# Multi-scalar Influences on Sustainable Solid Waste Management:

## Assessing the City of Edmonton's Approach

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**Abstract**

At its core, waste management is a sustainable development struggle, which, if treated improperly, poses severe consequences to human and environmental health. This paper will unpack the socio-economic, cultural, and ecological implications of solid waste management, and explore the potential solutions to alleviating the burdens of improper disposal and treatment of waste on different scales. In order to achieve the United Nations Sustainable Development Goals (UN SDGs)– particularly the targets for Responsible Production and Consumption (SDG 12) and Sustainable Cities and Communities (SDG 11) – we must not view waste management in silos. Rather, we must encourage responsible behaviors and regulation from the local, regional, national, and global scales, with particular emphasis on the obligations of affluent systems and the capacity building of under-developed systems to effectively mitigate the consequences of improper treatment and disposal of solid waste.

The exploration of this issue was inspired by the rollout of the City of Edmonton's new waste management scheme involving the collection of separated waste carts, with a pilot project in 2019 and full launch of the Cart Rollout in spring 2021. It is a point of interest now to reflect on the impacts of this updated system, and how it has (hopefully) reduced landfill accumulation and improved the environmental and social outlook for establishing successful local waste management. This paper will therefore address the following questions: How does the waste management approach in Edmonton interact with and encourage positive multi-scalar actions (i.e. a 'trickle- up' effect)? How does each increasing scale (regional, national, and global) influence city-level waste management (i.e. a 'trickle-down' effect)? Finally, what insights does this provide about sustainable solid waste management as a whole?

## INTRODUCTION

Dealing with consumption-based waste is a mundane task that we face every single day. The choices we make about where and how to best dispose of certain materials are generally quite mindless– just toss it in the bin, right? Unfortunately, the best practices for disposal are not always clear. What 'it' and what bin are we talking about? Are we provided the option to sort the waste at all? Where is the waste going anyways? Is the onus always on the consumer? Accordingly, several questions arise when we begin to break down the complexity of solid waste management. It is vital to remember that these issues extend far beyond the affluent, local municipalities that have (for the most part) the capacity to effectively address waste management. A 'flagship' example is the Great Pacific Garbage Patch. It is truly a nightmare in the face of waste management, especially since it is not the sole oceanic garbage island (National Geographic, 2023). While these blatantly obvious concerns for waste must be addressed through global commitments, there is an undeniable need for sustainable waste management to be prioritized at multiple interacting scales. Therefore, at its core, waste management is a sustainable development struggle, which, if treated improperly, poses severe consequences to human and environmental health. This paper will unpack the socio-economic, cultural, and ecological implications of solid waste management, and explore the potential solutions to alleviating the burdens of improper disposal and treatment of waste on different scales. In order to achieve the United Nations Sustainable Development Goals (UN SDGs)– particularly the targets for Responsible Production and Consumption (SDG 12) and Sustainable Cities and Communities (SDG 11) – we must not view waste management in silos. Rather, we must encourage responsible behaviors and regulation from the local, regional, national, and global scales, with particular emphasis on the obligations of affluent systems and the capacity building of under-developed systems to effectively mitigate the consequences of improper treatment and disposal of solid waste.

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## SETTING THE SCENE FOR SUSTAINABLE WASTE MANAGEMENT

### Definitions

Waste management in a general context may be defined as "the management of all responsibilities, practices, procedures, processes and resources for establishing a system that manages waste and complies with environmental regulations" (Elsaid & Aghezzaf, 2015). Solid waste specifically refers to recyclables, organic materials and garbage produced by residential and non-residential sources, including industry, commercial institutions, and construction or demolition projects (Government of Canada, 2022). In accordance with the 1987 Brundtland Commission's definition of sustainable development, or "development that meets the needs of the

