How to Transition Chicago to a Circular Economy

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Executive Summary

Linear economy models extract resources, create products and services, sell them to consumers, and discard waste. This model relies upon finite resources, produces waste, and leads to environmental degradation. Circular economy models, by contrast, reduce resource and energy usage, reduce costs, increase profits, and lead to more sustainable practices. Drawn from research on several nations, states, municipalities, and organizations, we identify the top four approaches used around the world to transition toward a circular economy model: (1) stricter regulations on waste, (2) improved energy efficiency and greenhouse gas reductions, (3) educational campaigns, and (4) intra- and inter-sector collaboration. We offer suggestions regarding how these four approaches can be applied in the Chicago area within the context of existing initiatives.

Introduction

In today's economy, products are made, consumed, and thrown out in a one-time use linear model that prioritizes convenience over anything else. This model begins through extraction of natural resources to produce a product and ends at the point of discard of the product. This approach exhausts finite resources on one end of the model while creating a buildup of waste on the other end of the model. Additional waste, loss, pollution, and costs occur throughout the linear model.

The circular economy is an alternative model to the linear economy that does not deplete resources and contribute to continued environmental destruction. This model keeps products in circulation in the economy, reuses products and components, and reduces costs, resource extraction, and waste. While this model is slowly being adopted by nations, states, cities, and businesses around the world, this paper addresses the challenge of how to support increased adoption of this model in the Chicago area.

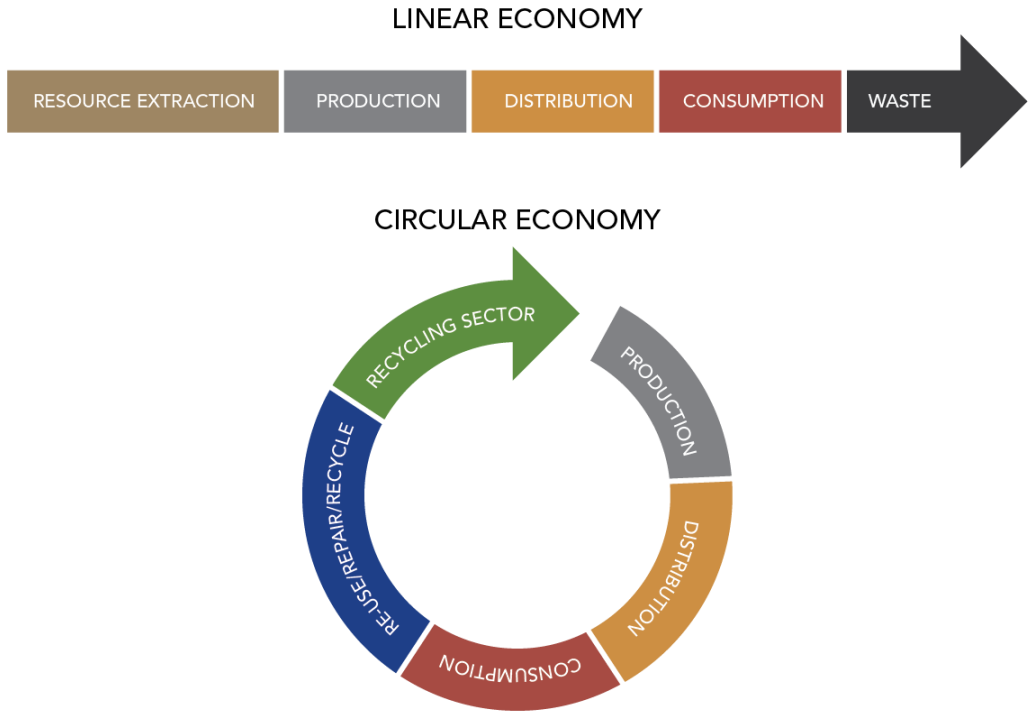

Image source: Sustainable Brands

A circular economy as described by the Ellen MacArthur Foundation is an economic cycle that keeps the value in all components of the production chain so they can be utilized in multiple steps of the production cycle, avoiding the landfill for as long as possible (Ellen MacArthur Foundation, 2014). An example of this could be a clothing company that also uses old clothes and fabric scraps to fill furniture and has a policy that allows customers to give back the furniture after its lifetime to be refurbished and resold. A circular economy is necessary in order to ensure sufficient natural resource reserves for years to come and to minimize landfill

