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Data Collection and Management

Policy brief 4 and its technical notes





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Waste management data are critical to creating policy and planning for the local context. Understanding how much waste is generated - especially with rapid urbanization and population growth - as well as the types of waste being generated, allows local governments to select appropriate management methods and plan for future demand.

What a Waste 2.0 – World Bank Group, 2018

”



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A.

Context

Lebanon faces challenges in solid waste management (SWM) marked by inaccurate and incomplete data, fragmented sources hindering integration, lack of standardization impeding system unification, inadequate data sharing hampering collaboration, and a shortage of visualization tools hindering effective analysis. The nation grapples with outdated infrastructure, weak legislation, and insufficient public awareness, resulting in a significant waste backlog, inadequate collection, and disposal infrastructure. These complex issues demand urgent attention to establish centralized data repositories, implement standardized frameworks, enforce data sharing policies, invest in visualization tools, and provide comprehensive training to SWM personnel. Addressing these challenges is pivotal for enhancing waste management practices, minimizing environmental impact, and safeguarding public health in Lebanon.

International organizations can offer vital support to help Lebanon overcome SWM data challenges. Drawing on its waste management and data expertise, the EU can provide technical assistance, financial backing, knowledge sharing, policy guidance, and technology transfer. This includes aiding Lebanon in creating a centralized SWM data repository, implementing data standardization, fostering sharing policies, deploying visualization tools, and conducting training for SWM personnel. Financial aid can cover software, training, and tool development. By promoting collaborative platforms and advocating policy reforms, the EU aims to empower Lebanon in establishing an effective data infrastructure for robust SWM practices, contributing to improved waste management and environmental and public health outcomes.



B.

Analysis

The interviews conducted with mayors across 24 districts in Lebanon highlighted that local waste collection, overseen by municipalities, is preferred, with a readiness to participate in waste management programs if transparent, continuous, and well-planned. The establishment of homogeneous waste management clusters is seen as a potential solution to shared challenges. Expert opinions underscored the priority of creating national strategies and master plans, aligning with the need for an SWM Observatory. The Reducing Marine Litter initiative and the UN-Habitat's Global Urban Observatories exemplify successful observatories, emphasizing data-driven decision-making.

In the realm of Industrial and Special Waste Streams (ISWS) Inventories, the National E-waste Monitor identified a critical need for a clear legal framework, role delineation, and Extended Producer Responsibility (EPR) introduction. These inventories play a vital role in regulatory compliance, resource optimization, risk management, and decision-making processes. Specifically, the inclusion of EPR introduction underscores the importance of accountability and sustainable waste management practices across various industrial sectors. Studies by UNIDO and UNITAR unveiled the lack of comprehensive records as one of the major challenges in Lebanon's e-waste infrastructure. The UNOPS project for Lebanon aims to establish a National Solid Waste Management Information System. UN-Habitat plan for a SWM observatory under their ReMAL project.

The analysis also explores data management initiatives in other countries like UAE, Saudi Arabia, Qatar, and Jordan, emphasizing comprehensive databases and systems for hazardous and non-hazardous waste. In Germany, the MAVG serves as a model, showcasing the benefits of a centralized waste reporting system for tracking and improving waste management.

These examples and interviews justify the proposed solutions: the SWM Observatory, aligning with successful models globally; ISWS Inventories, essential for targeted interventions; and a Central Data Management System, crucial for integrating and enhancing Lebanon's waste data infrastructure.



C.

Recommendations

Lebanon's SWM data issues stem from inaccurate reporting, fragmented sources, and insufficient sharing practices. The absence of a centralized system hampers informed decision-making, making it imperative to adopt comprehensive solutions. Three proposed solutions stand out:

1. Solid Waste Management (SWM) Observatory

A SWM Observatory is a centralized system for collecting, analysing, and sharing data on waste management activities within a specific area. It integrates information from various sources to support decision-making and policy development aimed at improving waste management practices.

