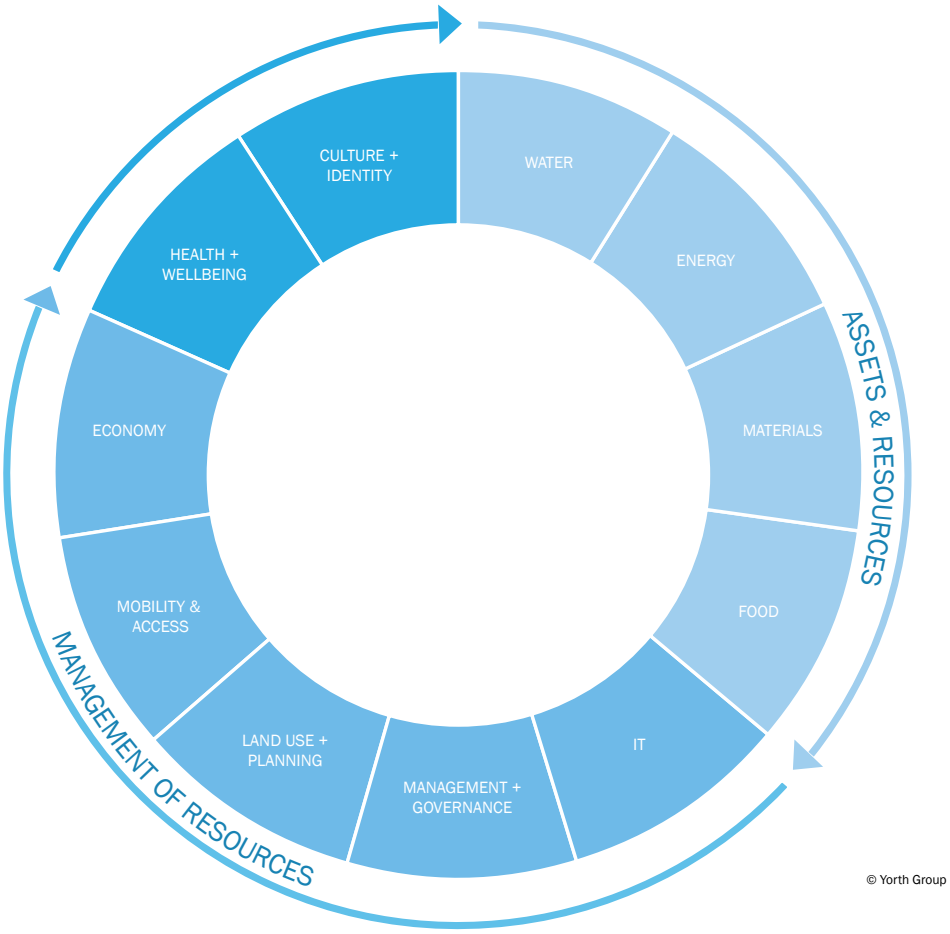
MATERIALS

a world of plenty

Restorative Development: Full Resource Integration to Power a New Local Economy

To assess performance, Yorth uses its proprietary Restorative City Standard™. The Standard has 11 performance areas, each with goals and key performance indicators (KPIs). When these are managed systematically and synergistically, net-positive results can be achieved.



As shown, the performance areas create a virtuous cycle of positive action. Effectively integrating physical resources such as energy, water, and materials in closed-loop systems creates economic, social and environmental benefits. This attracts new investments, industries and employment opportunities. If managed according to restorative standards, this new local economy improves residents' quality of life, which in turn strengthens culture and identity.

