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SOLID WASTE MANAGEMENT IN ARAB CITIES

THE INTERVIEW
His Excellency the Director General of Ajman Municipality and Planning Department, talks about the Emirate's efforts towards Environmental Sustainability

URBAN INSIGHTS
Experts' insights on Urban Waste Management

Toolkits on Managing Solid Waste in Cities

CITIES IN ACTION
Solid Waste Management projects and initiatives from across Arab cities

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ELEVENTH ISSUE

SOLID WASTE MANAGEMENT IN ARAB CITIES

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Dr. Anas Almughairy | General Supervisor
Dr. Ziad Alameddine | Editor in Chief
Mishel Ijaz | Managing Editor
Lama El khushman | Associate Editor
Abdullah Al-Abdulaziz | Communication Officer
Khalid Khairy | Senior Translator

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Bee'ah MRF (conveyor sorting hall), Sharjah, UAE
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EDITORIAL

MODERN TRENDS IN SOLID WASTE MANAGEMENT

By Dr. Ziad Alameddine- Editor in Chief

There is no doubt that solid waste management poses a significant challenge for cities worldwide. The issue has evolved beyond simple waste collection and disposal to encompass the need for sustainable solutions that address environmental impacts. Daily solid waste generation in many major cities exceeds the operational and processing capacity of municipal systems, creating challenges that manifest in various forms. The situation is exacerbated by rapid urban expansion, rising population density, and outdated or insufficient waste collection infrastructure that is often ill-equipped to manage large volumes. The lack of a clear strategic framework further aggravates the problem, as recurring failures in waste management translate into serious consequences for both environmental sustainability and public health.

Studies in Arab cities reveal that solid waste management has shifted from being a technical task to a major challenge affecting community well-being and urban resilience. The uncontrolled expansion of informal landfills on unused land makes the situation worse, causing groundwater contamination, environmental pollution, and greenhouse gas emissions, while also creating additional risks for cities already struggling with climate change. These combined pressures undermine public confidence in municipal authorities and reduce the willingness of both residents and stakeholders to support or participate in urban management efforts.

Despite ongoing challenges, encouraging progress is emerging in several Arab cities. Some have introduced management frameworks that enhance the efficiency of solid waste collection, while others are piloting recycling and waste-to-energy initiatives. This variation in approaches highlights the absence of a standardized model that can be applied across all Arab cities, as each city faces different economic realities, social dynamics, governance structures, and institutional capacities.

Some integrated planning practices are proving that solid waste management can play a vital role in advancing the circular economy. Such approaches encourage innovation and establish creative solutions, from raising public awareness and involving households in waste sorting, transforming organic waste into compost and expanding infrastructure to meet local needs. To build on this progress, Arab cities need to reassess governance and financing systems while empowering municipalities to build strong partnerships with the private sector. These partnerships can drive sustainable solutions supported by digital technologies that enable effective tracking of collection, recycling, and waste-to-energy processes.

This issue of 'Mudununa' delves into pioneering approaches to solid waste management in Arab cities, with a focus on waste-to-energy initiatives, recycling of construction and demolition materials, and the integration of technology and artificial intelligence (AI) in the sector. It also spotlights innovative efforts to transform organic waste into economic opportunities, advancing the vision of a circular economy.

Additionally, in his interview, the Director General of the Ajman Municipality and Planning Department (MPDA), H.E. Mr. Abdulrahman Mohammed Al Nuaimi emphasizes that environmental sustainability is a core

strategic objective, essential to ensuring quality of life and enhancing the emirate's attractiveness and livability. He highlights the municipality's pioneering role in adopting the latest technologies for solid waste management, particularly initiatives that promote waste sorting at source. These include smart sorting systems powered by sensors and IoT, as well as AI-driven recycling plants that significantly improve sorting efficiency and resource recovery.

In 'Urban Insights', we feature an article from Engineer Abdullah Ahmed Al-Karani of the Ministry of Municipality, Qatar, on the country's successful efforts in transforming waste into an economic asset. We also hear from Markus Luecke of the GIZ who highlights the role of the Extended Producer Responsibility System in the MENA region, focusing particularly on the content of Jordan. Furthermore, the Maria Sarraf from the World Bank talks about the MENA region and the challenges and opportunities that lie within it for sustainable waste management.Mudununa also feature four toolkits developed by international organizations, each underscoring the importance of knowledge exchange in this field and addressing the different dimensions of solid waste management.

The newsletter showcases leading strategies and success stories from Arab cities in solid waste management, including waste-to-energy initiatives, recycling of construction and demolition waste, and the integration of technology and AI. It also highlights innovative efforts to transform organic waste into economic opportunities. Among the prominent projects are the waste-to-energy facilities in Sharjah and Baghdad, designed to reduce dependence on landfills and fossil fuels, transport significant amounts of waste to treatment plants, reduce environmental pollution, and meet growing clean energy demands. In addition to this, the newsletter covers Khartoum's collaboration with the Japan International Cooperation Agency (JICA), which has enhanced solid waste management in Khartoum State by improving landfill operations and strengthening both the institutional and financial frameworks that underpin sustainable waste management.

The newsletter also spotlights three notable initiatives from Saudi Arabia, Qatar, and Iraq: the rapid urban expansion of Riyadh, the continued development of infrastructure in Al-Shahaniya, and the post-war reconstruction efforts in Mosul. In each case, strong municipal leadership has played a pivotal role, ensuring policy alignment, driving operational success, and facilitating the reintegration of recycled materials into local economies.

In Cairo and Tripoli, grassroots and community-led initiatives have turned waste management challenges into opportunities for inclusion and sustainability, empowering residents economically and achieving remarkable recycling rates. Similarly, the experiences of Abu Dhabi and Makkah underscore the vital role of digital transformation in enhancing quality of life, making essential urban services smarter, more efficient, and environmentally sustainable, while showcasing the potential of AI and the Internet of Things (IoT) to optimize waste management systems. Meanwhile, in Aqaba, Jordan, and Barja, Lebanon, strong partnerships between local communities, municipal authorities, and environmental stakeholders, combined with the adoption of eco-friendly technologies, have successfully transformed organic waste into valuable economic opportunities.

At the regional and international level, a delegation from AUDI, led by H.E. Dr. Anas Almughairy, Director General of the Institute, visited the Sultanate of Oman to strengthen partnerships and benefit from the Sultanate's municipal capacity development programs. The delegation also visited Jordan, where a Memorandum of Understanding (MoU) was signed with the Greater Amman Municipality at its headquarters, in the presence of H.E. Dr. Yousef Al-Shawarbeh, Mayor of Amman. The agreement included collaboration on the project "Participatory Greening of Neighborhoods" in Arab Cities.

Finally, the newsletter concludes with highlights from coverage of the fifteenth and sixteenth sessions of the "Cities in Action" webinar series organized by AUDI. The fifteenth session titled "Embedding Universal Accessibility in Arab Cities", emphasized the importance of embedding universal accessibility principles into urban planning, while the sixteenth session titled " Aleppo's Recovery Master Plan: Challenges and Pathways Forward," examined recovery strategies across different urban scales, presenting a multi-track model built around five key pillars: disaster management, legislation, financing, governance, and project management.

INTERVIEW

DIRECTOR GENERAL OF AJMAN MUNICIPALITY AND PLANNING DEPARTMENT

HIS EXCELLENCY ABDUL-RAHMAN MOHAMMED AL NUAIM

In dialogue about Ajman's efforts towards Environmental Sustainability

H.E. Abdulrahman Mohammed Al Nuaimi is a distinguished government leader, serving as the Director General of Ajman Municipality and Planning Department (MPDA) since 2016. He is spearheading infrastructure development, digital transformation, and sustainability, and began his career in 1997 at the Ministry of Interior, later joining the Roads and Transport Authority in 2007, then moved to MPDA and played leadership roles before assuming his current position.

He holds a bachelor's degree in law from the Police College in Abu Dhabi. He is also an active member of various entities focused on urban development, environmental protection, education, the circular economy, and food security, contributing to realizing Ajman Vision 2030.



Director General of Ajman Municipality and Planning Department, H.E. Abdulrahman Mohammed Al Nuaimi

Founded in 1968, the Municipality and Planning Department of Ajman (MPDA) has been a cornerstone of sustainable development, aligned with Ajman Vision 2030 and centered on people. The department develops infrastructure, promotes community health and safety, and protects the environment through integrated waste management, climate neutrality initiatives, expanded green spaces, and biodiversity preservation. Leading digital transformation, it provides innovative services that enhance quality of life. It also launched the Ajman International Environment Conference and the Humaid bin Rashid International Sustainability Award to honor excellence in creating a sustainable and resilient future. In this issue of 'Mudununa', we explore the city's Solid Waste Management approach with the Director General of MPDA, and its impact on environmental protection and quality of life.

How would you assess the efforts of the Ajman Municipality and Planning Department in promoting environmental sustainability and ensuring a healthy environment for residents and visitors?

Environmental sustainability is a key strategic priority for the Ajman Municipality and Planning Department (MPDA), forming the foundation of our vision and future development plans. We continuously adopt international best practices in environmental protection, focusing on conserving natural resources, reducing carbon emissions, promoting afforestation, and expanding green spaces.

To support this, MPDA has launched several initiatives, including the Ajman Carbon Neutrality Project to achieve net-zero emissions, the Zero-Carbon



Sludge-to-Energy Project, Ajman
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Schools Initiative, and the development of a fully integrated system for reusing 100% of treated wastewater.

In the renewable energy sector, we encourage facilities to adopt solar power according to their capabilities. Furthermore, in partnership with stakeholders, we have also implemented a sludge treatment and power generation project that now supplies about 60% of the treatment plant's electricity needs.

Additionally, we collaborate with the private sector to recycle more than 90% of construction and demolition waste (CDW), ensuring safe and sustainable reuse. We also support projects to recycle waste from oil and grease traps, along with the collection and recycling of used cooking oils from food facilities.

As part of our efforts to improve quality of life and environmental health in the Emirate, we have achieved an air quality index of 96%, one of the highest in the region.

What key new technologies or innovative approaches has the city adopted to enhance waste sorting, recycling, and waste-to-energy generation? And what early results or outcomes have been observed from these initiatives?