Implementing an SWM observatory would establish a dedicated platform for data collection, analysis, and dissemination. This observatory would act as a central hub, consolidating data from various stakeholders and facilitating real-time monitoring. Additionally, it would provide updated information on best practices, research studies, reports, and analyses to support decision makers. This solution aligns with EU practices and can significantly enhance Lebanon's waste management capabilities.

2. Industrial and Special Waste Streams (ISWS) Inventories

An ISWS Inventory is a database that tracks various industrial and special wastes, like hazardous chemicals and electronic waste, within a specific area or sector. It helps with waste management planning, regulatory compliance, and environmental monitoring.

Drawing inspiration from the ISWS inventories, Lebanon can develop a systematic compilation of data on industrial and special waste. This approach ensures a comprehensive understanding of diverse waste streams beyond municipal solid waste. By aligning with EU and international waste directives, Lebanon can create a robust inventory that guides effective waste management strategies and aligns with international standards.

3. Central Data Management System

A Central Data Management System is a unified software platform that securely stores, organizes, and manages data from diverse sources within an organization. It enables authorized users to efficiently access, analyse, and share data, facilitating seamless data management across departments or functions.



Establishing a Central Data Management System represents a fundamental step in addressing Lebanon's data challenges comprehensively. This system would involve standardized data collection forms, collaboration with stakeholders, and robust data analysis tools. The EU can provide technical and financial support to build this system, ensuring its alignment with global best practices.

The European Union, with its wealth of experience and commitment to sustainability, can play a pivotal role in supporting Lebanon's adoption of these solutions. Collaboration between Lebanon and the EU holds the promise of not only alleviating the immediate data challenges but also fostering a sustainable waste management ecosystem. The EU's continued support is essential for turning these recommendations into tangible realities and ensuring a resilient and effective waste management infrastructure for Lebanon.





D.

Technical Note #4.1 – Solid Waste Management Observatory

A Solid Waste Management (SWM) Observatory is a data-driven governance tool designed to optimize waste management practices within a defined geographic area. It serves as a centralized platform for collecting, analysing, and disseminating information on all aspects of solid waste, encompassing generation, collection, treatment, and disposal. By integrating data from diverse sources, such as government agencies, municipalities, private waste management entities, and research institutions, the observatory provides a comprehensive picture of waste management practices and facilitates informed decision-making for policymakers and stakeholders.

D.1. JUSTIFICATION

Establishing a SWM Observatory plays a pivotal role in supporting the development and implementation of a comprehensive SWM masterplan framework. An observatory with publicly available data can also support feasibility analysis, roadmaps and circular economy strategies and action plans. By systematically collecting, analysing, reporting and monitoring data, the observatory ensures standard outcomes across SWM Service Zones (SZs), facilitating strategic alignment with national goals. Moreover, it enhances collaboration among national, regional, and local authorities, fostering a politically neutral and technology-neutral approach through informed data-driven decision-making. The observatory can also help in optimizing resources by identifying areas where waste management practices can be improved, leading to better resource allocation. Additionally, it can allow for the monitoring of progress in waste management initiatives, helping to evaluate the effectiveness of policies and interventions.

The SWM Observatory also addresses challenges posed by the informal waste sector, such as scavengers, by providing insights into their impact on formal waste management activities. Through a dedicated national program informed by the observatory's data, a uniform approach can be applied across the country, promoting equal opportunities and minimizing localized public opposition. The observatory, as a centralized hub for information and insights into waste generation, composition, collection, recycling, and disposal, ensures the effectiveness of waste management strategies and promotes adaptive solutions to evolving waste management needs.



D.2. DESCRIPTION

A SWM Observatory refers to a system or organization that systematically collects, analyses, and monitors data related to solid waste management activities. The observatory focuses on a holistic understanding of the waste management landscape, considering socio-economic, environmental, and policy-related aspects. It may include data on waste composition, public attitudes, environmental impacts, and policy effectiveness. The key components of the observatory data collection, analysis and reporting, and technology integration, additionally a series of support actions are required to make the observatory operational.