wastes. In order to move forward with this sustainable economic model in Chicago, it is necessary to raise awareness through education, while getting policy-makers to implement more stringent laws and regulations in areas like waste management, extended producer responsibility, and preferential taxes.

Background

Most current models of production focus on a singular output and don't consider what happens after consumption. This culture of take, make, and dispose is not sustainable as the population of humans continues to grow, still depending on the finite natural resources on earth. This is the linear economy, an economic model that begins at the point of raw material extraction and ends at the point of product disposal thus leading to resource depletion, pollution, and environmental destruction.

An alternative system has been proposed. In order to keep up with the demand for goods, it is crucial to switch to a system centered around reuse, resource efficiency, and waste reduction. One such model, the circular economy, is being advanced by the Ellen MacArthur Foundation. There are a number of practices that define and support the circular economy.

1. **The use of waste as a valuable resource**. Waste has historically been viewed as a product without economic value or practical use. In the circular economy, waste is viewed as a viable resource to be used and reused in place of other materials. This can result in cost savings by avoiding the purchase of materials and using the waste materials instead or it can result in the creation of an income stream as companies can sell this byproduct to other companies that can use the product as an input to their processes. To achieve this, products should be designed to use non-toxic renewable resources that can be returned, disassembled, and reutilized. By reusing waste rather than disposing of it, the circular economy can help us move toward zero waste.
2. **The use of renewable energy**. In the circular economy, emphasis is placed on using renewable energy rather than fossil fuels or other finite sources of energy. Nuclear energy is not included in this definition of renewable energy.
3. **Product usage rather than ownership**. Another defining characteristic of the circular economy is a focus on producing a service based upon product utilization rather than product ownership. The focus is on becoming users and consumers rather than owners. This also requires company investment in take-back, extended producer responsibility mechanisms, and customer repair services.
4. **Extending the life of products and their circulation in the economy**. The circular model is conceptualized as a series of cascades in which products remain in the economy to extend the life of the product and reduce resource usage. Human-made technical products go through the following cascades in progressive order: usage of the original product by the original user → maintaining/repairing products by the original user to prolong the product's lifespan → reusing or redistributing the product through a service provider to a secondary user → refurbishing or remanufacturing the product through a product manufacturer into a nearly new product → recycling the product through a parts manufacturer to extract the component parts for new or different products.

Biological products go through the following cascades in progressive order: edible food products are consumed with excess products redistributed to other consumers → non-consumable biological products become feedstock for other uses such as energy, animal feed, or farming.

5. **Internalize costs**. In both technical and biological instances, waste and negative externalities are minimized and products should be non-toxic to be safely reabsorbed into the biosphere. This allows products to be priced in a way that reflects their true social, economic, and environmental costs. Following are six principles that underly the circular economy.