MPDA is dedicated to adopting the latest technologies in waste management. We have established an advanced facility for sorting municipal solid waste, making it one of the Emirate's flagship projects. At the same time, we continue to implement initiatives for waste sorting at the source, which have already been introduced in key facilities such as hotels, markets, and retail outlets.

In this effort, we rely on cutting-edge solutions, including smart sorting systems equipped with sensors and Internet of Things (IoT) technologies, as well as AI-powered recycling plants designed to enhance the efficiency of sorting processes.

We have also launched waste-to-energy projects that significantly reduced the volume of waste directed to landfills and lowered harmful emissions. These initiatives have already yielded tangible results, with the recycling and treatment rate of municipal solid waste reaching approximately 36%, a major milestone in advancing environmental sustainability and achieving our strategic goals in this area.

Can you elaborate on the strategies adopted by MPDA to encourage residents and private sector companies to play a more active role in reducing waste generation and adopting best practices in recycling?

As part of our commitment to fostering environmental awareness and embedding a culture of sustainability across community, MPDA has launched



continuous awareness campaigns targeting all community groups. We also provide incentives for residents and businesses that actively comply with sorting and recycling practices.

We are working to expand the implementation of waste sorting at source, which has already been introduced in several key facilities, while also encouraging the private sector to engage in recycling a variety of waste, including electronic waste.

In a major step to reduce plastic pollution, MPDA issued a decision banning single-use plastic bags, significantly reducing plastic waste. We also maintain close cooperation with federal entities to address packaging waste, which represents a considerable portion of unnecessary waste.

Among our flagship initiatives are the Zero-Waste Schools Initiative, launched in collaboration with the Ministry of Climate Change and Environment, and the Zero-Carbon Schools Initiative, both of which aim to instill sustainability and waste reduction values within the education sector.

Additionally, MPDA conducts a wide range of awareness programs across various sectors to minimize waste generation, while continuously encouraging private sector companies and institutions to contribute to achieving this vital environmental objective.

What strategies has MPDA implemented to collaborate with private sector companies in waste management, such as offering investment opportunities in new recycling facilities, or outsourcing key municipal waste services?

MPDA is committed to developing and enhancing the waste management system while working closely with the private sector. We actively support the sector by implementing privatization policies and outsourcing waste collection and management activities in the Emirate, in line with international best practices.

Currently, more than 70% of the Emirate's waste collection and cleaning operations have been privatized, and efforts are underway to complete the privatization of all waste collection services across the Emirate. The private sector is also involved in managing landfills, and operations such as medical waste treatment and sludge treatment were fully outsourced to specialized companies.

These initiatives reflect our dedication to promoting practices of circular economy in the waste sector. By engaging the private sector, we aim to build a sustainable and integrated system for resource and waste management, reducing environmental impact while enhancing operational efficiency and service quality.

What are the main challenges MPDA faces in achieving its waste management objectives, and how does the Department contribute to addressing these challenges?

MPDA consistently seeks to transform challenges into opportunities and enablers. In the waste management sector, rapid urban growth and increasing population density have led to a significant rise in waste generation. To address this, MPDA follows carefully planned strategies aimed at developing sustainable solutions and overcoming existing obstacles.

Among the key initiatives underway is a study for an integrated waste-to-energy project, which represents an advanced approach to managing waste while reducing environmental impact. Parallel to this, a sludge treatment project is being implemented to ensure sustainable and comprehensive management of the entire operational cycle. MPDA is also developing a robust hazardous waste management program that adheres to the highest environmental and health standards.

We remain committed to continuously enhancing waste management infrastructure and technologies, while collaborating with strategic partners to establish a balanced and sustainable ecosystem that meets the aspirations of the Emirate and its residents.

What are the most notable innovations or planned investments your city aims to implement over the next five to ten years to advance its solid waste management system?

MPDA is focused on establishing advanced waste-to-energy plants, launching integrated digital waste management systems, and expanding the use of artificial intelligence in sorting and processing operations. We also plan to strengthen partnerships with the private sector to develop recycling facilities and invest in research and development to identify innovative and sustainable environmental solutions. Looking ahead, the future of waste management will be guided by an integrated system designed to anticipate challenges and implement forward-looking solutions.

How does the city's vision for waste management align with sustainability and the principles of the circular economy?

Ajman's vision strongly supports the principles of sustainability and the circular economy. Its strategy is based on minimizing waste, reusing resources, and converting waste into economic value, in line with both local and global sustainable development goals. A key government priority is enhancing environmental sustainability, which is driven by the objective of achieving effective waste management and reducing pollution.

How does your department use digital tools and smart solutions to monitor waste flows in real time, and how effective have these tools been in improving waste collection, sorting, and recycling?

MPDA employs advanced systems to monitor waste in real time, along with digital applications that track collection and transportation operations. These tools have improved collection efficiency, lowered operational costs, and boosted recycling rates through regular data analysis and informed decision-making. As a result, the department received the 11th Global Best Practices Award in recognition of its innovative and sustainable central waste data management platform.

Landfill-related pollution is a major challenge for cities and urban areas. What steps has MPDA taken to tackle this issue?

MPDA monitors landfills on a regular basis to minimize environmental impact. Emission and odor sensors have been installed at the Emirate's main landfill to ensure emissions remain within the allowed limits, while permanent surveillance cameras prevent the disposal of hazardous or high-emission materials. This monitoring program is crucial for enabling timely corrective actions.

Contractors also perform daily checks with portable devices. By using environmentally friendly materials, MPDA has reduced emissions and environmental complaints by over 90%. Additional measures include odor-reducing sludge pond systems and vehicles that spray eco-friendly substances to control odors. These efforts reflect the MPDA's strong commitment to environmental protection and sustainable practices across the emirate.

URBAN INSIGHTS

External Article

QATAR'S PATHWAY TO SUSTAINABILITY: TURNING WASTE INTO ECONOMIC AND KNOWLEDGE ASSETS



Engineer Abdullah Ahmed Al-Karani

He holds a Bachelor's degree in electrical engineering and has been with the Ministry of Municipality since 2005. Over the years, he has served in the Planning Implementation and Urban Planning Departments, advancing through several leadership positions, including Director of the Urban Planning department and Director of the Qatar National Master Plan(QNMP). He played a key role in the comprehensive urban plan project for the State of Qatar, contributing significantly to the development of the country's urban planning ecosystem in alignment with sustainable development objectives. In 2024, he was appointed Assistant Undersecretary for Public Services Affairs, continuing his work in supporting the Ministry's development and modernization initiatives across various sectors.

Qatar, in its drive for global leadership in sustainability, is spearheading a major shift in resource management—moving from conventional waste practices to an innovative circular economy model. This shift supports the goals of the Third National Development Strategy and Qatar National Vision 2030, while strengthening the country's role as a leading example of sustainable environmental and economic development.

At the Ministry of Municipality, we are committed to embedding sustainability at the heart of national planning, in line with the Qatar National Vision 2030 and the Third National Development Strategy. Our efforts focus on turning challenges into opportunities by developing an integrated waste management system that strives toward achieving "zero waste to landfill".

We have introduced several pioneering initiatives, most notably the national "Zero Waste" campaign, designed to raise public awareness and engage all sectors of community. In addition, we host the annual International Recycling and Sustainability Conference

and Exhibition, which has grown into a global platform for showcasing cutting-edge technologies and building strategic partnerships. To strengthen international collaboration, we also organized specialized events such as the Qatari French Workshop on the Circular Economy, drawing on leading global expertise.

Our strategy is built on clear key pillars: promoting waste sorting at the source, banning single-use plastic bags, and expanding recycling and processing infrastructure—most notably through the Al Afja Recycling Industries Zone, which now serves as a key hub for advancing the circular economy in Qatar.

We place strong emphasis on digital transformation and smart solutions to enhance operational efficiency. For example, we have begun applying artificial intelligence algorithms to optimize waste collection routes—a pilot project successfully launched in Al Wakra Municipality and now being expanded to other municipalities. In addition, we have established an advanced sorting station in Al Khor, equipped with automated sorting technologies and optical sensors.

The impact has been significant. In 2024, the Domestic and Solid Waste Treatment Center produced over 277,000 megawatt-hours of clean electricity, generated more than 40,000 tons of compost, and restored over 27,000 tons of recyclable materials. These accomplishments highlight both the efficiency of our technologies and our success in converting waste into valuable resources.

We firmly believe that partnerships are the cornerstone of success, and our efforts focus on two key areas: raising community awareness and providing direct support to the private sector. At the community level, we continue to advance the "Zero Waste" campaign and enforce the ban on plastic bags.

To support the private sector, we provided over freely 28,000 tons of sorted materials to recycling facilities in 2024. We also launched a digital version of the Waste Removal Permits Program, issuing more than 20,000 permits instantly demonstrating our commitment to facilitating business and assisting our private sector partners. The private sector is a strategic partner in our sustainability journey, particularly through its role in operating recycling facilities in the Al Afja Industrial Area, where 51 plots have been allocated for various recycling activities, with 23 facilities currently in operation.

To reinforce this direction, in February 2025, we unveiled 30 new investment opportunities in the Al Afjah area. These include key sectors such as wood, glass, and electronic waste recycling. By fostering a circular economy and supporting industrial diversification, these opportunities also demonstrate the state's commitment to reinforcing public-private partnerships (PPP).

"In 2024, the Domestic and Solid Waste Treatment Center produced over 277,000 megawatt-hours of clean electricity, generated more than 40,000 tons of compost, and restored over 27,000 tons of recyclable materials."

A major challenge for the Ministry in waste management area is fostering a culture of source-sorting across all segments of society. To tackle this, we have implemented clear regulatory measures, including Ministerial Resolution No. (170) of 2021, which requires intelligent waste sorting.

Regarding landfills, our strategy is focused on achieving "zero waste," with most of the waste being converted into energy or recycled materials. We have achieved notable global accomplishments, including achieving zero waste to landfills during major events such as the 2022 World Cup and the 2023 Asian Cup—an unprecedented accomplishment worldwide. Looking ahead, we are developing a new engineered landfill that meets the highest environmental standards and reclaiming old landfills to reduce their impact.