D.2.1. Assessment and planning

The preparation of an action plan for the SWM observatory is crucial. Such detailed action plan should take into consideration the main stakeholders involved in the process, which should be engaged in its creation to promote accountability and buy in. The action plan needs to consider various components, starting with the **background** that elucidates the rationale behind establishing the observatory, justifying data needs, and assessing local demand in alignment with national development priorities. The background should include a detailed needs assessment study evaluating the existing state of solid waste management in the country to identify challenges, gaps, and opportunities.

The action plan of the observatory should follow a structured approach. A clear **objective** needs to be defined, followed by the identification of a **mission** statement and **vision** for the observatory, and finally a purpose of the observatory is identified. All of them should highlight how the chosen approach contributes to enhanced local monitoring, supporting evidence-based decision-making, and reinforcing accountability. The action plan should have a clear **geographical coverage** focusing on the relevant municipalities, districts, or regions. Following this, the **primary actors** and the **composition of the observatory** is discussed and agreed upon, including the specification of the **level of intervention** expected from each of them.

The action plan further **details the observatory and monitoring system**, including key functions and components. **Expected outcomes** are articulated, emphasizing **results** such as increased capacity, improved data utilization for policies, and heightened accountability at the local level. **Specific activities** to achieve these outcomes are delineated, with a focus on the commitment of government and local authorities, **engagement of partners**, an **implementation plan** with milestones, and a **monitoring mechanism**.

To complement the action plan, the **necessary skills** required to accomplish the objectives are identified. The **sustainability plan** is outlined, ensuring that the observatory is financially sustainable and integrated into local data production systems. The potential for **replication and scaling-up** is explored, emphasizing the transfer of experiences and expertise to other cities or fields. The action plan should include a summarized **budget** for establishing the SWM observatory and a series of preliminary **indicators** aligned with the observatory's objectives, including waste generation, collection, treatment, and disposal data.



D.2.2. Data collection mechanisms

Standardized data collection protocols, achieved by **identifying diverse stakeholders**, **implementing rigorous methods**, and **establishing clear procedures**, ensure the reliability and comparability of collected information within the Solid Waste Management (SWM) observatory. This cohesive dataset facilitates evidence-based decision-making and strategic planning in waste management. The proposed protocol encompasses the design of standardized instruments, pilot testing, data collector training, quality control measures, ethical considerations, data validation procedures, and comprehensive documentation. Notably, the European Commission's updated guidance¹ (2) serves as a valuable reference, emphasizing critical considerations for municipal waste data compilation and reporting, aligning with the observatory's commitment to robust and standardized data practices.

D.2.3. Data analysis, monitoring, and evaluation

To effectively analyse and utilize collected data, the SWM observatory should establish a data analysis protocol that aligns with the observatory's defined objectives. This protocol should utilize statistical and analytical tools to identify trends, patterns, and relationships in waste generation, collection, treatment, and disposal practices. Developed data visualizations and dashboards should effectively communicate key insights to stakeholders. Periodic reviews, incorporating performance metrics and KPIs, should assess the ongoing effectiveness of the SWM system and identify areas for improvement. Continuous monitoring and evaluation, tracking key metrics in real-time, should ensure timely interventions.

Regularly updating data collection methodologies and analysis tools is crucial to adapt to evolving needs and data availability. Engaging stakeholders actively and transparently documenting findings foster accountability within the observatory's operations. Lastly, the observatory's scope and objectives should be adapted to address emerging waste management challenges and policy priorities to ensure continual relevance and impact.

D.2.4. Data visualization and dissemination platform

Designing a robust data visualization platform for the observatory involves user-centricity, clear objectives, and strategic design. It entails selecting suitable visualization techniques tailored to various user profiles, ensuring a user-friendly interface with real-time updates, and prioritizing accessibility. Additionally, implementing robust security measures, providing user support, and seamlessly integrating with decision-making processes are essential aspects. Soliciting feedback for continuous improvement and designing the platform with scalability and adaptability in mind are crucial. This comprehensive approach aims to create an agile, user-friendly platform that evolves with changing needs and technological advancements.