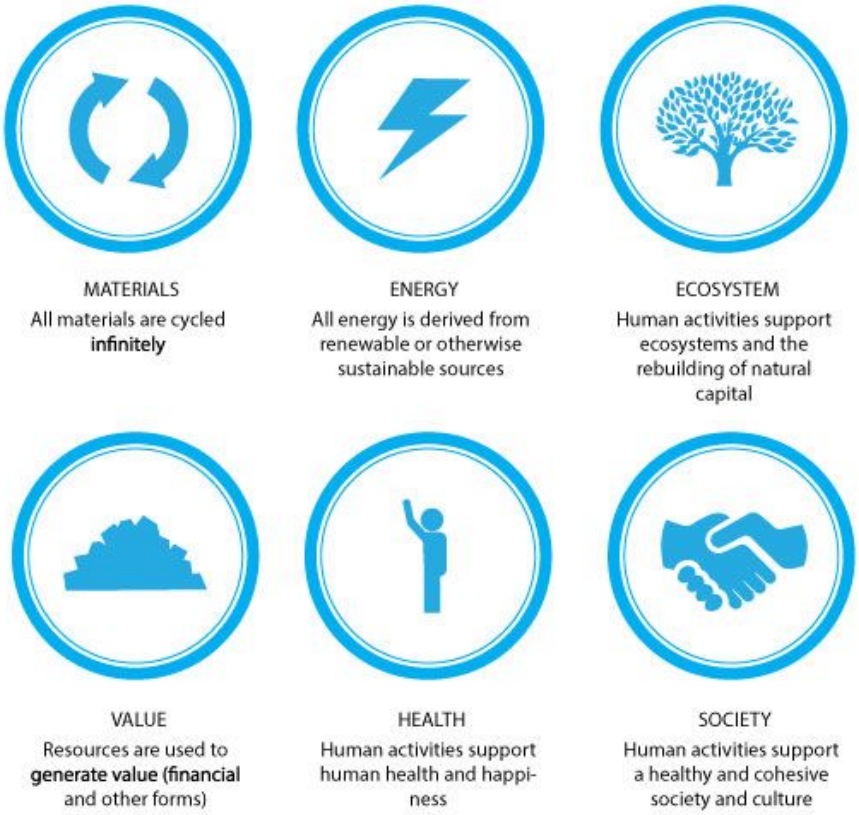

Image source: Circle-economy.com

Challenges in implementing the circular economy model include

1. **Redesign of products**. There are additional expenses connected with redesigning products at the production level
2. **Logistics of supply chains**. Companies must work with both upstream and downstream suppliers. Upstream suppliers must provide renewable non-toxic inputs while downstream suppliers must work to establish take-back mechanisms.
3. **Resistance to change**. Both companies and customers may be resistant to the concept of products to be used rather than owned and the company's responsibility to internalize costs, resume ownership of products, redesign

nontoxic products for disassembly, and move toward renewable inputs and renewable energy.

Nonetheless, the circular economy has been adopted by numerous countries, cities, and companies as a means to reduce waste, reduce reliance on finite resources, reduce costs while increasing profits, and create an independent, energy efficient economy. For example, according to the Ellen MacArthur Foundation's 2012 report, if cell phones were optimized for a circular economy, the cost of remanufacturing a phone would be reduced by 50% (Ellen MacArthur Foundation, 2014). This cost reduction gives companies a greater chance for profits and consumers would enjoy an updated phone model at an affordable price. Another benefit of this model comes in the form of municipal profits. The Ellen MacArthur Foundation also found that the UK could create an annual income stream of $1.5 billion by processing food waste from households and businesses (Ellen MacArthur Foundation, 2014). Turning trash into profit makes it possible to provide more public services from which everyone can collectively benefit. In these examples, producers, consumers, and the government are able to profit while saving natural resources and reducing the human impact on our earth.

Research and case examples from Europe, Asia, North America, Australia and South America provide abundant evidence that a circular economy is plausible on all scales and has the potential to be a larger movement in America. At all levels (national, state, and municipal), our research found that the most common approach toward the implementation of a circular economy was to develop legislation focused on stricter waste regulations. A variety of strategies and tactics are used to implement the legislation (rebates, incentives, targets for reduction, restricted items from trash bins, improved labeling, increased availability of recycling and composting, standards for building, EPR requirements, training, education).