Our ambitious plans align with Vision 2030, including the establishment of a new waste-to-energy plant, an advanced materials recovery facility (MRF), and the rehabilitation of old landfills.

These projects, together with the ongoing expansion of the Al Afjah area, will strengthen our infrastructure and promote sustainable resource management for coming generations. Recognition such as the Gulf Excellence Award for Sustainable Project Management for our Waste Treatment Center, along with the GCC Summit's recommendations for the Green Middle East, further motivates us to continue leading in this field.

Smart solutions form the backbone of our system development. Beyond leveraging artificial intelligence to optimize collection routes and employing advanced automated sorting technologies, we plan to link all treatment sites through integrated digital systems. This connectivity will allow real-time monitoring and effective data analysis, enhance operational efficiency and move us closer to a zero-waste community.

Qatar's achievements in recycling and sustainability were recognized when the Ministry of Municipality received the Gulf Excellence Award for Sustainable Project Management for the Waste Treatment Center – Kuwait 2023. The award highlights the center's pioneering role in transforming municipal and solid waste into clean energy, organic compost, and recyclable materials, establishing it as one of the region's leading projects in integrating waste management with sustainable energy production.

The new engineered landfill was also honored with the Best Engineering Design Award at the Environmental Engineering and Sustainability Conference and Exhibition – Qatar 2023, underscoring our commitment to the highest international standards in waste management infrastructure.

Confirming this progress, the 11th Joint Gulf Municipal Work Conference – Kuwait 2022 awarded the Ministry of Municipality an appreciation shield in recognition of its initiatives and efforts to advance sustainability and public services, highlighting Qatar's role as a regional model in this field.

Qatar has progressed from merely discussing waste management to actively turning waste into economic and knowledge value, positioning itself as a global leader in the circular economy. Driven by the vision of our wise leadership and reinforced through strong partnerships across all sectors, the country is steadily moving toward a more sustainable and prosperous future.

External Article

JORDAN ON THE WAY TO A CIRCULAR ECONOMY



Markus Luecke

Is an Environmental and Civil Engineer with almost 40 years of professional experience. From 1986 to 2001, he oversaw projects in the fields of Infrastructure, Urban and Environmental planning, and Sustainable employment. He joined the Gesellschaft für Internationale Zusammenarbeit (GIZ) in 2001 and has gained long-standing professional experience in Germany and abroad, particularly in the MENA region and Southeast Asia. Since 2018 he has been heading a global project to support the BMUV "Export Initiative for Environmental Protection".

As consumption and thus also the use of packaging materials continues to rise in Arab cities due to rapid urbanization, economic and population growth, governments in the region are urgently seeking innovative, sustainable, and cost-effective ways to address this issue. With the introduction of a mandatory Extended Producer Responsibility (EPR) system for packaging, Jordan has become the first country in the MENA region to do so, positioning itself as a regional pioneer in sustainable waste management. From 2025, the Jordanian Government gradually holds companies accountable for their packaging waste and transform its waste sector as it pursues its Green Growth National Action Plan. On its ambitious way towards a circular economy, the Jordanian government has been supported by the German federal enterprise Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN) through the funding programme Export Initiative Environmental Protection and private sector expertise from Germany.

Understanding EPR: A Policy Tool for a Circular Economy

EPR is a policy approach that makes producers (manufacturers, importers and brand owners) responsible, financially and sometimes operationally, for the environmental impacts of their products throughout the entire lifecycle, particularly after consumer use. This includes collection, sorting, recycling, and a safe disposal of post-consumer waste. Globally, EPR has been used to address the growing challenges of packaging waste, electronic waste, textiles, and more. It is a cornerstone policy of the circular economy, aiming to reduce the volume of waste sent to landfills, promote prevention, reuse and eco-design, and increase recycling rates.

The Jordanian Ministry of Environment has taken a structured and inclusive approach to implementing

the EPR framework. This includes:

- **Policy and Legal Framework:** The legal basis for the EPR system, the Waste Management Framework Law, was adopted in 2020. Specific EPR Instructions were adopted in 2022, with nationwide implementation set to begin in 2025.
- **Formation of Steering Committee for EPR:** A committee comprising all key stakeholders from both the public and private sectors, chaired by the Jordanian Minister of Environment, has been established to oversee and guide the implementation of the Extended Producer Responsibility (EPR) system.
- **Establishment of a Producer Responsibility Organisation (PRO):** A central body is being created to manage compliance, coordinate logistics, and serve as a liaison between producers, recyclers, and public institutions.
- Capacity Building: The Ministry has worked with national and international partners to develop technical resources and has conducted workshops to support implementation.

"The EPR system offers the opportunity to integrate these workers into the formal waste management system and provide them with better working conditions, social protection, and recognition for their work"

Impacts on Key Stakeholders in Jordan's Waste System

The introduction of EPR in Jordan is expected to lead to significant improvements in the country's waste management. A key change is that the financial burden will be shifted from local authorities, which have long struggled with tight budgets, to producers. At the same time, local authorities will play a central role in setting up collection systems and raising public awareness. Experience shows that EPR encourages producers to adopt more sustainable packaging designs by reducing packaging volume, using recyclable materials, and avoiding non-recyclable components. As producers begin to finance the system, investment in recycling infrastructure and waste collection systems is expected to increase. The private sector, particularly recycling and waste management companies, will benefit from the growing demand for their services.

Special attention should be paid to the informal sector, as informal workers play an important role in waste collection in Jordan. The EPR system offers the opportunity to integrate these workers into the formal waste management system and provide them with better working conditions, social protection, and recognition for their work. Finally, one of the most important components of a functioning EPR system is public participation. Citizens will be encouraged to separate waste at the source and engage with local recycling initiatives. Outreach campaigns led by municipalities, the PRO and NGOs have to build awareness and shift behaviours over time.

EPR without borders: Global Knowledge Exchange on Circular Economy and EPR

The knowledge transfer extends beyond Jordan and Germany: GIZ promotes regional knowledge exchange on EPR systems, as other countries in the MENA region are also working on this topic. In addition to many online events, the workshop "Scaling up EPR in the MENA region" took place in Tunis in March 2024 with representatives from Tunisia, Jordan, Egypt, Libya, the Palestinian Territories, Lebanon, and Morocco.

Most recently, GIZ translated the EPR Toolbox of the PREVENT Waste Alliance into Arabic, making this collection of expertise on EPR and country examples more accessible to partners in the MENA region. The Toolbox is available on our GreenTechKnowledgeHub, an open digital platform for sharing experiences, best practices, insights, and innovative approaches. The platform offers communities of practice and virtual events on circular economy topics. Practitioners, policymakers, entrepreneurs, environmentalists are invited to register on the GreenTechKnowledgeHub.

Long-term and locally anchored – the Partnership between GIZ and the Jordan Government

Since 2019, GIZ has supported the Jordanian Government in developing a national EPR system for packaging on behalf of the German Environment Ministry. In collaboration with German companies like cyclos GmbH, expertise has been shared with Jordanian stakeholders through policy advice and pilot projects. GIZ initiatives include the procurement of electric vehicles for the ancient city of Amman and a mobile app for separate collection with SynoptiCons. A digital, open-source registration tool by Ambient allows companies to report packaging volumes transparently and can be adapted by other countries. In July 2025, cyclos GmbH trained staff from the Producer Responsibility Organisation and other stakeholders on key elements of EPR system - such as PRO structure, registration, fee models, compliance, and communication.

Outlook: A vehicle for sustainable growth

Jordan is the first country in the MENA region to officially introduce a mandatory EPR system, demonstrating how environmental policy, business and society can work together successfully. The Jordanian government has developed a robust and workable EPR system that can provide impetus for the entire region. An effective EPR system contributes to environmental protection and enables the sustainable financing of investments in technical infrastructure. This opens market potential for green tech companies, recycling technologies and sustainable product design.

External Article

FROM WASTE TO VALUE: AN OPPORTUNITY FOR THE MIDDLE EAST AND NORTH AFRICA REGION



Maria Sarraf

The Regional Manager of the Environment Department, covering the Middle East, North Africa, Pakistan, and Afghanistan. Maria joined the World Bank in 1997 and has a long-standing experience in the environment sector. She has held various positions in South Asia, Sub Saharan, and West Africa. Over the course of her career, she has managed projects on air and water pollution, waste management, brick and industrial pollution, coastal embankment, and natural resources management, and has authored numerous publications in the field of environmental economics.

She holds a master's degree in environmental and natural resources economics from the University College of London, in England and a master's degree in economics from McGill University in Canada.

The World Bank is preparing a report on waste management and the circular economy in the Middle East and North Africa (MENA) region. The report finds that the region is facing a mounting waste crisis, generating more waste per capita than East Asia, South Asia, and Sub-Saharan Africa, with an average of 0.9 kg per person per day—above the global average of 0.79 kg per person per day. It highlights the urgent challenges the region faces—from rising waste generation and inadequate disposal to environmental and public health impacts. The report also outlines opportunities to transform waste into a driver of economic growth, sustainability, and social well-being through tailored circular economy approaches. It covers 19 countries in the region: Algeria Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, UAE, West Bank and Gaza, and Yemen.

The consequences are dire: poor waste management exacerbates air pollution because of the open burning of waste and the contamination of soil and water due the lack of sanitary landfills. It threatens public health

and urban development, disproportionately affecting disadvantaged communities. It undermines the tourism sector, with key destinations currently endangered by plastics and other waste. Our research estimates that the environmental damages caused by poor waste management amount to US$7.2 billion annually—a sum equivalent to the entire GDP of Jordan or Tunisia every six years.

In the MENA region, most countries have a high waste collection rate, with some cities - especially in high-income countries- reaching almost 100 percent. However, a large portion of this waste is inadequately managed: 68 percent of the waste in MENA is still uncollected, openly dumped, burned, or not tracked, compared to the global average of 33 percent.

Food waste is a particularly acute challenge. Each year, MENA loses around US$60 billion to food waste, with about 19 percent of food discarded—ranging from 75 kg and 130 kg per person. This is especially alarming given that 80 percent of staple foods are imported and one in six people experiences severe food insecurity.