D.2.5. Decision support interface

The platform should also include a decision support interface including research studies, reports, and analyses that provide a comprehensive view of the entire waste management system, including its social, economic, and environmental dimensions. Tailored to offer more than conventional data display, the interface seeks to empower users with dynamic insights into waste generation patterns, recycling behaviours, economic implications, and

¹ For more information, go to D.3. Benchmarking



overall sustainability considerations. As a user-friendly and interactive tool, it can be a catalyst for informed decision-making, offering capabilities for scenario analysis, trend identification, and impact assessments. By bridging the gap between data and actionable intelligence, the creation of this decision support interface could revolutionize how stakeholders engage with and contribute to the evolution of sustainable waste management practices.

D.2.6. Stakeholder network

Using the information from the ReMal project² as a reference, complement the list of all relevant entities through comprehensive stakeholder analysis, engaging government agencies, local authorities, waste management companies, environmental organizations, and the public. By initiating early involvement, the aim is to secure continued commitment while delineating clear roles and responsibilities. Establishing effective communication channels will serve as a conduit for seamless collaboration and the timely resolution of concerns. Moreover, the approach should encompass robust capacity-building programs, comprising tailored training sessions and technology transfer initiatives, aimed at strengthening stakeholders' competencies. To ensure agility and responsiveness, regular reviews, and updates of the stakeholder network, complemented by feedback mechanisms, should be considered for implementation. Simultaneously, monitoring and evaluation systems need to be deployed to meticulously track progress. Recognizing achievements and motivating public participation through targeted communication strategies and community engagement activities can promote a sense of ownership. Furthermore, prioritizing international collaboration, partnerships, and knowledge exchange activities can enable leveraging invaluable expertise and secure essential financial support. Emphasizing funding and resource mobilization efforts will be pivotal in sustaining the observatory's effectiveness over the long term. This approach ensures a proactive stakeholder network contributing to the observatory's success in SWM.

D.2.7. Dissemination and Policy Engagement

The development of a comprehensive communication plan is essential, aiming to transform complex data into easily understandable formats while ensuring regular updates on observatory findings through various channels such as reports, presentations, and workshops. By employing diverse engagement platforms, the observatory seeks to disseminate insights to policymakers, tailoring outreach efforts to meet their specific needs and priorities effectively. Moreover, the creation of concise policy briefs and recommendations fosters interactive sessions, encouraging discussions on challenges and potential interventions. Through collaborative efforts with stakeholders, the observatory should intend to develop and implement pilot projects rooted in its insights, while also engaging in advocacy initiatives to heighten public awareness and forge strategic alliances for broader impact. Establishing feedback mechanisms enables refinement of data collection methods based on policymakers' input, complemented by capacity-building sessions to enhance their comprehension of observatory data. Lastly, maintaining ongoing collaboration with government agencies and waste management professionals is pivotal, facilitating discussions on policy recommendations, legal framework updates, and capacity-building programs to ensure effective implementation. This approach contributes to evidence-based decision-making and positive changes in solid waste management policies, aligning with the observatory's overarching goals.

² For more information, go to D.3. Benchmarking



INSIGHTS FROM STAKEHOLDERS

Towards Efficient Waste Management in Lebanon

Interviews with about 80 mayors in 24 districts excluding Beirut showed that collection is mostly done locally (82%) with 95% of the interviewees agreeing that despite the challenges, the best entity to oversee waste collection is the municipality. Additionally, it reflected that there is a high readiness to participate in waste management programs if there is **transparency, continuity, good planning, and sound management**. Finally, 92% of the mayors stated that nearby towns share the same burdens and challenges proving that creating homogeneous clusters for waste management in the country could alleviate some of them.

When interviewing 41 experts in the sector, it was found that creating national strategies and master plans had the highest priority for 78% of them, while waste diversion was a priority in 67% of the cases.