The second most common approach uncovered through our research differed by level of implementation (Appendix A). There was a focus on educational campaigns at a national level (public education and school-based curriculum), more stringent regulations for energy efficiency and greenhouse gas emissions at a state level, and inter- and intra-sector collaborations at a municipal level (research, incentives, waste valorization, certifications). The challenge we are faced with is how to support this transition in the Chicago area.

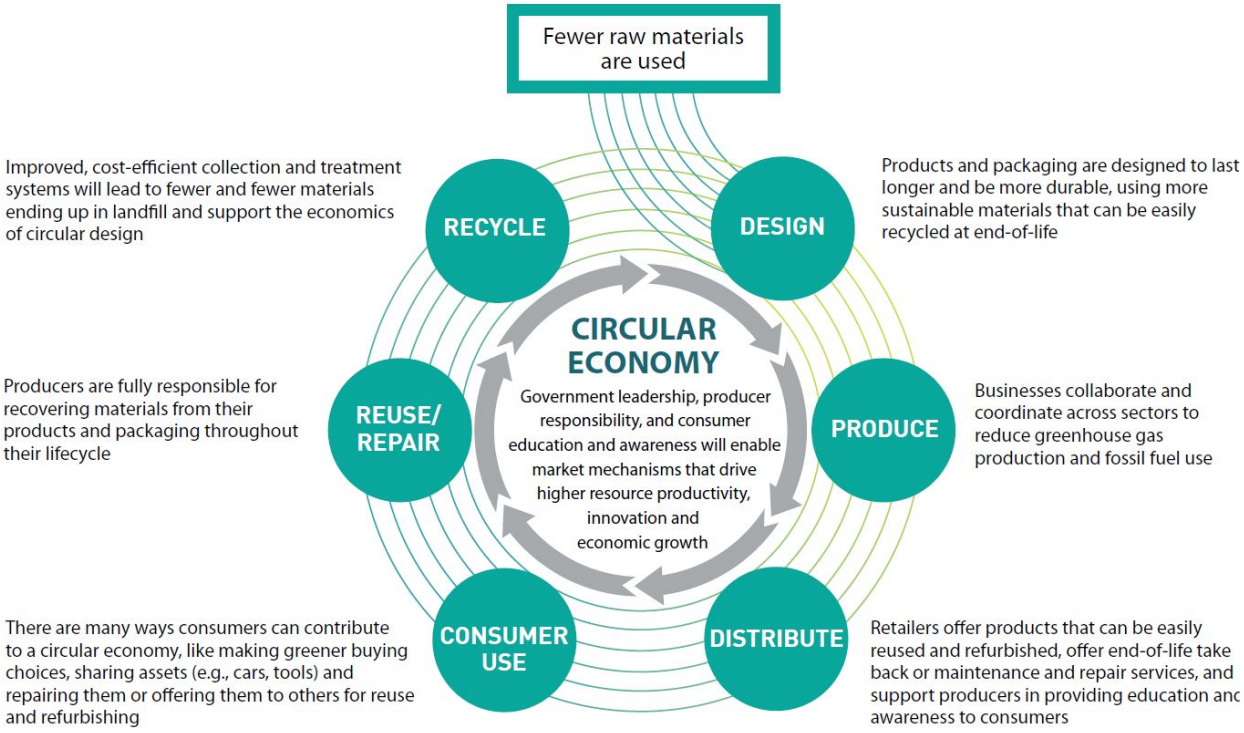

Image source: Government of Ontario (2017)

Solution: Four Target Areas to Transition Chicago to a Circular Economy

We have conducted extensive research to learn how the circular economy has been implemented by others around the world at a national, state, municipal, and business level. Based upon research of others' examples and successes, four areas have emerged as the predominant approaches utilized by others to support the creation of a local circular economy:

1. **More stringent waste regulations**. Strategies and tactics widely adopted by nations, states, municipalities, and businesses adopting circular economy principles include extensive extended producer responsibility mandates, restrictions on items in waste bins, increased opportunities for recycling and composting, improved labeling for recyclable items, increased targets for recycling, landfill diversion, and reuse, incentives and training to repair items, higher standards for C&D waste, and a larger network of resale shops.