If no significant action is taken, waste generation in the region is projected to nearly double by 2050, rising from 153 million metric tons of solid waste produced annually today to 290 million metric tons. This increase will be most pronounced in countries already affected by conflict and fragility and in populous nations such as Egypt and Morocco.

MENA countries collectively spend US$7.5 billion annually on waste management. Compared to global benchmarks, this level of spending is broadly consistent with the services received. However, treatment and disposal levels remain far below global standards and need significant improvement.

Yet, within these pressing challenges lies an enormous opportunity: to transform waste from an environmental liability into a driver of economic value, sustainability, and social responsibility.

The potential for improvement is clear. A mere 1 percent reduction in waste generation could save the region up to US$150 million annually, while also keeping waste volumes manageable. Even more strikingly, 83 percent of collected waste could be reused, recycled, or composted - yet only 10 percent currently is. Public awareness and engagement, supported by targeted policy interventions and segregated waste collection, are essential to "bend the waste curve", which is a priority.

"A mere 1 percent reduction in waste generation could save the region up to US$150 million annually, while also keeping waste volumes manageable."

Achieving these goals will require significant investment. To keep pace with projected waste growth, deliver better service and proper disposal, and lay the foundation for more circular economy practices, annual spending would need to increase threefold by 2050. However, this investment need not solely come from public spending. Secure, sustainable financing is another priority requiring improved cost recovery based on user fees, stronger engagement with the private sector via public-private partnerships, and establishment of Extended Producer Responsibility mechanisms.

There is no one-size-fits-all solution as countries in the MENA region have different circumstances, resources, and entry points for change. However, effective solid waste management requires stronger coordination between national and local authorities, clear mandates, and active stakeholder engagement. Enhancing the status and conditions of informal workers can also be a powerful driver of sector improvements.

Different groups of countries in the MENA region will require tailored circular economy. Such approaches provide scalable solutions across all contexts, transforming waste challenges into drivers of economic growth, sustainability, and social well-being:

- **High-income countrie**s are well positioned to make an ambitious push toward advanced circular economy approaches. With strong public policies and active private sector engagement, they could scale up recycling, composting, and incineration to

reduce landfill use from 77 percent today to below 30 percent by 2050.

- **Middle-income countries** could expand collection services and ensure safe disposal while advancing strategies such as deposit-refund and bring-back-bottle schemes; introducing tax incentives for recycling; and diverting 40% of waste away from landfills by 2050.
- **Economies affected by fragility, conflict, and violence** could prioritize establishing reliable collection services and building capacity for safe waste disposal. Small-scale, community-based recycling and composting initiatives tailored to local contexts offer the most practical path forward, with the goal of diverting at least 20 percent of waste away from landfills by 2050.

Waste management is everyone's responsibility. Achieving success will require innovation and coordinated efforts among individuals, businesses, and all economic sectors. Such bold, transformative measures are essential for cities to thrive and for the region to fully realize its tourism potential.

TOOLKITS ON SOLID WASTE MANAGEMENT

As urban areas expand and infrastructure needs grow, cities face increasing challenges in solid waste management, from rising waste generation and limited disposal capacity to significant environmental impacts. Municipalities require the right tools and resources to effectively address these issues through improved collection, treatment, recycling, and sustainable disposal systems.

To facilitate knowledge sharing on this subject, this issue of Mudununa presents four toolkits developed by international organizations that deal with various aspects of solid waste management. These have been designed specifically to help municipalities better understand the steps needed to develop and implement effective waste management strategies, while promoting environmental sustainability and enhancing urban resilience.

1

Toolkit 1:
Zero Waste City Manual

2

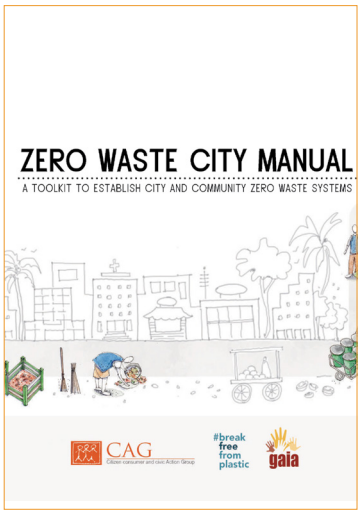
Toolkit 2:
Waste Wise Cities Tool

3

Toolkit 3:
Policy Toolkit on Municipal Waste Management

4

Toolkit 4:
Solid Waste Management Toolkit



Citizen consumer and civic Action Group (CAG), ©2020

https://www.no-burn.org/wp-content/uploads/ZWC-Manual_20200725-1.pdf

Toolkit 1:
Zero Waste City Manual

The Zero Waste City Manual is useful document for putting zero waste systems into place in cities. It places a strong emphasis on source segregation, decentralized waste management, and integrating resource recovery procedures with workers in the informal sector. Through neighborhood composting facilities and a reduced need on central disposal facilities, it encourages in-situ waste processing.

The manual's fundamental tenet is the precautionary principle, which promotes action despite scientific uncertainty. Preventive action, shifting the burden of proof, exploring alternate options, and increasing public participation in decision-making are its four main pillars. Holistic environmental management is supported by these moral and equitable foundations.

The manual tackles the intricate subject of waste management, acknowledging the impact of conflicting interests and the necessity of striking a balance between social, environmental, and financial objectives. It is meant for communities, organizations, and municipal actors who are establishing or promoting waste systems at the local or city level.



UN Habitat, ©2021

https://unhabitat.org/wwc-tool

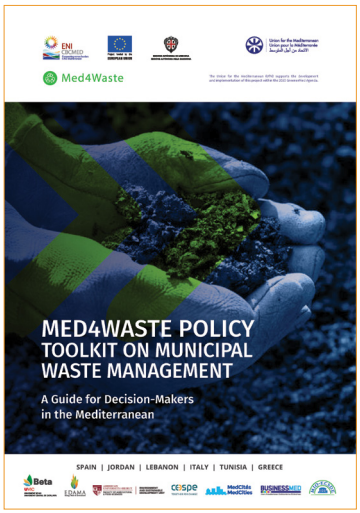
Toolkit 2:
Waste Wise Cities Tool

The Waste Wise Cities Tool (WaCT), developed by UN-Habitat, is a hands-on framework that enables cities to gather accurate, comparable data on their municipal solid waste systems. By providing a clear methodology, it helps decision-makers pinpoint weaknesses in service delivery, set improvement priorities, and design targeted interventions particularly in fast-growing and resource-constrained urban areas.

The approach walks users through the entire waste management chain, from generation and collection to transport, sorting, recycling, and final disposal. Its standardized steps ensure results are consistent across different locations, while practical components such as training local survey teams and engaging residents in data collection help build trust, ownership, and accuracy.

Strongly aligned with the Sustainable Development Goals, especially SDG 11.6.1, WaCT also supports UN-Habitat's Was te Wise Cities Campaign. The toolkit serves as both a diagnostic and planning resource, enabling cities to base waste policies on solid evidence.

Municipal authorities, planners, NGOs, and development agencies can use WaCT to benchmark performance, guide investment in infrastructure, and design integrated, inclusive systems. Its focus on community participation, climate responsiveness, and data-driven decision-making makes it a valuable asset for creating resilient, sustainable waste management strategies.



Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE), ©2023

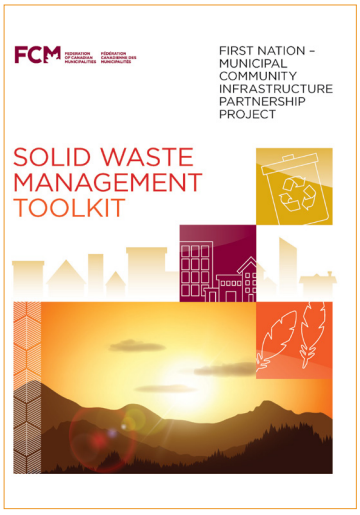
https://medcities.org/wp-content/uploads/2024/03/Med4Waste-Policy-Toolkit_double-page-low.pdf

Toolkit 3:
Policy Toolkit on Municipal Waste Management

Developed under the EU-funded Med4Waste project, this toolkit provides a detailed policy framework for municipalities to modernize and improve their waste management systems. It consolidates lessons from Mediterranean cities and is structured into five key sections: governance, regulatory frameworks, economic instruments, technical measures, and stakeholder engagement.

The governance section outlines institutional roles, coordination mechanisms, and monitoring processes. The regulatory component covers legislative alignment with EU directives, permitting, and enforcement. Economic instruments include fee structures, extended producer responsibility schemes, and incentives for waste reduction. Technical measures address infrastructure planning, collection models, waste treatment technologies, and landfill management.

A dedicated section on stakeholder engagement offers practical methods for public participation, awareness campaigns, and partnerships with NGOs and private operators. The toolkit also features case studies demonstrating successful policy applications in waste prevention, recycling markets, and circular economy integration.



Federation of Canadian Municipalities (FCM), ©2017

https://documents.worldbank.org/pt/publication/documents-reports/documentdetail/290301468159328458/safer-homes-stronger-communities-a-handbook-for-reconstructing-after-natural-disasters

Toolkit 4:
Solid Waste Management Toolkit

The Solid Waste Management Toolkit, created under FCM's towns for Climate Innovation Program, offers towns a methodical framework for planning, assessing, and enhancing their waste management systems with a particular emphasis on mitigating the effects of climate change. Assessment and baseline data collecting, planning and goal-setting, infrastructure and technology options, financial and policy instruments, and monitoring and continuous improvement comprise its five primary sections.

The toolkit has a strong emphasis on integrated waste management, which includes organics diversion, recycling, reuse, waste prevention, and ecologically responsible disposal. Along with initiatives to lower greenhouse gas emissions, it provides assistance on the selection of technologies like anaerobic digestion, composting, and material recovery facilities.

To assist towns in evaluating present performance, creating scenarios, and setting investment priorities, it offers worksheets, checklists, and decision-making templates. Additionally, the toolkit offers case studies from Canada that show affordable, community-supported solutions while paying close attention to public education and stakeholder participation.