Interviewed service providers acknowledge the potential of a SWM Observatory to enhance efficiency in waste collection and disposal services. Real-time data and insights provided by the observatory could optimize routes, allocate resources effectively, and reduce operational costs. Collaboration between waste management companies and local authorities could also be improved through transparent communication and data sharing facilitated by the observatory.

Additionally, **interviewed academics** working in SWM agree on the importance of establishing a SWM Observatory. Researchers possess accurate datasets that could enrich the observatory's sources, while the observatory, in turn, would provide comprehensive data for academic research. Identified research gaps or challenges in waste management that could be targeted by the observatory include the need for data quantification throughout the waste management process, which can inform data-based strategies and planning.

Finally, **interviewed NGOs** emphasize the importance of a SWM Observatory in promoting sustainable waste practices. From the NGOs point of view, priority areas for the observatory should include data collection and standardization, waste characterization, infrastructure improvement, public awareness, and policy development. By addressing these areas, the interviewed NGOs agree that Lebanon could move towards a more sustainable and efficient waste management system, with the observatory playing a central role in informed decision-making and collaborative efforts.

These results **support the creation of the observatory with a targeted and detailed action plan**. Observatories can provide detailed and accurate data to feed masterplans, feasibility analysis and roadmap. At the same time, it can provide necessary data for the identification of local clusters for collaboration and to inform the centralized and decentralised components of the National Integrated Solid Waste Management Strategy (Article 10 of Law 80/2018 on Integrated Solid Waste Management) (3).



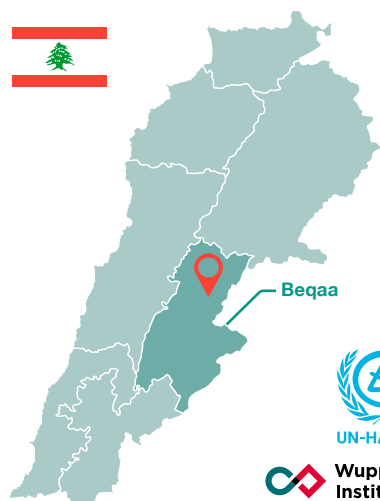
D.3. BENCHMARKING

The benchmarking section provides an overview of key initiatives and observatories worldwide that aim to enhance waste management practices and promote sustainability. Detailed information on these benchmarking initiatives is available in Appendix 1, providing valuable insights into best practices and strategies for effective waste management.



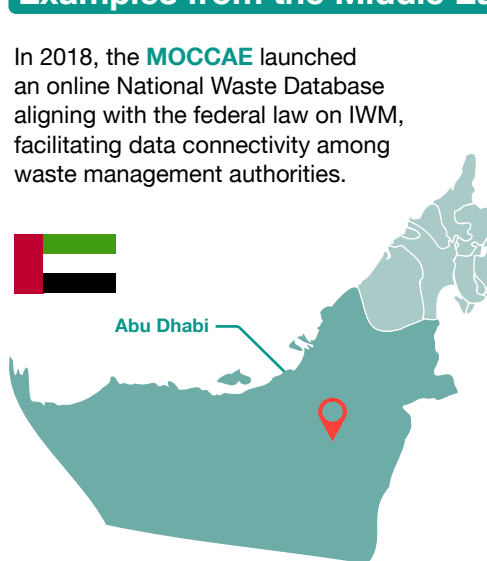


The **ReMal** project establishes stakeholder networks through effective synergy and engagement among various governmental and local authorities, the public and environmental entities. Assist Lebanese coastal Unions of Municipalities (UoMs) in improving ISWM programs at the municipal level, with the aim of reducing marine litter.

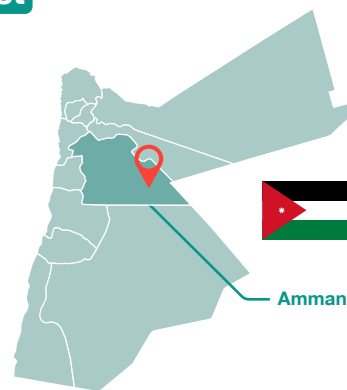


Examples from the Middle East

In 2018, the **MOCCE** launched an online National Waste Database aligning with the federal law on IWM, facilitating data connectivity among waste management authorities.



