various groups he employed, Paul said that turnover rates were roughly comparable between returning citizens and those without employment barriers). Around 2014, Urban Ashes started to become recognized for their progressive labor practices. Urban Ashes had contact with such organizations as Sustainable Brands, Leaders' Quest, AIG, PwC, Crédit Agricole, and Google. Urban Ashes even had the opportunity to escort Google leadership on a site visit to a local prison, where Google then decided to establish a tech program for inmates.

In terms of the benefits of working with returning citizens, Paul sees many. They include:

- Buy-in and loyalty once trust is established
- The opportunity to teach learning skills and workforce skills
- The satisfaction derived from making a positive impact on a vulnerable and highly discriminated against population

Working with individuals from this population does, however, come with its challenges. From the outset, gaining trust is a “tough mountain to climb” and takes time and energy to achieve. However, Paul has stated that once mutual trust is achieved, considerable commitment, buy-in, and pride quickly follow. Another challenge, according to Paul, is helping returning citizens “de-program” the expectation of being told what to do, and instead empowering employees to think on their own, think on their feet, and to take initiative.

He has said that working with returning citizens is one of the most important aspects of the work Urban Ashes has done. Paul wishes that other organizations would “drop the fear factor” and start to offer employment opportunities to those who were formerly incarcerated. He has stated, “These folks definitely have different challenges... You do need to be often more flexible, particularly early on, and especially if they’re fresh out” but that it is “the...human thing to do.”

Federal Data on the Cost of Incarceration

In a 2017 study, The Prison Policy Initiative analyzed the true cost of incarceration, looking at areas that go beyond direct costs that are required to house and feed the US’s incarcerated population. By including costs associated with judicial and legal (criminal law only) proceedings, public corrections agencies (e.g., healthcare and correctional officer wages), policing, Civil Asset Forfeiture, bail fees and costs to families, the Prison Policy Initiative revealed a ballpark annual cost figure of US \$182 billion (see Appendix G for full breakdown)(Wagner & Rabuy, 2017). The estimated missed revenue from lack of access to employment for returning citizens is between \$78.1 billion to \$86.7 billion (CEPR, 2016). Even after an individual is released from prison, there are incredible costs to their families and society, with one study showing that around half of newly-released individuals (122 participants) were unemployed, two-thirds received public assistance, and many relied on female relatives for financial support and housing (Western et al., 2014). Although these numbers provide a more accurate picture of the true cost of incarceration relative to numbers coming out of state and county systems, they are still somewhat superficial in terms of the enormous missed opportunity in maximizing human capital and potential – both during and after imprisonment.

Key Insight

The estimated missed revenue from lack of access to employment for returning citizens is between \$78.1 to \$86.7 billion.

With over 2 million people currently incarcerated in the US, those individuals with skills and talents

are provided the opportunity to contribute the full capacity of their human capital to society. Further, once released from the prison system, many have to secure housing and resources alone, often making it difficult to maintain stable employment; this assumes they are able to secure employment at all given the longstanding societal stigmas against formerly incarcerated individuals.

Local Perspectives on Incarceration

In an interview with our team, newly-elected Washtenaw County Prosecutor Eli Savit cited employment as a top challenge for returning citizens and a key factor to reducing recidivism. He further explained the notion of untapped human potential in terms of how many returning citizens are employed in positions below their qualifications and skills, often in the foodservice industry. To prepare incarcerated individuals for life outside of the prison system and to encourage employers to hire returning citizens, researchers and activists highly support correctional education programs and vocational training programs during incarceration as a tool for returning citizens to both obtain post-release employment and avoid recidivism (Davis et al., 2013).

Aaron Sukanuma, who was previously incarcerated, is now the Reentry Coordinator of the Washtenaw County Sheriff's Office. In a conversation, he emphasized that the county is always looking to foster connections with organizations and companies that can help provide reentry support. He said that more “healing” jobs were needed and that companies like Urban Ashes are well-positioned to help fill that gap.

As part of our research, we spoke with four formerly incarcerated individuals to understand their perspectives on the importance of employment in the reentry process. A common theme throughout our interviews was the issue of stigma. Returning citizens often face challenging—if not insurmountable—stigma from the criminal records attached to their names. Washtenaw County Prosecutor Eli Savit argued that the stigma of having been incarcerated was incredibly harmful to individuals and to entire communities.

One interviewee spoke about how difficult it was to secure stable employment. He said, “It was really, really difficult to get a job... People didn't really trust me. I found it really difficult for anyone to trust me with security. It was really tough within the first two years of getting out. I didn't really have a stable job.” He now works as a security guard for a restaurant and has been in the position for about six months. When asked about what resources he wished he would have had when he was first released, one interviewee said “I would have liked for people to have been less judgmental.” The stigma of incarceration is one of the biggest barriers for returning citizens to overcome.

Employment was a clear barrier in the reentry process. One returning citizen we spoke with said, “Employment was really my problem. Getting a job was a problem. That was all I wanted.” This individual now works informally for a family, without health insurance or sufficient days off every week. While she says she feels good about her employment situation, she admits, “[I] have to work on weekends. That's one of the challenges. I don't really have time for myself.” She typically works seven days per week, without days off unless she is sick or otherwise unwell. Barriers to employment can cause returning citizens to accept jobs that may be ripe for abuse. Another individual we spoke with said that when you reenter the job market, “you do far more than you're getting paid for” because you don't have a sense of self-worth. Having been in prison makes returning citizens more vulnerable.

One returning citizen we interviewed said he felt incredibly lucky to have stable employment and that, “I’m just really grateful to have a job... I’m just focused on keeping this job for a while, making sure that I have a stable income.” Another individual said of employment, “For me, it’s been everything. I had nothing. Like I said, I was in a homeless shelter... I worked two jobs just to get on my feet.” From the conversations we had, it was clear that employment is an integral part of a successful reentry process.

Support is also a key element needed to ensure the successful transition of returning citizens back into society and the workforce. On this topic, one interviewee said, “There should be more counseling for people who just got out... It feels almost like, ‘what do I do now that I’m out?’”

Key Insight
Returning citizens cite stable employment as an integral part of their successful reintegration process.

Other Success Stories

Urban Ashes is not, in fact, unique in its focus on employing formerly incarcerated individuals. Dave’s Killer Bread and Greyston Bakery, best known as the brownie baker for Ben & Jerry’s ice cream, are two well-known Second Chance Employers—employers that offer opportunities to those with criminal records. Dave’s Killer Bread (DKB) was established in 2005 by Dave Dahl after having served 15 years in prison. It was a natural choice for Dave’s Killer Bread to be a Second Chance Employer given Dave’s background; now approximately one third of DKB employees have a criminal history. While DKB found success since its founding, in 2011 it was recognized by Inc. Magazine as one of the fastest growing 5,000 companies (Dave’s Killer Bread). Since 2016, DKB bread can be found in all 50 states, and internationally in Canada and Mexico. In 2015 in order to help other businesses adopt a similar employment model, DKB went on to found the DKB Foundation, which provides guidance to companies looking to become Second Chance Employers.