It is a technical reference and a strategic planning tool that can be tailored to various municipal sizes and circumstances. It helps local governments create robust, low-carbon waste systems that safeguard the environment and public health.

CITIES IN ACTION

Project 1



Emirates Waste to Energy Plant
©2022 Beeah group

Innovations in Sharjah and Baghdad

Transforming Waste into Power

As global urban populations rise and landfill space shrinks, cities are under growing pressure to find sustainable solutions for managing municipal solid waste. Among the most promising strategies is waste-to-energy (WTE), a process that not only reduces landfill dependency but also generates electricity or heat from waste that would otherwise be discarded. This article explores best practices across two cities in the Arab region, Sharjah and Baghdad, and explores how these cities are turning trash into a resource, driving innovation in waste management and renewable energy alike.

The Waste-to-Energy project in Sharjah is the first such scheme that was financed in the Gulf region, as a key component of the UAE's zero waste to landfill target. Developed through a partnership between Bee'ah and Masdar, the project began operations in 2021. Currently, the 80,000 square-metre facility currently generates 30 MW of low-carbon power per year, enough to power 28,000 homes, displacing almost 450,000 tonnes of CO2 emissions and conserving up to 45 million cubic metres of natural gas.

By 2024, the Sharjah Waste to Energy Plant achieved the milestone of processing 500,000 tonnes of waste with a notable uptime of 93%, indicating a high-level efficiency and minimal disruption in its initial years of operation. As a result of the 500,000 tonnes milestone, the Sharjah Waste to Energy Facility has also successfully abated 750,000 tonnes of CO2 emissions,

recovered 2,000 tonnes of metal since it began operations and exported 300,000,000 kWh of electricity to the public grid through a power purchase agreement with SEWA. These milestones The facility align with the UAE Energy Strategy 2050, which aims to support the country in fulfilling its clean energy targets and reduce the carbon footprint associated with power generation, and with the UAE Environment Policy, which is driving the transformation of waste-related challenges into development opportunities.

The success of the plant has paved the way for a Phase two expansion of the facility, which aims to double the total capabilities of the current plant, allowing it to process a larger volume of hard-to-recycle waste, generate more clean energy, power more homes with clean energy and displace more CO2 emissions.

Along similar lines, in March 205, Baghdad launched its Waste-to-Energy (WtE) Project, a large-scale solid waste management and energy transition initiative located in Nahrawan district of Baghdad. It is the city's first project designed to convert solid waste into clean electrical energy. Being part of the Iraqi government's plans to shift towards clean energy and reduce dependence on fossil fuels, the project addresses the city's waste and energy challenges by implementing a high-efficiency WtE solution.

Envisioned as "Baghdad's first environmentally sustainable energy project", the initiative aims to reduce the city's dependence both on landfills and fossil fuels by generating renewable energy from urban waste. It intends to divert significant volumes of waste from landfills, reduce environmental pollution, while supplying Iraq's energy needs as part of Baghdad's plan for waste treatment and clean electrical energy production.

Situated on a 1 square kilometer site, the facility will incinerate approximately 3,000 tons of solid waste daily to produce 100 megawatts of clean electricity. The incineration process uses advanced fourth generation grate technology, with an electrical power generation efficiency exceeding 30% and a landfill rate below 5%. Generated power will be fed into the national grid to reduce Iraq's supply gap. The process involves collection of waste through dedicated vehicles that will transport it to the waste-to-energy plants, followed by the production of energy through turbines that use superheated steam produced by combustion in the facility's boilers. The project is developed as a collaborative effort between the municipality of Baghdad the Ministries of Electricity, Environment, Science, and Technology in Iraq. The primary contractor is Shanghai SUS Environment Co. Ltd , which is operating under a design-build-own-operate model. With a total investment of approximately $497 million, the project is funded by the government of Iraq.

These waste-to-energy initiatives demonstrate not only the technical feasibility of converting urban refuse into valuable power, but also underscore the potential of visionary policy, strategic investment, and cross-sector collaboration to drive lasting environmental change. By harnessing advanced technologies, setting ambitious emission abatement targets, and aligning with broader national energy strategies, both cities have shown that waste can be transformed from a liability into a sustainable asset. Their successes offer a compelling blueprint for other urban centres striving to meet the dual imperatives of environmental stewardship and energy security. As more cities adopt such integrated approaches, the region moves ever closer to a circular economy, one where resources are continually renewed, and tomorrow's challenges are met with today's ingenuity.



Baghdad, Iraq
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Project 2



Khartoum, Sudan
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Experience from Khartoum

Building Municipal Capacity in Solid Waste Management

Across rapidly growing cities worldwide, municipal solid waste management has emerged as a defining challenge of sustainable urban development. As populations grow and consumption patterns change, local governments are under increasing pressure to collect, process, and dispose of ever-rising volumes of waste in ways that protect public health, preserve the environment, and make efficient use of resources. Therefore, building municipal capacity in solid waste management is not just about upgrading infrastructure, it's about developing the skills, systems, and partnerships that enable cities to plan strategically, operate effectively, and respond to evolving needs. This article focuses on the capital of Sudan, Khartoum, and the various efforts undertaken by the city to manage its solid waste as well as enhance the capacity of its municipality for greater efficiency and impact.

Like many modern-day metropolises, Khartoum has faced significant obstacles related to infrastructure limitations, informal waste practices, and environmental degradation. In 2014, approximately 6,000 tons of solid waste was being generated every day in Khartoum state, with a collection rate as low as 65% due to old equipment and inefficiencies in the system. As a result, solid waste remnants in many places in the state caused deterioration of the sanitary



Waste transfer station in Khartoum North
©2015 Labourintensiveworksudan | Wordpress

environment, particularly in low-income residential areas. In addition, despite the vast areas of the landfills, the operation was not satisfactory due to the lack of heavy vehicles and insufficient soil cover.

In response to this, the Project for Improvement of Solid Waste Management in Khartoum State was initiated by the Japan International Cooperation Agency (JICA) in 2014. It aimed to improve the capacity to collect and dispose of waste by procuring waste collection and transportation equipment, and by establishing a maintenance workshop to service waste collection and transport equipment. The project was designed around four key measures in an effort address the challenges comprehensively. These include the revision of the Solid Waste Management Masterplan for Khartoum state, the improvement of the capacity of waste collection and transportation, enhancement of the operation and management of the landfills, and the strengthening of measures related to the institutional setting and financial status in solid waste management.

Through Japanese Grant Aid, Khartoum State procured approximately 100 waste collection vehicles and a significant number of heavy machinery for landfill sites, and constructed maintenance facilities for the vehicles. As a result, it made it possible to collect approximately 1,400 tons of solid waste per day. Additionally, the repair of facilities made it possible to improve the efficiency and management of solid waste collection.

In addition to the Grant Aid, technical assistance was conducted for the Ministry of Environment, Natural Resources and Physical Development (MENRPD), and Khartoum Cleaning Cooperation (KCC). Such assistance comprised of support for soft components such as strengthening the organization, its capital, as well as the management of its waste collection and transportation systems. Through these activities, data on solid waste was collected and organized, making the flow of solid waste easier to visualize and analyze. In doing so, the project focused on enhancing collection systems, upgrading waste disposal facilities, and promoting community participation to foster more sustainable practices. Crucially, it also emphasized building the capacity of local institutions through technical training and the introduction of effective operational frameworks.

As a result, illegal dumping during transportation from the collection sites to the landfill sites drastically decreased. The vehicles provided by the project have increased the amount of collected waste from 3,200 tons/day to 3,727 tons /day in October 2016. The project also utilized "Captain Tsubasa" stickers on granted vehicles, in order to attract the interest of citizens and raise awareness regarding the city's efforts to improve their solid waste management system.

Khartoum's efforts toward improved solid waste management highlight the transformative potential of strategic investment and institutional strengthening. By combining infrastructure upgrades with technical assistance and public engagement, the city has taken a step in the right direction. However, while notable progress has been made, the project's longevity is dependent on continued efforts by the local government and the various entities responsible for solid waste management in Khartoum.

Project 3



Sorting construction and demolition waste at one of Akam's site in Saudi Arabia
©2024 SIRC

Riyadh, Mosul, and Al-Shahaniya
Construction and Demolition Waste Recycling

Arab cities are witnessing rapid growth and modernization, with some rising from the aftermath of conflict and reconstruction. In this dynamic landscape, the challenge of managing construction and demolition (C&D) waste has become increasingly prominent. Once regarded as a burden, C&D waste is now recognized for its substantial potential in supporting new infrastructure projects, urban renewal, and fostering economic opportunities. Across the region, municipal governments collaborate with national authorities, private industry, and international agencies to reclaim, recycle, and repurpose C&D waste, advancing the shift toward circular economies. Case studies from Al-Shahaniya in Qatar, Riyadh in Saudi Arabia, and Mosul in Iraq illustrate the effectiveness of tailored approaches that convert rubble into valuable resources, simultaneously addressing environmental sustainability and developmental objectives.

In Al-Shahaniya in Qatar, the Rawdat Rashed Landfill Recycling Operations have emerged as a national model for integrating landfill management into a circular economy framework. Situated in Al-Shahaniya, the site has been transformed into a large-scale hub for recycling construction and demolition (C&D) waste into high-quality building materials. In 2019, the Ministry of Municipality (formerly the Ministry of Municipality and Environment) partnered with Qatar Primary Materials Company (QPMC) to expand recycling capabilities, focusing on converting rubble, sand, and

gravel into reusable aggregates. By 2020, the facility had produced 434,000 tons of recycled materials and processed over 482,000 end-of-life tires. The municipality's regulatory oversight and alignment of recycling targets with national infrastructure plans have been pivotal in reintegrating recovered resources into public works. This transformation not only reduces dependence on imported raw materials but also advances Qatar's broader sustainability objectives by positioning landfill operations as engines of resource recovery.

Further west, Riyadh has advanced sustainable urban growth through the Saudi Investment Recycling Company (SIRC) Construction and Demolition (C&D) Recycling Facility. Opened in 2020, it stands as the city's first large-scale plant dedicated to processing and reusing C&D waste. The Riyadh Municipality allocated 1.3 million square meters of land for the site, reflecting strong leadership in enabling the shift toward a circular economy.