2. **Increased energy efficiency and GHG reductions**. Strategies and tactics widely adopted by others include increased energy efficiency measures: rebates, tax breaks, incentives, loans, standards for new construction and existing structures, standards for HVAC systems, retrofitting or replacing inefficient appliances, and investment in

green/clean energy job development. These efforts are used in conjunction with practices to improve air quality and reduce greenhouse gas emissions: ban on new incineration plants, reduction targets for waste-to-incineration, increased fuel efficiency standards, carbon sequestration, research, renewable/clean energy, and regional cap and trade.

3. **Educational campaigns**. Strategies and tactics widely adopted by others include school-based education: the inclusion of circular economy in school-based curriculum, environmental literacy requirements, and environmental education requirements. This is used in conjunction with public education: informative websites that identify actions individuals and businesses can take, information about sustainable food systems, incentives to encourage reuse and second-hand shopping, town hall meetings, municipal committees, and pilot or demonstration projects.

4. **Collaboration among stakeholders**. Strategies and tactics widely adopted by others include collaboration between higher education, government, business and industry, non-governmental/nonprofit institutions, and the public. These collaborations result in research, training and education, collaborative problem solving and solution generation, waste reutilization partnerships, innovation in business models, value chains, and product/service design, consumer education and participation, and the creation and adoption of certification schemes.

Four Target Areas to Transition Chicago to a Circular Economy

Chicago Efforts in Four Target Areas

The next step is to determine Chicago's efforts in each of the four target areas and identify opportunities to move toward a closed loop circular economic model. Chicago's Climate Action Plan (City of Chicago, 2008) aligns with these four target areas as it seeks to reduce 90% of waste by 2020 and improve energy efficiency in 50% of commercial and residential buildings. Chicago's target is to achieve a 30% reduction in energy usage along with other energy efficiency strategies while simultaneously adopting more renewable energy and low-carbon transit options. Clearly, public education and collaboration among stakeholders will be necessary for success. These four areas of waste, energy efficiency/GHG reductions, public education, and collaboration should serve as the starting point for Chicago's entryway toward a circular economy.

Waste Regulations

Waste regulations were implemented by 100% of the countries, states, cities, and businesses in our study. Specific to waste in Chicago and Illinois, Chicago's Waste Characterization Study found that paper (29.5%), organics (29%), plastic (12.5%), and C&D (12%) account for 83% of the City of Chicago's municipal waste (Camp Dresser & McKee, 2010). The Illinois Commodity/Waste Generation and Characterization Study found that paper (28.3%), C&D (22.5%), organics (18.8%), and plastic (11.2%) account for over 80% of municipal solid waste across the state of Illinois (Camp Dresser & McKee, 2009). Cook County, Illinois has pre-existing laws regarding demolition debris that could transition into a state-wide law. San Francisco and Vermont have both adopted successful waste diversion policies that could serve as a model for Chicago to create environmentally friendly initiatives and more jobs in waste management. Therefore, the four material categories of paper, organics, plastic, and C&D represent the greatest opportunity for stricter regulations that will target waste reduction and could help Chicago reduce 80% of its landfill waste thus moving the city closer to zero waste and a more circular model.