Through its integrated approach, restorative development generates the following outcomes:

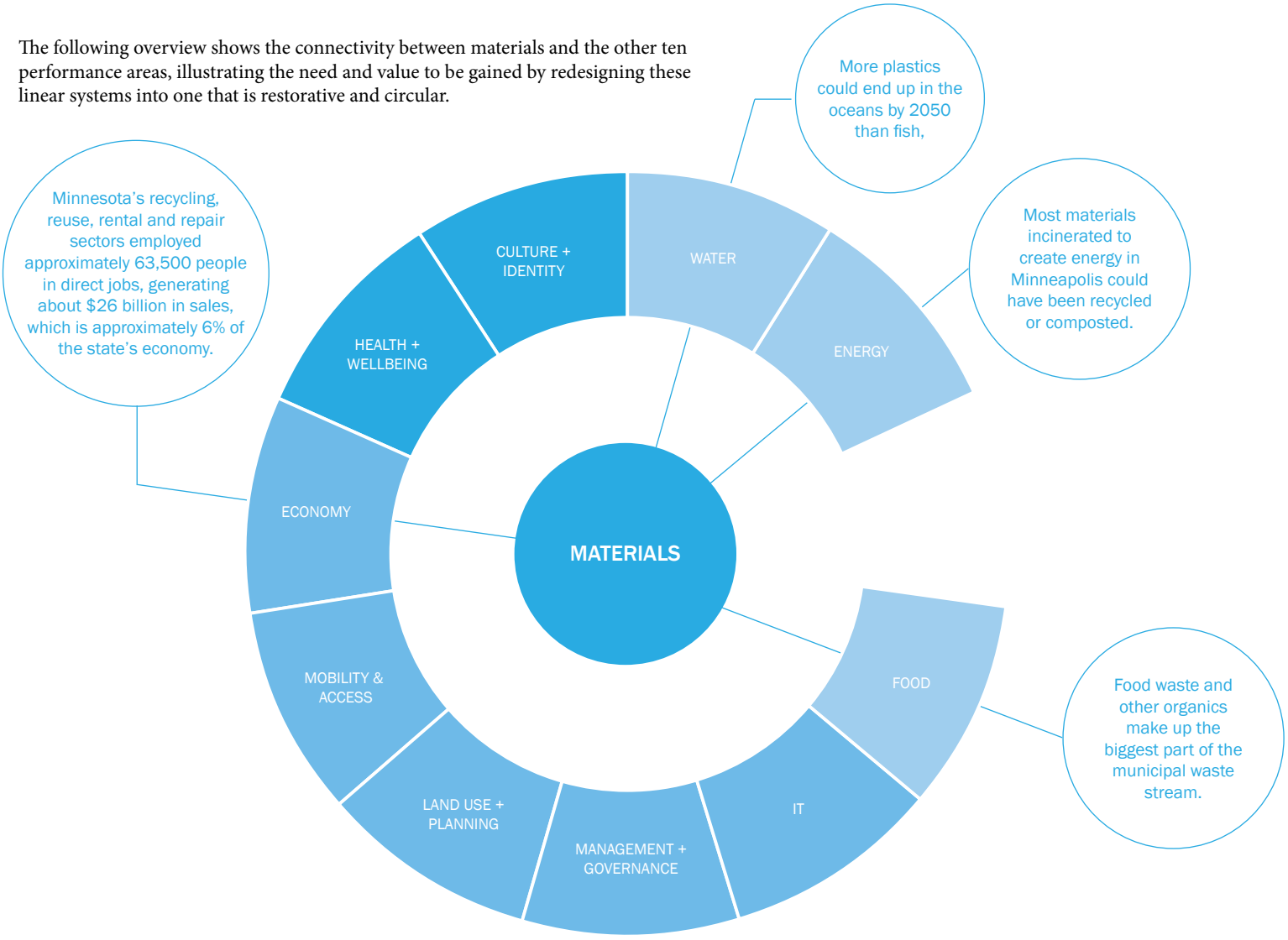
- Resilient and climate-proof infrastructure
- Zero-emission energy, water, materials and food infrastructure
- Energy, food and water security
- Resilient and green local economy with new jobs and career pathways
- Incentives for local developers and industries
- Increased economic, social and environmental equity across all sectors

SUMMARY

FROM
A finite and linear take-make-waste economic model

TO
Circular materials management that keeps molecules at the highest possible value

The following overview shows the connectivity between materials and the other ten performance areas, illustrating the need and value to be gained by redesigning these linear systems into one that is restorative and circular.



