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Theme C: Resilient Cities and Urban Futures

Circular Cities:
Building Self-Sustaining Urban Ecosystems for the Twenty-First Century

Cities are hungry creatures. Every day, millions of tons of food, fuel, and other commodities are [transported](#) into urban centers from Astana to Zagreb by road, rail, air, and water. At the same time, cities must contend with the massive amounts of [waste](#), much of it hazardous, that the consumption of these goods creates, employing elaborate and [costly](#) systems of waste management to keep themselves from drowning in their own rubbish and effluvia.

In metropolises around the world, however, innovative efforts are being made to make cities more self-sufficient—to close the loops via which goods and materials are transported into and out of urban zones, thereby saving time, money, and energy. This concept of closed-loop urban symbiosis, sometimes referred to as [circular cities](#), goes far beyond traditional notions of recycling—in which, for instance, a glass bottle is [melted](#) down in order to make another glass bottle—to encompass complex, integrated networks in which waste of all kinds is creatively repurposed in ways that create resilient, self-sustaining urban ecosystems.

One essential commodity that cities are integrating into these closed-loop systems is food. New York City, for instance, has implemented a system whereby food scraps—along with other kinds of organic materials, such as yard waste—are

[collected](#) by the Department of Sanitation and [composted](#) at city-run facilities. This nutrient-rich compost is then used to grow food in urban farms, both [publicly](#) and [privately](#) owned, that are located throughout the city's five boroughs—from [rooftops](#) in Manhattan to [community gardens](#) in the Bronx. The development of this closed-loop system was facilitated by the city council's passage of a [law](#) that mandates the separate collection of organic waste and by the establishment of the [Mayor's Office of Urban Agriculture](#), which aims to promote and support urban farming. Not only does this system provide food for some of New York's millions of residents, but it also yields economic and environmental benefits that will help the city face the challenges of the twenty-first century. For instance, the composting of organic waste helps decrease the cost and environmental impact of transporting that waste out of the city, while urban farmland [absorbs](#) stormwater, [purifies](#) the air, and [mitigates](#) local heat islands—all of which will be ever more vital functions as climate change [increases](#) the frequency of extreme precipitation events, [worsens](#) air quality, and [raises](#) global temperatures.

Besides contributing to a closed-loop system that provides food for urban residents, the composting of organic waste can also provide another critical resource to cities: energy. The decomposition of organic matter in the composting process [yields](#) methane, which can be [burned](#) to generate electricity and heat, thus reducing the amount of fuel and energy that cities have to import. Ljubljana, the capital city of Slovenia, has developed and implemented such a system. The gas that is produced is used to [generate](#) four gigawatt-hours of electricity annually, enough to [power](#) almost four hundred homes per year, as well as 2.8 gigawatt-hours of thermal

energy. While the scale of this project is not large enough to power an entire city, it points a way toward greater energy self-sufficiency, and thus greater energy security, for urban areas. Such advances will be useful in the uncertain and unstable geopolitical landscape that is developing in the twenty-first century. Recently, for instance, European cities have contended with [interruptions](#) in fuel and energy imports as a result of the Russian invasion of Ukraine. By decreasing reliance on external suppliers, closed-loop energy systems like the one in Ljubljana could help temper the negative repercussions of such disturbances.

In addition to utilizing organic waste to produce food and energy, cities have also begun exploring the adaptive reuse of other types of materials in order to create efficient and sustainable circular economies. For instance, in a public park in the city of Vršac, Serbia, driftwood recovered from the nearby Sava River has been used to [build](#) an “eco-gym,” complete with barbells, parallel bars, and other exercise equipment. The involvement of the European Union and the United Nations Development Program, both of which provided support for this project, demonstrates the interest of the international community in promoting the efficient use—and reuse—of resources within cities. Elsewhere in Serbia, a similar closed-loop material economy has taken shape in the city of Novi Pazar, where, as part of the municipality’s Sustainable Development Strategy, textile waste from the metropolis’s numerous clothing manufacturers is [salvaged](#) for use in other industries, including furniture production, thus decreasing the amount of waste that the city must export and the amount of material that its industries must import. In this way, Novi Pazar is decreasing both its waste-disposal costs and its

environmental impact—all while creating a self-sufficient economy that, in a time of [tariffs](#) and [trade wars](#), will help shield the city from the vagaries of the global economy.

Some cities are making ambitious attempts to implement closed-loop symbiosis in virtually every aspect of the urban ecosystem. The Polish city of Gdansk, for instance, is aiming for a “[circular future](#)” in which water, building supplies, and even industrial waste are integrated into self-contained cycles of materials and energy. For example, the city is [installing](#) water retention infrastructure in order to capture rainwater, which will then be used to irrigate parks and other public green spaces. In addition, Gdansk is exploring methods to better [monitor](#) the industrial waste that is produced by the various factories located within the city limits, an initiative that is meant to facilitate the identification of opportunities for the sharing of resources and the adaptive reuse of waste flows among the city’s various industries. Similar initiatives are being implemented for the construction industry, with specialized data storage platforms being used to [keep track](#) of the materials that are present in a given building, so that those materials can be more efficiently and effectively reused upon the eventual demolition of the structure. Importantly, by [involving](#) a variety of other stakeholders—including businesses, NGOs, and the public—in these efforts, Gdansk increases the likelihood that its circular future will come to pass and will remain sustainable in the coming decades.

As cities continue to grow, accounting for an ever-increasing proportion of the world’s population, the quantity of resources they demand and the amount of

waste they generate will only increase, exacerbating the economic and environmental stresses that will likely characterize the twenty-first century. Cities around the world, however, are showing that the implementation of closed-loop urban symbiosis is not only possible but is already underway. By creatively repurposing waste, integrating sustainable energy solutions, and fostering collaboration between various stakeholders, cities can become more self-sufficient, resilient, and environmentally responsible. As the pressures of climate change, economic uncertainty, and geopolitical instability mount, these innovations will be critical in shaping cities that can withstand the challenges of the decades to come. By serving as models for other municipalities that aspire to create circular economies, cities like New York, Ljubljana, Novi Pazar, and Gdansk can pave the way for a future that is both more urban and more sustainable.