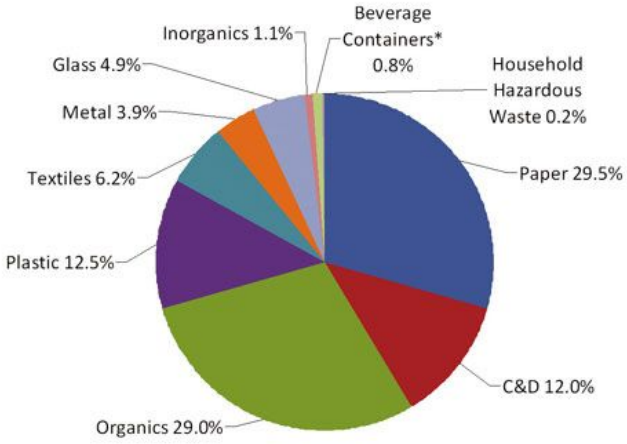

Figure 3. DSS- and Privately-Collected Waste Composition

***Beverage Containers include only water bottles and coated milk/juice cartons**

Image source: Camp Dresser & McKee Inc. (2010)

Energy Efficiency and GHG Reductions

Our research revealed that at a state level, more stringent regulations for energy efficiency and greenhouse gas emissions were the second most common approach toward implementing circular economy principles. Specific to GHG emissions in Chicago, the latest inventory found that stationary emissions were the largest contributor (70%) followed by the transportation (26%) and waste sectors (4%) (AECOM, 2017, p. 2). The subsectors of residential buildings (28%), commercial and institutional buildings and facilities (25%), on-road transportation (17%), and manufacturings industries and construction (16%) together accounted for over 85% of the city's emissions (AECOM, 2017, p. 2). The city has adopted a number of initiatives to improve energy efficiency and reduce GHG emissions: increased recycling opportunities, the Clean Diesel Contracting ordinance, numerous environmental permits, and more. A review of current initiatives and adoption of new and more stringent regulations can help Chicago improve its energy efficiency, reduce its greenhouse gas emissions, achieve its planned targets, and become aligned with principles of a circular economy.

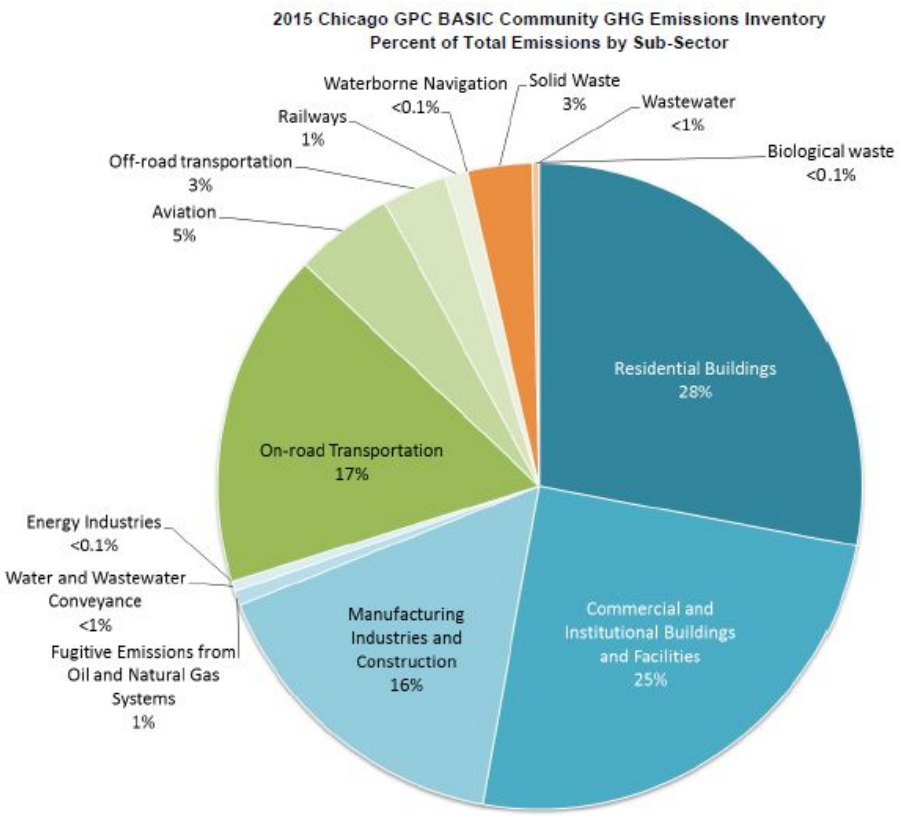

Image source: AECOM (2017)

Educational Campaigns

The Illinois State Board of Education launched the Environmental LIteracy for Illinois Strategic Plan in 2011 to require environmental education that includes climate change, conservation, energy, and more (State of Illinois, 2010). Chicago Public Schools (CPS) include education on energy, waste and recycling, transportation and air, land, and water (Chicago Public Schools, 2016).

