A 2024 Snapshot of Circular Economics

Educational and Transitional Opportunities for Small and Medium-sized Businesses in Michigan

MICHIGAN STATE UNIVERSITY
Center for Community and Economic Development

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Executive Summary

Our current economic paradigm, the linear economy, is built on a take-make-waste model of thinking and action in a society that currently throws away most products. This strategy is reliant on the continual extraction of resources and short material lifecycles, normalizing intense waste generation. The linear economy critically lacks coordination between supply chain sectors and is increasingly susceptible to economic, environmental, and social disruptions. Circular economic modeling can offer a transformative framework for addressing the current disconnect between economic and environmental health and sustainability. Circular practices represent a systemic shift towards long-term environment, social, and economic resilience by embracing ecological truths, working to keep materials in use longer, and embracing collaboration throughout a material's life cycle.

Circular-supportive policy can also be important to addressing some of the most complex and pressing issues of the 21st century. This paradigm shift has the potential to combateconomic instability and social inequalities, and may also be fundamental in confronting environmental health concerns including climate change. As the concept of circularity has gained traction in the United States and across the globe, many businesses are beginning to adopt circular practices that reduce material waste disposal costs while helping them to adopt more carbon neutral production practices. The capacity as a state and nation to identify, discover and disseminatebest practices in material waste reduction, salvage and reuse are critical to maintaining a quality environment into the future and competing in the global economy as a part ofcircularity.

To enter the broader circularity network at this time means joining a pivotal moment at which critical advancements and innovations are not only necessary, but increasingly tangible. Therefore, this overview attempts to provide an environmental scan of current circular practices, with focus on small and medium-sized businesses, while identifying opportunities and transitions that support more regenerative practice and market development. Beginning with a global overview, innovation across the United States is then discussed and specific leading sectors highlighted. The scan also provides an overview of recycling initiatives and equity in transition. This information builds context for state of Michigan activities, related legislation and academic institution educational and training efforts that support innovative circular economies and transition from traditional markets. In conclusion, activities specific to forming a Michigan State University Circular Economic Institute, related policy action, recommendations and pilot training certificate development offer consideration for moving into a more sustainable future.

Introduction

A Circular Economy (CE) stands opposite our current linear economy in which we manufacture, buy, use, and waste or discard products. Circularity proposes a fundamental change to this structure and presents a model in which products are manufactured for more environmentally regenerative purposes to extend their lifecycle. This may be done with intentional design for reuse, repair, and recycling. Leading this effort globally, the Ellen MacArthur Foundation is a non-profit organization that helps develop and promote the concepts

of circular economics and how scarcity informs the collective futures on the planet with regard to climate change challenges and issues as well as biodiversity loss (*About Us: What We Do*, n.d.). As such, the Foundation identifies three key impacts that are also functional goals of CE as (1) eliminating waste and pollution, (2) circulating products and materials, and (3) regenerating nature. In defining CE, it is important to note that it is distinct in language from other modern concepts, such as sustainability. As an example, while sustainability is close in relation to circularity (and at times argued to be interchangeable), that is but one aspect of the overarching concept. Sustainability is typically considered to be an environmental and social goal of maintenance. While this is more positive than depletion, ultimately, it does nothing to replace or reinvest in precious resources. Instead, CE offers a more holistic working model that does involve sustainability within design, but also includes sharing, leasing, and/or recycling at the level of consumption, and environmental solidarity.

As climate change and pollution become an ever more pressing issue in our current world, citizens demand action from governments and the private sector. Production of material items continues to increase in proportion to demand. One of the most drastic increases in production and consumption can be viewed through industry, such as plastics and polymer production. Plastic production has increased since 1950 from approximately two million tons to current levels of output at approximately 450 million tons in 2023 (Ritchie, 2023). Additionally, the world generates 2.01 billion tons of municipal solid waste (or MSW) each year. This number is projected to nearly double to 3.4 billion in a few decades (Filipenco, 2023). Notably, extraction of nonrenewable raw materials has also tripled in the last four decades as Earth's population has rapidly increased according to the United Nations Environment Programme (2019).

It is clear that continuing on this trajectory would be disastrous for the environment, however, leadership at the global level and collaboration amongst nations may support the transition from a linear to a more circular economy. As an example, it is possible to decrease the amount of greenhouse gases released into the atmosphere due to the reduction of extraction of raw materials. This is projected to reduce the impact of climate change on our planet (*Climate Change and the Circular Economy | NC DEQ*, n.d.). As countries become aware of and incorporate components of circularity, a wave of new supportive policies have been introduced. The body of this document will focus on those relevant to small and medium-sized businesses and related activities within the state of Michigan – including learning and skill-building opportunities.

Within the United States specifically, small and mid-sized businesses (SMBs) employ nearly 46% of the workforce and account for approximately 43.5% of the national GDP (Ferguson & Lucy, 2023; Main, 2024). According to the federal Small Business Administration (and variable by industry and number of employees), small businesses *typically* employ fewer than 100 employees up to 500, and mid-sized business at 100 to 900 employees. This is also demonstrable by annual receipts and revenues. To help put this in perspective, that is approximately 32,540,953 small businesses composing 99.9% of all firms in the U.S. In comparison, large business (about 20,516) have also created some 7.9 million jobs whereas small

business is responsible for about 12.7 million jobs according to the U.S. Small Business Administration Office of Advocacy (2024). For additional information regarding the definition of small and mid-sized businesses, please see the U.S. Small Business Administration's Officeof Advocacy (2024).

In Michigan, SMBs account for 48.3% of Michigan commerce (*Whitmer Announces New Data Showing Record Small Business Growth*, 2022). However, Michigan's workforce (as of December, 2023) associated with SMBs accounted for about 62.2% (*Michigan Jobless Rate Remains Unchanged in December,* 2024). This contributes $675 billion to the state's GDP (USAFacts, 2023).

Transitioning to more circular practices offers a unique opportunity for SMBs and entrepreneurs to reduce operating costs and improve their production and sales efficiency. Continuing education such as professional development or certification training in circularity will be critical to successful transition. While entrepreneurs and SMBs may likely be challenged by the incorporation of circular practice in the short-term, the cost-effectiveness of these practices in the long run will determine if this paradigm shift truly takes root. Additionally, while transnational enterprise and conglomerates may be able to pivot and afford, for example, sourcing and production shifts along their supply chain, it is unlikely all necessary components (including financial capital and procurement support) will be available and/or readily accessible for smaller entities. To highlight this opportunity, faculty and research assistants at Michigan State University are working to investigate, develop, disseminate and ultimately evaluate supportive SMB transitional practices.

Background

Currently, only about 8.6% of global materials are cycled back into the economy worldwide ("Circularity Gap Report 2020", 2020). This low rate of material recycling is due, in part, to the take-make-waste model that does not focus on regeneration nor reduction of waste. However, this circularity gap may be reduced as discussed through this summarization of circular efforts such as the increase of materials recycled. Many policies and practices foster global collaboration to collect and share data, translate global trends into national pathways, and build global coalition for action that is both diverse and inclusive ("Circularity Gap Report 2020", 2020).

The United Nations (UN) and the European Union (EU) to date have led the promotion of sustainable and circular-specific practices. In 2015, the UN introduced 17 Sustainable Development Goals adopted on January 1, 2016 with the overarching goal of reaching "peace and prosperity" by 2030. The EU has also worked to embrace a more circular economy as documented in their Circular Economy Plan adopted in 2021 (*Circular Economy Action Plan*, n.d.). Building on this, the EU released "A New Circular Economy Action Plan" in the summer of 2023 providing a pathway forward (European Commission, 2023). *Of significant consequence, it was found that 80% of a product's environmental impact is deliberated at the design phase* (European Commission, 2023).

Jointly, other countries in partnership with the UN have also developed collaborative projects such as 2CIRCULAR. This working project is functionally implemented by the United Nations Industrial Development Organization (UNIDO) in partnership with the Ministries of Industry, Economy & Trade, Environment, and Finance and the Association of the Lebanese Industrialists (ALI) with the support of the Federation of the Chambers of Commerce, Industry and Agriculture (FCCIAL). As such, this program aims to advance investment into resource efficiency and cleaner production to reduce the costs of production (*EU Invests 3.7 Million Euro to Support Green and Circular Economy in Lebanon Through a Project Implemented by UNIDO*, n.d.). With boots on the ground in Lebanon, 2CIRCULAR facilitates a shift of more than 50 food and beverage companies towards circular modeling. Building on past success, UNIDO previously supported 15 Lebanese companies and today works to triple this through 2CIRCULAR – affecting not only EU sourcing and trade, but also the Mideast.

Regulation efforts through legislation and collaboration span from Western European countries to Southeast Asia. Multinational efforts such as Green Public Procurement (GPP) have been adopted by Germany, Japan, Korea, Austria, France, and Iceland with mandatory requirements and targets (OECD 2023). International law affecting countries with GPP requirements also include Sweden, Italy, Denmark, Belgium, Canada, and Portugal. An official "UN observer", the Organization for Economic Co-operation and Development (OECD) leads GPP research and advocacy working for standardization internationally. Beginning with its "Green Growth Strategy" in 2009, this organization attempts to stimulate economic growth and development "while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" (OECD 2023). These efforts continue to be updated and policy recommendations revised as circular modeling continues to emerge alongside climate-related and public health challenges.

Promoting circular economic transition and practice nationally, France and the Netherlands demonstrate global leadership. France's effort includes being the first to ban leftover/unsold food disposal as well as policies requiring companies to reuse, donate, or recycle food remains. Commitment to regenerative practices was also demonstrated with President Macron's signature enabling the Anti-Waste Law in 2020 (*France's Anti-waste and Circular Economy Law*, 2022rea). Other activities include being the first country to adopt a mandatory repairability index on electronics. This index is a first-of-its-kind ranking of how environmentally friendly electric appliances are based on criteria such as availability of spare parts, how easy it is to deconstruct and reassemble, et cetera (*Remarks on the French draft Decree and Orders on the durability index of electrical and electronic equipment,* 2023).

