

Circular Economy: A milestone for Zero Waste Municipality

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ABSTRACT

People around the world generate billion tons of waste. Over two billion tons of solid waste was produced in 2016 and it is estimated to rise to 3.4 billion tons by 2050. The world's trash amount is reaching crisis and seems to getting bigger and bigger unless we take a systematic action to deal with it. The purpose of this article is to study a methodology for zero waste municipalities, examine the role of a community in addressing municipal waste and moving towards zero waste, and to evaluate how circular economy can contribute in achieving zero waste municipality. Zero waste is likely adopted as a mechanism for waste management, but circular economy is a mechanism for industries and businesses in both eliminating waste and promoting resource efficiency as products are intentionally designed and manufactured to be repurposed and recycled. The result showed that with the circular economy concept, the waste can be reduced at the first stage of prevention as products are designed to use regenerative materials and designing technic to make them last longer and repairable in the light of designing out waste. Also, waste can be getting less and less due to the practices of reuse and repair service which extends product life cycle. Recycling is another practice that contributes to waste elimination as the component parts and materials will be used for manufacturing new products.

Keywords

Zero waste municipality, the Circular Business Model, Circular Economy

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Introduction

Many cities have completely changed after the COVID-19 crisis. What and how we consumer and how we interact with each other in our communities are not the same as it used to be. The pandemic has caused many problems to societies around the world and governments have launched several measures to tackle those problems. The zero-waste approach is now more relevant to people than it ever has been. It is an urgent requirement for nations around the world to reduce the negative impact we are causing to our planet and at the same time to promote the resilience of our health and economic systems. By adopting a zero-waste practices, countries around the world will be able to minimize the negative consequences of the pandemic. Zero waste masterplan can provide guidance and strategies to bring sustainability, resource-efficiency, and climate-resilience to nations.

Over the next 12 years, cities around the world are making commitment to minimize waste with an effort to reduce global warming and finally transition to zero-waste cities. According to the C40 new initiative, cities are encouraged to eliminate waste production and end the practice of waste burning. 23 cities have agreed to become zero-waste and will try to achieve the goal by minimizing the amount of municipal solid waste sent to landfill and incineration by at least 50 % and increase the diversion rate away from incineration and landfill to at least 70 percent by 2030 [1]. The cities, such as San Francisco, New York City, Washington D.C, Catalonia, Auckland, Dubai, Copenhagen, London, Montreal, Toronto, Vancouver, Milan, Rotterdam, Sydney, Paris, Tokyo, and Tel Aviv, also committed to reduce waste generation by 15 % and enhance alternative waste management practices by 2030. Additionally, each city has agreed to cut down on waste that ends up in landfills by at least half over the next decade [2].

Cities around the world are trying to increase recycling rates and targets and finding new uses for wastes arising from their built environment as well as from consumption. With their national goals to promote sustainability, many cities are also increasingly promoting circularity of their resource flows, especially in water and high value-added food production, and reducing negative impacts associated with other needs, such as carbon emissions and pollution from energy consumption.

A Methodology For Zero Waste Municipalities

Due to changes in our societies after the COVID-19 crisis, nations around the world should have made a change in zero waste masterplan to provide clear guidance on how zero waste can be transition towards a circular relationship with resources and environment. To accelerate progress towards zero waste and circular economy, a methodology and strategy for zero waste transition at the local level should include ideas and solutions that can be followed and replicated in the local communities. It should cover the concept of zero waste, its guiding principles, steps for designing a zero-waste plan at the municipal level and a challenge to some of the myths and fiction surrounding the narrative on zero waste. It should be designed to understand what zero waste is and how to implement a zero-waste strategy within community [3].