present without compromising the ability of future generations to meet their own needs" (United Nations, 1987), sustainable solid waste management must reflect this temporal element and a need for an integrated systems approach. Therefore, existing definitions incorporate the underlying theme that waste must be managed with the long-term best interest of both humans and the environment in mind to ensure that consequences associated with multiple forms of waste are minimized. The City of Edmonton Waste Management Branch (City of Edmonton, 2010) explains that their system of SSWM "protects human health, property, and the environment, and conserves valuable natural resources". The City also recognizes the complex environmental and economic relationship present within the theory of sustainable development, with a further aim to protect "future generations from environmental degradation and associated financial burdens" (City of Edmonton, 2010). Elsaid and Aghezzaf (2015) similarly acknowledge that "for a solid waste management system to be sustainable, it needs to be economically affordable, socially acceptable and environmentally effective". These are essential elements that support the foundation of these types of interlocking social, economic, and environmental systems. SSWM must also encompass multiple forms of waste reduction, sorting, recycling, and treatment in order to mitigate the consequences of improper disposal across a wide range of solid waste products. This might include household recycling programs, eco-stations, big-bin events, materials recovery and transfer facilities, electronics recycling, and compositing (City of Edmonton, 2010).

**Environmental and Human Health Consequences**

Within these understandings of waste management, it is evident that there is potential for severe consequences of improper disposal or treatment of solid waste on multiple scales. We will first discuss the numerous environmental impacts associated with waste-based pollution. Yee et al. (2013) describes the relationship between waste management in cities and climate change. Due to the concentration of people in urban areas, waste generation is concentrated through this hub of consumption, which naturally leads to higher greenhouse gas emissions. A central concern for poorly managed waste arises with landfill-based methane and carbon dioxide emissions. Due to the anaerobic conditions of landfills, the decomposition of organic goods (like food waste) releases these potent GHGs and contributes to the atmospheric buildup of gases that are expediting global warming (Yee et. al, 2013). The other consideration is the problem of marine-based and land-based pollution. Not only does the presence of excessive waste render negative perceptions of an area as degraded and neglected, but the underlying ecological implications are also highly destructive. Contamination of the air, soil, and water can occur through improper treatment of waste, including the leaching of toxic chemicals from landfills. (Somani, 2023). Contamination is especially a concern when hazardous waste is not sorted out from municipal wastes. Improper solid waste management further places ecosystems and the species within at risk of exposure (Somani, 2023). In marine systems, litter is largely composed of discarded plastics carried through storm-water runoff or deposited around shorelines from recreational activities and shipping (Galgani et al., 2019). The impacts of this litter are detrimental due to the decomposition of plastics into nanosized fractions, or microplastics, which persist in the environment and threaten the trophic web of marine ecosystems when species ingest these pollutants. While marine litter may be more prevalent in coastal regions, the sources of waste are diverse and can be broadly tied to poor solid waste management (Galgani et al., 2019).

Moreover, the human health consequences of waste mismanagement can also be severe. Contamination of the ecosystems that humans rely on for drinking water, food, and resources places us at risk of exposure to harmful chemicals (Somani, 2023). Open landfills and incineration

of waste can generate unpleasant odours and contribute to air pollution, particularly through methane gas production and release of fine-particulate matter. Respiratory illnesses like asthma have been linked to this type of pollution (Somani, 2023), and the likelihood of contracting diseases such as cholera, malaria, and diarrhea among others also increases with improperly managed waste (Omang et al., 2021). There are also linkages between proximity to landfill sites and reproductive health implications, such as congenital defects and low weights at birth (Kah et al., 2012).

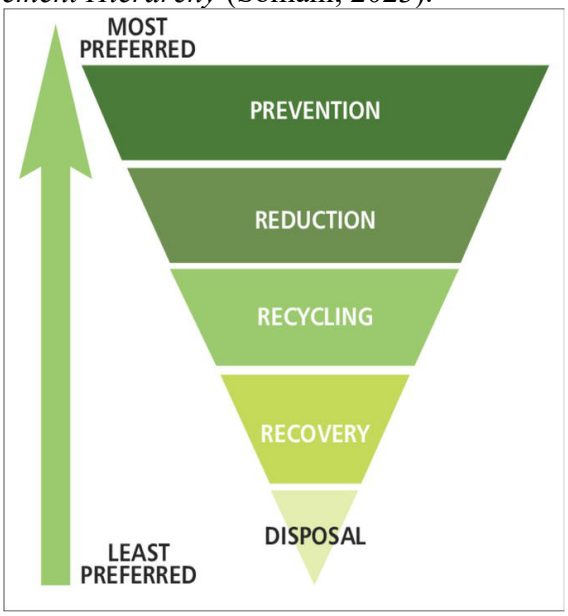
**Socio-economic and Political Foundations of SSWM**