Capable of processing up to 600 tons of waste per hour and achieving a recovery rate above 90%, the facility produces recycled aggregates supplied directly to local construction projects. The initiative is a core part of Riyadh's waste management strategy, which aims to divert 60% of C&D waste from landfills by 2035. Backed by national waste management authorities, it demonstrates how municipal planning and state-supported investment can deliver significant environmental gains, economic value, and enhanced resilience in urban infrastructure.

In a post-conflict setting, Mosul, Iraq, faced the daunting task of managing an estimated 55 million tons of debris that blocked roads, damaged neighborhoods, and posed serious environmental hazards. Clearing this waste was vital not only for restoring basic services but also for enabling the city's long-term recovery. From the outset, Mosul Municipality was central to the response, selecting the site for the Mosul Debris Recycling Centre, issuing permits, and working with technical partners to ensure materials met national building standards and could be used in public works such as road repairs and municipal construction. Established in 2021 through a partnership between the United Nations Environment Program (UNEP), the International Organization for Migration (IOM), and UN-Habitat, with funding from the Government of Japan, the facility processes debris into construction-grade aggregates for road base, concrete blocks, and curbstones. In July 2022, it was officially handed over



Waste Management in Qatar
©2019 WGOQatar

to the municipality, securing local ownership and embedding recycling into Mosul's reconstruction strategy. By combining technical efficiency with municipal leadership, the project has turned a post-conflict challenge into a sustainable driver for urban renewal.

These three initiatives, whether in the steady expansion of infrastructure in Qatar, the strategic modernization of a megacity in Saudi Arabia, or the rebuilding of a war-torn city in Iraq, highlight the versatility and potential of C&D waste management in different urban contexts. In each case, municipal leadership has been the constant driver, enabling policy alignment, operational success, and reintegration of recycled materials into the local economy. High-throughput processing, targeted investments, and strong partnerships have turned what was once considered waste into a strategic resource. By reframing C&D waste as an asset rather than a liability, municipalities can reduce landfill dependency, cut carbon emissions, and stimulate local economies, contributing to a truly circular urban future.



:Small scale crushing of debris by the International Organization for Migration (IOM) at the Mazen Debris Recycling Pilot Site in Mosul
©2020 United Nations Environment Programme

Project 4



A garbage truck driving through the Streets of Manshiyat Nasser, Mokattam, Cairo, Egypt, where the Zabbaleen people are recycling the waste
©2013 Fabian Deter | Wikimedia Commons

Cairo and Tripoli
Community Efforts in Waste Management

Informal sector and community-based solid waste management systems play a crucial role in addressing urban waste challenges, especially in rapidly growing cities where formal waste services often fall short. These grassroots approaches leverage local knowledge, social networks, and community participation to collect, sort, and recycle waste in cost-effective and environmentally beneficial ways. Despite facing challenges such as limited resources, lack of formal recognition, and operational constraints, informal and community-led initiatives offer valuable insights into sustainable waste management practices that promote inclusion, job creation, and improved urban sanitation. This article explores these models, examining their impact, challenges, and potential for broader application through two notable examples from Cairo in Egypt and Tripoli in Lebanon.

The Manshiyat Naser neighborhood in Cairo, famously known as the 'Garbage City' or 'Zabbaleen', is home to a unique community of informal recyclers. With its streets brimming with solid waste, it is known as one of the world's most efficient and sustainable recycling systems. Compared to Germany, the country with the highest recycling rate in the world at 66%, the informal workers in this community are estimated to recycle over 80% of the garbage that they collect. Currently, almost all of the 100,000 residents of the neighborhood are directly or indirectly involved in

garbage-related activities, ranging from collection, transportation, sorting, washing, processing, and even production.

Families play out specific roles to keep the economic system of recycling operational. Some focus on door-to-door collection, accumulating about 30-40kg of garbage each day for sorting into organic, plastic, metal, fabric, and cardboard waste. Other families buy the accumulated garbage for further sorting by material and color, following which they sell it to the families who own machines that can wash, granulate, or pelletize plastic. Ultimately, the material is sold to factories in Cairo, Alexandria, and the Nile Delta to be manufactured into various recycled products, including plastic buckets, brooms, curtains, clothing, which are then exported across the world.

This process is supported by its own institutional mechanism. In the 1940s when the neighborhood of Manshiyat Naser began to be inhabited by the Zabbaleen, they forged an agreement with the older migrants who had been carrying out garbage collection in the parts of the city. By the 1980s, the neighborhood had been connected to Cairo's electricity and water grids, allowing the Zabbaleen to invest in machinery for garbage collection and processing. With the profits of their activities, they also establish various community-based organizations to help improve the infrastructure of the settlements. Over time, several members of the community have formed companies in order to work more effectively with the formal system. This also means that they are provided with government uniforms, vehicles, and even training programs. This integration indicates the impact of informal processes in supporting local economic development and presents the Zabbaleen as a model for effective collaboration between local governments and communities.

Another notable example of a community-led initiative for waste management is present in the city of Tripoli in Lebanon. The city has faced several challenges, with waste spreading across twelve meters over the landfill's planned capacity and eventually ending up in the Kadisha river and sea. In 2017 a citizen of Tripoli established 'Green Track', starting with awareness campaigns in his neighborhood on the importance of sorting waste at the source. He followed this by collecting recyclable waste from residents and transporting it to factories that can use it for their production processes. For its operations, Green Track employs women, as well men and youth who are seeking employment opportunities, contributing to local economic development. Its impact through social entrepreneurship led the organization to partner with international organizations such as Oxfam, and the other municipalities in Lebanon such as the municipality of Bqarsouna on projects that focus on generating employment opportunities for the most vulnerable communities.

The cases of both Cairo and Tripoli indicate that informal and community-driven waste management can transform urban challenges into opportunities for inclusion and sustainability. These approaches empower residents, boost local economies, and deliver impressive recycling rates. Their success speaks of the power of grassroots innovation, emphasizing the importance of recognizing and supporting such initiatives to foster transformative initiatives in cities.



Green Track, Lebanon
©2020 Green Track | Facebook

Project 5



Smart bins, Abu Dhabi
©2025 Yallah Abu Dhabi Life

Lessons from Abu Dhabi and Makkah

Using Artificial Intelligence in Waste Management

Across the globe, cities are turning to artificial intelligence (AI) and digital technologies to tackle one of the most persistent urban challenges: waste management. From optimizing collection routes and predicting waste generation patterns to automating sorting at recycling facilities, AI-powered systems are enabling municipalities to operate more efficiently, reduce costs, and minimize environmental impact. Digital platforms are also improving transparency and citizen engagement, making it easier for residents to report illegal dumping, track collection schedules, and participate in recycling programs. By integrating data-driven tools into solid waste management, cities are not only modernizing their operations but also laying the groundwork for more sustainable, circular economies. This article explores AI-driven integrated waste management systems in Abu Dhabi in the UAE, and Makkah in Saudi Arabia, highlighting the unique approach adopted by both to advance the effectiveness of their municipal service delivery.

In 2008, the government of Abu Dhabi established a company responsible for the policy, strategy, and contractual systems of waste management across the emirate. Known as Tadweer, it is the sole custodian of waste management in Abu Dhabi and in 2025 it announced the launch of the region's first AI-driven Integrated Waste Management platform. It aims to bring the power of Artificial Intelligence and the

Internet of Things into every stage of the waste management process. In doing so, the system offers a fully integrated solution that streamlines the entire waste lifecycle.

Tadweer has implemented various initiatives across Abu Dhabi to optimise solid waste management systems through innovative digital solutions. In 2024, it initiated a trial of advanced smart bins, which provide data on the quantity and type of waste. They can detect the contents and fill levels, thereby making collection operations more efficient and enabling the city to accurately determine suitable times for emptying the bins. It also helps the city plan where to install a higher number of reverse vending machines or recycling bins. The smart bins decrease the number of times trucks need to go out and empty bins, contributing to the reduction in carbon emissions. This strategy also serves as an effective model of data collection for city planning purposes.

Reverse-vending machines installed at Yas Mall and World Trade Centre mall in Abu Dhabi exemplify the success of this initiative. People are incentivized to use these bins by receiving points for every plastic bottle they recycle through the bin. Similarly, the bins installed at Abu Dhabi's main bus station provide users the opportunity to win points to pay for transportation fares every time they dispose of plastic bottles. It is estimated that an average of 3,000 bottles are deposited in the machine every week.

In the case of Makkah, which welcomes millions of pilgrims annually, waste management is a significant task in ensuring public health and safety. In 2021, the National Center for Waste Management and Makkah Municipality's hygiene department began distributing 15 smart, solar-powered machines to collect and sort empty plastic bottles in Makkah. Through a pilot project, known as 'TUHR', the city is leveraging Internet of Things (IoT) and AI to keep Makkah clean during peak pilgrimage days. This involves the installation of bins that have sensors which are constantly monitoring waste levels and environmental conditions. Similar to the case in Abu Dhabi, by monitoring capacity levels, the bins optimize waste collection processes. As the capacity reaches 95%, the sensor triggers the controller to send an alert over the network to a central cloud platform. With data coming in from various bins, the AI platform is able to predict waste generation trends and calculate optimal collection routes for waste trucks. Sanitation teams are able to interact with TUHR through an app on which they update the status of emptied bins, thereby closing the loop of collection. Through this pilot, uncollected waste was cut by 40% in trial sites, and the city achieved approximately 20% savings in fuel costs for waste transport. The approach adopted by TUHR is in alignment with Saudi Arabia's Vision 2030 of a smarter and more sustainable future.

These systems adopted in both Abu Dhabi and Makkah speak volumes of how digital transformation can enhance quality of life by making essential urban services smarter, more efficient, and environmentally sustainable. The integration of AI and IoT into solid waste management not only reduces operational costs and environmental footprints but also creates cleaner, healthier, and more livable cities for residents and visitors alike. While Abu Dhabi demonstrates how policy-driven innovation can scale across an entire emirate, Makkah illustrates the vital role of technology in addressing unique, high-intensity challenges such as pilgrimage seasons. Together, they highlight how forward-thinking adoption of digital tools can help cities, both in the region and across the globe, move closer to a circular economy model that balances economic growth with environmental stewardship.