Zero waste is the principle of designing waste and the toxics and inefficiencies come with it out of the economic system. The value of materials and products must be kept within the community where they are reused over and over. Any technology that encourages material recovery is required to extend the resource lifespan as long as possible. Recycling is important to close the loop but it should be considered as an end-of-pipe solution because we cannot recycle all of the waste created in a wasteful society. The best zero waste plan is designed to stop waste generation in the first place. It

requires intervention at the design stage to manage and prevent waste that should not exist. For example, to reduce food waste, there should be right training, incentives and procurement policies in canteens, restaurants, hotels, hospitals or homes.

City authorities can play an important role in encouraging the roll out of important initiatives such as refillable systems for beverages and ban on single use plastic packaging and containers in the local shops. For durable goods like electric appliances, furniture, or clothes, local organizations need to encourage repair and reuse operations in the form of second-hand shops. Changes in public procurement can make change to market and increase purchasing power as well as can be used as tools for preventing waste from being generated at the local level. Products and packaging need to be redesigned not to become waste and retain as much value as possible at the end of their useful life. If a product cannot be reused, repaired, refurbished, recycled or composted then it should be redesigned or taken out of the system.

An effective zero-waste system needs to be able to detect recoverable material from waste and design alternatives so they can be managed within a circular system. Residual waste should be regularly studied in local screening facilities so that non-recoverable products can be either redesigned or removed from the market. From the design stage, it should be made clear whether the product or packaging should be part of the biological cycle (products for consumption) or part of the technical cycle (products for service). Normally, products or packaging that mix technical and biological components are very difficult to dispose in current resource management systems, hence, they should not be allowed onto the market, unless there is a clear direction how to separate them for further different recycling operations. If material separation is done properly at the collection stage then resources keep their value and they can be recycled into secondary raw materials.

In aligning with the new paradigm, changes must be done to the infrastructure. Disposal infrastructure, such as landfills or incinerators, should be gradually closed down due to the reduction of waste generation and the increase of recycling rates. Flexibility is needed in zero waste system, so cities' contracts and waste plans should be designed to overcome challenges and promote transition towards zero waste.

A local zero waste municipality strategy should include the following core practices: [4]

1. Make a strong commitment on zero waste by making a public announcement and conducting preliminary public consultation
2. Provide support and examination through zero waste advisory board with local stakeholders, civil servants empowerment by education and training, and data collection on waste generation and recycling rates.
3. Design Zero Waste plan with specific goals to reduce residual waste (in kgs/person) and outline the key steps that will take to achieve these goals
4. Design collection plan, at least for organic waste, dry recyclable materials (paper, glass, cardboard, cans, etc.) and create municipal recycling centers for items that are too expensive for or cannot be incorporated into regular collection schedules, such as; light bulbs, construction and electronic waste

5. Develop strategy to optimize organics management which may include; Home composting, Community led composting centres, Decentralised composting systems organised by a municipality, Centralised professional composting systems, for handling organic waste on a larger scale, ideal in densely populated cities

6. Encourage local waste prevention initiatives, such as; Packaging free shops, Refillable water centres, Zero waste public procurement, Regulations to encourage plastic free lifestyles, such as bans on plastic bags or straws.

7. Promote Reuse/Repair Centers either at municipal or district level by working with the local community to establish centres where products and resources can be reused by another community member or repaired by a local expert

8. Incorporate law and regulation enforcement with the plan to encourage waste prevention, such as Pay-As-You-Throw (PAYT), Deposit Return Schemes (DRS), Extended Producer Responsibility (EPR)

9. Analyse residual waste and use the data to feedback and improve the system by creating a system where the composition of your residual waste can be regularly analysed to find the most problematic materials/resources are most problematic; Use the data to improve the efficiency of the collection schemes with more effort to make recycle materials more visible; Give this information to businesses and industry to encourage the industrial design of recyclable products and packaging

10. if local regulations do not allow the right away, adopt or promote more efficient systems to manage residual waste that recover more recyclable materials; use transitional landfill capacities for pretreated waste; flexibly manage and adapt pre-treatment sites into compost and recycling ones.