To understand the foundations of SSWM more fully, it is important to note that there is reliance on a strong socio-economic system and the political will to support SSWM to mitigate the negative consequences discussed above. The creation of waste is always connected to its origins in production. Whatever goes into the creation of a good will reach the end of its life cycle eventually– some products far sooner than others. The composition of the product will determine what type of waste it becomes, which controls whether it is biodegradable or compostable, recyclable or recoverable, incinerated, or simply landfilled. Hence, it is essential to consider SSWM from the production origins, which positions us to reflect more critically on the type of economic system we reside in and whether or not it is compatible with the targets of SDG 12 (Responsible Production and Consumption). As consumers there is undoubtedly an individual level of responsibility that we must accept when we purchase, use, and eventually discard all goods. However, the burden for proper waste disposal should not be placed solely on consumers. Potential solutions to this problem will be addressed in detail later, but the overarching economic system is what structures the capacity to approach these solutions to begin with. The capitalist global economy has its grip on nearly every aspect of our lives, affecting the choices we make daily. Revolutionizing the detrimental effects of this economic system requires the adoption of green solutions within a circular economy.

D'Amato and Korhonen (2021) explain the macro-level sustainability associated with revamping our economic systems to align with a conjoint green, circular, and bioeconomic approach. These three approaches together form a narrative for sustainable development, in which the commitments to advancing waste management must arise. The authors suggest that the different levels of a "Natural Step Framework" can achieve these narratives. This includes, in order: recognizing that social systems function within ecological systems; establishing a shared vision for the end-state of a system; creating strategies for public and private decision-making; implementing concrete measures; and, finally, ongoing monitoring of the outcomes (D'Amato & Korhonen, 2021). While these narratives must be considered together to enact this framework, the circular economy may have the greatest leverage on influencing a SSWM system in practice. The circular economy is best understood as a system that "keeps materials and products in use as long as possible by extending the lifespan, recirculating them back into the economy through recycling, refurbishing or repurposing, and by moving away from ownership of products to services and the sharing economy" (Government of Canada, 2021). This explanation further connects to the waste management hierarchy. This is a fairly basic and relatively universal understanding of the desired process for managing solid waste. Figure 1 frames the outcomes of waste management in order of preference, emphasizing the need for waste prevention and reduction to always occur as the primary steps. Disposal through landfills or incineration is always the least-preferred outcome for a SSWM system (Somani, 2023). Yee et al. (2013) clarifies that "only when all of the above

possibilities in the hierarchy have been exhausted should waste then be disposed of through landfilling".

**Figure 1.**
*A Simplified Waste Management Hierarchy* (Somani, 2023).




Finally, the global UN SDGs are another important backdrop to bear in mind when approaching issues of SSWM. Within SDG 12, targets 12.3, 12.4, and 12.5 respectively seek to "halve global per capita food waste", ensure the "responsible management of chemicals and waste", and "substantially reduce waste generation" (The Global Goals, n.d.-a). The adoption of SSWM at all levels of government will ensure that a commitment to these targets can be met. With this interrelated socio-economic and political landscape of SSWM in mind, the following section will discuss how creating a culture of responsibility for waste management begins at the individual level and is influenced by the immediate local system at play. Thus, I will consider the relationship to SDG 11 as the focal goal for the community and local scales of this issue. I will also examine the extent to which this has shaped the City of Edmonton's approach to SSWM.