Greyston Bakery, another Second Chance Employer, was founded in Yonkers 1982, with an “Open Hiring” ethos, which means that Greyston does not ask interested candidates for a resume, interview, or background check; they are simply placed on a waiting list and when an opportunity becomes available, they are offered a job. This ethos originated from a desire to give jobs to people who had barriers to employment and to reduce poverty in the community (Marquis, 2021a). Greyston has had considerable success; they are the brownie provider for Ben & Jerry’s ice cream and their brownies are sold nationwide in Whole Foods Market and Wegman’s. Mike Brady, Greyston’s CEO, has noted that Greyston has little turnover because employees “appreciate their jobs and hold onto them” (Tran, 2015). This is one of the key benefits to the business since turnover costs \$3,520 to replace an \$11/hour worker, based on 2019 data (Rosenberg, 2019). A 2017 Northwestern study based on over 1 million job applicants highlights that there is no difference in firing rates between employees with criminal histories versus those without, while there is a 13% lower rate of turnover for those with criminal backgrounds (KelloggInsight). One of Greyston’s

formerly incarcerated employees said, “I was afraid of having to resort back to what I was doing before. I now have a sense of pride and feel good about coming to work” (Tran, 2015).

Inspired by Greyston’s approach to hiring, the beauty giant The Body Shop began implementing the Open Hiring model in 2019 in its distribution centers and has since expanded to all of its North American retail locations due to the impressive success of the program (Marquis, 2021b). In an interview with Forbes, Nicolas Debray, President of The Body Shop Americas said, “When you give people access to something they have been struggling to find, like employment, they will work hard to keep it. In our case, we saw an overall improvement in both retention *and* productivity. In fact, during a time when many employers, especially retailers and warehouses, are scrambling to find employees, we have filled all our available positions. Many employees have said that just getting a second chance has given them a reason to be excited to go to work” (Marquis, 2021b). The Body Shop has plans to expand this program to its locations in the UK and Australia (Marquis, 2021b). When The Body Shop began the program in its warehouse in 2019, it saw turnover drop 60%—from 38% in 2018 to 14% in 2019 during the November holiday season (Peters, 2020).

Key Insight

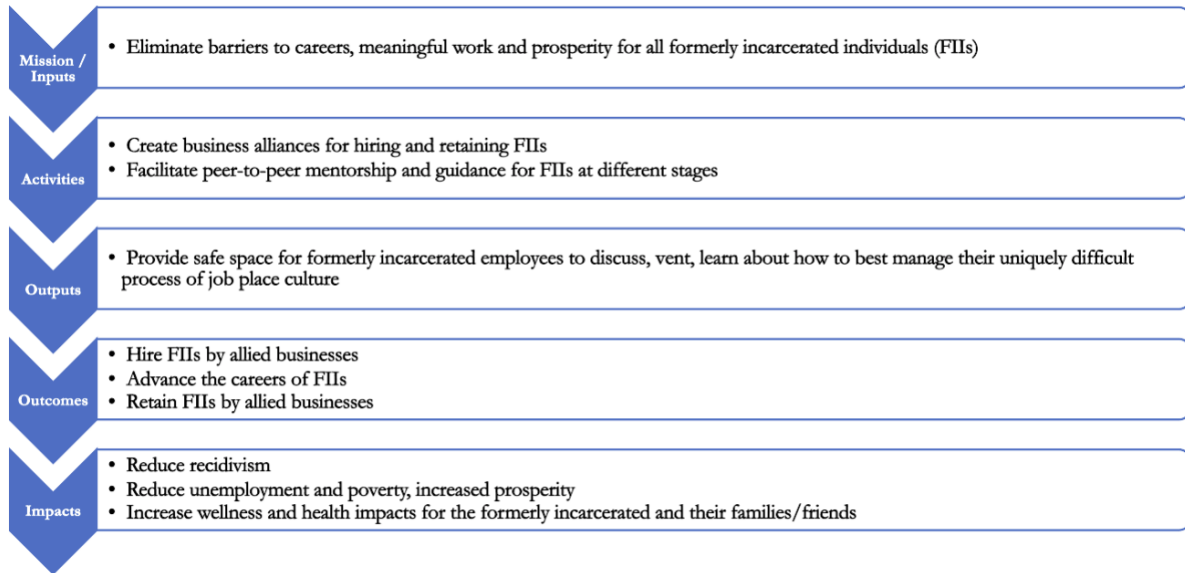
According to a study by Northwestern University, there is a 13% lower turnover rate for formerly incarcerated employees.

Theory of Change Model

In order to access the benefits of providing meaningful employment opportunities for returning citizens, we have developed a theory of change that outlines a way in which we envision this opportunity coming to fruition. If implemented, this model presents the opportunity to reduce unemployment, poverty, and recidivism and to increase overall wellbeing of returning citizens. With greater access to employment opportunities created through business alliances and mentorship programs, returning citizens will become less likely to recidivate and will be able to secure a stable livelihood that will help not only themselves, but also their families and communities.

Figure 13: Theory of Change

SOCIAL IMPACT BENEFITS: THEORY OF CHANGE



Recommendations

As part of its business offerings, Urban Ashes should lend its expertise in working with returning citizens to municipalities and other entities it works with to encourage the consideration of working with this population. Paul has a wealth of knowledge and experience working with returning citizens and is able to speak to both the joys and challenges of working with formerly incarcerated individuals.

There are four main organizations and programs that Ann Arbor area businesses seeking to work with returning citizens should consider partnering with. They are:

Community Corrections: This program seeks to divert individuals from the criminal justice system when possible. There are multiple aspects to this program, which include community programs and partnerships to provide alternative sanctioning options for offenders and jail programs that allow early release of eligible inmates, among others.

Peer-2-Peer program: This program pairs peer mentors called Community Outreach Workers with those on probation with the goal of supporting offenders to secure and maintain employment, providing access to resources, and decreasing substance use, among others.

A Brighter Way: This nonprofit aims to reduce the recidivism rate in Washtenaw County by providing key services to returning citizens, including mentoring programs, resources, and advocacy.

Youth Justice Fund: This nonprofit focuses on assisting those who were sentenced to prison as youths by providing support as it relates to housing, employment, healing and health, transportation, and

education.

The data is clear; those who are imprisoned and those released from prison are a severely under-utilized resource that costs the United States billions of dollars every year in lost productivity, to the tune of roughly \$80 billion in addition to the \$182 billion of direct costs of incarceration. Failing to tap into the human capital that returning citizens offer is not just doing a disservice to those individuals, but harms society and the economy. Creating and ensuring a greater volume and depth of opportunities for this population serves not only to benefit individuals, but entire communities and society at large. With proper implementation, businesses can expect to see turnover rates decrease.

Hearing from returning citizens themselves, it is clear that employment is both a key barrier to and an opportunity for greater stability and purpose in life after prison. Formerly incarcerated individuals are at risk of finding themselves in precarious employment situations, making more widely available options all the more important so that they do not have to resort to accepting the most dangerous or abusive employment situations. With time, greater opportunities will also help destigmatize returning citizens as people realize that there is little reason to maintain these barriers to employment. Finally, support in the form of counseling and peer groups will help ensure an unruffled integration process.