Figure 1. The Circular Economy diagram [5]

Adopting a zero-waste approach could bring benefits to municipality, specifically in term of a reduction in the costs of waste management and the levels of waste generated. As a powerful model for tackling many of today's challenges especially about resource efficiency and climate change, circular economy is widely recognized as transition to zero-

waste. (as figure 1) Moreover, the potential benefits of shifting to a circular economy extend beyond the economy and into the natural environment. By ending waste and pollution, keeping products and materials in use, and regenerating rather than degrading natural systems, the circular economy represents a powerful contribution to achieving global climate targets.

Towards Zero Waste Communities

Transition to zero waste is not a single-party's responsibility, but needs cooperation from all parties in the community. Community as a whole needs to work hand in hand through the path towards zero waste. Community should establish benchmarks and a timeline to meet goals and to be able to measure success and monitor accomplishments along the path. All parties in communities should aim to make a significant step forward within a scheduled timeframe and to invest their resources and leadership in achieving tangible accomplishments for the public to recognize this new direction as soon as possible. For example, communities should set a goal to divert waste generated from landfills and incinerators within a limited timeframe, such as 10 or 15 years of adoption a plan. The important thing is communities should make it clear in the planning process what is a reasonable goal for their community while recognizing the urgency of moving quickly to address the problems of climate change [6].

Landfill practices need to be reformed to prevent air and water pollution and to pre-process all residues at landfills before burial to stabilize the organic fraction and prevent methane generation. Landfills are a major source of greenhouse gases, which warms the atmosphere 23-72 times more quickly than carbon dioxide as well as ground contamination [7]. Existing incinerators need to be shut down and no new ones built. Incinerators and other burning and thermal treatment technologies such as biomass burners, gasification, pyrolysis, plasma arc, cement kilns and power plants using waste as fuel, can directly and indirectly produce greenhouse gases to the atmosphere and turn resources that should be reduced or recovered into toxic ashes that need to be disposed of safely. Communities should work together to replace landfills and incinerators with Zero Waste policies and programs which include resource recovery centers, and reuse, recycling, and composting facilities [8].

It is important for communities to engage all sectors of the community in zero waste programs. All organizations including local government, nongovernment, grassroots movements, private organizations, and business that provide waste reduction, takeback, reuse, recycling and composting services should get involved in achieving Zero Waste. All members of these groups and people in the community should be encouraged to pursue Zero Waste at home, at school, at university, at work and at play, and their communities need to develop longer term policies and programs for the entire community. Existing service providers should also be asked to aim for Zero Waste achievement as a goal and find opportunities to reduce waste, provide takeback services to local manufacturers and retailers, as well as help communities and businesses get to Zero Waste. All sectors of the community should

communicate each other's actions in all planning and implementation phases of the Zero Waste plan.

Local businesses need to engage in taking back products and packaging at their stores and factories from consumers. State and national policies and programs that promote responsibility of brand-owners and producers, such as Extended Producer Responsibility (EPR) should be established in order to shift the discard management costs for products and packaging that are difficult for reuse, recycling, or composting in most local programs from government to the producers of the product. This will motivate producers to redesign products to make them less toxic and easier to reuse and recycle. Producers should be required to take back products and packaging that are toxic and cannot be reused, recycled, or composted at local facilities without any cost for the public. Collaborative programs to promote reuse, recycling, and composting should be developed with support of small, local businesses and nonprofits [9].

Local governments should take actions in promoting zero waste procurement in both private and government organizations, such as adopting the precautionary principle for municipal purchasing to eliminate toxic products and services. The actions also move the community a step forward to zero waste through purchasing zero waste products and services, avoiding single use products and packaging, returning to vendors any wasteful packaging, purchasing reused, recycled, and compost products, increasing lease, rent, and share equipment, and encouraging businesses and institutions to follow these practices. New rules and incentive programs need to be developed to move towards zero waste communities. Contracts and policies should be restructured to make the avoided costs of collection and disposal a key driver for moving towards zero waste.