The smart, solar-powered containers work on sorting and separating empty plastic bottles from other waste to facilitate and accelerate the collection process.
©2021 Arab News

Project 6



Composting facility in Aqaba, Jordan
©2023 ENICBCMED

Successful experiences from Aqaba and Barja

Transforming Organic Waste into Economic Opportunities

Throughout Arab cities, organic waste makes up the largest portion of the municipal waste stream. When this waste is sent to landfills, local authorities face double costs: first for collection and disposal, and then from methane emissions and the lost opportunity to return valuable nutrients to the soil. However, if this organic material is captured and processed, it can be transformed into compost or biogas, reducing landfill volumes and associated expenses while promoting urban greenery and creating local jobs. For municipal officials, the challenge is not whether organic waste should be prioritized, but how to develop straightforward, cost-effective systems suited to local conditions. This includes clear regulations for source separation, efficient collection routes, simple and dependable treatment technologies, and outlets for the final products in public parks, streetscapes, and nearby agricultural lands. This article explores the successful implementation of this approach in two cities in the Arab region, Aqaba in Jordan, and Barja in Lebanon.

In Aqaba, this approach has been implemented through the EU-funded SIRCLES program (Supporting Circular Economy Opportunities for Employment and Social Inclusion) and the EDAMA Association. They developed a composting model fed by the hospitality sector, taking advantage of the city's tourism-driven concentration of food waste at its source. Collaborating with the Aqaba Special Economic Zone Authority (ASEZA), EDAMA obtained the necessary land

approvals and prepared the site by late 2022. They then acquired equipment such as shredders and composting tumblers to manage a controlled process, regularly monitoring temperature, moisture, and pH to produce a consistent soil amendment. The facility is now operational, regularly receiving separated organic and green waste. Equally significant, the program trained women and NEET (Not in Education, Employment, or Training) youth to run the operation, combining skill development and employment with daily service delivery while providing compost for city landscaping. Hotels and restaurants contribute by following simple source-separation procedures and scheduled deliveries to the facility, which reduces contamination and ensures a steady production cycle, allowing high-quality compost to be supplied to municipal users on a reliable schedule. Lacking large generators or quick contracts, cities can still succeed: neighborhood-scale setups prompt behavior change and demonstrate that clean, separated organics become a safe, useful product.

Across the border in Lebanon, the coastal town of Barja shows how these principles translate to household scale. Scholarship students from the American University of Beirut launched "Compost Barja" with the Municipality of Barja, USAID's University Scholarship Program, and Compost Baladi SAL. The team went door-to-door to introduce sorting at source, distributed biodegradable bags and 240-liter bins, and installed a supervised composting system on municipal land. The mayor underscored the town's daily waste burden and the municipality's limited capacity, making facilitation, site access, and coordination decisive for the pilot. The technical partner oversaw operations and routine checks to manage odor, moisture, and aeration, essentials for keeping neighbors on board and producing a stable product. Initiated in April 2018 and concluding in June, the effort converted heaps of organic waste into fertilizer that was distributed for gardening, and the community marked progress at a closing ceremony on December 1, 2018. Just as important as the output was the method: clear instructions, regular follow-up with participating households, and a visible municipal role that built trust and signaled that organics recovery is a public service, not just a volunteer initiative.

These two projects, Barja's community-powered pilot and Aqaba's city-anchored facility, illustrate how organics recovery may adapt to various urban environments while achieving comparable results. Composting was incorporated into regular service delivery in Aqaba through a designated location and collection connected to the hospitality industry. In Barja, separated organics were transformed into a safe, usable product through household sorting, a monitored neighborhood system, and a noticeable municipal role. In all situations, reliable operations and public trust were reinforced by civic partnerships, municipal coordination, and appropriately sized technology. Progress was easy to track because of simple markers, tons averted from landfills, compost stability and quality, and involvement. The loop closes and demand stabilizes when a portion of the production is allocated to green space upkeep and gardening. These experiences collectively demonstrate distinct responsibilities and consistent supervision as anchors. The results are obvious: better soil, more local jobs and skills, greener public areas, and less dependency on landfills and methane. Organics recovery turns liability into value and provides short-term, scalable benefits for Arab cities.



Classic backyard composting set
©2019 Compost Baladi | Facebook

OUR NEWS

AUDI LAUNCHES FIRST EPISODE OF 'MAYOR TALKS' PODCAST SERIES

The Arab Urban Development Institute (AUDI) has launched, today, 'Mayor Talks' podcast series, an innovative knowledge platform that features firsthand insights from mayors across Arab cities. The podcast aims to preserve the memory and identity of cities while highlighting exemplary practices in municipal and urban development.

The podcast series brings together mayors from Arab cities to explore the pressing challenges and opportunities in urban development. By sharing inspiring experiences and innovative practices, it seeks to spark meaningful urban dialogue, promote the exchange of expertise across the region, and advance sustainable development in Arab cities.

In its debut episode, the podcast welcomed H.E. Mr. Saleh bin Ali Al-Turki, Mayor of Jeddah, who discussed critical themes shaping the city's future. Topics included Jeddah's urban identity, environmental sustainability, digital transformation and smart city initiatives, governance and financial sustainability, quality of life, urban humanization, and the development of informal neighborhoods.

Al-Turki also highlighted Jeddah as a model for ambitious Arab cities aiming to strengthen their regional and international presence. The city achieves this by investing in infrastructure and enhancing municipal services, while carefully balancing the preservation of its historical identity with the adoption of innovative solutions and modern technologies.

It is worth noting that the launch of this podcast series marks a significant step for AUDI in broadening its knowledge base and leveraging modern media platforms to advance the development of Arab cities. AUDI envisions "Mayor Talks" podcast as a key reference and source of inspiration for decision-makers, researchers, and those who are interested in municipal and urban affairs across the Arab world.

Note:

You can watch the first episode here:

https://www.youtube.com/watch?si=6d8hlHVn6M-BBMG1&v=SjJ7WSHNkhY&feature=youtu.be



H.E. Mr. Saleh bin Ali Al-Turki, Mayor of Jeddah, in the first episode of 'Mayor Talks'
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AUDI VISITS SULTANATE OF OMAN TO STRENGTHEN PARTNERSHIPS

As part of its mission to strengthen partnerships with the municipalities and cities in the Arab Region, a delegation from the Arab Urban Development Institute, chaired by AUDI's Director General H.E. Dr. Anas Al-Mughairy, Director of the Capacity Development and Training at AUDI, Dr. Montaser Hiyari, and the Strategic Communications Specialist at AUDI, Mr. Abdullah Al-Abdulaziz, visited the Sultanate of Oman. The delegation met with senior officials and leaders from Muscat Municipality, Dhofar Municipality, the Ministry of Housing and Urban Planning, and the Royal Academy of Management.

During the visit, AUDI showcased executive and training programs designed to boost human resource development in Omani municipalities, while heads of municipalities and officials called for stronger partnerships to tap into AUDI's urban research and share best practices with Arab municipalities and member cities.



AUDI visit to Sultanate of Oman
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AUDI SIGNS A PARTNERSHIP AGREEMENT WITH GAM FOR A PARTICIPATORY NEIGHBORHOOD GREENING PROJECT.

The Arab Urban Development Institute (AUDI) has signed an agreement with the Greater Amman Municipality (GAM) to implement the Participatory Greening Project in Amman, following approval from Jordan's Council of Ministers.

The signing ceremony at GAM's headquarters was attended by AUDI's Director General, Dr. Anas Al-Mughairy, and His Excellency Dr. Yousef Al-Shawarbeh, Mayor of Amman, along with senior officials from both sides.

Dr. Al-Mughairy considered this agreement as a practical initiative to expand green spaces and foster community participation in enhancing the urban environment. H.E. emphasized that the project reflects AUDI's commitment to supporting Arab cities in achieving sustainable and environmentally friendly urban development.



AUDI Partners with GAM to Expand Green Spaces in Jordan's Capital
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The project will engage local communities in greening efforts, improve public spaces, and support Amman's broader goals for sustainable urban growth.

For his part, Dr. Al-Shawarbeh said the agreement represents a represents a major step in strengthening Amman's green infrastructure and advancing sustainable planning. advancing initiatives that support sustainable urban planning. He noted that these efforts contribute to improving quality of life and promoting community well-being.

The agreement includes implementing a participatory greening project in neighborhoods to enhance public involvement, establishing a new public park with funding from the Arab Fund for Economic and Social Development, and organizing training programs and workshops on participatory planning. It also provides for joint initiatives to support urban sustainability and integrated planning.

Both parties affirmed that the partnership embodies their shared commitment to building strategic partnerships and strengthening institutional capacities to support sustainable urban development in Amman and local communities.



AUDI Partners with GAM to Expand Green Spaces in Jordan's Capital
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AUDI VISITS AMMAN TO ENHANCE INTERNATIONAL COOPERATION IN URBAN DEVELOPMENT

A delegation from the Arab Urban Development Institute visited Amman to support urban development and reinforce partnerships with Arab municipalities. The visit was led by AUDI's Director General H.E. Dr. Anas Al-Mughairy, Director of the Capacity Development and Training, Dr. Montaser Hiyari, and the Strategic Communications Specialist at AUDI, Mr. Abdullah Al-Abdulaziz.

Over the course of the visit, the delegation met with H.E. Eng. Walid Al-Masri, Minister of Local Administration, and the Director General of the Public Corporation for Housing and Urban Development, Eng. Jumana Al-Attiyat. The delegation focused on AUDI's programs and initiatives supporting Jordanian cities and reviewed urban development trends under AUDI's 2030 Strategy, aimed at strengthening Arab municipalities and addressing urban challenges.