As Urban Ashes expands beyond the greater Ann Arbor region, it must continue to build its network of non-profit organizations, government agencies, and key community and political figures in order to create the systems needed to support a thriving returning citizen workforce. Washtenaw County is invested in reducing recidivism and diverting individuals away from prison. As Urban Ashes expands its reach, it should continue to work closely with the County and relevant municipalities in order to facilitate the development of networks between these entities and local businesses.

Conclusion

After comparing current BAU practices in Ann Arbor urban wood disposal, analyzing city tree inventory and carbon storage potential, and the economic and social impact of the CUT diversion model, the CUT Model is a viable model that engenders positive environmental, social, and economic outcomes in small- and medium-sized towns seeking to better manage and utilize their urban wood waste.

From an environmental standpoint, our LCA analysis shows that Ann Arbor sees a reduction in its carbon storage capacity of 1,111 metric tons of CO₂ per year in the BAU management of its urban trees. At this rate of tree planting versus tree removals, the city will see more emissions from decomposing trees by 2030 than from added carbon sequestration from new trees. By adopting the CUT model, for every additional 1% of furniture grade merchantable lumber, the city of Ann Arbor can gain approximately 10 metric tons of net CO₂ storage/abatement. Extrapolating these data to other cities, states, and nations seeking to set aggressive climate action targets, the CUT model has potential to at least partially address carbon reduction targets in urban areas. For this case study of Ann Arbor, the carbon abatement benefits, as well as other co-benefits, are apparent and significant, and we expect they will easily translate to other locales, too.

The CUT model offers a pathway for the majority of fallen trees in urban areas to be disposed of in ways that are economically beneficial. Cities and municipalities often face small budgets for urban tree removal/disposal. Thus, programs structured in the fashion of the CUT model are few and far between. However, academic studies and city-sponsored reports now increasingly highlight the economic opportunities associated with “upcycling” urban wood into merchantable goods. Such positive incremental economic benefits could, if sustained over an appropriate length of time, potentially allow for long-term financial breakeven in covering the costs associated with the setup and ongoing operation of a circular economy urban wood model. In Ann Arbor and beyond, the economic gains from the CUT model can more than make up for the shift in structure, and yield long-term benefits for cities that pursue them for years to come.

The social impact aspect of the CUT model holds significant potential for individuals returning from incarceration, as well as for other disadvantaged groups. The CUT model presents the opportunity to reduce unemployment, poverty, and recidivism, as well as increase overall wellbeing of returning citizens and their communities. With greater access to employment opportunities created through business alliances and mentorship programs, returning citizens have an opportunity to secure a stable livelihood that will help not only themselves, but also their families and communities. One returning citizen highlighted just how integral employment has been to her reentry process: “For me, it’s been everything.” Utilizing more inclusive hiring practices not only enables stability, but also affords dignity.

Key Questions to Consider for Urban Wood Circular Economy Models Going Forward

Carbon Abatement / Life Cycle Assessment Questions

- What levels of merchantable lumber can Ann Arbor and similar cities achieve under the CUT model?
- How can cities better take care of trees during their lifetime to maximize end-of-life utilization?
- Which species of tree is best suited for reclamation and merchantability in various regions of the country? How does that align with demand from off-takers / retailers?
- What is the “low-hanging fruit” for municipalities seeking to improve upon their urban wood circularity?
- What software or tools exist for cities / municipalities to easily track their carbon abatement over time due to program implementation?

Business Questions

- What strategic partnerships can help propel players in this industry? Do specific sectors hold particular promise in this regard (e.g., furniture manufacturers, local government officials, etc.)
- How many employees are needed to drive early growth? What is the ideal number of employees in a steady-state?
- What kinds of skills will ideal employees bring to maximize the likelihood of success?
- How will activities be tracked and evaluated over time to assess long-term progress towards environmental and economic goals?
- What level of educational materials, case-studies, or tools are needed for seamless stakeholder buy in and support of new program implementation?
- What is the short and long-term consumer demand for finished goods made from recycled urban wood? What is the price premium (if any) the market will allow for such products?
- How will Urban Ashes choose to position itself in the nascent market of circular, urban wood businesses? What are the 3-5 differentiating characteristics that can drive value for clients?
- What is the TAM/SAM/SOM of urban wood reuse businesses in the US? What percentage of market share does Urban Ashes hope to achieve in one, three, and five year's time?

Social Impact Questions

- What partnerships should businesses create with municipalities and nonprofits that maximizes the communal benefits of employing returning citizens?
- What support systems need to be in place to ensure the successful integration of returning citizens into this model?
- How will successful programs be measured? (e.g., what metrics will be used?)

Appendix

Appendix A

Press Release: Urban Ashes announces commitment to NextCycle Michigan as a partner



URBAN ASHES ANNOUNCES COMMITMENT TO NEXTCYCLE MICHIGAN AS A PARTNER

URBAN ASHES JOINS PARTNERS COMMITTED TO RECOVERY CHALLENGE IN MICHIGAN

April 20th, 2021 Ann Arbor, Michigan – Urban Ashes announces its commitment as a NextCycle Michigan Partner to maximize opportunities for developing recycling, recovery, and sustainable businesses in Michigan.

Urban Ashes is excited to be one of [more than 30 Michigan companies, organizations and nonprofits](#) partnering in such a critical program allowing us to target the missed opportunities and wasted natural resources within the urban forests of Michigan. It is estimated by the US Forest Service that Michigan misses out on the potential of a virtually untapped \$27.6 Million industry and the 1.7 Million Tons of furniture grade lumber, lost to the waste stream every year. Urban Ashes is on a mission to help the state dramatically change this incredible missed opportunity.

As a national brand and a longstanding leader at the vanguard of the urban wood movement, we are uniquely positioned to leverage and share our 10 years as a manufacturer and over 25 years in the urban wood world. As a partner with NextCycle we are geared to maximize the value and environmental impact of such an overlooked opportunity by collaborating with our municipalities and corporations to build Circular UrbanWood Triconomies™.

New in 2021, NextCycle Michigan, a Michigan Department of Environment, Great Lakes, and Energy (EGLE) initiative, is an idea incubator that provides technical support, expert mentoring, and resources. This program offers an innovative pathway to identify and incubate ideas that will grow Michigan's recycled materials supply. NextCycle Michigan is funded through state funds and private and non-profit partnership investments identified through the Renew Partnership Portal. Funding partners sustain the program and increase opportunities for statewide recovery projects.

As a NextCycle Michigan Partner, [Urban Ashes](#) is committed to sustaining the program and increasing opportunities through new projects, partnerships, collaborative efforts, or direct support for NextCycle Michigan Innovation Challenges.

Each year, Michigan landfills accept 6.8 million tons of material that could be recycled. Recovering 2.7 million tons of that material could generate \$9 billion in potential annual labor income and \$33 billion in potential economic output, elevating Michigan's diversion rate to 45%.

Currently, Michigan has gaps at every link in the recycling supply chain – access to recycling, comprehensive collection and sorting, robust end markets and material processing, and innovative recycled-content manufacturing.

Michigan needs collaboration, innovation, partnerships, investment, and commitment to improve recycling supply chains and catalyze development of domestic end markets.

More information on NextCycle Michigan can be found on the [NextCycle](#) website.

More information on Urban Ashes can be found on the [Urban Ashes](#) website.