Local governments and all stakeholders should engage in expanding zero waste infrastructure by providing locations and facilities for reuse, recycling, and composting to collect and process materials, including resource recovery center. Efficient repair and reuse programs should be established to retain the form and functions of products. Residuals need to be appropriately separated at a residual separation center and made very visible, since they represent either bad industrial design or bad purchasing habits, both of which to be changed through a dedicated research and educational effort. Also, compostable organics should be taken out of landfills and back to the soil as soon as possible to reduce methane and other landfill gases. Small local composting operations should be developed to large centralized facilities so more compost can be used locally to grow food and restore soil to promote food security, local self-reliance and sustainability. Support should be provided to locally owned and operated enterprises so they can manage and use local discards sustainably and create more jobs and training opportunities in the local community.

Zero waste is a strategy that aims for better organization, better education, and better industrial design. It requires cultural change and communities need to provide education and training for residents, school children, college students, businesses, and visitors to understand new rules and programs. Besides, communities need to conduct waste assessment scheme to find out amount and type of waste

being produced in their community. The scheme should be used as baseline to identify recovery and employment opportunities, cost savings, and measure the success of waste reduction and recovery program. Communities also need to evaluate what additional programs and facilities, such as source reduction, reuse, recycling, composting, are required to make the services more convenient for users than mixed material collection and disposal services [10].

Circular Economy: An Important Milestone

A circular economy is an economic system that has a positive net effect on the environment. In circular economy, value of resources and materials used can be retained as much as possible which is contrary to a linear economy of take, make, use, and dispose. It ensures lesser and lesser of waste is generated through the production process and the life history of the product, thus, it has significant influence on reduction of resource extraction. The idea is simply emphasizing on three principles: use only the materials needed, manufacture without creating additional waste, and produce products that can be used again later [11].

The concept of circular economy is to design out waste and pollution, keep products and materials in use, and regenerate natural systems, so that we do not over exploit the natural resources of our planet. Changing the way we make and use products can reduce global greenhouse gas emission by 45%, making a critical contribution to the reduction of climate crisis. With circular economy, we can reduce our

reliance on scarce resources and increase our economic resilience, as well as build a \$4.5 trillion economic opportunity by avoiding waste, making businesses more efficient, and creating new employment opportunities [12]. By creating a circular economy we can make the system stronger and flatten or even reverse some of the trends that now threaten the existence of future generations.

A successful circular economy in cities depends on collaboration between public and private sectors as much as possible. Cities should take these opportunities to create a system that is beneficial for all sectors in cities and can work long term for the economy, society, and environment. These benefits can happen by changing the way urban systems are planned, designed, financed, and how they are made, used and repurposed. The business model should focus on the development of new materials to promote the use of renewable energy, bio-based, less resource-intensive or fully recyclable materials. Materials, components and parts of a system should be captured and sent back into the system instead of virgin or recycled materials [13]. Finite resources must be kept in the manufacturing and business chain as long as possible through sharing, reuse, refurbish, and recycle, then sent back into the system as raw materials again. (Figure 2) The future cities, while sustaining this population, also need to become resilient to climate change, increase energy and resource efficiency, solve the existing social imbalances, and improve human well-being [14].