KEY TAKEAWAYS

- China's refusal to take U.S. recyclables showed that most domestic recycling infrastructures were unable to extract value out of the mixed recycling stream, forcing some municipalities to burn it instead.
- In 2019, the City of Minneapolis recycled and composted 38% of its waste, and it aims to bring that number up to 50% of its overall waste stream by 2020, and to 80% by 2030.
- The Minnesota Pollution Control Agency estimates that by not recovering materials that could be have been recycled, $2.3 billion of potential material was discarded between 1996 and 2013 in Minnesota.[1]

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For decades, the world has followed the linear path of the take-make-waste economy, pegging economic growth to the frequency with which consumers buy, discard, and replace products. Bound by the current growth paradigm, cities and governments have a mandate to find ways to make any waste disappear as quickly and cheaply as possible.

In the United States, as in many Western countries, authorities have succeeded at this task, enabling consumers to expand their consumption without ever seeing where the contents of their overflowing bins go, and without feeling a significant hit on their wallets from waste disposal costs. What's more, with lifestyle changes such as increased online shopping and more frequent purchases of packaged foods, many consumers now see a large portion of their waste go into the single sort recycling bin, suggesting net progress even as consumption increases to unsustainable levels.

Then in 2018 came a big change. When China refused to accept contaminated recyclables from other countries, it exposed the inadequacy of the American recycling system. It forced change unto an industry that was optimized to dispose of materials as quickly and cheaply as possible, even if that meant shipping it halfway around the globe for sorting and processing. As recyclables piled up at home, it became painfully clear that most domestic recycling infrastructures were unable to extract value out of the mixed recycling stream, forcing some municipalities to burn the materials instead.

China's ban exposed not just a crisis of recycling, but also a crisis of recyclables. For decades, the public's perception of the recyclability of plastics has contributed to its proliferation, stymieing any impulses for material innovation. With increased public awareness of the true impact—the United Nations warned that more plastics could end up in the oceans by 2050 than fish – comes an opportunity to rethink waste.

Eliminating the concept of waste in favor of closed-loop materials management, where the value of materials is maintained or even improved with each cycle, unlocks opportunities for innovation in materials design and development, and in lifecycle management. When materials are actually worth recycling, regional recycling and remanufacturing infrastructures can be built that offer living-wage jobs and workforce development opportunities.

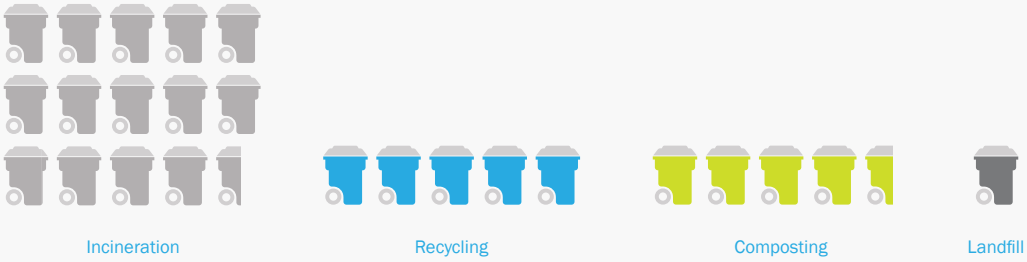
1. Waste Management in Minneapolis

1.1 System Characteristics & Existing Infrastructure

Solid waste and recycling services within the city are provided through a combination of services from the city and private service providers.

The City of Minneapolis manages waste for single residential units, as well as for city operations. In 2019, a total of 138,816 tons (down from 141,450 tons in 2018) of material were collected by the city's Solid Waste & Recycling division of Public Works. 58% of the material was sent to a waste-to-energy facility in downtown Minneapolis, 20% of materials were recycled, and 18% were composted, bringing total diversion for 2019 to 38%. Lastly, just under 4% of materials were landfilled.[2]

Where does residential waste go in Minneapolis?