Appendix B

ANN ARBOR'S LIVING CARBON NEUTRALITY PLAN (A2ZERO), Strategy 6 Goal 3 (City of Ann Arbor April 2020)

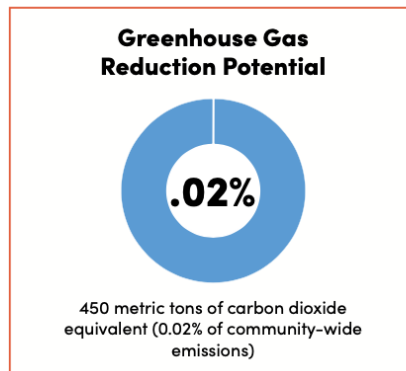
3. PRESERVE AND ENHANCE THE LOCAL TREE CANOPY

This action begins with conducting an analysis and creating a shared inventory of the local tree canopy as well as updating the master plan to incentivize shade tree and vegetation planting for private projects. This will increase the impact of shade trees as a natural cooling mechanism in urban areas. Tree type and placement are important considerations in advancing this action.

Vision for Preserving and Enhancing the Local Tree Canopy

A properly managed and diverse urban forest increases resiliency against invasive insects that carry diseases and impact the human population. By planting diverse tree species, the community benefits from increased shade and decreased heat island effects, while supporting biodiversity. Careful planning and management help the City mitigate and adapt to changing climate conditions.

<p>Party Responsible for Implementation</p> <ul style="list-style-type: none"> City Forrester/Public Works, with support from the Office of Sustainability and Innovations 	<p>Equity Impacts</p> <p>Studies have found that tree canopies in low-income communities and communities of color tend to be smaller. Ann Arbor's first Health Impact Assessment should be updated to ensure equitable enhancement of tree canopy in underserved neighborhoods is prioritized.</p>
<p>Collaborators / Project Co-Designers</p> <ul style="list-style-type: none"> Local nurseries Neighborhood associations Ambassadors 	<p>Indicators of Success / Goals</p> <p>By 2030, 10,000 new trees are planted on city property and in the right of way and 10,000 new trees are planted on private property.</p>
<p>Assumptions</p> <ul style="list-style-type: none"> City continues to plant 1,000 trees per year on City property and in the right of ways Community plants 1,000 trees per year on private property; These trees all survive Over the duration of this Plan, a single tree will absorb 48 pounds of carbon dioxide 	



By 2030, the **Preserve and Enhance the Local Tree Canopy** strategy will have achieved all of its potential greenhouse gas emissions reductions.

Appendix C

Inventory Analysis for Ann Arbor public urban trees, adapted from October 2020 tree inventory by DRG (Davey Resource Group, 2020)

Trees by Species and Age

Total #public trees		51,010											
Source: Davey Institute Oct. 2020 tree invent		Species											
common name		Norway Maple	Sugar Maple	Honeylocust, thornless	Flowering crabapple	Red maple	London planetree	Silver maple	Littleleaf linden	Northern red oak	other		
scientific name		Acer platanoides	Acer saccharum	Gleditsia triacanthos	Malus hopa	Acer rubrum	Platanus x acerifolia	Acer saccharinum	Tilia cordata	Quercus rubra	N/A	Total	
Age	Young (0-10")	2,653	2,122	1,857	1,326	1,326	1,061	796	796	796		13,793	26,525
	Established (11-20")	1,581	1,265	1,107	791	791	633	474	474	474		8,223	15,813
	Maturing (21-30")	714	571	500	357	357	286	214	214	214		3,714	7,141
	Mature (>30")	153	122	107	77	77	61	46	46	46		796	1,530
Total		5,101	4,081	3,571	2,551	2,551	2,040	1,530	1,530	1,530		26,525	51,010

Trees by Age and Condition (general)

Source: Davey Institute Oct. 2020 tree invent		Condition			
		Poor to Dead	Fair	Good to Excellent	Total
Age	Young (0-10")	2,387	11,406	12,732	26,525
	Established (11-20")	1,898	9,488	4,428	15,813
	Maturing (21-30")	1,071	4,642	1,428	7,141
	Mature (>30")	291	1,025	214	1,530
Total		5,647	26,561	18,802	51,010

Trees by Age and Condition (detailed)

Source: Davey Institute Oct. 2020 tree inventory		Age				
		Young (0-10")	Established (11-20")	Maturing (21-30")	Mature (>30")	
Condition	% dead	1.17%	248	198	111	30
	% critical	0.89%	188	149	84	23
	% poor	9.20%	1,951	1,551	875	238
	% fair	51.88%	11,406	9,488	4,642	1,025
	% good	31.30%	10,813	3,760	1,213	182
	% very good	5.49%	1,897	660	213	32
	% excellent	0.06%	21	7	2	0

Annual Tree Removal by Age and Species (detailed)

ANNUAL TREE REMOVAL BY AGE AND SPECIES													
Source: Davey Institute Oct. 2020 tree invent		Species											
common name		Norway Maple	Sugar Maple	Honeylocust, thornless	Flowering crabapple	Red maple	London planetree	Silver maple	Littleleaf linden	Northern red oak	other		
scientific name		Acer platanoides	Acer saccharum	Gleditsia triacanthos	Malus hopa	Acer rubrum	Platanus x acerifolia	Acer saccharinum	Tilia cordata	Quercus rubra	N/A	Total	
Age	Young (0-10")	25	20	17	12	12	10	7	7	7		129	248
	Established (11-20")	20	16	14	10	10	10	8	6	6		103	198
	Maturing (21-30")	11	9	8	6	6	6	4	3	3		58	111
	Mature (>30")	3	2	2	2	2	2	1	1	1		16	30
Total		59	47	41	29	29	24	18	18	18		306	588

Appendix D

Impact Assessment Results: Current Stock of Carbon Stored in Ann Arbor trees (in kg CO₂)


CO ₂ STORAGE CAPACITY BY AGE AND SPECIES (kg)												
Source: https://www.fs.usda.gov/ccrc/tool/cufr/												
Age		Species										
		common name	Norway Maple	Sugar Maple	Honeylocust, thornless	Flowering crabapple	Red maple	London planetree	Silver maple	Littleleaf linden	Northern red oak	other
	scientific name	<i>Acer platanoides</i>	<i>Acer saccharum</i>	<i>Gleditsia triacanthos</i>	<i>Malus hopa</i>	<i>Acer rubrum</i>	<i>Platanus x acerifolia</i>	<i>Acer saccharinum</i>	<i>Tilia cordata</i>	<i>Quercus rubra</i>	N/A	Total
Age	Young (5 ^Y)	203.5	261.3	205.8	99.4	97.8	156.4	130.4	143.0	109.9	156	4365941.819
	Established (15 ^Y)	1,614.5	2,071.6	2,370.5	1,351.0	1,088.4	1,643.6	1,783.6	1,238.0	1,631	1,644	26488254.99
	Maturing (25 ^Y)	4,101.5	5,253.5	7,377.5	3,233.9	3,159.1	4,743.9	5,822.7	3,281.1	5,722	4,744	34048909.75
	Mature (35 ^Y)	5,548.6	9,613.6	9,245.5	3,233.9	3,159.1	6,865.1	12,508.7	4,564.9	7,046	6,865	10496024.7
	Total	11,468	17,200	19,199	7,918	7,504	13,409	20,245	9,227	14,509	13,409	75,399,131

*Note: London Planetree not available in Carbon Calculator. Average carbon storage values used for London Planetree and Other species.