## ASSESSING THE POWER OF LOCAL SSWM SYSTEMS

In this section, community and individual action will be framed within the local scale of governance. Local level SSWM is fundamental to achieving SDG 12 within the context of SDG 11, and vice versa. 'Sustainable Cities and Communities' can only be achieved through the incorporation of multiple interrelated SDG targets, including the focus on our production systems and consumption practices within SDG 12. Target 11.6 aims to "reduce the environmental impact of cities" (The Global Goals, n.d.-b), which relates to the mitigation of GHG impacts tied to waste disposal that were previously discussed. Hence, these two goals and the concept of a circular economy are inextricably linked to SSWM beginning in local systems. Yee et al. (2013) emphasizes that municipal SSWM must be integrated, holistic, and site-specific while working to achieve the desired waste management hierarchy introduced above. Management of municipal solid waste should incorporate "a transition from the linear 'take, make, waste' model to the

circular economy [which] would help efforts to implement the waste hierarchy" (Government of Canada, 2021).

Additionally, individual behaviors are influenced by the waste management scheme operating within their municipality (City of Edmonton, 2010). This creates an important role for local governments in shaping the development of effective waste collection and sorting services, thereby encouraging responsible individual waste disposal. Furthermore, SSWM broadly relies on the voluntary commitment to reduce waste on an individual basis in order to contribute to waste reduction at the community and local level. There is strong potential for this individual willingness to manage waste at the source (which targets the most preferred outcomes on the waste management hierarchy) to produce a trickle-up effect. This may occur through the creation of positive environmental externalities through waste reduction and sorting that further aligns with the policies and regulation along higher scales of government. To better demonstrate the individual, community, and local functioning of SSWM, I now turn to a case study assessment of the City of Edmonton's system for waste management.

**Highlighting the City of Edmonton's Approach**

The City of Edmonton claims its position as a leading major city in Canada for its early adoption of SSWM. This approach is fundamentally rooted in the classic 'reduce, reuse, recycle' framework, which is the over-simplified foundation of the waste management hierarchy. The City asserts its strategy to target waste reduction at its source, implement multiple collection services, and divert landfilling by recycling, composting, and recovering material goods and residual energy (City of Edmonton, 2010). The history of waste management in Edmonton is long and varied, and this sustainable approach was not always the case. Yee et al. (2013) discusses how landfill siting within City limits was the norm since the early 1900s. However, an economic boom in the 1980s coincided with an influx of waste received at the newly constructed Clover Bar landfill. Out of concern for the operational capacity at Clover Bar, the City once again would need a new location to manage the tonnes of waste being generated. However, this was countered with the NIMBY ('not in my backyard') resistance to landfills being placed in proximity to residential areas. Partly due to community push-back, the City transitioned to waste diversion as the primary tactic to reduce landfill accumulation according to a new Waste Management Strategic Plan (Yee et al., 2013). This introduced residential composting and recycling programs, which revolutionized how Edmonton conducts its waste management system that retains these foundational approaches today. Social marketing was an essential strategy to encourage a community-level transition to active waste reduction and sorting. The culmination of these efforts eventually saw the completion of the Edmonton Waste Management Centre to connect the old Clover Bar landfill and various waste treatment facilities (Yee et al., 2013).

In 2019, the City launched a pilot program to once again revamp its waste management system, which would involve the rollout of a separated cart system to sort waste where it is generated by consumers at the source. Due to the COVID-19 pandemic, official rollout was delayed until spring 2021 (City of Edmonton, 2020). New colour-differentiated carts were distributed to households across Edmonton, including a green food scraps cart and complimentary indoor collection pail, and a black garbage cart. Edmontonians were directed to continue sorting recycling into blue bags and to follow the guidance of the "What Goes Where" poster that accompanied the cart distribution to properly sort out food scraps from residual black bin waste (City of Edmonton, 2021b). Yard waste is also placed into its own category of waste sorting to be collected seasonally in clear plastic or paper yard bags or added to the green bins as needed. A

city-wide collection schedule was established based on a colour-zoned map, and detailed instructions on the placement and spacing of bins were provided (City of Edmonton, 2021b). As mentioned, because of the reliance on individual behaviour, education initiatives are essential to a successful SSWM program. The City's approach to the waste system aims to support the highest possible voluntary commitment among all residents. The various forms of user-friendly guidance received during the cart rollout are also accessible online, and there is an additional WasteWise app that was created to assist residents in keeping track of collection dates and to facilitate proper disposal of different types of waste without confusion (City of Edmonton, 2021b).