In 2022, the French also reported their early warning assessment of progress made towards achieving 2025 goals for municipal and packaging waste. This innovative early warning assessment measures not only MSW, but also climate-related risks in working towards their Waste Framework Directive 2008/98/EC targeting recycling and preparing for reuse of 55% of municipal waste generated by 2025 (*Early Warning Assessment Related to the 2025 Targets for Municipal Waste and Packaging Waste*, 2022). As of Spring 2024, such legislation and action is

set to become widespread and every French household will be provided with a solution for sorting its food waste and other biodegradable natural waste.

The Netherlands is another leading country taking action to promote circular economies. The Dutch intend to reach complete circularity by 2050 with the first step towards reducing raw material use by 50% by 2030 (Government of the Netherlands 2016). Five target points have been prioritized, including 1) biomass/food, 2) plastics, 3) consumer goods, 4) the manufacturing industry, and 5) the construction sector according to the constitutional monarchy (Government of the Netherlands, 2016). Every two years the Netherlands Environmental Assessment Agency monitors and evaluates this progress offering the bi-annual Circular Economy Progress Report. As of 2022, the Report identifies the Netherlands as 24.5% circular with area to improve outside of material efficiency (*Circular Economy Progress Report 2022*, 2022). Additionally, the report notes policy intensification is required to enable a more government-wide and multi-faceted approach that offers strategy beyond recycling.

Also of note, the City of Amsterdam has committed to becoming its own circular economy, wasting nothing and recycling everything by 2050. Here, *Circle Economy* – an international team based in Amsterdam – has recently become a global impact organization due to their work crafting a vision for an economic system that ensures the planet, and all people, can thrive (*20220602 - CJI - III-Evidence to Action - 210x297mm.pdf*, n.d.). In doing so, they have partnered with over 20 different nations to promote circularity. With a priority goal of doubling global circularity by 2032, their flagship efforts through the Circular Jobs Initiative works to ensure a transition to a circular economy will be a positive event(s) for those workforces and innovations enabling it. According to their Amsterdam Circular 2020- 2025 Strategy report, current understanding of circular economics fails to address primary issues of global social inequalities caused by both assumption and oversight according to the Municipality of Amsterdam (2020).

Due to the emerging, complex and interconnected nature of circularity, new educational programs are also in development across the world. Through anecdotal research and observation, it is found that many programs are geared toward leadership, workforce skill development and operations management. Of note, the University of Cambridge offers premier courses on Circular Economy and Sustainability Strategies. This 6-week online program offers an overview of circular economies as well as sustainability strategies. "It is designed to help understand the growing business for sustainable solutions and learn how to manage and grow a business by incorporating circular economy principles into strategy" (*Sustainability Strategies Online Course | Cambridge Judge Business School*, n.d.). Additionally, more EU learning opportunities are available through entities such as the European Circular Economy Stakeholder Platform and the Circular Economy Institute – a joint initiative by the European Commission and the European Economic and Social Committee. As America also implements stronger environmental regulation and new incentives for circular activity, U.S. training and technical support for transition will be required.

International Circular Practice Highlights From the Food and Agriculture Sector

According to the World Bank (2022), "about 80% of the global population most at risk from crop failures and hunger from climate change are located within Sub-Saharan Africa, South Asia and Southeast Asia, where farming families are disproportionally poor and vulnerable. According to the interview series produced by the World Bank Group: Climate Change (2022) "Climate Explainer Series", William R. Sutton, Global Lead for Climate Smart Agriculture for the World Bank shared critical information regarding food security and climate change. During this interview, he noted that the number of people suffering from acute food insecurity increased from 135 million in 2019 to 345 million in 2022 – an increase of almost 40%. Simultaneously it is estimated that the global food system is responsible for about one-third of greenhouse gas emissions – second only to the energy sector; it is also the number one source of methane and biodiversity loss. However, transitioning to more sustainable and ultimately circular practices has strong potential to slow the use of finite natural resources, reduce landscape and habitat loss, and limit biodiversity loss.

Efforts on the international scale to implement more circular practice have been underway in the recent past with particular emphasis on sustainability. Citing examples of this, the paper "Quiet Revolution by SMEs in the Midstream of Value Chains in Developing Regions: wholesale markets, wholesalers, logistics & processing" by Reardon et al. (2021) observes how small and medium enterprises (SMEs) and value chains have developed across Africa, Asia, and Latin America. The authors cite midstream SMEs as accounting for roughly 65% of the food supply in Africa and South Asia. Necessary to ensure food security, SMEs have an important role in food availability, inclusive food access, and food utilization. They also make the important point that "commercialization-induced intensification may induce excessive use of pesticides and fertilizer with attendant pollution of rivers and groundwater or siltation from aquaculture and effluents of manure from pork and poultry production" as observed in South Asia. Lastly, they state that farmers in Africa are directly affected by wholesale SMEs (both public and private) through farm profit and productivity inputs like fertilizer or soil conservation items (Reardon et al., 2021).

Today, electronic platforms also provide information about food resources and both sustainable and regenerative practices. One highlighted example of this is the "Olio" platform, beginning as an initiative to end food waste, and already utilized by more than seven million people worldwide, most notably in the UK, U.S., Australia, New Zealand, South Africa, and Namibia (*Our Story | Olio*, 2023). Olio connects neighbors and allows them to offer up and request leftover food helping to prevent household food waste. Headed by Tessa Clarke and Sasha Celestial-One, Olio partners with restaurants, caterers, and hotels. These partners are projected to be responsible for more than 6.5 million portions of food waste prevention *(London's Circular Food Pioneer Projects,* 2021). Participation in this platform encourages both owners and consumers of Olio to think in terms of a non-waste economy. A second example, the Sustainable Agriculture Initiative (SAI) a non-profit platform network consisting of more than 180 members worldwide, considers most of the major food corporations in the world as its

members. In September of 2023, the SAI released the Regenerating Together Framework V1.1 as a global approach to regenerative practices (SAI, 2023).

Most recently in Fall of 2023, the GreenBiz Group, a California-based hybrid organization, is working to accelerate the transition to a clean economy. Their Food Weekly newsletter highlights numerous additional and far-reaching changes in the food and agriculture sector. These include moving to more regenerative types of agriculture, changing diets, and reducing food waste globally. Senior Manager, Seth Olsen, writes that "changing how we grow food, what we eat, and how we value the resources placed in our food are the three main priorities when considering food system transformation" (*Food 10-05-2023*, n.d.-b).

Industry examples offer agricultural businesses in Michigan empirical examples on how both brick and mortar as well as electronic organizations can move towards circularity. Nationally, the food and ag sectors only account for about a 5.5% share of the GDP whereas, in Michigan, it is about 13% (SOM, 2016; USDA ERS, 2024). The food and agriculture sector is, of course, necessary to human survival and it is also a relatively easier point of entry requiring lessor amounts of financial capital and infrastructural upgrades for circular transition. This is in part due to some growers overhauling their own backyard operations within residential or community-based management as well as micro-organizational abilities to develop independent value chains as part of a broad yet local ecosystem.

Social Research on SME Waste and Recycling

Of note, a social research case study conducted by the Environment Protection Authority (EPA) in New South Wales (NSW), Australia, highlights the opinions of small and medium enterprises (SMEs) regarding waste and recycling. The research objective of this 2016 study was to benchmark SME knowledge, attitudes, and behaviors regarding recycling and waste to serve as a baseline for recycling/waste initiatives moving forward (EPA, AU). The study included 639 businesses, all smaller than 200 full-time employees, and covers a wide variety of industries.

It was found that nearly all SMEs across all industries claimed to participate in some form of recycling activities. Furthermore, some SMEs firmly believed that they have done all they can to minimize waste, with 68% agreeing or strongly agreeing. Additionally, 86% of SMEs are satisfied with their recycling efforts. However, only about one-third of the SMEs representatives interviewed felt well-informed about waste and recycling. This data implies that despite businesses stating they are satisfied with their recycling efforts, many SMEs are not largely educated on sustainable practices and are likely not managing their waste streams at capacity. Within Figure 1 below (reprinted from EPA, AU, 2016), those interviewees that include waste tracking as a part of their business practice are noted by industry followed by those tracking recycling in Figure 2. (EPA, AU)

Figure 1: SMEs waste volume tracking in New South Wales, Australia (2016)