Impact Assessment Results: Annual carbon storage lost from tree removal in Ann Arbor (in kg CO₂)

CO ₂ RELEASE DURING DECOMPOSITION (kg CO ₂)												
Age		Species										
		common name	Norway Maple	Sugar Maple	Honeylocust, thornless	Flowering crabapple	Red maple	London planetree	Silver maple	Littleleaf linden	Northern red oak	other
	scientific name	<i>Acer platanoides</i>	<i>Acer saccharum</i>	<i>Gleditsia triacanthos</i>	<i>Malus hopa</i>	<i>Acer rubrum</i>	<i>Platanus x acerifolia</i>	<i>Acer saccharinum</i>	<i>Tilia cordata</i>	<i>Quercus rubra</i>	N/A	Total
Age	Young (5 ^Y)	5,056	5,194	3,579	1,235	1,215	1,554	972	1,066	819	20,206	40,897
	Established (15 ^Y)	31,887	32,731	32,772	13,341	10,748	12,985	10,568	7,335	9,665	168,799	330,831
	Maturing (25 ^Y)	45,729	46,858	57,578	18,028	17,611	21,156	19,476	10,975	19,137	275,030	531,576
	Mature (35 ^Y)	16,791	23,274	19,585	4,893	4,780	8,310	11,356	4,144	6,397	108,031	207,563
	Total	99,463	108,058	113,515	37,497	34,354	44,005	42,372	23,520	36,018	572,066	1,110,867

Sample Output of Total CO₂ stored in a Midwestern 15" Norway Maple from CUFR Tree Carbon Calculator (USDA)



CUFR Tree Carbon Calculator

Developed by the Center for Urban Forest Research
Pacific Southwest Research Station
US Forest Service

In partnership with the California Department of
Forestry and Fire Protection




Figure 1 Project Data entry

Data name	Data entry	Units	Description
Flag1	1		Tree dbh selected
Flag2	1		Shade & climate selected
Climate Zone	12 (Midwest)		Midwest
Electricity CO2 emissions factor§	395	(kg/MWh)	
Electricity CH4 emissions factor§	0.0030	(kg/MWh)	
Electricity N2O emissions factor§	0.0017	(kg/MWh)	

§required for energy project

Help Commands

Help for Selected Cell

Help Menu

Figures 6 & 9 Tree and Building Data entry

Enter Tree data below one tree at a time, then record results

Data name	Data entry	Units	Description
Species code and scientific name	ACPL (<i>Acer platanoides</i>)		norway maple
DBH (in)	15	DBH (in)	41.1 ft high
Tree azimuth	1		N
Tree distance class	1		Adj
Building vintage	1		pre-1950
air conditioning equip.	1		Central air/heat pump
Heating equip.	1		natural gas
Heating emissions factor- CO ₂ §	53.1	(kg/MBtu)	
Heating emissions factor CH ₄ §	0.0059	(kg/MBtu)	
Heating emissions factor N ₂ O§	0.0001	(kg/MBtu)	

Output Help

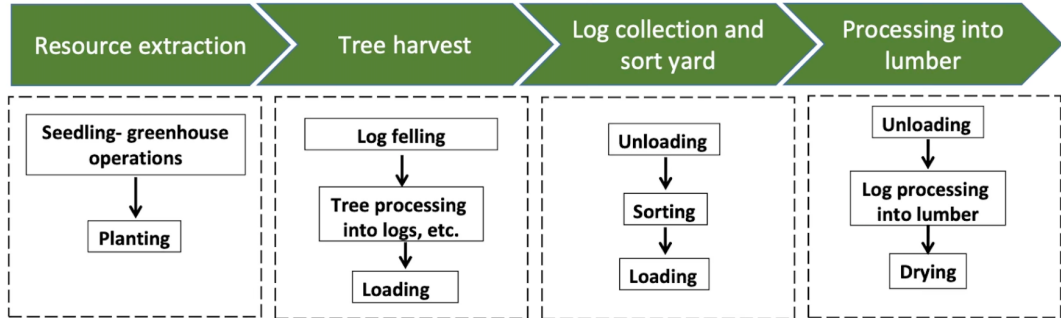
Figures 7-10 Carbon Calculator Results (annual)

Energy reductions		Emission reductions (CO ₂ equivalents)			CO ₂ Sequestration	Total CO ₂ Stored	Above ground biomass
Cooling	Heating	Cooling	Heating	Cooling + Heating	(A value of 0.0 indicates no tree growth)		(dry weight)
kWh/tree	MBtu/tree	(kg/tree)	(kg/tree)	(kg/tree)	(kg/tree)	(kg/tree)	(kg/tree)
105.70	3.879	41.8	206.6	248.4	136.8	1614.5	686.3
kWh/tree	GJ/tree	lb/tree	lb/tree	lb/tree	(lb/tree/year)	(lb/tree)	(lb/tree)
105.70	4.093	92.2	455.6	547.7	301.6	3,559.5	1,513.0

Appendix E

System Boundary of USDA Forest Service LCA (USDA Forest Service, 2020)