Abu Dhabi



Amman

Amman Urban Observatory (**AUO**) has been, since 2008, producing comprehensive data and indicators on solid waste at the city level.

UN-Habitat Global Urban Observatories

The UN-Habitat **GUO** oversees 374 certified observatories, ensuring adherence to guidelines and utilizing indicators aligned with the New Urban Agenda, including SDG 11: 11.6.1: Sustainable Cities and Communities.

374 urban observatories
SDG 11 Goal 11.6.1

Observatories in the Middle East under the GUO:



TUNISIA

Monastir City: Observatoire National Urbain de Tunisie

SAUDI ARABIA

Sharqia Region: Sharqia Urban Observatory

Buraidah city: Qassim Urban Observatory

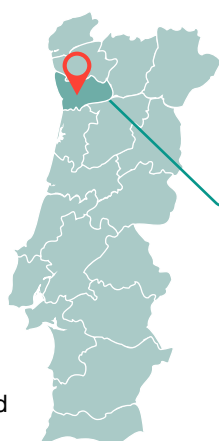
Riyah City: Riyadh Urban Observatory

Country level: National Urban Observatory Saudi Arabia

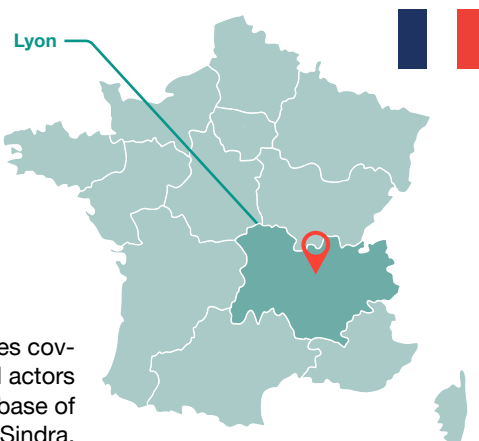
The EU Case

In 2010, the European Observatory on Municipal Waste Performance launched by the **ACR+** and **CEFAT** to optimize sustainable and environmental practices across Europe.

The **LIPOR** Observatory in Porto offers real-time data on municipal waste, recyclables, and undifferentiated waste, with expanded coverage.



Porto



Lyon

Data from 370 entities covering 90% of regional actors and updated database of waste information in Sindra.

E.



Technical Note #4.2 – Industrial and Special Wastes (ISWS) Inventories

An Industrial and Special Waste Streams (ISWS) Inventory is a comprehensive database or record-keeping system that catalogues and tracks various types of industrial and special wastes generated within a specific geographic area or industrial sector. These inventories typically include detailed information about the types, quantities, sources, and characteristics of industrial and special wastes, such as hazardous chemicals, electronic waste, construction debris, medical waste, and agricultural by-products, among others. The purpose of an ISWS Inventory is to provide valuable data for waste management planning, regulatory compliance, pollution prevention, resource optimization, and environmental monitoring efforts. By maintaining accurate and up-to-date inventories of industrial and special wastes, policymakers, regulators, and waste management professionals can make informed decisions to mitigate environmental impacts, promote sustainability, and ensure the safe and responsible management of these waste streams.

E.1. JUSTIFICATION

Lebanon's commitment to international environmental conventions such as the Montreal Protocol, the Basel Convention, the Stockholm Convention, the Rotterdam Convention³, among others, underscores the necessity of developing an inventory for industrial and special wastes. By adhering to these agreements, the country not only demonstrates its dedication to sound waste management practices but also ensures compliance with international requirements. The inventory serves as a tool to set and achieve waste management goals tailored to Lebanon's specific needs. Understanding the current generation and composition of industrial and special wastes such as industrial, electronic, oils, vehicles, tires, etc., allows the country to craft strategies for realistic waste reduction, recycling, and disposal targets. Furthermore, the inventory aids in identifying and prioritizing waste management needs, highlighting areas where infrastructure is lacking, or stricter regulations are essential.