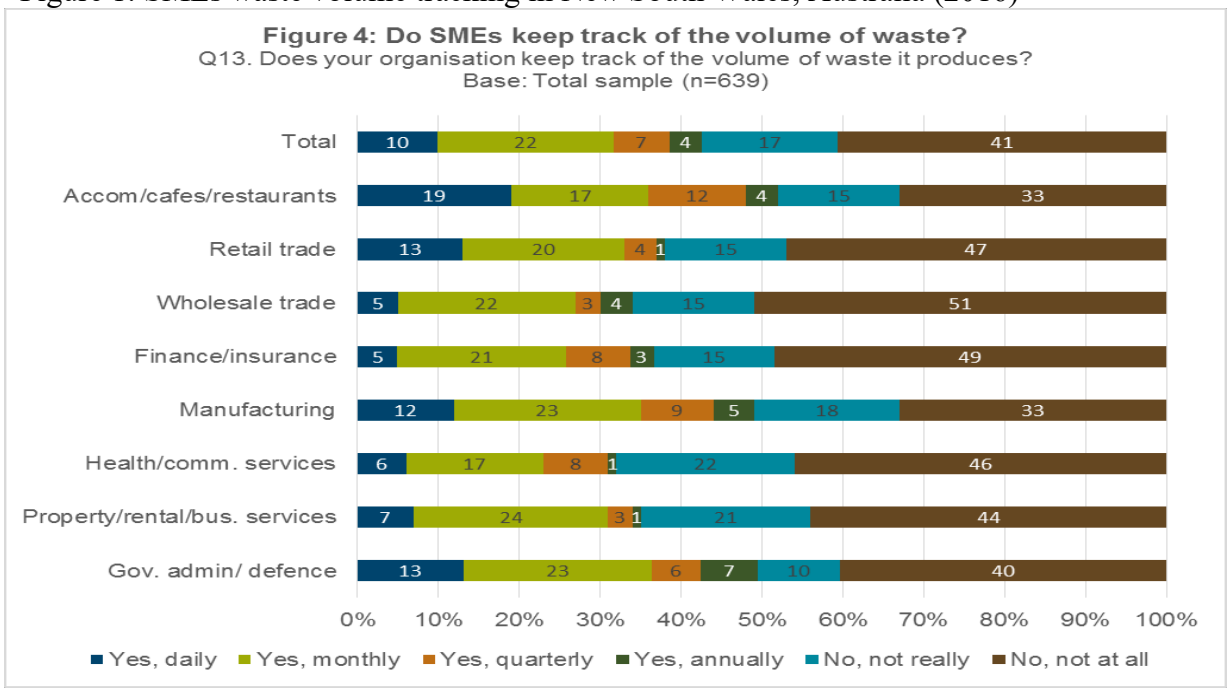
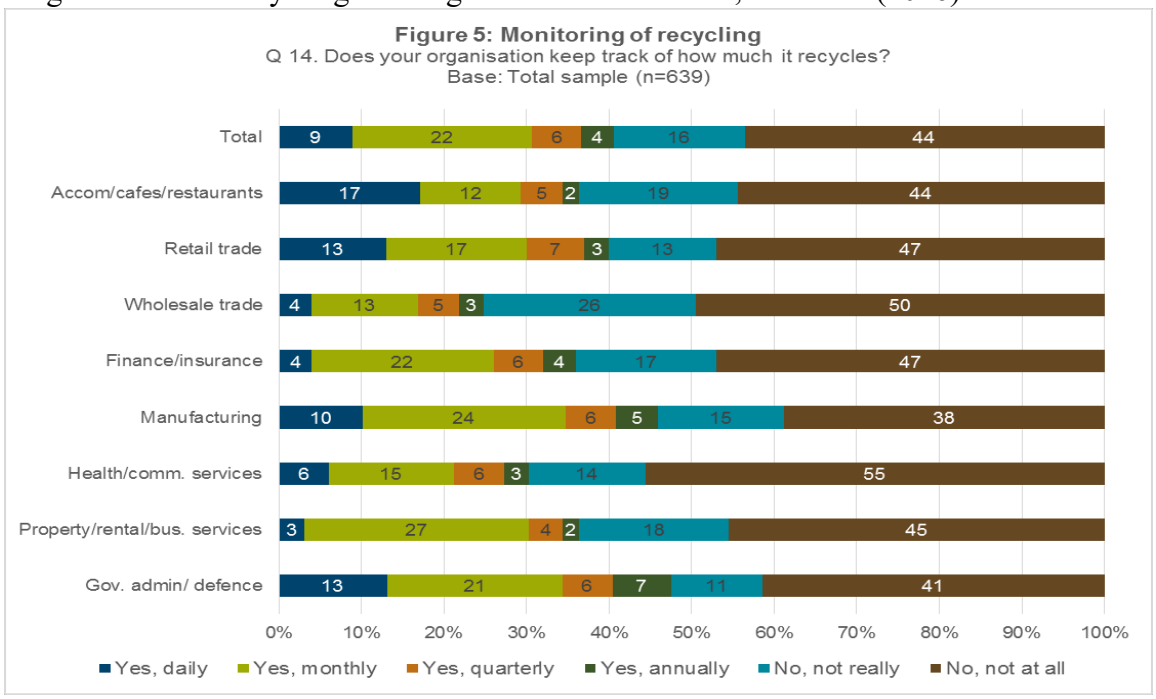


Figure 2: SMEs recycling tracking in New South Wales, Australia (2016)



Circular Economic Transitions in the United States

Stateside, manufacturing research and development institutes are leading many of the educational, research, and development activities towards more circular practice. Recently in 2017, the U.S. Department of Energy's Office of Advanced Materials and Manufacturing Technologies helped found the REMADE Institute which is a division of the Sustainable Manufacturing Innovation Alliance Corporation. The REMADE Institute is a circular economy public-private partnership that advocates for Circular Economies in the United States and helps to connect American businesses with the United Kingdom's Ellen MacArthur Foundation. They also enable early-stage applied research and development of key technologies geared towards reducing embodied energy and carbon emissions associated with industrial-scale materials production and processing (REMADE, 2024).

Through their primary purpose of driving down the cost of technologies essential to reuse, remanufacturing and recycling energy-intensive materials, REMADE has four goal areas that round out their mission: (1) Developing technologies capable of reducing energy emissions through a reduction in primary materials consumption and increase in secondary feedstock use in energy-intensive industries, (2) Developing technologies capable of achieving feedstock "better than cost and energy parity" for key secondary materials, (3) Promoting widespread application of new enabling technologies across multiple industries, and (4) Educating, training and developing the incumbent and future workforce to support deployment of REMADE technologies. REMADE also offers training online including short courses, webinars, and certificate pathways in addition to determining competency levels which vary from awareness level training to practitioner and expert level development.

Also in 2017, in partnership with the Environmental Protection Agency (EPA), the United States Agency for International Development (USAID) introduced the *Scaling Up Renewable Energy* (SURE) program. This program is intended to pair local governing bodies, civil society, and the private sector for the development of transformative processes that address waste while creating employment opportunities. The SURE program offers support to anybody looking to build more sustainable business practices, business models, and innovations – including partnering countries (USAID, 2017). With growing momentum, this program supports renewable energy planning and procurement, grid integration, and circular economy support services. It also equips policymakers, utilities, and regulators with training, tools, and resources in an effort to modernize energy sectors and create policies that enable renewable energy markets to flourish. As more organizations join, additional funding will also be provided through its Innovation Fund, which helps identify opportunities to deploy clean energy and achieve net zero emissions by 2050. (USAID, 2017)

In 2021, the Biden Administration announced the Federal Buy Clean Initiative to reduce America's carbon footprint through sustainable procurement. In March of 2022 the U.S. Securities and Exchange Commission also proposed amendments to the Securities Act of 1933 and the Securities Exchange Act of 1934. New regulations will require that publicly traded companies disclose information on the governance of climate-related risks, how those risks may consolidate financial statements, and how climate-related risks can affect registrant

strategies/business outlooks as well as the impact of climate-related events online and registrant financial statements. The proposal also requires that registrants disclose information on the levels of their greenhouse gas (GHG) emissions through both electric use and other forms of energy. (SEC 2022)

Further, the United States Department of Commerce's National Institute of Standards and Technology (NIST) expanded to incorporate a circular economic division. Since hosting numerous workshops regarding construction, manufacturing, plastics, etc., circular long-term efforts have been supported additionally through collaborative cross-sector efforts with the EPA. In 2022, the Biden Administration invested $375 million in environmental action initiatives through the EPA. These included action items aimed to increase public awareness and education on circularity such as grant programs for funding recycling education and outreach. At this time new legislation was also proposed for Solid Waste Infrastructure for Recycling (or SWIFR grants) to update and improve practices for battery collection, recycling, and labeling. (EPA, 2024)

Rounding out landmark United States federal law, the Biden Administration successfully introduced three acts (the Inflation Reduction Act, the Creating Helpful Incentives to Produce Semiconductors (CHIPS) & Science Act, and the Bipartisan Infrastructure Law) intended to reduce pressure and constraints on supply chains by recirculating "critical materials" and products, and to save money by lengthening the life cycle of individual materials. These three legislative acts are intended to create well-paying jobs in battery manufacturing, critical material recycling, biomanufacturing, and more (Biden Administration, 2023).

The Biden Administration continues to work closely with the EPA strengthening and funding environmental policy in support of circular transition. As such, in February of 2023, the White House Office of Science and Technology Policy (OSTP) convened a roundtable with the Ellen MacArthur Foundation identifying areas the U.S. can successfully support its journey towards net-zero waste (OSTP, 2023). To spur this, the NIST has since partnered with the American Society for Testing and Materials (ASTM International) for increased environmental impact measurements to help inform policy decision-making (NIST, 2023). By Spring of 2023, additional focus on plastic pollution and production was planned by the Administration together with the Interagency Policy Committee on Plastic Pollution and a Circular Economy (IPC). The IPC has outlined goals and guidelines (many of which are observed in other countries focused primarily on waste reduction) at the production level and preventing micro-plastic pollution in waterways. It is the "IPC that will coordinate federal efforts on plastic pollution reduction, prioritizing public health, economic development, environmental justice, and equity to ensure that the benefits of acting on plastic pollution – including jobs, minimized exposure to harmful chemicals, and clean communities – are available to all" (EPA 2023).

As a critical component of circular economies, recycling strategies have benefited from significant focus and funding in recent years. In 2021, the EPA introduced its National Recycling Strategy outlining five goals to increase and improve recycling across the U.S.: (1) improving markets for recycled commodities, (2) increasing collection and improving materials management infrastructure, (3) reducing contamination in the recycled materials stream, (4)

enhancing policies and programs to support circularity, and (5) standardizing measurement and increasing data collection (EPA, 2021). Each of these areas includes measurable objectives. To successfully implement these through sound activity, the EPA has partnered with a variety of agencies on strategy including the Council on Environmental Quality (CEQ), the U.S. Department of Commerce (DOC), NIST, the National Oceanic and Atmospheric Administration, and the U.S. Department of Agriculture, and Department of Energy (EPA, 2020).

While the National Recycling Strategy remains a primary EPA initiative, additional"sub-initiatives" related back to overarching themes are also front and center including the Trash Free Waters Program (2022) and the Save Our Seas Act 2.0 (2020). The draft National Strategy to Prevent Plastic Pollution is the EPA's most recent action as of July 2023. With one of the furthest stretching goals yet, it is aimed at eliminating plastic waste and other material waste from the environment by 2040 (Toto, 2023). Language within this draft specifically identifiesthe EPA's National Recycling Strategy and is similar in nature. The National Strategy to Prevent Plastic Pollution extends beyond this though by specifically promoting circularity strategies. Circularity is directly addressed through recommendations to reduce the consumption and production of single-use plastics as well as facilitating more efficient and effective composting, improving water management, researching microplastic pollution, etc. (EPA, 2023).