The Solid Waste and Recycling Fund coordinates services related to collection, disposal, and recycling of household waste, yard waste, and problem materials, as well as organics. In addition to providing weekly and bi-weekly pick-ups for trash, yard-waste, organics, and recycling material for half of the city (single residential units and municipal operations), SWR also operates a solid waste transfer station providing service to over 107,000 households.

Funding for solid waste and recycling activities is primarily generated from solid waste collection fees through monthly utility bills, and grants from Hennepin County.

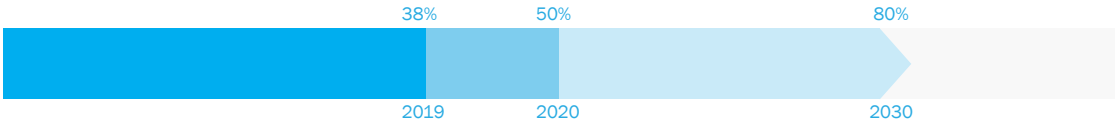
Multi-family and commercial waste management is managed by 70 private haulers. Unfortunately, there is a significant lack of data with regard to the make-up and processing of this significant portion of the waste stream. The city is currently working with these private contractors to get data on multi-family and commercial properties.

Municipal solid waste is largely incinerated in the Hennepin Energy Recovery Center. Recyclables are sent to the Eureka Recycling Materials Recovery Facility (MRF), where the

single-sort recyclables stream is processed, marketed as recovered materials that provide revenues to the city. The city has recognized the need to increase the organics processing capacity which may include an anaerobic digestion facility managed by Hennepin County.

The City of Minneapolis has joined other American and global cities in setting a Zero Waste goal. In 2019, the city recycled and composted 38% of its waste, and it aims to bring that number up to 50% of its overall waste stream by 2020, and to 80% by 2030. It also seeks to achieve a zero-percent growth rate in the total waste stream from 2010 levels. Strategies and near-term tactics to making progress include increasing the price differential between small and large trash carts to incentivize reduction of waste, and increasing recycling and organics pick up frequency while reducing remaining garbage collection to every other week.

Organics and Recycling Diversion Goals, Minneapolis Zero Waste Plan



1.2 Rates + Tipping Fees

The 2020 base fee per residence is $25.08, with an average monthly cost of $30.08. This is projected to rise to $33.44 in 2024[3]. For comparison, a household occupying a single building in San Francisco, the country's zero waste leader, pays $43.94 for garbage, recycling and organics collection. Notably, the standard size cart for garbage in San Francisco is only 16 gallons, whereas in Minneapolis, the smallest cart available is 32 gallons, with the vast majority of residents (92%) using 96-gallon carts. As it moves further along on its zero-waste journey, Minneapolis plans to create bigger financial incentives to increase adoption of the smaller carts.

The City of Minneapolis pays $58 per ton to dispose of waste to be burnt at HERC. For comparison, the average landfill tipping fee in Minnesota was $61.67[4] in 2018, and St. Paul pays $82 to dispose of waste in its waste-to-energy facility.

The City of San Francisco pays $180 a ton to its zero-waste partner, Recology[5]. In Germany, where 60% of waste is diverted to recycling, prices per ton for incineration typically range around $180, but have reached $260 for some facilities. While lower tipping fees can help a municipality fulfill its mandate of providing affordable services for its residents, it also stymies innovation and can hinder the development of a more robust materials management industry that could serve as a multiplier of economic, social, and environmental value.