Urban wood utilization stages



Appendix F

Board feet of furniture grade lumber from Ann Arbor's annually removed trees

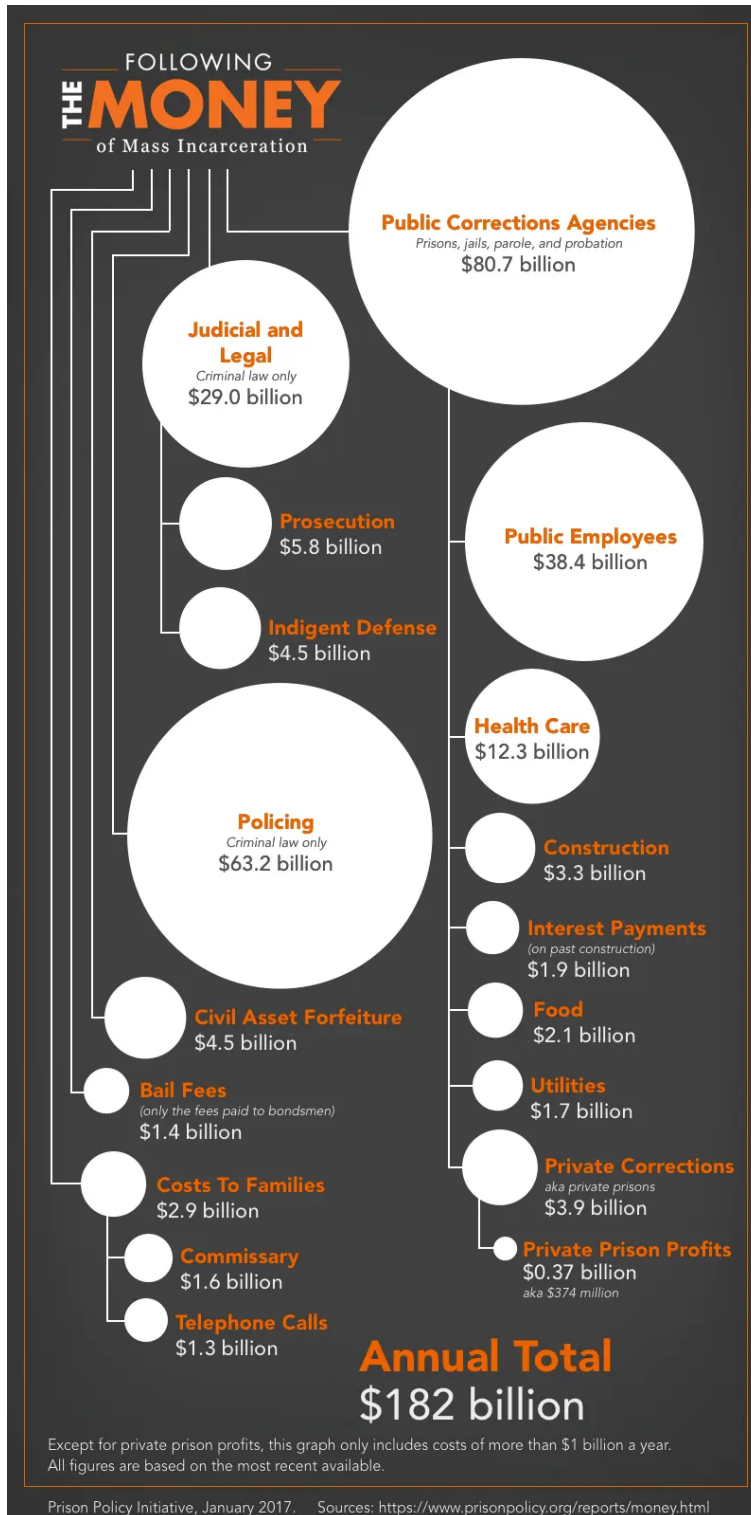
	Total Biomass of removed trees	Furniture grade biomass = 4%	Furniture grade biomass = 8%
kg dry weight (source: USDA Tree Carbon Calculator)	472,194	18,888	37,776
cubic meters (source: inchcalculator)	689	28	55
board feet (423.8 board feet per m ³)	291,905	11,676	23,352

Processing emissions for Ann Arbor furniture grade lumber (based on % furniture grade and study location)(USDA Forest Service, 2020)

Processing Emissions (metric tons CO ₂ e)	Per m ³ lumber product	4% furniture grade	8% furniture grade
Baltimore study	0.114	3.141	6.282
Milwaukee study	0.268	7.384	14.767
Average	0.191	5.262	10.525

Appendix G

Prison Policy Initiative: True cost of incarceration (Wagner & Rabuy, 2017)



Appendix H

Urban Ashes Summary Pitch Deck



Costs and Failures of Underutilization Of Environmental and human resources

MISSED OPPORTUNITY

\$753 Million
Per YR

STRAIN THEORY

Lack of Monetary Success
Positive Societal Support

Gangs & Crime

LANDFILL COSTS

Substantial tipping fees

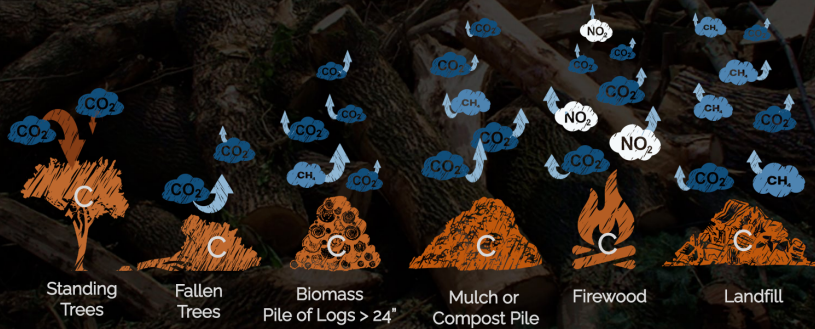
114.5 million metric tons
CO₂-equivalent emissions

INCARCERATION vs EDUCATION COSTS

\$40,227 vs \$20,598
Per YR

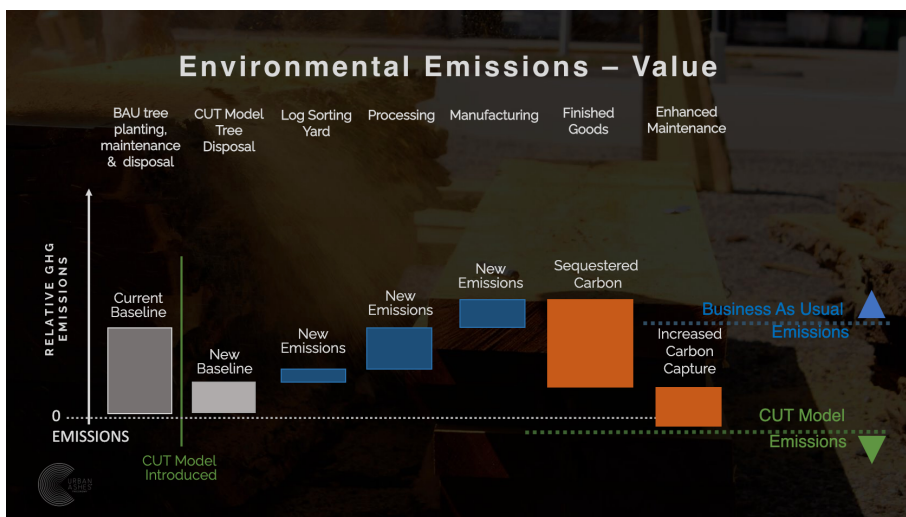
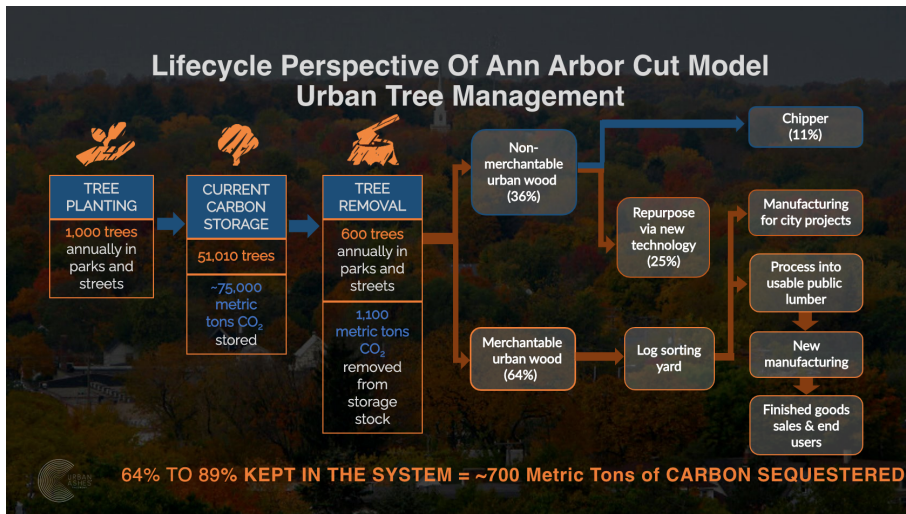
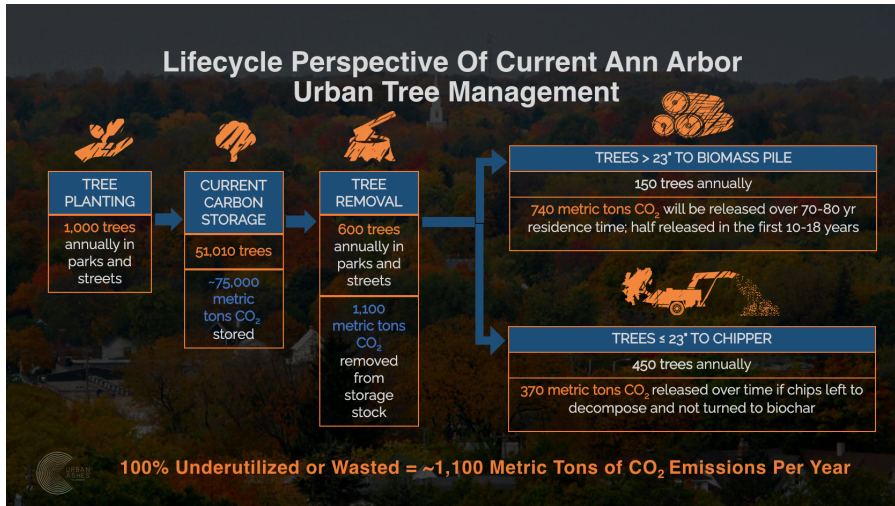