The City of Chicago maintains a newsletter and public webpage on environmental programs and initiatives to educate citizens on volunteer opportunities, water, air and natural resources, energy, retrofitting/energy efficiency, waste and recycling, green buildings, transportation, business, climate action, and smart grid (City of Chicago, 2017).

Both the school-based and public education campaigns need to be used in conjunction with other efforts to help transition toward a circular economic model.

Collaboration

Engaging all stakeholders is crucial to success. Companies must be encouraged to work together to form a closed loop with reclaimed natural inputs and outputs designed to carry out another function. Modeling a collaborative space after Phoenix, Arizona, states and cities can engage Public Works Departments in projects that foster environmental innovation. For example, Chicago's City Council and Mayor should allocate resources to bring together participants from public, private, and university sectors. Loyola is one of the greenest campuses in the country and already does a large amount of research on environmental topics. Companies such as The Plant Chicago, a functioning circular economy, would be great partners with the city. Based on Phoenix's collaboration space, this could be a way to create more jobs and form a closer bond with groups around Chicago and the government.

The initial role of stakeholder collaboration is to determine the baseline data, future targets, aggressiveness of goals, standards, and strategies and tactics for achieving the goals. At this time, sustainability collaboration in Chicago occurs in isolated pockets with no formal coordinating mechanism. Therefore, more concerted efforts are needed to improve collaboration, such as a city-wide group that includes higher education, research, public and private companies ranging from small to multinational businesses, government, nonprofit, certification bodies. A larger group could set the vision and goals while subgroups could be formed around themes to address challenges and solutions. This could be developed within existing groups, or the formation of a new group, the re-launch of the Chicago Waste to Profit Network, or the launch of a local/state/regional unit of the United States Materials Marketplace.

Conclusion

Many countries, cities, and businesses all over the world utilize circular economy principles and practices to reduce resource and energy usage, reduce costs, increase profits, and lead to more sustainable practices which also improves overall health for citizens. In a time when natural resources are seen as finite, industries must transition from a one-time use model to thinking in a cycle.

European and Asian countries have already adopted circular economy models. In the United States, some states have also begun adopting circular models. There are also numerous examples of businesses utilizing circular approaches toward sustainability. In all cases, our research found that strict waste reduction regulations were the primary strategy to begin the circular economy transition. Therefore, in order to transition Chicago to a sustainable circular economy, it is necessary to target waste by making laws more stringent and providing incentives for exemplary waste practices. Additional strategies to transition toward the circular economy are improved energy efficiency and greenhouse gas emissions reductions, educational campaigns, and collaboration among stakeholders. These four approaches (waste reduction, energy efficiency and GHG reduction, educational campaigns, and collaboration) will serve as the point of transition for Chicago to begin adopting practices supporting a circular economy. While Chicago has begun work in these areas, there are many additional opportunities to continue this transition. The next step is to precisely define Chicago's initiatives

and progress in each of the four target areas and identify the opportunities to move toward a closed loop circular economic model.