The U.S. Chamber of Commerce Foundation also leads "Beyond 34" which is a multi-stakeholder initiative aiming to advance circular economy in cities and regions nationally. Their goal is to increase the national recycling rate with the help of communities nationwide by providing a scalable model that identifies and implements high-impact waste solutions focused on local needs (Beyond 34, 2021).

Most recently, the Petaluma Reusable Cup Project led by the NextGen Consortium and the Center for the Circular Economy at Closed Loop Partners, is a new initiative set to launch in August 2024, in Petaluma, California. This collaboration, involving multi-national brands such as Starbucks, the Coca-Cola Company, and PepsiCo, aims to make reusable cups the default option in both national and local restaurants across the city of Petaluma. More than 30 restaurants in Petaluma have agreed to participate and will replace single-use cups with to-go reusable cups for customers at no cost. Facilitating this transition, the city will install 60 return bins for the reusable cups, to be collected, washed, and recirculated for future use. This initiative is the first of its kind in a U.S. city, including a mix of large national chains and local independent restaurants, convenience stores, community hubs, and public locations. Running until November of 2024, the project will collect baseline data to measure customer participation and the environmental impact of offering reusable cups as the default choice (Closed Loop, 2024). The Petaluma Reusable Cup Project will serve as a base for future circular transitions, and if it proves to be successful, may initiate a shift in future company operations and regional collaborations.

Equity in Circularity

Broadly speaking, practitioners, business, academia and broad stakeholders are becoming more conscious, as well as intentional, about incorporating equity, environmental, health and social justice into public and private efforts. Stemming from mulitple contributing factors, namely, higher levels of outdoor labor performed by lower-income individuals, limited access to healthcare amongst low-income demographics, and poor healthcare infrastructure for low-income individuals and families, lower income communities disproportionately experience higher levels of unsafe pollution resulting in cascading negative impacts. While nearly the entire human population is exposed to unsafe levels of particulate matter composed of solid and liquid droplet in the air (PM2.5) around 716 million people living on less than $1.90 a day are exposed to dangerously high levels of pollution (Leonova & Rentschler 2023; World Bank, 2022).

Across the Midwest, impoverished communities also experience higher levels of nitrate within their water supply and Black communities across the nation are exposed to particulate matter of 2.5-micrometer levels at a rate of 13.7% higher than white communities (EWG, 2021; Harvard T.H. Chan School of Public Health 2022). Additionally, factory pollution is typically concentrated in distressed areas as the cost of production is typically lower (Currit, 2022). As of March 2023, the most polluted cities in the United States are Colombus, Atlanta, Chicago, Indianapolis, and Dallas (AQLI, 2023). Unfortunately, both environmental and health indicators are directly linked to industrial pollution affecting the most vulnerable within society (EPA, 2023). By transitioning to a more circular economy and supporting more circular practices Americans may reduce energy consumption and emissions, as well as limit further health and environmental inequities (Ashton, Fratini, Isenhour, & Kruger 2022).

Regional Circularity in the Midwest

Within the United States and spanning much of the Midwest, *Circular Great Lakes* (CGL), a 2021 initiative of the Council of the Great Lakes Region, is another entity working to increase circular economy initiatives and capacity through guiding principles of innovation, investment, and collective action. With partners working from Toronto, Canada, down to Ohio, Illinois, Michigan, Wisconsin and beyond, this collaboration has a five-year goal of attaining a 50% recycling rate by 2027. As of their initial 2021 benchmarking to evaluate the bi-national Great Lakes regional partners' performance in six key areas of materials management and best practices, there was an 18% recycling rate. That rate will need to be tripled in a little over half of the next decade to meet their 2027 goal. Therefore, a preliminary year was dedicated to the planning process and launch in 2022 to "forge a future without plastic packaging waste and litter" (CGL, 2023). Three action areas are targeted to focus on quick win projects, transformational projects, and scaling. To accomplish this, CGL has set three main priority action plans. The first includes clean up and an end entirely to waste and litter entrance into the Great Lakes watershed. However, priorities two and three offer the most promising ideas concerning circular economies (CGL, 2023).

Priority Two of the CGL report is to "Accelerate Development of Great Lakes Flexible Plastic Packaging Recycling Supply Chains and Markets," which aims to increase the capacity

and sustainability of Materials Recovery Facilities (MRFs) in the market. Within this actionplan, the main goals are to scale MRF processing and expand end-market capacity while also increasing the post-consumer supply of flexible materials collected. To achieve these goals, CGL recognizes that more facilities that can collect, process, and sell recyclable materials are required for this increase in capacity. The steps that CGL is taking to advance these goals includes investing in the capacity of large MRFs in need of upgrades, developing co-investing in post-consumer recycled (PCR) building material plants, assisting and expanding collection services for underserved populations, increasing the implementation of bagged programs, and partnering with higher education institutions for sustainable, regenerative and circular research and dissemination.

Priority Three is to "Achieve a Step Change in Plastics Recycling with Technology, Policy, and Education," which aims to upgrade the technological capacity of current tracking information and MRF processing systems. The objectives included in this action plan are to establish transparent tracking methods throughout the plastic packaging supply chain, integrate advanced technologies like artificial intelligence to increase MRF efficiency, develop cloud-based data storage methods for ease of access, conduct educational programs and policy development aimed to increase recycling, and develop a scaling roadmap for balance. Both action plans two and three focus on building the physical and virtual infrastructure necessary for supporting the rapid increase in the recycling rate that CGL is targeting for circular transition.

Circular Economic Efforts within the State of Michigan

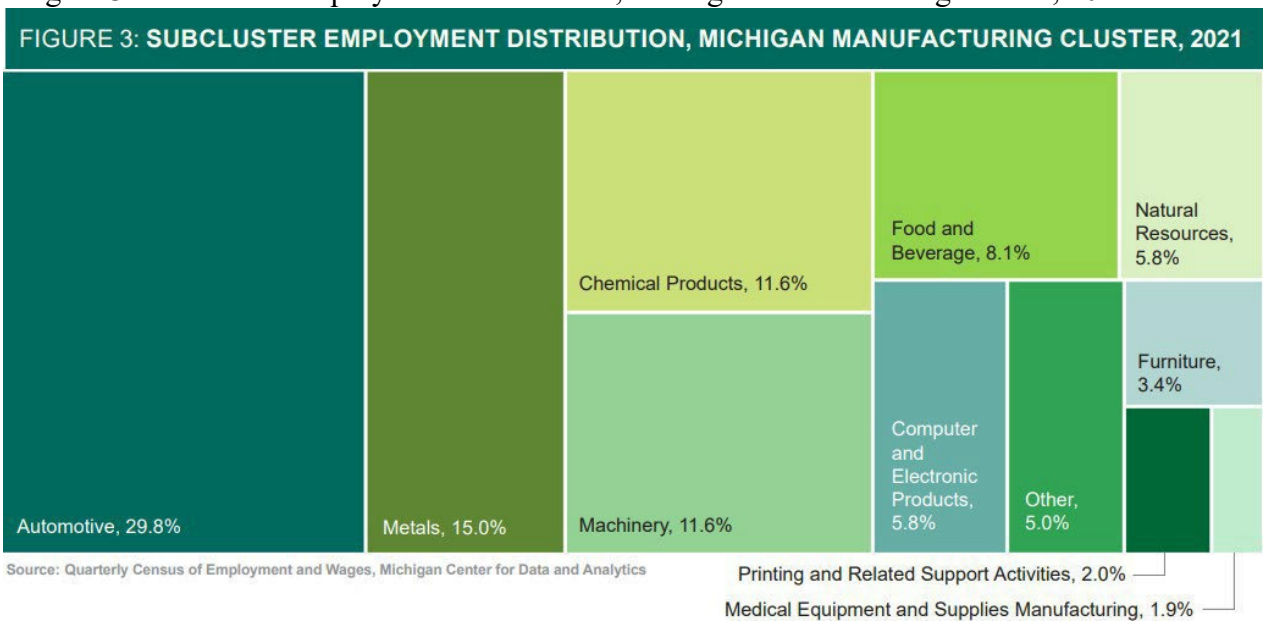
Defining characteristics of circularity within the state of Michigan include preservation and regeneration. Michigan is uniquely positioned to adopt circular practices, due to its multitude of natural resources and strong manufacturing tradition. This includes 200,000 acres of sand dunes, which support a range of plant and animal life that in some cases cannot be found elsewhere in the world (Michigan Legislature, 2001). Four Great Lakes border the state of Michigan and provide regulation for temperature and precipitation as well as supporting the irrigation of many Michigan farms. Spanning 3.8 million acres, Michigan also has the largest State Forest system in the US as well as over 3,000 miles of coastline. Maintaining the water quality of this precious resource is critical. However, protecting Michigan's natural beauty and resources requires robust efforts in adopting more circular strategies to reduce pollutant contamination such as PFAS used in manufacturing or fire retardants (Michigan Legislature, 2001).

The combination of Michigan's manufacturing heritage and strong agricultural industry both offer significant opportunity for circular transformations. The Michigan agriculture industry accounts for about 17% of Michigan's workforce (MDARD, n.d.) with roughly 47,600 farms and just under 10 million acres of farmland. As an example, Michigan's organic production specializes in value-add food products, wood, beans, vegetables, cereals, baked goods, and pasta (MDARD, n.d.). While these products are only some of Michigan's main exports, they represent opportunity for increased processing capacity, as an example, to maximize circular efficiencies. Herein lies a niche area where academic institutions, particularly land grant institutions such as

Michigan State University, are well primed with extension outreach efforts to support the state in rolling out circular business practices and workforce development training.