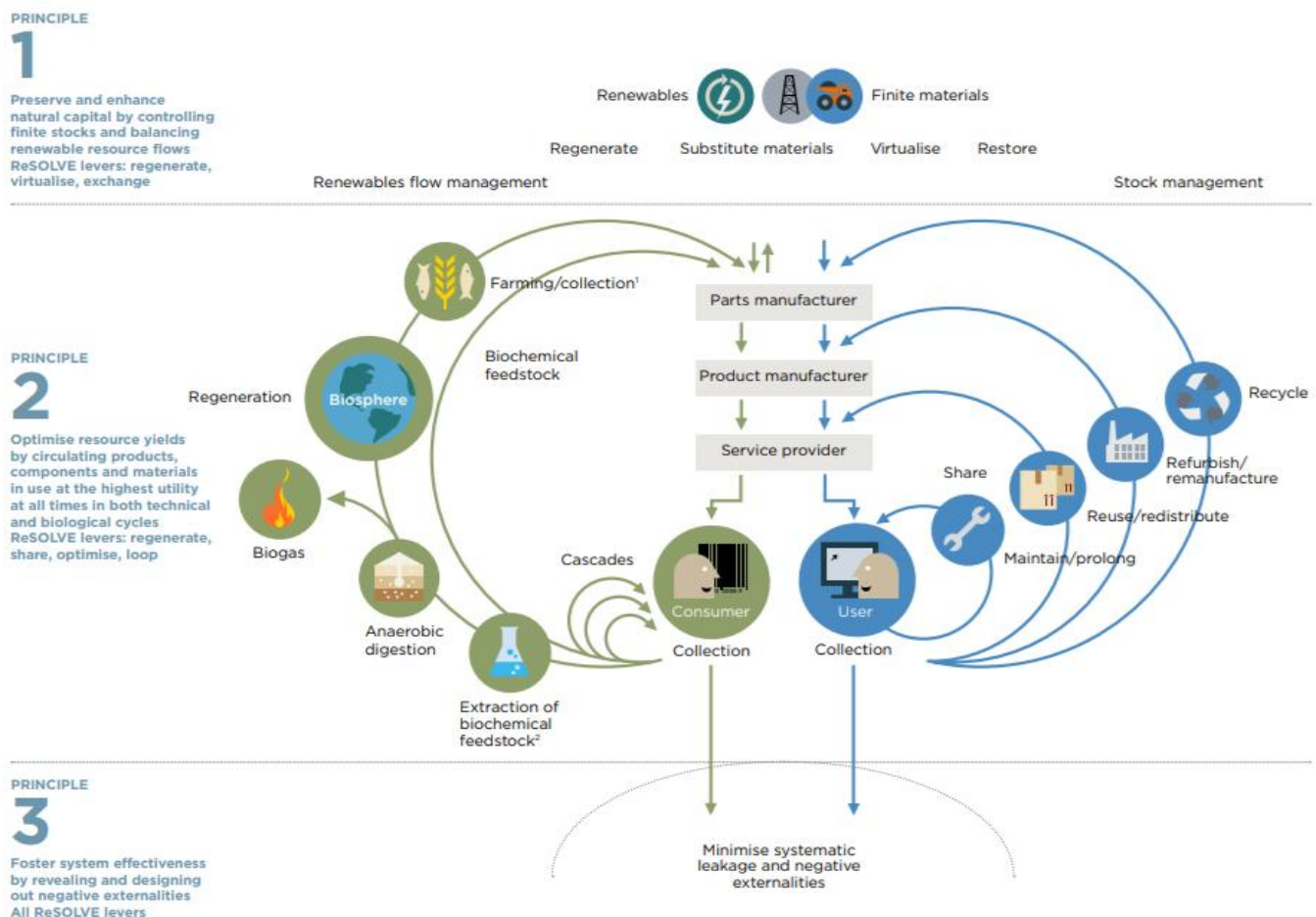


Figure 2. Outline of circular economy [15]

Allowing a circular economy to function, these different types of Circular Business Model (CBM) will need to interact and work together. However, the full circular benefit can happen only if the business model allow change in product and process design to reduce the use of virgin

resources. Business organizations need to work together in a built environment based on a circular economy and they have opportunity to expand the services they offer or collaborate with others to maximize value. (as figure 3)