The attendees highlighted the value of AUDI's expertise and research, emphasizing partnerships to exchange best practices among Arab cities and municipalities to advance local development



AUDI Delegation's visit to Amman, Jordan
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THE INSTITUTE RECEIVES THE COUNSELOR AND DEPUTY HEAD OF MISSION AT THE SWISS EMBASSY IN THE KINGDOMT

In a bid to strengthen international cooperation in urban development, Arab Urban Development Institute Director General Dr. Anas Al-Mughiri met with Mr. Yannick Reichenau, Counsellor and Deputy Head of Mission at the Swiss Embassy in the Kingdom, to discuss prospects for collaboration and partnership.

The meeting featured an overview of the Institute's regional programs and initiatives aimed at supporting cities, enhancing institutional performance, and building the capacities of municipal and development agencies. Discussions also explored avenues for joint cooperation with the Swiss side. Mr. Yannick Richenau expressed Switzerland's interest in strengthening collaboration and exchanging expertise with the Institute, while both parties reviewed initial proposals to organize joint events on city planning and urban hospitality in partnership with academic institutions and specialized centers in Switzerland.



The Institute receives the Deputy Head of Mission and Counselor of the Swiss Embassy in the Kingdom
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AUDI'S GENERAL DIRECTOR EXPLORES COLLABORATION WITH LEADING EXPERTS IN URBAN DEVELOPMENT

The Arab Urban Development Institute's (AUDI) Director General H.E. Dr. Anas Al-Mughairy, welcomed, at AUDI's headquarters in Riyadh, Mr. Peter Rowe, Professor of Urban Development at Harvard University, and Dr. Arnaiz Carlos, Principal at CAZA Architects.

The meeting focused on exploring potential areas of cooperation between AUDI and the guests in the field of urban development in Arab cities.

Professor Rowe shared his experience collaborating with several Arab and Chinese cities on urban design and public space projects.

Both parties agreed to utilize Casa Urban Consulting's expertise to support ongoing and future projects and initiatives in Arab cities.



The Institute receives Mr. Peter Rowe, Professor of Urban Development at Harvard University, and Dr. Arnaiz Carlos, Principal at CAZA Architects
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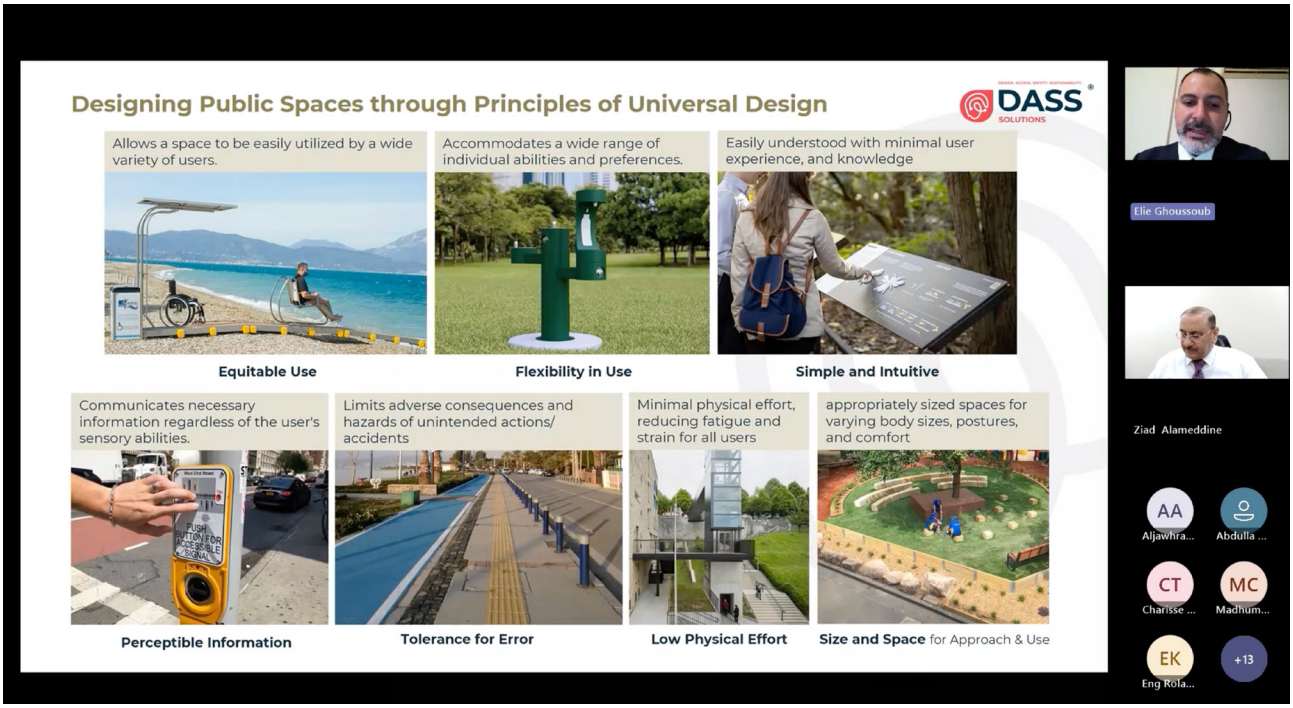
Cities in Action: Webinar Series

EMBEDDING UNIVERSAL ACCESSIBILITY IN ARAB CITIES

As part of its ongoing commitment to inclusive urban planning, the Arab Urban Development Institute (AUDI) today held the 15th session of its "Cities in Action" webinar series, focusing on the theme "Embedding Universal Accessibility in Arab Cities." The session brought together a diverse group of specialists and professionals working in urban development to discuss practical strategies for making Arab cities more accessible and inclusive for all segments of society.

Dr. Abdullah Daifallah, the webinar moderator and professor of urban planning, opened the session with an overview of the "Cities in Action" series, underscoring its role in fostering discussions among specialists and urban development experts across the Arab region. He highlighted the series' contribution to showcasing leading urban development projects, sharing best practices, and facilitating the exchange of ideas on effective strategies and success factors in urban planning.

The session featured a keynote presentation by Eng. Elie Ghossoub, Director of Access, Safety, and Inclusion Consulting at DASS. A specialist in inclusive urban design, Ghossoub holds a master's degree and is a registered member of the UK's National Register of Accessibility Consultants (NRAC). Drawing on his extensive experience in modernizing building codes and designing accessible environments, he emphasized the importance of embedding universal design principles to better serve people with disabilities, the elderly, and other vulnerable groups.



Cities in Action: Embedding Universal Accessibility in Arab Cities
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In his presentation, Eng. Elie stressed the critical need to integrate universal accessibility principles into urban planning, pointing out that disability extends beyond visible impairments to include invisible, situational, and age-related disabilities. He shared insights from projects he led in Abu Dhabi, Dubai, and Riyadh, where comprehensive design guidelines were developed to promote accessibility across mobility networks, public facilities, open spaces, and intelligent transportation systems.

Ghossoub emphasized that universal access should not be seen as a regulatory obligation, but rather as an opportunity to create more equitable, sustainable urban environments. He stressed that meaningful progress begins with inclusive planning, followed by thoughtful policy development, and culminates in the implementation of urban projects that are accessible to all segments of society.

At the conclusion of the session, Dr. Abdullah Daifallah expressed his appreciation to the attendees for their active engagement and meaningful contributions. He commended Eng. Elie Ghossoub for his valuable insights and his role in shedding light on emerging dimensions of comprehensive urban planning. Dr. Daifallah also underscored the importance of sustaining such discussions through ongoing sessions, which serve to strengthen cooperation and knowledge exchange among urban development professionals.

Note:

You can watch the recording of this webinar at the following link: https://araburban.org/en/podcast/building-inclusive-arab-cities-embedding-universal-accessibility-in-urban-planning/



Cities in Action: Embedding Universal Accessibility in Arab Cities
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Cities in Action: Webinar Series

ALEPPO'S RECOVERY MASTER PLAN: CHALLENGES AND PATHWAYS FORWARD

As part of its ongoing commitment to promoting inclusive urban planning across the Arab Region, the Arab Urban Development Institute (AUDI) held, today, the 16th session of its "Cities in Action" series, bringing together a wide range of specialists and professionals in urban development.

Dr. Abdullah Daifallah, the webinar moderator and professor of urban planning, opened the session with an overview of the "Cities in Action" series, underscoring its role in fostering discussions among specialists and urban development experts across the Arab region.

The session began with a speech by Eng. Lina Kuteifane, Director of World Heritage Sites at the Directorate-General of Antiquities and Museums (DGAM) in Syria, who outlined the current situation in the Old City of Aleppo and highlighted the administrative, social, and economic challenges it faces during ongoing reconstruction efforts.

Dr. Anas Soufan, Assistant professor at Wentworth Institute of Technology-Boston, associate researcher, Architect, and World Heritage Management Specialist delivered a detailed presentation titled "Aleppo's Recovery Master Plan: Challenges and Pathways Forward".

In his presentation, Dr. Soufan outlined the main features of the master plan, developed in cooperation



Cities in Action: Aleppo's Recovery Master Plan: Challenges and Pathways Forward
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with local and international partners, highlighting its strategic framework for urban recovery. The plan strikes to balance the preservation of Aleppo's historic fabric with the creation of a modern urban environment that meets residents' aspirations. He stressed that the framework is built on two interlinked pathways: preservation—safeguarding the city's heritage and identity—and development—ensuring basic services delivery, affordable housing, and economic and social opportunities that reinforce residents' ties to their city.

He noted that the plan relies heavily on community participation and is designed with a multi-layered vision—starting from the regional framework of Greater Aleppo and narrowing down to neighborhoods and individual architectural elements. This approach, he explained, allows recovery projects to be coordinated and integrated across different levels. He added that real success will depend on fostering transparency and participation, as well as securing backing from international organizations and donors.

Dr. Soufan closed the session by stressing that recovery is about more than rebuilding structures—it is about reviving memory, identity, and daily life in Aleppo's Old City, so it can once again stand as a living symbol of cultural heritage and legacy.

Note:

You can watch the recording of this webinar at the following link: https://araburban.org/en/podcast/aleppos-recovery-master-plan-challenges-and-pathways-forward/



Cities in Action: Aleppo's Recovery Master Plan: Challenges and Pathways Forward
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Riyadh 11452
Kingdom of Saudi Arabia

P.O Box 6892,
Diplomatic Quarter

T. +966114802698
mudununa@araburban.org

araburban.org

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