Furthermore, manufacturing is nearly as large as agriculture within the workforce, employing 14.2% of total statewide jobs. Within, the automotive sector is by far the most dominant subsector of the job market, containing nearly 30% of manufacturing jobs within the state (Gandhi, 2023). Due to this, Michigan ranks number one among the top ten manufacturing clusters for money generated. In 2019, this generated just under $41 billion in economic activity compared with the second largest subsector, machinery, generating just under $9 billion. Another manufacturing subsector, chemicals, represents 11.6% of the manufacturing workforce and ranks third in market size and fourth in economic output (Gandhi, 2023; National Association of Manufacturers, 2021). Of this subsector, plastics represent almost 50% of the job force and are a major target for circular economy programs. Lastly, sub-sectors like metals, machinery, and food and beverage also represent larger portions of the manufacturing sector, while other targets for circular economies like electric products, natural resources, and textiles are smaller within Michigan as show in Figure 3 below, reprinted from Ghandi, 2023 as "Figure 3: Subcluster Employment Distribution, Michigan Manufacturing Cluster, 2021.

Figure 3: Subcluster Employment Distribution, Michigan Manufacturing Cluster, 2021



State of Michigan

Despite Michigan's historical reliance on agriculture and manufacturing, recent data tracking industry employment in the state reveals that SMBs cover a large variety of fields outside of just those two industries. With SMBs representing 47% of Michigan's workforce, it's crucial to examine different industries to identify gaps and opportunities for growth. Michigan

has 908,007 small businesses, accounting for 99.6% of all businesses in the state and employing over 1.9 million people, as reported by the U.S. Small Business Administration Office of Advocacy. According to the data, pulled from a 2020 census, the most common small businesses in Michigan are in Other Services (111,442 businesses), Professional, Scientific, and Technical Services (108,656 businesses), Construction (103,531 businesses), Real Estate and Rental and Leasing (89,766 businesses), Retail Trade (85,368 businesses), and Transportation and Warehousing (82,166 businesses). However, the sectors with the highest employment levels among small businesses are Healthcare and Social Assistance (276,859 employees), Manufacturing (257,828 employees), and Accommodation and Food Services (249,465 employees), (U.S. Small Business Administration Office of Advocacy).

This data demonstrates the important role of small businesses in Michigan's economy and highlights the largest sectors of SMBs in the state. While small businesses are an important part of the economy in Michigan, there is a shortage of data and information on their waste streams. With minimal tracking information on SMB industry waste streams, recommending opportunities to promote circularity becomes challenging. Lack of tracking prevents businesses from being held accountable for their waste and limits the state's efforts to promote sustainable solutions and achieve sustainability goals. Effective waste management strategies require data, and without it, creating impactful policies and initiatives is difficult. With SMBs making up nearly half of Michigan's workforce, it is vital moving forward that the information gap is acknowledged, and collective effort put forth to improve data tracking.

Despite this, in 2021 Michigan ranked as one of the leading states in sustainability by Site Selection magazine, tying for third with New York. Site Selection magazine is a service of Conway Data with over 48,000 qualified corporate subscribers delivering information for expansion planners and economic developers in the private and public sectors (Site Selection, 2024). States like Illinois and California ranked above Michigan, while others like Minnesota, Washington, and Ohio were slightly below Michigan (Site Selection, 2021). The cities of Grand Rapids and Lansing also ranked as the nation's number two and number six metros in sustainability, respectively. Factors that resulted in this ranking included LEED-certified buildings, green industry projects, energy star buildings, brownfield grants and cleanups, renewable energy development, green laws and incentives, corporate social responsibility rankings, Sharecare Well-Being rankings, and the Solar Jobs Census (Site Selection, 2021). As such, Michigan is growing its reputation as a leader in sustainability and circular economic growth. Among those programs and laws supporting sustainable and regenerative practices in Michigan, one of the most important steps that the state government has taken is to craft and implement the *MI Healthy Climate Plan*.

MI Healthy Climate Plan

To ensure a carbon neutral Michigan by 2050, the MI Healthy Climate Plan for 2030 was established by Governor Whitmer's executive directive 2020-10, which tasked the Department of Environment, Great Lakes, and Energy (EGLE) with creating a roadmap to 2030. The executive

directive committed to a 26-28% reduction below 2005 levels in greenhouse gas emissions by 2025 and was accompanied by the 2019-12 directive to join the United States Climate Change Alliance (Governor Gretchen Whitmer, 2020). The goals outlined by the MI Healthy Climate Plan are to commit to environmental justice and pursue a just, circular transition, clean the electrical grid, electrify vehicles, increase public transit, repair and decarbonize homes and businesses, drive clean innovation in the industry, and protect Michigan's land and water (EGLE, 2022).

While most of the goals outlined in the plan are targeted towards either environmental remediation or energy production/usage, the priority to drive clean innovation in the industry is aligned with the circular economy model. Circular economy, again, focuses on practices to achieve zero waste and to increase the life cycle of a product while moving towards regeneration of precious resources. Multiple goals within the MI Health Climate Plan address this by encouraging "clean innovation hubs where private enterprises strategically co-locate and collaborate to develop and deploy new, cleaner manufacturing technologies and conduct research and development to reduce emissions from hard-to-decarbonize industries." The document also sets a goal to "triple Michigan's recycling rate to 45 percent and cut food waste in half by 2030" (EGLE, 2022). These goals are heavily invested and strategically developed to support manufacturing industries by improving their efficiency in both material waste and consumer use. By having such goals to reduce food, material, and consumer waste, industries are also positioning to directly support small and medium-sized businesses in their transition to circular economy practices.

NextCycle Initiative

One of the programs that targets small businesses and emerging community projects is NextCycle Michigan, a partner initiative of EGLE, Resource Recycling Systems, the Centropolis Accelerator, and the Michigan Recycling Coalition. NextCycle has a variety of public and private partnerships in its network with 122 active partners and 73 partner projects (NextCycle, 2024). These partners provide sponsorships and collaborative project proposals to NextCycle, increasing the flow of information and resources among entities for circular economy projects. Thus far, private organizations in the NextCycle network have committed $327,000 in award funding, but an additional $97 million in investments have been leveraged by NextCycle that are planned and underway (NextCycle, 2024).

NextCycle has tracked a total of $771 million over the course of 223 completed and underway projects through a combination of public, private, and EGLE-based investments since 2019 (NextCycle, 2023). To reach the Michigan Healthy Climate Plan's goal of a 45% recycling rate by 2030, NextCycle estimates that more than $1 billion must be invested into recycling and organics, positioning Michigan currently at about 77% of the way towards reaching this goal (NextCycle, 2023). By 2023, about $29 million in EGLE grants followed almost $100 million in public funds and over $640 million in private funds for completed and uncompleted projects (NextCycle, 2023). EGLE funds are also used as a magnet for other investments, leveraging

additional supports such that NextCycle may address a much larger number of projects and even exceed its goals for sustainability, or at least reach them significantly faster (NextCycle 2023).

Working towards this, one of the programs targeting small businesses and emerging community projects is NextCycle's business accelerator. Through multiple tracks, this offering has supported 121 projects in over 54 counties in Michigan totaling $574,565 in awards (NextCycle, 2024). The Accelerator program contains many areas of support for innovative projects and helps identify business solutions, including organic solutions, new innovations and technology, road and path construction, as well as public sector solutions. Each of these tracks target different gaps in Michigan's recycling and material waste sectors, aiming to complete the same goals for recycling and material reuse as outlined in the MI Healthy Climate Plan. Benefits to business include: access to data, development, consultancy, customize membership, extensive networking gateways, funding opportunities, marketing and visibility and showcase/pitch competition events.

NextCycle's 2021 report estimated that a total of 100 strategically placed comprehensive drop off stations could service 98% of Michigan's population and reduce an additional 411,950 tons of municipal solid waste (MSW). Of these drop off stations, only 17 are needed to service half of Michigan's population if they were placed in high population or metro areas (NextCycle, 2021). NextCycle also projects the economic benefits of achieving MI Healthy Climate Plan's goal of a 45% recycling rate, claiming that it would result in a total of 120,300 collection, processing, and manufacturing jobs statewide, or $28.7 billion in economic output (NextCycle, 2023). Overall, they also estimate that reaching the 45% rate will result in an additional 7 million tons of greenhouse gas emission reductions per year (NextCycle, 2021).

In its Gap Analysis Update (2023), NextCycle estimated that achieving the MI Healthy Climate Plan's goal of a 45% recycling rate will require numerous additional investments made in material recycling facilities (MRFs) and organics processing capacity. NextCycle (2023) estimates that there were about 8.2 million tons of municipal solid waste in Michigan's waste stream, 84% of which could be recyclable or compostable while 31% of the waste stream would be compatible with MRFs (NextCycle 2023). By 2022 it was also noted that the state had reached an annual capacity of 411,400 tons per year in estimated throughput from the state's current MRFs, while 816,464 total tons of material was recycled in 2022.

As for organics, NextCycle (2023) reported that 309,322 tons of organic waste was reported at compost facilities in 2021. To reach the 45% goal, Michigan will require an additional 1.2 million tons of MRF compatible recyclables and 1.0 million tons of organic material to be processed per year (NextCycle, 2023). This figure means increasing the amount of MRFs from about 12 to 59 depending on their size, location, and output (NextCycle, 2021). Due to reporting challenges, NextCycle (2023) used reporting guidelines from the Part 175 Recycling Reporting Guidelines of Act 451 (2016) to estimate a minimum recycling rate of 21% in 2022, with true rates being much higher. NextCycle (2023) estimates that about 900,000 tons of municipal solid waste is currently being missed by the state via business-to-business commercial channels.

Good For Michigan

Pure Michigan Business Connect (PMBC) and People First Economy have partnered to promote sustainable business development in Michigan through their Good For Michigan initiative. This program aims to identify, measure, and guide the implementation of practices that create positive social and environmental impacts working towards circularity. Participating companies must first complete a UN Sustainable Development Goals Baseline assessment or finish at least 25% of the B Impact Assessment – a tool used to measure the impact of a business on the environment, communities, customers, suppliers, employers and governance as part of the B Corp movement – and to stay in good standing, retaking either assessment every two years.