The scale of household distribution and educational materials available is rather impressive, however the other aspect to consider is the accessibility of participation for all Edmonton residents, not just homeowners. Edmonton's waste management system is divided by the processes of curbside collection versus apartment and condo collection, also known as communal collection (City of Edmonton, n.d.). Curbside collection occurs for all household residents that received the new waste carts. On the other hand, apartment residents are provided with large on-site communal bins to sort recycling and garbage, but they do not yet have the option to sort food waste from general waste. This discrepancy between the available city-wide options for waste sorting is an area to improve. However, this is expected to change in the coming years. Under the City's Waste Services Bylaw (20363), a three-stream waste collection service will be phased out over four years to equalize the waste sorting options available to apartment and condo residents (City of Edmonton, n.d.)

Now turning to analyze the success of this new system, it is helpful to consider landfill diversion rates. Landfill diversion has long been and remains the primary goal of the City of Edmonton's waste management system. In 2010, the City had a commitment to 60% landfill diversion for household waste (City of Edmonton, 2010). In 2018, the City reported a 36% single unit household diversion rate, dropping to 23% in 2019 (City of Edmonton 2020). The lofty goal of 90% landfill diversion was set under the 25-year Waste Management Strategy in 2019. However, 2020 saw a further drop down to 18% (City of Edmonton, 2020). The City suggests that this decline is connected to the closure of the Edmonton Composting Facility aeration hall in 2019, and reduced capacity of the Materials Recovery Facility in processing blue-bag recycled goods. However, investment was directed to a new Anaerobic Digestion Facility and upgrading the Materials Recovery Facility to improve these landfill diversion rates. In 2021, there was a promising increase to 27%, and in 2022, which was the first full-year operation of the cart rollout, reports revealed that the diversion rate jumped back up to 37% and can be related directly to the success of the new system (City of Edmonton, 2022). Now in 2023, concluding the third year of this revamped waste management system, updated landfill diversion rates are yet to be reported. Moreover, Yee et al. (2013) examined the effectiveness of Edmonton's policy surrounding waste management and climate change in relation to GHG emissions. Since the 2013 publication date, there is hope that the commitment to increasing landfill diversion should have vastly improved the GHG outlook for the City's waste operations and should continue on this path for years to come.

With these strategies and data in mind, the question arises of whether the City of Edmonton aligns with existing and recommended solutions for local level waste management? To start, the City's encouragement of waste sorting through separate black and green carts, recycling, and yard waste collection aligns with long-standing best practices. Maystre and Viret (1995) explain that "separation, or more precisely, non-mixing at the source, is one of the most promising strategies". Based on the improved landfill diversion rates, the individual compliance with waste sorting is setting up the City of Edmonton for success in conjunction with these recommended procedures.

Furthermore, the 25-year Comprehensive Waste Management Strategy and the Roadmap '24 both acknowledge the waste management hierarchy and seek to rethink and redesign our production and consumption systems in support of a circular economy, with an eventual goal of achieving zero-waste (City of Edmonton, 2019; City of Edmonton, 2021a). These strategies do align with the foundational approaches to addressing SSWM as discussed in previous sections, which enable success on multiple interacting scales through a trickle-up effect beginning on the individual, community, and local level interface.

Overall, the new cart system has been generally well-received and well-complied with. It is clear that achieving the goal of 90% landfill diversion over the next 20 years will take a high degree of commitment and funding to continue operating the necessary infrastructure to collect, sort, and process waste. Extensive reporting on these rates remains somewhat unclear in the face of the new cart system, but perhaps it is too early to truly predict long-term impacts across the entire municipality. Progress updates will be telling of the effectiveness of the revamped waste management system.