2. HERC: From Waste to Energy

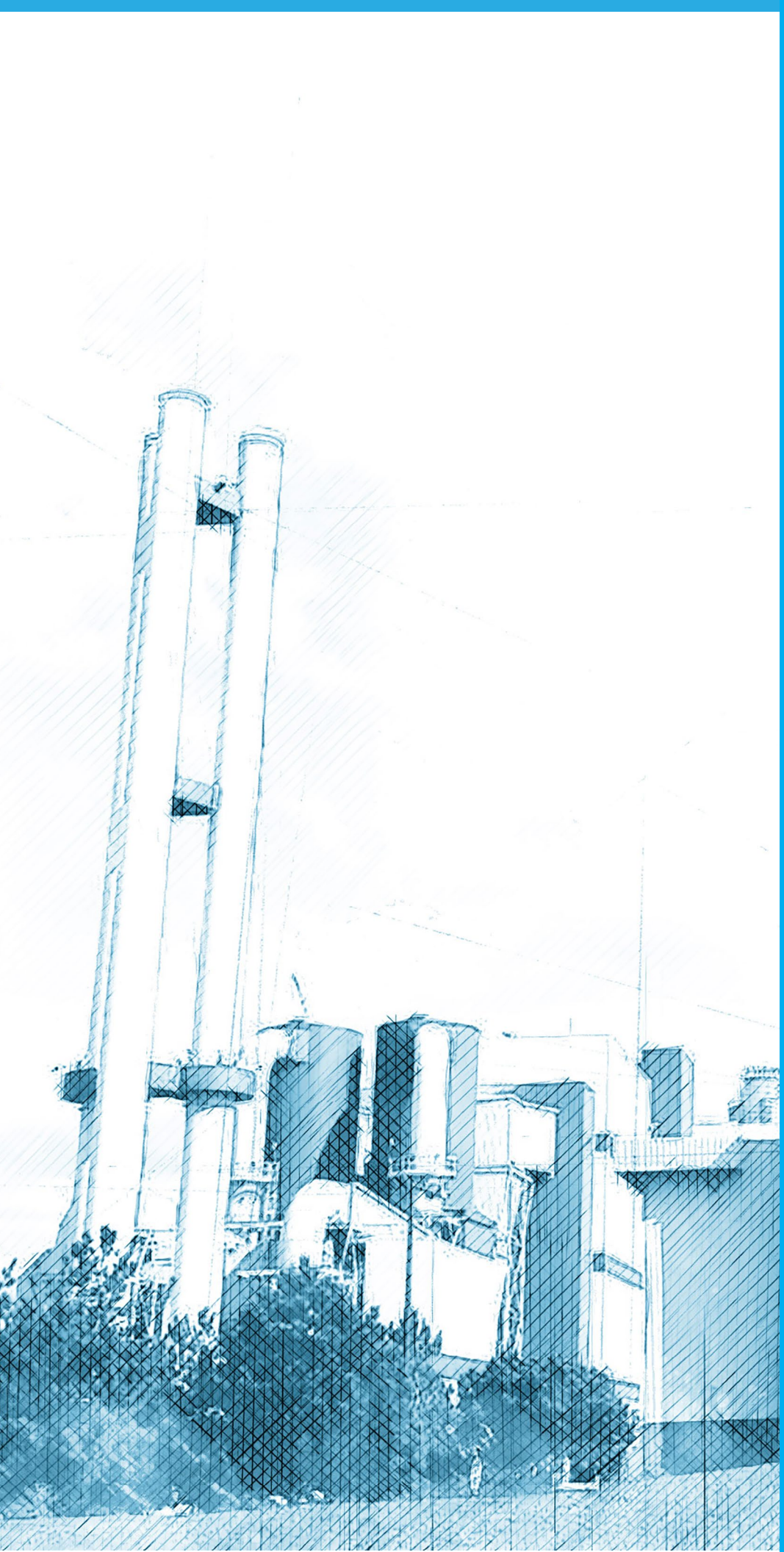
The Hennepin Energy Recovery Center (HERC) processes 365,000 tons of waste every year, generating electricity that powers 25,000 homes[6]. In addition to recovering some of the energy embedded in the materials, waste-to-energy is considered a preferable alternative to landfill which poses bigger environmental risks through higher greenhouse gas emissions, especially methane, and toxic leakage. While HERC's emissions remain under permitted levels set by the Minnesota Pollution Control Agency and federal standards, it is a source of many toxins in Minneapolis, including mercury, NOx, SOx, dioxins, furans, and particulate matter. Although no studies have been conducted to examine a possible link between HERC and emission-related respiratory diseases, communities surrounding the plant have reported higher cases of asthma and respiratory problems than in other parts of Minneapolis[7]. (It should be noted that some of these communities are subject to additional sources of environmental pollution.)