Following this baseline assessment, businesses are granted free social and environmental sustainability consulting services and access to impact performance reporting. On top of access to free consulting, business owners also have numerous opportunities that help grow their company including the PMBC showcase, listings on the Good For Michigan website and communication/social media platforms, as well as networking opportunities with value-aligned companies (PMBC, 2024). Overall, this program connects businesses with shared values, and then gives them a platform to catalyze collective sustainable action along with benchmarking tools that may lead to greater talent attraction, customer loyalty and increased revenue growth.

Small Business Pollution Prevention Loan

The Small Business Pollution Prevention (P2) Loan program is also a recent EGLE offering allowing for small businesses with an employee count of under 500 full-time employees to receive loans of up to $400,000 with interest rates of 5% or less. Businesses must include projects that either eliminate waste at the business location, result in environmentally friendly reuse methods for recycling purposes, or conserve energy or water on-site (EGLE, n.d.). This program was in operation from the 2000s through the mid-2010s and EGLE is looking to reinstate a similar program in the coming years (Devon Dodge, personal communication, January 25, 2024). In the future, it may be of use to understand if small businesses will take advantage of the new program on a larger scale than its predecessor.

Renew Michigan Fund

Additionally, one of the main funding sources for Michigan recycling projects is the Renew Michigan Fund. Established in 2018 by former governor Rick Snyder, the Renew Michigan Fund has allocated about $69 million per year, with $15 million dedicated to recycling projects and $9 million to waste management and material oversight. However, the funding has potential to expand, with recycling and oversight allocations occupying 22% and 13% of their respective fund sections. The rest of the funding is allocated to environmental remediation projects (Michigan Recycling Coalition, n.d.). This fund has been instrumental in recent years towards funding various EGLE recycling and circular economy efforts, with NextCycle directly

using Renew Fund allocations as magnets for investment (NextCycle, 2023).

Circular-supportive State Policy

The most important recent change in state policy regarding circular economy was the adoption of HB 4454-4461 in December of 2023, an eight-bill package that has changed Michigan's Municipal Solid Waste Law, Part 115 (Michigan Recycling Coalition, 2021). The package was passed to help Michigan achieve the recycling and municipal solid waste goals that it outlined in the MI Healthy Climate Report, and enacted in late December of 2022 by Governor Gretchen Whitmer. Contained in Figure 4 is a summary of each of the bills by title, the categorical purpose of the bill, and a summary description provided by the Michigan Recycling Coalition, one of the key stakeholders responsible for working with the sponsors. This information is reprinted from https://michiganrecycles.org (2023).

Figure 4: HB 4454-4461 Summary

HB 4454 | General & Definitions | Rep. Howell

- Defines Benchmark Recycling Standards, as minimal level of service provision. With the following goals:
  - 90% of single family households in municipalities over 5,000 to receive curbside recycling service for one or more materials by 2028.
  - Counties with population less than 100,000 to host one drop-off recycling per 10,000 residents.
  - Counties of populations over 100,0000 to host at least 1 drop-off for every 50,000 residents
- Defines types and levels of composting facilities requirements for managing volumes and types of organics.
- Defines functional stability of a landfill.

HB 4455 | Definitions & Goals | Rep. Cambensy

- Defines required host community approval for hosting a facility within jurisdiction.
- Defines managed material and materials utilization facilities.
- Establishes goals to optimize and reach a 45% recycling rate.
- Requires facilities to comply with Part 115, county plans, and defines terms for required registration and permitting.

HB 4456 H-1 | Disposal Areas & Waste Diversion Centers | Rep. Sowerby

- Adjusts fees on disposal areas as negotiated with industry, less than inflation.
- Includes new landfill gas management and flexible post-closure requirements.
- Allows EGLE to enter, inspect, and monitor sites and facilities.

HB 4457 H-1 | Financial Assurance | Rep. Rabhi

- Sets forth financial assurance requirements for site clean-up in cases of bankruptcy and other catastrophic failures.
    - Adjusts the financial assurance required for landfills.
    - Establishes financial assurance for other types of materials management facilities.

HB 4458 | Miscellaneous Provisions & Enforcement | Rep. O'Malley

- Provides option for the state to develop a materials management plan for a county that chooses not to plan.
- State-developed plan will ensure haulers operating within the county will offer services that meet the benchmark recycling standards.

HB 4459 | Funds and Grants & Beneficial By-Products | Rep. Martin

- Identifies how state Renew Michigan funds are to be allocated for activities that include planning, grants and loans for market and infrastructure development, education & outreach, and economic development.

HB 4460 H-1 | Materials Utilizations Facilities | Rep. VanSingel

- Establishes a larger regulatory structure to provide increased oversight of compost facilities, as well as recycling plants and anaerobic digesters.
- Identifies the limits of small, medium, and large compost facilities and fees for registration.

HB 4461 H-1 | Materials Management Plans | Rep. Tate

- Updates county solid waste planning to county materials management planning.
- Encourages the development of regional planning.
- Sets forth a timetable for planning and requirements for involvement in the process.
- Identifies current mechanisms that can be used to fund service provisions.
- Requires notice of planning activities to municipalities with 2 miles of a proposed facility.
- Makes funding available for planning and implementation of those plans.
    - Every year $60,000/county, first three years of a planning cycle counties will receive $.50 per capita not to exceed $600,000.
    - Directs some types of funding to those counties that can demonstrate progress toward defined goals and benchmark standards.

Examples of Public and Private Circular-supportive Partnerships in Michigan

The Michigan Sustainable Business Forum hosts a Michigan Campus Sustainability Collective that includes colleges and universities working together to advance sustainability and sustainable business. Current members include Albion College, Aquinas College, Calvin University, Central Michigan University, Davenport University, Eastern Michigan University, Grand Valley State University, Hope College, Kendall College of Art and Design of Ferris State University, Michigan State University, Michigan Technological University, Northern Michigan University, Western Michigan University, and Siena Heights University (*Campus Sustainability Collective – MISBF*, n.d.).

The West Michigan Sustainable Business Forum promotes business practices that advance climate leadership, social justice, and the creation of a circular economy. In particular, the Circularity Forum and Circular Economy Challenge (*Circular Economy – West Michigan Sustainable Business Forum*, n.d.) have been identified to assist the creation of circular and low-carbon economies.

The Southeast Michigan Council of Governments (SEMCOG) announced in 2021 their partnership with Circular Great Lakes (CGL), a regional initiative focusing on keeping plastic materials out of the waste stream and the Great Lakes. CGL works to create a circular waste economy by closing the loop on the life of plastics. They are currently participating in a five-year strategy and action plan moving toward a sustainable recycling network (Grantham, 2021).

The Michigan Materials Marketplace connects businesses to develop and scale new reuse and recycling market opportunities. Some of the activities and organizations assisting to inform this internationally include the Ellen MacArthur Foundation, World Economic Forum, and World Wildlife Fund. At the national level, it also includes the U.S. Chamber of Commerce Foundation, Rheaply's Resource Exchange Platform, Remade Institute, and ReFED. Working at the state and local levels, this Marketplace also connects over 2,000 companies, community organizations, academic institutions, and governmental entities (*Michigan Materials Marketplace*, n.d.).

Higher Education Support of Circular Economy Training and Development in Michigan

In Michigan, many academic institutions are partnering with federal, state, public and private, as well as philanthropic and independent sector collaborators to offer research, design, education, training, technical assistance and more. Known globally as a leader in sustainability, Michigan State University (MSU) is also supporting the transition to circularity by creating solutions for a more resilient world (MSU, 2024). MSU advances sustainability globally, nationally and regionally through engagement to meet the challenges identified by the U.N. Sustainable Development Goals (2024). Through innovative partnerships, members are engaged in convening and fostering cross-sector and multi-disciplinary dialogue, publishing data, serving as subject matter experts, and advocating for smart policies that advance solutions. (Sustainability, 2024)

Inside MSU's University Outreach and Engagement, the Center for Community and Economic Development (CCED) advances MSU's land-grant mission by creating, applying, and disseminating valued knowledge through responsive engagement, strategic partnerships, and collaborative learning. It is dedicated to co-creating sustainable prosperity and equitable economies with communities (*Home - Center for Community and Economic Development - Michigan State University,* n.d.). MSU CCED's foci includes four guiding pillars supporting more equitable communities and economic co-creation including: (1) Planning ~ supporting multi-sector comprehensive planning processes that incorporate social, environmental, and economic considerations. (2) Financial Resiliency ~ increasing equity and expanding community, stakeholders and financial institutions' capacity to invest in local businesses. (3) Circular Economies ~ exploring new strategies that include minimizing waste, conserving energy, reducing greenhouse gas emissions and utilizing outputs from one process as inputs in another. (4) 21st Century Communications ~ ensuring everyone has access to the tools and technologies needed to create more connected and equitable communities within a democratic society.

Domicology

In 2015, CCED's Director Dr. Rex LaMore, coined the term "Domicology" as the *study of economic, social and environmental characteristics relating to the life cycle of the built environment* and began teaching the practice of examination. This involves identifying structural life cycles, designing structures to ensure usefulness even at the end of their lifecycle, as well as identifying policies and employing practices that ensure a more sustainable lifecycle. MSU CCED has also supported the creation of one of the first Domicological exhibits in the country at the MSU Museum, available for viewing from December of 2023 through March of 2024. Domicology is a quintessential example of circularity, aimed towards the planning, development, reuse and/or deconstruction of more sustainable built environments including analysis and evaluation.

Circular Economic Institute Development at MSU

In 2021, the CCED also began to build out framework for the development of a Circular Economy Institute (CEI) at Michigan State University with advice and guidance of a broad-based consortium representing Michigan's higher education institutions, public and private partners. It is tasked with undertaking innovative and transdisciplinary research, teaching, and outreach efforts on technical, economic, and social impact areas of circularity such as material use reduction and product reuse, recycling, and recovery (CCED, 2024). The MSU CEI will prioritize activities that provide much-needed support to industries critical to Michigan's (and beyond) economy such as the automotive, chemical, agri-business and infrastructural materials (built environment) sectors. Strategic advancement will leverage the Institute's consortium in critical topical areas such as materials upcycling and remanufacturing, new product design and development, extended producer responsibility, business development, materials salvage and recovery, reuse and resale, networking, and public policy. Capitalizing on these strengths, the MSU CEI would also serve as a central hub, catalyst, and a leader of efforts to mitigate the

negative social, economic, and environmental impacts associated with a linear economic approach of material use and waste (CCED, 2024).