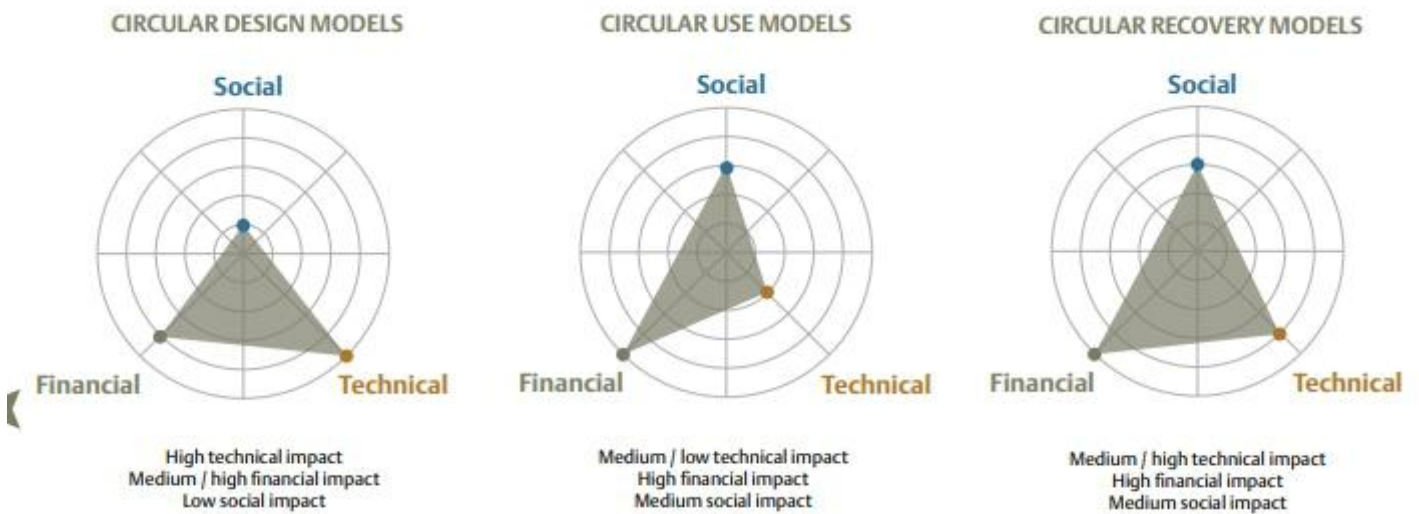


Figure 3. Expected impact from a social, technical and financial standpoint for the over-arching business model types [16]

In a circular economy, products and packaging should be designed out of becoming waste and for retaining its value as much as possible at the end of their useful life. If a product cannot be reused, repaired, refurbished, or recycled, then it should be redesigned or removed from the system. Some substances in products or packaging can harm human health and other living creatures. Therefore, a product or packaging must be designed to be safely reintroduced into the production cycle, otherwise its recirculation as a secondary raw material can negatively impact the recycling systems and the items using this recycled content. Therefore, a successful circular economy needs to appropriately manage the potential wasteful substances to make it safe for sending back into the system again and thus contribute to zero waste system. Consequently, residual waste in the community should be regularly studied in local screening facilities in order to redesign or remove the non-recoverable products out of the market. It should be clear since the design stage whether the product or packaging should be part of the biological cycle (products for consumption) or part of the technical cycle (products for service). The product or packaging that is difficult to digest due to its mix biological and technical components should be removed from the market unless it is clear how to separate its components in different recycling operations. For any case in which materials and products are circularity but the local waste collection and treatment system are not able to manage them, the producer should ensure that these materials and products are effectively recycled in their own facilities [17].

In achieving circular economy, it is essential to explain what can be recycled and how, to explain what materials can and cannot be accepted for recycling, to simplify recycling services, to make collections more consistent, and how to persuade those who can recycle more. Only doing so, we can gain the environmental and economic benefits that recycling offers, for example, reducing the demand for new oil-based products, keeping the oceans healthy, driving

down greenhouse gas emissions, conserving our limited natural resources in use, and reducing demand for virgin raw materials. Therefore, most types of waste should be classified as controlled waste which includes commercial, industrial, and household waste and all of us need to take legal responsibility to ensure that our produce, store, transport and dispose of controlled waste without harming the environment [18].