HERC was built in the 1980s as a temporary solution to divert waste from landfills until other ways of waste management, such as recycling, would become more developed. Decades later, Minneapolis has become reliant on HERC for 75% of its municipal solid waste, of which 83.5% consisted of materials that could have been composted and recycled in 2012.

Today, HERC finds its future caught between multiple visions and goals, with some sign pointing towards its ultimate retirement. The state of Minnesota set a state-wide goal of 75% recycling (including organics) by 2030. According to the Minnesota Pollution Control Agency, to achieve this 75% recycling goal, approximately 50% of the material currently going to waste-to-energy or landfill would need to be diverted from these facilities.[8] While the state generally takes a supportive stance towards waste-to-energy technologies, this indicates that materials that are currently being incinerated can be more efficiently managed up the waste stream. Under this scenario, Minneapolis (and the entire metro area) will not generate enough material to operate HERC at full capacity.

Countries such as Sweden and Germany, who are leaders in waste-to-energy, face a similar dilemma when trying to reach recycling rates set by national and international goals. As they recycle more, and having already heavily invested in capital-intensive incineration facilities, they need to import waste from abroad in order to keep the investment viable. In doing so, they de facto import toxins and pollutions to burn near their cities, all in the name of a waste management strategy that can only be considered a success when compared to landfills.

The City of Minneapolis, meanwhile, has issued multiple planning documents that indicate it doesn't see HERC as its future. The city's Zero Waste Plan does not consider waste-to-energy as an acceptable way to dispose of waste, and the resolution to run Minneapolis on 100% renewable energy by 2030 does not consider waste-to-energy a renewable source. The Zero Waste plan states: "Furthermore, there is a strong community interest in reducing the quantities of materials transported to HERC for energy recovery and increasing the quantities of materials reduced, reused, recycled and recovered to create local jobs associated with these activities."[9]



The Restorative Mindshift

Thirty years ago, investing in waste-to-energy may have come with good intentions to solve the landfill crisis. However, taking the “less bad” approach to addressing one problem in isolation did very little to change the trajectory of the broader, systemic issue: the increasing generation of waste. Indeed, our growing ability to whisk waste away quickly and efficiently—out of sight, out of mind for producers and consumers alike—has almost certainly allowed cheap, low-value materials to proliferate, and may very well have kept us from developing alternatives to single use plastics and other hard-to-recycle materials a long time ago.

In a restorative system, “less bad” approaches are never acceptable, because over time they turn from a well-intentioned ‘patch’ to an integral part of a broken system. As a guiding principle, when the path has narrowed to a choice between a “bad” and a “less bad” option, we need to acknowledge that no good decisions can be made. Instead, it should be taken as a sign that we are asking the wrong question and that we need to reframe the problem, until alternative solutions are possible that are win wins for everybody.