Specifically, the CEI proposes to engage a broad representation of sectors through MSU faculty expertise to:

- Identify, conduct, and support innovative research with industry, public and non-profit partners on material waste reduction, product reuse, recycling, andrecovery with an emphasis on topics important to the state of Michigan.
- Conduct training and provide technical assistance to Michigan industries, public agencies, and other key stakeholders in the implementation of best practices in material waste reduction, product reuse, recycling, and recovery.
- Develop and support professional development opportunities through certificate programs and other appropriate means that improve Michigan's circular economic workforce capacity.
- Create an MSU CEI virtual and physical hub and network that will guide and link faculty, students, staff, industry and stakeholders with ongoing and future circular projects, accomplishments, and resources. (CCED, 2024)

To support this work the MSU CCED has facilitated a broad faculty network, including key advisors from the following diversified disciplines: the School of Packaging, Department of Community Sustainability, Department of Plant, Soil and Microbial Sciences, Department of Animal Science, Department of Political Science, and the Department of Chemical Engineering and Material Science. In addition to the core faculty team, this forming Circular Economy Institute has an extensive network of over 30 partners and additional stakeholder collaborations within public departments like the Michigan Department of Environment, Great Lakes, and Energy and the White House Office of Management and Budget, as well as various private industries. The MSU Circular Economy Institute is also taking root through its commitment to continuously facilitating conversations and highlighting ongoing research among economic and sustainable champions, faculty, and circular economic thought and practice leaders by hosting and promoting relevant forums. These webinars contribute to the forming Institute's mission of public education and stakeholder collaboration on circular economy ultimately supporting and driving positive regional change *(Circular Economies, n.d., MSU).*

In 2022, CCED began hosting a series of informal panels regarding circularity and highlighting MSU faculty expertise covering a variety of circularity topics. The series has included presentations from Dr. Gemma Reguera from Microbiology and Molecular Genetics, Dr. Satish Joshi from the Department of Agricultural Food and Resource Economics, Jim Anhut from the School of Hospitality and Business, Dr. Mark Wilson from the School of Planning, Design and Construction, Sandra Lupien and Dr. Rafael Auras from the College of Agriculture and Natural Resources, Dr. John Dorgan and Dr. Annick Anctil from the College of Engineering, Professor Verdat Verter from the Department of Supply Chain Management, Dr. Courtney Carignan from the Department of Food Science and Human Nutrition, and Professor Karen Draths from the Department of Chemistry. These panels can be viewed at https://ced.msu.edu/foundations-of-socially-just-and-equitable-communities/circular-economies

where they provide insights and overviews on current barriers to circularity, as well as scientific context behind circular practices and research.

MSU Office of Sustainability

MSU also has an Office of Campus Sustainability serving as the central coordination for university sustainability advancement. Their mission is to "cultivate and embed sustainability and climate change actions throughout the institution in alignment within four pillars of success: Campus, Curriculum, Community and Culture" (*About Sustainability at MSU | Sustainability | Michigan State University*, n.d.). Accordingly, MSU has adopted a sustainability framework that aligns with its strategic goals to meet this mission. MSU currently is in 25th place in the 2024 Times Higher Education Impact Rankings globally and 2nd place nationally for sustainability, making it the only Michigan and Big Ten university in the top 25 (*About Sustainability at MSU | Sustainability | Michigan State University*, n.d.).

MSU Extension

Within MSU, Extension outreach also provides programming through four Institutes, including Agriculture & Agribusiness; Community, Food & Environment; Children & Youth, and; Health & Nutrition. The goal of Extension services is to improve people's lives by bringing the knowledge resources of MSU directly to communities, individuals, and businesses (*MSU Extension*, n.d.). From supporting agricultural biodiversity research and environmental contaminants to building alliances with farmers and both urban and rural community stakeholders, Extension supports the growth of future leaders in circular economics as a part of the premiere land grant institution in the United States. To execute this work, Extension offices are housed within all 83 counties within the state of Michigan.

MSU Center for Regional Food Systems

The MSU Center for Regional Food Systems (CRFS), established in 2012, also provesto be a highlight of Michigan State University's dedication to advancing the knowledge and implementation of circularity into regional food system business practices, as well as revitalizing communities impacted by food insecurity and economic disadvantage through uplifting diverse voices and equitably promoting healthy and affordable food (*Our Work*, n.d.). The most recent reflection of this is the establishment of the CRFS as lead partner in the creation of the Great Lakes Midwest Regional Food Business Center, funded with generous support from the USDA in 2022. Over the next 5 years, MSU will receive $20 million to aid farms and food businesses in the Great Lakes supporting access to new markets and helping all understand and utilize government resources (Kiel, 2023). The project will channel a total of $400 million through 11 other regional food business centers besides MSU's CRFS, including the Menominee Indian Tribe of Wisconsin's Department of Agriculture and Food Systems (DAFS), to serve regional food businesses and indigenous food systems (*Our Work*, n.d.). Of this, $10 million is also

allocated to fund technical assistance such as resiliency and adaptability building, business coaching, increasing profitability, etc. — for food businesses and small to mid-sized farms owned by underserved people in the Great Lakes region (*Our Work*, n.d.) while supporting health and environment.

In addition to the Great Lakes Midwest Regional Food Business Center initiative, MSU's CRFS has inspired direct impact in the region's communities through diverse programs ranging from financing, technical assistance, and economic development projects for small farmers, farmers of color, and entrepreneurial agricultural business owners. Relevant research and publication includes Financing Farming in The U.S., Michigan's Emerging Farmers, Farm Business Record Keeping for the Global Majority, Michigan Good Food Fund Technical Assistance Providers, and more. The Center also works to support planning and policy initiatives meant to develop innovation hubs, information sharing, and councils for Michigan's agricultural entrepreneurs, marginalized communities facing food insecurity, and the overall food system workforce. These include the Michigan Food Hub Learning and Innovation Network, Michigan Local Food Council Network, Racial Equity in the Food System Workgroup, Michigan Local and Regional Food System Workforce Assessment, all helping to continuously co-create 'thriving economy, sustainability, and equity' throughout the state and globe.

The MSU CRFS also received another award recently from the Michigan Department of Agriculture and Rural Development (MDARD) for $1.8 million in Value-Added and Regional Food System grants in 2023 supporting 24 diverse 'producers, processors, and community development organizations' across the state in order to directly invest in innovating food supply chain management to address food availability and affordability challenges while improving local agricultural businesses and environment (Throne, 2023). These grants are estimated to leverage more than the original investment of $1.8 million in matching funds (Throne, 2023). The potential for direct impact through improving regional food systems to become more circular is reflected in the expansion of grassroot organizations and government agencies across the country.

University Research Corridor

Also within the state of Michigan is the only national innovation cluster comprised exclusively of public institutions. The University Research Corridor (URC) is composed of Michigan State University (MSU), University of Michigan (UM) and Wayne State University (WSU) working dedicatedly together to improve the quality of life for the region while advancing knowledge at the global level. The URC is an academic research cluster leading talent production, academic research, and economic revitalization to help attract knowledge economy businesses feeding new enterprise while educating the workforce and planting the seeds for the new industries of tomorrow – *including circular economy*. Their main foci are Mobility & Automotive, Education, Infrastructure, Environment, Life, Medical & Health Sciences, Innovation & Entrepreneurship, Economic Development, Research, Community Engagement,

Talent, Industry 4.0. (*University Research Corridor*, 2023)

University of Michigan

Within the URC, the University of Michigan has many opportunities to learn about sustainability, including some with circular foci. As more cross-disciplinary and collaborative partnerships are necessary for addressing large scale challenges, the School for Environment and Sustainability offers a Master of Science in Environment and Sustainability, as an example. There, students may choose between seven specializations. These include Behavior Education & Communication, Environmental Justice, Environmental Policy & Planning, Ecosystem Science and Management – Conservation Ecology, Geospatial Data Sciences – Environmental Informatics, Sustainability and Development, and Sustainability Systems. The thematic areas include Cities & Mobility, Built Environment, Climate & Energy**,** Conservation & Restoration**,** Food Systems**,** and Water (*Homepage | University of Michigan School for Environment and Sustainability*, n.d.).

Within the UM there are also centers, institutes, and initiatives. As an example, the Erb Institute for Global Sustainable Enterprise is a partnership between the Ross School of Business and the School for Environment and Sustainability (SEAS). In this cross-sector collaboration, undergraduate students can join as a fellow from business or the sustainability program while graduate students may earn joint degrees such as an MBA or an MS in sustainability (*About - U-M Erb*, 2023). In particular, the Sustainable Future Hub works directly to support sustainability decision-making on campus and beyond (*Welcome to the Sustainable Future Hub | University of Michigan School for Environment and Sustainability*, n.d.). Additionally, the Tishman Center for Social Justice and the Environment has enabled SEAS to expand the scope of its Environmental Justice program including the hiring and retention of top environmental scholars, including partner placements in the UM College of Engineering (*The Tishman Center for Social Justice and the Environment | University of Michigan School for Environment and Sustainability*, n.d.).

Also of note, the Graham Sustainability Institute at UM advances a more just and sustainable world where policy and practice are powered by science, collaboration, and creativity (*Graham Sustainability Institute*, 2024). Their strategic priorities include climate change, water resources, leadership development, policy integration and broader impacts. Most recently, launched in July of 2023, the Center for Empowering Communities assists in fostering decarbonization solutions simultaneously intended to advance community goals and priorities (Haddad, 2023).