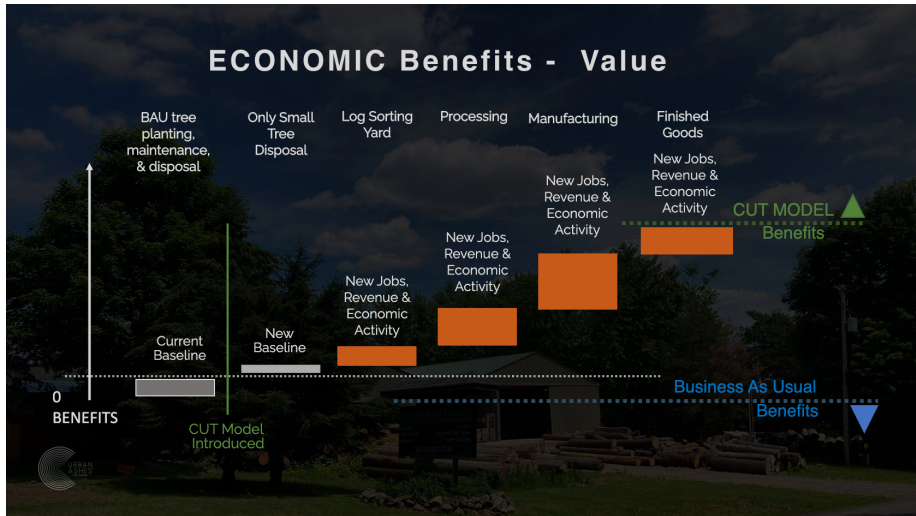
Business as usual for urban tree removal and Disposal Across American Cities



CARBON Emissions Equal ~ 22.9 million Tons of CO₂







URBAN ASHES Team



Paul Hickman
CEO & Founder



Marcy Hickman
CIO



John Pontillo
Contracted Triconomy Systems Developer



Anna Norman
Contracted Triconomy LCA Specialist




University of Michigan
Graduate Student & Triconomy Systems Developers




Michigan State University
Graduate Student & Triconomy Systems Developers


Milestones




1998




2005




2009 to 2019



2017



2017



2019

Urban Ashes picture frame company

Cities are Primed

<p>Michigan</p> <p><u>In Process</u> Ann Arbor</p> <p><u>Pending</u> Grand Rapids Traverse City</p>	<p><u>Waiting</u> Detroit Capital Area Kalamazoo Trenton</p>
--	--

<p><u>Interested</u> Syracuse, NY Pittsburgh, PA Eugene, OR</p>

Partnerships Established and growing














MAJOR COMPANIES ARE INTERESTED IN A NEW URBAN WOOD SUPPLY STREAM FOR THEIR MANUFACTURING

ANTHROPOLOGIE



HAWORTH




Room&Board

Lilypad

Leon

Daika

The Process and Where You can Help

Phase 1 – Completed

Phase 2 - Turnkey CUT Model - fully developed pilot with all the partners, tools and expertise needed for Ann Arbor to push the GO BUTTON and primed cities next up, to begin ADOPTION.

Seeking Partnerships And Matching Funds for a pending \$170,000 EGLE grant, to bring this to implementation for both Ann Arbor and commencing on primed cities.

Phase 3 - Implementation

Phase 4 – Scale Across the Country



Thank You for your time
&
Your consideration in our work
We cannot do this alone!

Paul Hickman

Urbanashes.com pmh@urbanashes.com 734·546·9657

References

About Us. Dave's Killer Bread. Retrieved on 16 April 2022 from

<https://www.daveskillerbread.com/about-us>

A Brighter Way, <https://www.abrighterway.org/>.

Center for Economic and Policy Research (CEPR). (2016). *The Price We Pay: Economic Costs of Barriers to Employment for Former Prisoners and People Convicted of Felonies*.

<https://cepr.net/images/stories/reports/employment-prisoners-felonies-2016-06.pdf>

Center for Sustainable Systems. (2021). *Industrial Ecology slides*.

City of Ann Arbor. (2020). ANN ARBOR'S LIVING CARBON NEUTRALITY PLAN. City of

Ann Arbor.

https://www.a2gov.org/departments/sustainability/Documents/A2Zero%20Climate%20Action%20Plan%20_3.0.pdf

City of Ann Arbor Forestry Public Works. (n.d.). The Urban Forest. a2gov.org. Retrieved April 22, 2021, from <https://www.a2gov.org/departments/forestry/Pages/The-Urban-Forest.aspx>

Climate Action Reserve. (2010, Marc 10). *Urban Forest Project Protocol V1.1*. Climate Action Reserve. Retrieved March 18, 2022, from <https://www.climateactionreserve.org/wp-content/uploads/2009/03/Urban-Forest-Project-Protocol-Version-1.1.pdf>

Cunningham, Bob. (2021, February 11). “Cambium Carbon Cuts Waste, Builds Green Future.” arbordayblog.org, Arbor Day Foundation, <https://arbordayblog.org/urban-and-community-forestrygreen-infrastructure/cambium-carbon-cuts-waste-builds-green-future/?fbclid=IwAR1eRSG4k5jJzs0uSHC2Ix3Ja48dwHcRQkQQHzWgwZTsV83gsphqDVLiMNU>. Accessed 01 March 2021.

Davey Resource Group. (2020, October). *Tree Inventory Summary Report: City of Ann Arbor, Michigan*.