3. Towards a Local Economy of Materials Management + Industrial Symbiosis

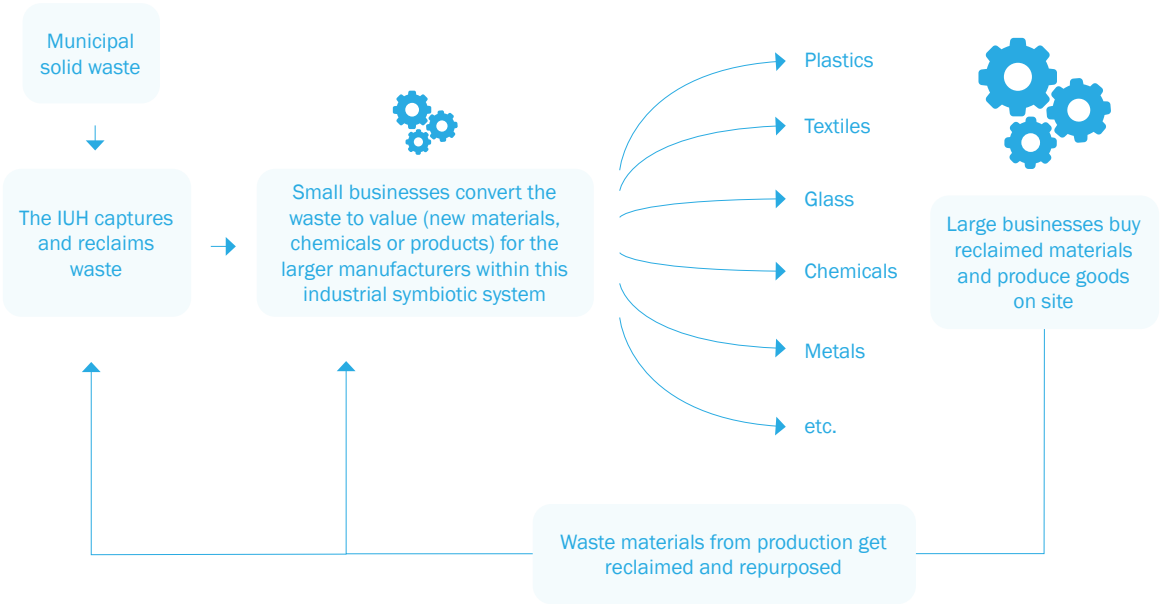
While other cities had to send their mixed recycling to incinerators following China's ban on imports, the impact on Minneapolis and St. Paul was cushioned by the increased resilience of the local recycling infrastructure, which is rooted in a long history of selling materials to regional Midwest markets. Furthermore, residents are doing better-than-average in keeping contaminants out of their recycling, thus increasing the amounts of materials that can be recovered. Lastly, the region is home to a non-profit recycler, Eureka Recycling, that has become a national model for its workforce development opportunities and living-wage jobs.

Statewide, the Minnesota Pollution Control Agency (MPCA) is a champion of expanding the state's recycling industry through a deliberate Recycling Market Development Program. A 2015 MPCA report estimated that the recycling, reuse, rental and repair sectors employed approximately 63,500 people in direct jobs, generating about $26 billion in sales, which is approximately 6% of Minnesota's economy. The report also estimated that "by not recovering materials that could be have been recycled, $2.3 billion of potential material was discarded between 1996 and 2013 in Minnesota."[10]

However, today's relative success in recycling should not stymie more ambitious efforts to rethink materials management. The reality is that most recyclables are subject to volatile market conditions, and some recyclables may never be recyclable in an economically feasible way. A 2017 study estimated that only 9% of all plastic ever produced has been recycled. Furthermore, these 9% would have largely been downcycled, meaning not only did they have no effect on demand for virgin materials, they also eventually will end up in landfills.[11]

INTEGRATED MATERIAL RECLAMATION, TREATMENT AND REMANUFACTURING PROGRAM

This process flow describes a closed-loop materials management program that could be housed in an Integrated Utility Hub (IUH)



Cities have an opportunity to invest in business incentives and in a recycling infrastructure that supports material management far into the 21st century. For example, London, one of the global fashion hubs, is investing in an infrastructure that would allow it to become a hub for circular economy textile design, returning a projected $1 billion per year in benefits. This presents an opportunity for manufacturers to spur the development of continued use of materials that are more easily remanufactured and kept at high value.

For the Minneapolis/St. Paul region, multiple 'hub' opportunities are conceivable.

For the Minneapolis/St. Paul region, multiple 'hub' opportunities are conceivable. For example, chemical recycling is emerging as a promising alternative to turn single-use plastics into virgin quality building blocks or even into higher-value materials, which could be of interest to local retailers and medical device manufacturers. Likewise, the region could become a Midwest electronics recycling hub, capitalizing on the opportunity for workforce development and creation of living wage jobs.

Future-proof material management means materials are designed, used and reprocessed in a way that maintains or increases their value. This requires innovative public and private partnerships, with both sectors coming together to build the system to support new products. Ideally, local infrastructures leverage industrial symbiosis to connect small and large businesses with local utilities to create closed-loop flows of materials, energy, water and by-products.