Wayne State University

Within the URC partnership, Wayne State University (WSU) oversees the Office of Campus Sustainability in Detroit. Their vision and mission encompass environmental justice, energy conservation, waste reduction, transportation, water quality, education, and food systems (Wayne State University, 2023). They also provide an eco-friendly guide to finances & saving (Jackson, 2023.). WSU also hosts the Center for Urban Responses to Environmental Stressors, the Healthy Urban Waters, and the Transformative Research in Urban Sustainability Training T-RUST ~ an innovative graduate training program integrating social and physical science, technology, engineering, and mathematics to tackle complex challenges in urban sustainability (*Transformative Research in Urban Sustainability Training*, n.d.).

Currently, the University also cultivates the Sustainability Learning Community as a body of students dedicated to sustainability and environmental justice (Wayne State University, 2021). In particular, this applied learning opportunity requires registration for two relatedcourses ensuring service to the broader community. Through this, students meet to discuss the topics of local and global sustainability while working to foster diversity. Finally, WSU also hosts Leadership in Energy and Environmental Design (LEED) projects with partnership from theU.S. Green Building Council in support of additions to their LEED portfolio of buildings and as part of a larger commitment to all major new construction projects designed to receive a level of LEED certification. (WSU, 2024)

Other Colleges and Universities in Michigan

Across Michigan, there are more than 93 academic institutions including eight research universities, 17 baccalaureate colleges, and 19 masters universities. A strong example of circular economic supportive programming is at Northern Michigan University (NMU) within the Upper Peninsula. NMU's environmental science and sustainability major is one of their flagship offerings as well as the Sustainability Hub for Innovation and Environment. Campus-based projects and initiatives involving circularity include textiles and recycling (*Current Initiatives | Sustainability Hub for Innovation & Environment*, n.d.).

Also in the upper peninsula, Michigan Technological University (MTU) offers an undergraduate major in sustainable bioproducts through Environmental Science and Sustainability. Notable research includes plastic reuse and converting plastic waste and inedible biomass into edible protein (Christensen, 2021). The University hosts regular Q&As with plastic reuse researchers discussing "cradle to cradle" regenerative practice verses "cradle to grave" ~ or more linear practice (Mills, 2023). Other initiatives include "Future Proof" Institutional Initiative and Sustainability and Resilience, as well as Advanced Materials and Manufacturing (*Sustainability and Resilience | Future Proof | Michigan Tech*, n.d.).

On the west side of the state, Western Michigan University (WMU) houses the Institute of the Environment and Sustainability offering an Environmental and Sustainability Studies course, fellowships, and internships (*School of Environment, Geography, and Sustainability*,

2023). Additionally, through the Michigan Sea Grant partnership, fellowships and internships are available with Knauss Marine Policy, Michigan Sea Grant Environmental Internship, NOAA Coastal Management and the Michigan Sea Grant Extension Fellowship (*School of Environment, Geography, and Sustainability*, 2023). The WMU Fiber Recycling course also assists to broaden and update knowledge and understanding in circularity regarding recycled fiber collection, processing, use, and market drivers conducted on-site at the Engineering campus (*WMU Fiber Recycling Course,* n.d.).

Central Michigan University hosts an online platform through the College of Science and Engineering dedicated to supporting their community in becoming more sustainable, known as *Central Sustainability*. Here, information on CMU Waste Management and Sustainability as well as other resources are provided (*Central Sustainability | College of Science and Engineering | Central Michigan University*, n.d.) online. Of note, the Department of Marketing and Hospitality Services Administration is also working to analyze the role artificial intelligence (AI) plays in improving reverse logistics within the circular economy. Here, differing forms of AI are analyzed for contributions to logistical tasks that help determine alternative uses for returned goods as well as algorithmic calculations identifying optimal sequencing for product disassembly. (CMU, 2024)

Other Academically and Circular-Supportive Programming in the United States

While CE is still a relatively new concept, universities across the U.S. have begun to offer more education, resources, and support toward circular practices. Of note, Massachusetts Institute of Technology (MIT), the University of Chicago (UC), Georgetown University (GU), Arizona State University (ASU) and the University of California Berkeley are developing new curriculums. On the east coast, MIT offers an academic 12-month professional certificate program in sustainability. MIT has also mobilized their Office of Sustainability, Water and Food Systems Lab, Climate and Sustainability Consortium, and proposed the Environmental Solutions Initiative, as well as the MIT Energy Initiative (MIT Facts, 2022).

The University of Chicago also offers an eight-week online course exploring best practices for integrating circularity metrics into traditional operating and financial models that examine the role of corporate boards, management teams, investors and consumers in supporting the circular economy. Georgetown University, within the District of Columbia, also makes courses available to students that include design analysis developments in technological advancements as they relate to sustainability. Through this, the McDonough School of Business provides frameworks for new enterprise implementing circular practice. Multiple classes focused on circular transition topical areas include: observing past energy transitions/innovations and examining contemporary disruptions in consumer energy sectors/energy dependent sectors, teaching the fundamentals of sustainability & balance between economic, social and environmental systems, and providing background on equity and justice issues concerning sustainability (Georgetown 2023).

In the southern U.S., Arizona State University (ASU) is one of the leading universities in circular economy. This academic institution has four main circular offerings. Perhaps most accessible, the "Introduction to the Ethical Circular Economy" is provided online and consists of seven weeklong sessions in collaboration with the Ray C. Anderson Foundation. The second is a certificate program for professionals, "Executive Certificate in the Ethical Circular Economy". Thirdly, ASU also collaborates with local partners in the greater Phoenix region on the ground. Finally, ASU has developed a four-year program between the Phoenix City Council and the Walton Sustainability Solutions Initiative at the ASU Wrigley Institute, "Resource Innovation and Solutions Network" (*Arizona State University*, n.d.).

Finally, the University of California–Berkeley is working to divert about 54% of their municipal solid waste stream to recycling, composting, or reuse (*Zero Waste | Sustainability & Carbon Solutions*, n.d.). Their Zero Waste Coalition is an opportunity for students to get involved in the zero-waste movement and to help them achieve zero waste at the broader university level (*Zero Waste | Sustainability & Carbon Solutions*, n.d.). Additionally, independent of the University and commonly known as DeCal – this related student organization offers the "Solutions for a Sustainable & Just Future" crash course entitled *Everything We Can Do to Save The Planet 101*. Ultimately, this informal organization assists to "equip students with tools necessary for improving the fate of humanity" (*DeCal*, n.d.).

Conclusion

Following an investigation covering almost the last decade of broad circular economic transformational activities, occurring both globally and locally, this overview highlights a limited scope of effective and supportive small and medium-sized business circular transitional practices. However, there is a lack of research, information and key performance indicators available for related markets, production, retrofitting and other circular economic strategies for SMBs and their overall contribution to the waste stream. As such, this snapshot and analysis emphasizes challenges SMBs will face within this emerging field.

Additionally, a knowledge gap focused on impact and equity exists across accessible resources and strategies more broadly available to large-scale enterprises. Here, institutions of higher education offering classes, certifications, apprenticeships, and degree programs will be pivotal. Navigating the limited network of resources and lack of standardized language is one barrier to establishing partnerships for collaborative and necessary transitional activities towards circularity efforts of SMBs. This introductory exploration sets the stage for delving into these challenges by sharing a broad range of circularity policy, partnerships and practices at all levels and across industry sector in attempts to help facilitate a foundation for data collection and sharing.

Globally, sustainable and circular-specific practices are aggregately promoted through United Nations and European Union action plans and sustainability goals. Countries across the

world have developed projects to advance resource efficiency and cleaner production. Circular models are also implemented by business impacting transnational supply chains as well as influencing market stability. Regulation efforts span from Western Europe to Southeast Asia, with multinational efforts like the Green Public Procurement (GPP) working for international standardization of environmental regulation and requirements. Various countries are leading their own material efficiency and packaging sustainability innovations. International nonprofit efforts, such as the Sustainable Agriculture Initiative (SAI), focus on developing local agricultural value chains and incorporating circular, regenerative practices, effectively transforming mostly disadvantaged food systems to become more sustainable and equitable.

On the national level, innovations in circular economy public-private partnerships are helping to develop key technologies aimed at reducing embodied energy and carbon emissions associated with industrial-scale materials' production and processing. Government sponsored research and innovation programs focus mainly on these innovations in renewable energy. Despite lacking the degree of regulation and legislation efforts found in parts of Western Europe and the Eastern Hemisphere, the United States has only recently passed legislation requiring disclosure of climate-related risks and information on greenhouse gas emissions levels. The U.S. Environmental Protection Agency and other agencies are funded to help research and innovate on waste reduction strategies. In some cases, they also offer programming to create relevant well-paying jobs that also promote circularity and effective recycling through broader national education. However, currently the U.S. has limited extended producer responsibility initiatives. The U.S. also lags on the development of materials tracking systems and lacks standardized assessment tools that help minimize greenwashing while offering simple and easily recognizable product labeling.

Extensive collaboration across the Great Lakes region is helping set new recycling goals and develop action plans that scale MRFs' processing and expansion of end-market capacity. This focuses on the interdependencies of supply chains at all levels. Successful efforts to regeneratively innovate and equitably transform supply chains in the Midwest are reflected in Michigan through specific activities focused on regional-level collaboration. Additionally, in Michigan, legislation to reinvent recycling strategies serves as a leading example of how other states can adopt circular practices in their waste management. It also offers models for collaboration through programming such as small business loans for community-based and small business projects aimed at advancing circular practice and sustainable innovation. However, little information is readily available on Michigan or state-specific sector waste streams, impacts, transformational resistance or incentives. In the future, it is hoped that additional research will be done on tracking trash flows from retail, restaurant, service, manufacturing and more by industry sector and state.

Perhaps the greatest challenge in the 21st century will be our ability to develop an economy that seeks to 'close the loop' on extractive and pollutive industries and move away from the 'take, make, use and throw away' model of production; exploring strategies to create new industries, products and services that minimize waste, conserve energy, reduce greenhouse

gas emissions and utilize outputs from one process as inputs into another. This fundamental transformation to a circular economic system will require the scholarly engagement of higher education, visionary entrepreneurship, policy leadership and informed and active citizen consumers. Such a comprehensive transformation calls upon all of us to do our part in creating a sustainable and just future.

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