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APPENDIX

Included in this research

Nations	● Japan ● China ● Germany ● France ● Scotland ● Finland ● Canada	● India ● Brazil ● Sweden ● Denmark ● Netherlands ● Australia ● European Union
States	● California ● Vermont	● Maine ● Illinois
Municipalities	Circular Cities Network: ● Austin, TX ● Boulder & Boulder County, CO ● Copenhagen, Denmark ● Ljubljana, Slovenia ● London, England ● New York, New York ● Peterborough, England ● Phoenix, Arizona ● Rio de Janeiro, Brazil ● Tel Aviv, Israel ● Toronto, Canada ● Vancouver, Canada	● Paris, France ● Amsterdam, Netherlands ● Glasgow, Scotland ● Dalian, China ● Chicago & Cook County, IL ● San Francisco, CA ● Dubuque, IA
Organizations	● Takao Furuno ● Nestle ● Marks & Spencer ● IKEA ● Argos ● Fibershed	● Mud Jeans ● Steelcase ● Interface ● Philips Lighting ● International Olympics

Summary of waste regulations with strategies and tactics for implementation

Waste regulations	**Strategies and tactics to implement regulations**
Automobile	Recycling fees at point of sale; EPR, encourage repair; regulations regarding tires, oil, batteries
Construction & demolition waste	Building methods allow buildings to be repurposed, reused, and removed; targets for recycling/landfill diversion/reuse
Food	EPR; restricted from trash bins; composting offered
Packaging	EPR (takeback or fee for 3rd party takeback); aluminum & glass recycling and rebates
Plastics	Better labeling, consumer recycling for bags & film
Carpet	EPR
Landscape debris	Restricted from trash bins; composting offered
Apparel	Large network of resale shops, encourage repair
Electronics	EPR, tax breaks to encourage repair, large network of resale shops, DIY training for repairs
Appliances	EPR, tax breaks to encourage repair, large network of resale shops, DIY training for repairs
Hazardous household waste (motor oil, antifreeze, paint, smoke detectors, styrofoam, tires, mercury thermostats, CFL lightbulbs, batteries, propane tanks, smoke detectors, etc.)	EPR
Medical waste	EPR
Inkjet cartridges	EPR
Automobile switches	EPR

Recycling & landfill diversion	Public education, increased diversion/recycling targets, incentives, tax breaks to encourage repair, EPR, large network of resale shops; recycling for plastic, paper, cardboard, aluminum, glass, composting for landscape debris, restriction of items from trash bins,

Educational campaigns with strategies and tactics for implementation

Educational campaigns	**Strategies and tactics to implement educational campaigns**
Schools	Inclusion of circular economy in curriculum, environmental literacy requirements, environmental education requirements
Public	Informative websites that identify actions individuals and businesses can take, information about sustainable food systems, incentives to encourage reuse and second-hand shopping, town hall meetings, municipal committees, pilot or demonstration projects

Energy and GHG regulations with strategies and tactics for implementation

Energy & GHG regulations	**Strategies and tactics to implement regulations**
Energy efficiency	Rebates, tax breaks, incentives, loans, standards for new construction and existing structures, standards for HVAC systems, retrofitting or replacing inefficient appliances, investment in green/clean energy job development
Air quality/Greenhouse gas emissions	Ban on new incineration plants, reduction targets for waste-to-incineration, fuel efficiency standards, carbon sequestration, research, renewable/clean energy, regional cap and trade
Agriculture	Certification schemes for regenerative practices

Collaborations with strategies and tactics to encourage collaboration

Collaborations	**Strategies and tactics to encourage collaborations**
Education	Research partners; provision of education and curriculum
Government	City partnerships with companies to collect data to inform legislation development; partnerships with universities for technological innovation and research
Business & industry	Collaborations between businesses to use waste byproducts as material inputs; innovative circular business models; partnerships with other businesses to become takeback point for end-of-life products; incentives for consumers to return products; work with suppliers to become more circular; circular certifications from NGOs (C2C, DfE, BIFMA, etc.)
Non-governmental/nonprofit	Partnerships with businesses for certification programs; partnership with businesses on addressing social and environmental concerns
Public	Companies and government provide public education on environmental impact, circular economy; companies provide consumers with options for return of end-of-life products