3.3 Construction & Demolition (C&D) Waste: A Massive Opportunity

Buildings currently generate almost 40% of global greenhouse gas emissions, with building operations contributing nearly 28%, and building materials and construction accounting for 11%[12]. In order to meet the commitments of the Paris Climate Agreement, the world would have to eliminate all GHG emissions from the built environment by 2040.

The City of Minneapolis is heavily invested in increasing the efficiency of buildings to reduce the city's carbon emissions, but with the city poised to continue its growth trajectory, how buildings are built is going to take on increasing significance. In fact, one of the biggest opportunities in circular materials management can be found in the built environment and construction industry, which stands much to gain from materials innovation and the development of new business models, as well as reclaiming and recycling of current waste.

In the current system, from the first to the last swing of the wrecking ball, the swift demolition of a building is devoid of concern for preserving any residual value of the materials. Here again, a network of private haulers has evolved to get rid of the waste as quickly and efficiently as possible. Due to the distributed, private nature of the C&D waste management business, decision makers have very little data with regard to the make-up of construction and demolition waste in Minnesota. The MPCA estimates that in 2017, the 1.6 million tons of documented C&D that were sent to landfills make up only 15.7% of the estimated total, stating that "MPCA does not have the data to conclude if the remaining 84.3% was sent to landfill, transferred out of state, reused, recycled, or managed elsewhere."[13]

Case Study: London Waste and Recycling Board's Circular Economy Route Map

The London Waste and Recycling Board (LWARB) is at the forefront of London's Circular Economy strategy. They estimate that out of all their focus areas, the built environment offers by far the biggest opportunity for net benefits. Finding ways to keep buildings, products and materials at their highest value for as long as possible could lead to GDP growth of between £3bn and £5bn annually by 2036.[15]

Consequently, LWARB's overall vision is for London to be a center for both design and demonstration projects that will exemplify:

- Buildings designed for adaptability, with the intention that they can be disassembled at end of life.
- Buildings that use innovative products and technologies to be more circular.
- Buildings being re-used and refurbished instead of demolished.
- Buildings deconstructed to enable maximum material re-use.
- The use of innovative business models which enable both current and new buildings to be used more flexibly and therefore perform more efficiently.
- Durable infrastructure that can adapt over time.

This means that not only are large amounts of C&D potentially entering unlined landfills and contaminating groundwater, but it is also a lost opportunity of retaining value through reclamation and repurposing.

In addition to reclaiming as much from existing buildings as possible, restorative development is in line with circular principles that focus on the whole lifecycle of construction products in a way that preserves resources and closes the loop. This means there are numerous business opportunities in rethinking the way we design, build, use and deconstruct buildings (See London case study). However, given the long lifespan of buildings, new public and private collaborations are required to align today's incentives and future rewards in a way that benefits private and public interests alike.

One example of innovative construction methods that are both modular and sustainable in nature are mass timber technologies, such as cross-laminated timber (CLT) and nail-laminated timber (NLT), which have allowed builders to construct high-rises with an environmental track record superior to reinforced concrete or steel.

T3, the largest modern mass timber building in the USA, was completed in Minneapolis in 2018. Designed as an office space that promotes health and wellbeing, the building uses 3,600 cubic meters of sustainably sourced wood in the structure, which will sequester about 3,200 tons of carbon for the life of the building.[14]

Notably, the mass timber panels were constructed in Winnipeg with timber sourced from the Pacific Northwest, and the building's beams (glulam members) were sourced and shipped from Europe. In the future, the mass timber materials could be fabricated closer to home. In 2019, the Bureau of Business and Economic Research at the University of Minnesota Duluth released a study that concluded that given our natural resources and existing infrastructure, Minnesota would be an ideal home for a mass timber manufacturer that could capitalize on the global expansion of the industry, which is projected to quadruple in size to $2 billion annually by 2025, with North America as the second-largest market.

Endnotes

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