## CHALLENGES AND SOLUTIONS ON INTERACTING SCALES

### Regional Influences

We may consider regional waste management as an extension of the local level, such as larger metropolitan areas that include surrounding municipalities or even broader districts. For example, the greater Edmonton area (or the Edmonton Metropolitan Region) broadly includes the surrounding Sturgeon County, Lamont County, Strathcona County, Leduc County, and Parkland County. The well-established municipalities include St. Albert, Spruce Grove, Sherwood Park, and Leduc (Capital Region Board, n.d.). All of these highly interconnected areas function within the central region of Alberta. SSWM systems are therefore impacted by the waste management relations within these regions. A specific example is the City of Leduc's Curbside Cart Collection and Recycling Program which resembles that of the City of Edmonton through waste sorting of recyclables, organics, and general waste (City of Leduc, n.d.). Because of the proximity to the City of Edmonton and movement of residents connected to both cities, these waste management systems do not operate in isolation from one another. Thus, effective linkages among these municipalities contribute to the trickle-up effect for the broader regional impacts of SSWM.

We may also consider the influence of provincial policy and regulations surrounding waste management as a regional determinant for the success of the local systems. The City of Edmonton (2010) even states that "other orders of government, in particular the Province of Alberta, provide the context in which Edmonton manages its operations". For example, the Government of Alberta's (2007) Too Good to Waste Strategy lays out a pathway for improved waste reduction and innovative management through resource and environmental conservation. Once again, this strategy asserts the waste management hierarchy of preferred outcomes. There is a desire for achieving 80% waste recycling and recovery as opposed to 80% disposal (as was reported at the time) on a long-term path to a zero-waste society that begins by targeting municipal waste (Government of Alberta, 2007). Additionally, there is recognition of the socio-economic determinants of waste generation, including the fact that "waste tends to be an indicator of economic success – the more prosperous society becomes, the more waste we generate" (Government of Alberta, 2007). The macro and microeconomic systems in which we operate connect the individual to the local, regional, national, and global scales. Thus, SSWM at the local level must be supported by foundational strategies (such as this one) established at higher levels of government in order to influence the economic activity that determines the daily consumption

choices and associated waste generation of the everyday person. The Government of Alberta (2007) further acknowledges that place-based approaches are needed across different regions of the province and across different waste sectors.

**National Influences**

Several new questions come to mind when considering the connection between local and national scales of governance for SSWM. For example, does the city of Edmonton have a positive national impact? How well is it supported or aligned with national values, policy, and regulation? How are cities influenced by the political landscape of the federal government more widely? The influence of top-down management above the municipal level should ideally function to ensure that all waste bases are covered. Municipal governments do not have the capacity or authority to regulate all sources of solid waste and therefore must primarily target the residential sector, as revealed by the City of Edmonton (2010): "Non-residential hazardous waste is managed under Federal and Provincial legislation and regulation. The City has no active role in the collection or treatment of non-residential hazardous waste" (p. 1-2). Thus, there is a vital role for SSWM to be adopted and enforced by higher levels of government to achieve the desired trickle-down effect for the prevention of mis-managed non-residential waste that is generated within municipalities. The City of Edmonton Roadmap '24 mentions the anticipation for federal legislation banning single use plastics (City of Edmonton, 2021a). This establishes the expectation for national commitments to facilitate SSWM on multiple interacting scales.

Furthermore, we must turn to private sector producers that are influenced by national policy to enforce these models for SSWM. Extended producer responsibility (EPR) is a possible solution to improving the sustainability of our production and consumption system and achieving a more circular economy. It must be supported at the national level through policy frameworks, such as the Canada-wide Action Plan for Extended Producer Responsibility (Government of Canada, 2017). EPR generally "shifts responsibility upstream in the product life cycle to the producer" by adopting the 'polluter-pays principles', which places the burden of waste management on the original creator of the waste (Government of Canada, 2017). This solution is aimed mostly at hazardous wastes and electronic wastes, including large appliances that are not a part of the typical municipal waste collection services and are generally more burdensome and higher risk to dispose of. Ideally, producers will assume innovative product and packaging design to cut back on wastes at the origin and facilitate the recycling process at the end of the product's life cycle (Government of Canada, 2017). McKerlie et al. (2006) explain that EPR in Canada has been interchangeably understood as equating to "product stewardship" programs. The authors believe that this is detrimental to successful waste management, as the notion of product stewardship dilutes responsibility across all involved parties (consumers, governments, and producers) and does not create a leadership initiative among producers to prevent rising waste levels. Because "solid waste in Canada falls under the shared jurisdiction of provincial/territorial and municipal governments", EPR implementation is essential to tackling Canada's growing consumption-based waste and residual materials from end-of-life products.