Davis, L., Bozick, R., Steele, J., Saunders, J., & Miles, J. (2013). Evaluating the Effectiveness of Correctional Education: A Meta-Analysis of Programs That Provide Education to Incarcerated Adults. RAND Corporation, Sponsored by the Bureau of Justice Assistance. https://www.rand.org/content/dam/rand/pubs/research_reports/RR200/RR266/RAND_RR266.sum.pdf

Ellen MacArthur Foundation. (n.d.). *Ellen MacArthur Foundation: How to build a circular economy*. Retrieved April 1, 2022, from <https://ellenmacarthurfoundation.org/>

Greater Baltimore Committee, *Quick Guide to Hiring Returning Citizens: Benefits, Resources, and Programs* [Brochure]. <https://gbc.org/wp-content/uploads/2017/11/Quick-Guide-HRC-Final-Small-Format-V2-LR.pdf>

Harmon, M.E., Fasth, B.G., Yatskov, M. et al. Release of coarse woody detritus-related carbon: a synthesis across forest biomes. *Carbon Balance Manage* 15, 1 (2020).

<https://doi.org/10.1186/s13021-019-0136-6>

Hickman, P. (n.d.). Municipality + Governmental Consulting. urbanashes.com. Retrieved April 19, 2021, from <https://urbanashes.wixsite.com/urbanashes-2021/municipalities-government>

inchcalculator. (n.d.). *Lumber and Hardwood Weight Calculator*. Inch Calculator. Retrieved March 18, 2022, from <https://www.inchcalculator.com/lumber-weight-calculator/>

ISO. (2006). ISO 14040:2006(en), *Environmental management — Life cycle assessment — Principles and framework*. ISO. Retrieved March 18, 2022, from

<https://www.iso.org/obp/ui/#iso:std:iso:14040:ed-2:v1:en>

“List of United States Cities by Population.” *Wikipedia*, 21 Mar. 2022,

https://en.wikipedia.org/wiki/List_of_United_States_cities_by_population.

Lumbercycle. (2020). *Upcycle Urban Wood*. <https://www.lumbercycle.org/>.

<https://www.lumbercycle.org/upcycle-urban-wood/>

Markolf, Sam, et al. “Pledges and Progress: Steps toward Greenhouse Gas Emissions Reductions in the 100 Largest Cities across the United States.” *Brookings*, Oct. 2020,

<https://www.brookings.edu/research/pledges-and-progress-steps-toward-greenhouse-gas-emissions-reductions-in-the-100-largest-cities-across-the-united-states/>.

Marquis, Christopher. (2021a, June 4). *How A Bakery Is Breaking Down Barriers To Employment Through Open Hiring and Job-Development Programs*. Forbes.

<https://www.forbes.com/sites/christophermarquis/2021/06/04/how-a-bakery-is-breaking-down-barriers-to-employment-through-open-hiring-and-job-development-programs/?sh=30ecbd7c1659>

Marquis, Christopher. (2021b, November 11). *With Expanded Open Hiring Program, The Body Shop Creates A More Inclusive and Supportive Work Environment*. Forbes.

<https://www.forbes.com/sites/christophermarquis/2021/11/01/with-expanded-open-hiring-program-the-body-shop-creates-a-more-inclusive-and-supportive-workplace/?sh=6fbc0ddbcaea>

Mcperson, E. & Nowak, David & Heisler, Gordon & Grimmond, Christine & Souch, C & Grant, Richard & Rowntree, Rowan. (1994). “Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project.” Proceedings of the 7th national urban forest conference.

Nowak, David, et al. (2019). “Annual biomass loss and potential value of urban tree waste in the United States.” *Urban Forestry & Urban Greening*, vol. 46, pp. 1-9.

Nowak, David J.; Coville, Robert; Endreny, Theodore; Abdi, Reza; Van Stan, John, II. (2020). “Valuing urban tree impacts on precipitation partitioning.” In: Van Stan, J., II; Gutmann, E.; Friesen, J., eds. *Precipitation partitioning by vegetation: a global synthesis*. Cham, Switzerland: Springer: pp. 253-268.

Pacitti, M. (2013, September 06). URBAN ASHES—Using Salvaged Wood to Make Artful Frames. *artbusinessnews.com*. Retrieved April 19, 2021, from <https://artbusinessnews.com/2013/09/urban-ashes-using-salvaged-wood-to-make-artful-frames-by-michael-pacitti/>

Peters, Adele. *The Body Shop will start hiring the first person who applies for any retail job*. (2020, February 12). Fast Company. <https://www.fastcompany.com/90462746/the-body-shop-will-start->

hiring-the-first-person-who-applies-for-any-retail-job

Pitti, A. R., Espinoza, O., and Smith, R. (2020). "The case for urban and reclaimed wood in the circular economy," *BioRes.* 15(3), 5226-5245.

Preston, S. (2022). Interview with Shaun Preston, Conducted by Anna Norman. Via Zoom.

“Reforestation Hub Assessment: Prepared for the Arbor Day Foundation and the City of Pittsburgh.” *Cambiumcarbon.com*, <https://cambiumcarbon.com/wp-content/uploads/2021/11/Pittsburgh-Assessment-Final.pdf>.

Repka, Mary, and James Anderson. “Seizing the Value of Fallen Trees.” *Greenbiz*, 18 Feb. 2022, <https://www.greenbiz.com/article/seizing-value-fallen-trees>.

Rosenberg, Tina. (2019, May 29). No Background Check, Drug Test, or Credit Check.

You’re Hired! *New York Times*. <https://www.nytimes.com/2019/05/29/opinion/greyston-bakery-open-hiring.html>

Should You Hire Someone with a Criminal Record? (2017, February 3). KelloggInsight.

<https://insight.kellogg.northwestern.edu/article/should-you-hire-someone-with-a-criminal-record>

Stai, S. M., P. E. Wiseman, and K. Fernholz. (2017). “Urban Wood Utilization in Virginia, North Carolina, and Georgia”, 19. Minneapolis, MN: Dovetail Partners, Inc.

Stanton, R. (2022, January 30). Two-thirds of trees planted by city of Ann Arbor not thriving, study finds. *MLive.com*. <https://www.mlive.com/news/ann-arbor/2022/01/two-thirds-of-trees-planted-by-city-of-ann-arbor-not-thriving-study-finds.html>

Tran, Mai P. (2015, June 1). *Brownies and Jobs: Greyston Bakery Employees Get a Second Chance*. The National Reentry Resource Center.

<https://nationalreentryresourcecenter.org/resources/brownies-and-jobs-greyston-bakery-employees-get-second-chance>

Urban Wood Network, <https://urbanwoodnetwork.org/>.

USDA. (n.d.). *CUFR Tree Carbon Calculator (CTCC) | Climate Change Resource Center*. USDA Forest Service. Retrieved March 18, 2022, from <https://www.fs.usda.gov/ccrc/tool/cufr-tree-carbon-calculator-ctcc>

USDA Forest Service. (2020, September). *Life Cycle Assessment of Lumber and Slab Production from Freshly-Cut Wood from Urban Forests*.

Wagner, P., & Rabuy, B. (2017, January 25). Following the Money of Mass Incarceration. [prisonpolicy.org](https://www.prisonpolicy.org/reports/money.html). <https://www.prisonpolicy.org/reports/money.html>

Western, B., Braga, A., Davis, J., & Sirois, C. (2014, October). Stress and Hardship After Prison. Harvard Department of Sociology.

<https://scholar.harvard.edu/files/brucewestern/files/trans08.pdf>