Making Zero Waste A Reality With Circular Economy

As zero waste ideally aims to design waste out of landfills and incinerators, it requires efforts to reduce waste generation as close to nothing as possible by designing and managing products and processes to eliminate waste and toxicity of waste and materials. According to Zero Waste International Alliance, zero waste means the conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health [19]. To successfully achieve zero waste, a community should adopt circular economy practices to their manufacturing and business system as it ideally aims to retain the value of materials for as long as possible and to eliminate waste. Within a circular economy, resources are restored when a product has reached the end of its life, so the resources can be productively reused for as long as possible.

In the circular economy, waste management plays a critical role. According to EU waste hierarchy, the first priority is put on waste prevention, then, preparation for reuse, recycling, and recovery through to disposal [20]. Circular economy is needed for tackling environmental crisis and waste problem because it offers new way to reduce risk of resource shortage and allow businesses to grow and

diversify as well as keep product and material circulate in high value of use along supply chains [21]. With the circular economy concept, the waste can be reduced at the first stage of prevention as products are designed to use regenerative materials and designing technic to make them last longer and repairable in the light of designing out waste. Also, waste can be getting less and less due to the practices of reuse and repair service which extends product life cycle. Recycling is another practice that contributes to waste elimination as the component parts and materials will be used for manufacturing new products. (Figure 4)

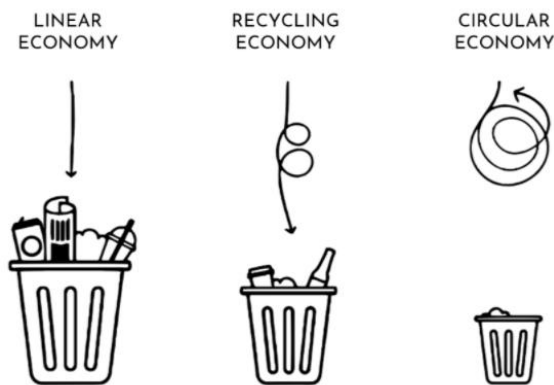


Figure 4. Illustration of Circular Economy Contributing to Zero Waste [22]

Conclusion

Due to the increasing pressure on the world limited resources and ecosphere, zero waste and circular economy are the concepts that are gaining more and more interest as they both aim to reduce such pressure on the planet through a number of strategies. Zero waste is a concept of waste management aiming to eliminate waste as close to nothing as possible while circular economy is a regenerative system aiming to minimize resource input and waste, toxic gas emission, and energy leakage. Circular economy can be used as a systematic approach to achieve zero waste as it focuses on long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling, so waste is eventually faded out of the economy. It also promotes social, economic, and environmental sustainability. In the municipality/city level, the mayors, committees, and organizations should work together to promote certain initiatives that strive to achieve the goals of a sustainable circular economy.

The COVID-19 crisis has completely transformed modern society. The zero-waste approach is now more relevant to all people in society than it ever has been. It is an urgency that we must reduce the negative impact we are having done to our planet. Zero-waste concept should be adopted as a guideline to direct where we are going after the COVID-19 crisis. In every crisis, there is an understandable fear of the recession but also the possibility to learn the lesson and creating something new. Rooted in community participation, zero waste policies can help us pave the way toward sustainable waste management systems that work for both communities and the environment.

As we are moving from the economic slowdown into the post-COVID-19, we must not get stuck in the past, but look ahead to the future. Circular economy principles can be a mechanism for not only achieving not only zero waste in cities, but also promoting social, economic, and environmental sustainability. With all the knowledge, manpower and influence we have to push forward on the priorities, we will be able to build a circular economy. It is essential to get collaboration among business, industry, government, and civil society, but the rewards will be well worth it. Waste and toxic gases will be eliminated, ecosystem will become healthy and resilient, resource extraction will get less, products will be better designed and last longer, economy will be prosperous due to more job opportunities as well as people and nature can live together in harmony. The future cities must become resilient to climate change, increase energy and resource efficiency, solve the existing social imbalances, and improve human well-being. Zero waste municipality can be reached through the ladder of circular economy.

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