It appears overall that local and national interests do align for the broader support of SSWM. The City of Edmonton's new approach to waste management can positively trickle-up while federal government programs and policy (such as EPR and the legislated plastic ban) can trickle-down to affect sustainable change at lower levels.

**Global Concern and a Call to Action**

Each scale thus far has provided hopeful examples of innovation and partnerships for the effective management of waste. We must, however, acknowledge the limitations of SSWM on the global scale. For one, it is inherently difficult to enact international change when nations have different capacities for adopting SSWM, which is rooted in lower levels of governance and overall political will and is impacted by economic constraints (SSWM can be extremely costly for many municipalities, regions, and nations). It also goes back to the local level community and the individual will to consume and dispose of waste more responsibly. Undoubtedly, global political unrest may prevent nations and their internal communities from supporting and implementing the desired SSWM approaches that account for innovative solutions discussed in the previous scales of management. Thus, we must acknowledge the influence of "developed" or affluent countries to establish and encourage effective SSWM through regulations and policy creation. This is more of a top-down approach that must function alongside bottom-up producer and consumer willingness to participate in waste management from the origins of creation and the source of disposal. Global partnerships may be increasingly necessary to achieve large-scale commitments to SSWM and build capacity for under-developed nations to facilitate their own systems across lower levels of governance that are comparable to leading examples such as the City of Edmonton.

The UN Environment Programme (UNEP) created a Global Waste Management Outlook that serves as "a call for action to the international community" (UNEP, 2015). At a time of global crisis to keep warming below 2 degrees, there is an urgent need to address waste management solutions internationally and to combat the severe repercussions for environmental and public health. Common themes seen at lower scales that are reinforced by this report include a recognition of the circular economy to integrate the targets for various SDGs and reduce GHG emissions tied to current global economic systems. Governance issues associated with sustainable development are the underlying barrier to the majority of issues presented in this Outlook. Recommendations and policy tools for global leaders provide hope for the future of sustainable waste management through what they are calling a "holistic approach". The necessary action includes several interrelated steps, such as the extension of proper waste management services to all citizens, controlling hazardous wastes, targeting waste prevention at the source, and closing the material cycle. These steps can be adopted internationally through stakeholder partnerships, proactive policy, financial investments, and generation of high-quality data essential to decision-makers. The report concludes with an emphasis on waste as a national *and* local issue, and by inciting a Global Call to Action to adopt Global Waste Management Goals that will "facilitate early progress against more than half of the sustainable development goals" (UNEP, 2015).

**CONCLUSION**

Overall, there is hope for the development of SSWM on each of the local, regional, and national scales that interact to produce a trickle-up effect with the potential of global impact due to the interconnectedness of policy and planning around SSWM. If multiple nations have the capacity to support SSWM policies, this can enable a united global approach and mitigate the large-scale negative externalities and often unintended consequences of mis-managed waste. Reflecting back on the local case study of the City of Edmonton, the expansion of their waste management system reflects a commitment to sustainability and is an inspiration for assessing the power of local systems to enact change. Of course, there is always room for improvement and no SSWM system can be flawless in design nor execution due to the range of actors involved in the generation of results. It will be interesting to see how the data evolves in the future of the City of

Edmonton's waste management, and whether long-term commitments to sustainability will be achieved. With the guidance of the UNEP Global Outlook, there is hope for improved SSWM in the face of a changing climate and ever-evolving socio-economic and political challenges in our globalized society.

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