³ Montreal Protocol on Substances that Deplete the Ozone Layer, ratified by Lebanon in 1993. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, ratified by Lebanon in 1994. Stockholm Convention on Persistent Organic Pollutants (POPs), ratified by Lebanon in 2003. Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, ratified by Lebanon in 2006.



In addition to these general benefits, Lebanon faces specific challenges that make the collection of industrial and special waste data imperative. The nation's expanding industrial sector contributes to a growing waste stream, emphasizing the need for sustainable management practices. With limited waste management infrastructure, particularly for hazardous waste treatment and disposal, the inventory becomes a vital tool for Lebanon to pinpoint areas requiring investment and development. Moreover, Lebanon's vulnerability to environmental disasters, coupled with its seismically active geography, accentuates the importance of the inventory in mitigating risks. By identifying potential pollution sources, the country can take proactive measures to prevent environmental contamination during natural disasters. Overall, the establishment of an effective waste management system, supported by comprehensive data collection, positions Lebanon to address its specific challenges and contribute to global environmental sustainability.





INSIGHTS FROM STAKEHOLDERS on the importance of ISWS Inventories

From an environmental advocacy standpoint, **interviewed NGOs** emphasize the critical role of an ISWS Inventory in addressing pressing environmental concerns and promoting sustainable waste management practices. Such an inventory serves as a valuable tool for identifying waste sources, quantifying waste generation, and assessing environmental impacts. Furthermore, it facilitates regulatory compliance and fosters public awareness and advocacy for responsible waste management. By providing transparent data on waste generation and management practices, the inventory promotes accountability among industries and authorities, encouraging the adoption of more sustainable approaches. Ultimately, NGOs view the establishment of a comprehensive waste inventory as instrumental in driving innovation, collaboration, and transparency in the waste management sector, leading to a more sustainable and circular economy.

For **waste management service providers**, the implementation of an inventory holds significant potential for enhancing operational efficiency and effectiveness. By providing a comprehensive overview of waste generation patterns and characteristics, the inventory enables better resource planning, optimized collection routes, and improved waste treatment processes. This holistic approach not only could reduce operational costs but also minimize environmental impact. Additionally, service providers anticipate benefits such as improved waste tracking, enhanced recycling efforts, and the development of targeted policies to address specific waste management challenges. However, challenges such as the sorting of waste at its source remain a focal point for improvement, underscoring the need for ongoing innovation and adaptation in the sector.

Finally, **academics** recognise the importance of addressing research gaps in industrial waste management, especially where data is limited or unavailable. Currently, the absence of a comprehensive inventory limits the scope of research, which often targets specific industrial waste streams based on readily available data. However, with the establishment of an inventory, academia anticipates a broader perspective on potential research areas, including exploring reasons for ineffective recycling or composting, understanding regulatory frameworks, and reducing operational costs. Moreover, collaboration with government and industries is seen as essential to ensure the accuracy and reliability of inventory data. Academic institutions can play a crucial role in defining data requirements, ensuring systematic data collection and validation, conducting thorough analysis, and periodically reviewing data quality to meet objectives effectively.



E.2. DESCRIPTION

ISWS Inventories are systematic compilations of data and information related to the generation, handling, treatment, and disposal of industrial and special wastes within a specific geographic area or country. These inventories aim to provide a comprehensive and detailed understanding of the types, quantities, characteristics, and management practices associated with industrial and special waste streams. The ISWS Inventory serves as a strategic tool to align Lebanon's waste management goals with international standards and regulatory frameworks. By undertaking this effort, Lebanon aims to set realistic targets, identify areas for improvement, and bolster its waste management infrastructure to address emerging challenges. The key components of the ISWS Inventory are:

E.2.1. Harmonization of terminology – Definition and classification

A universally adopted definition and classification system ensure consistency in data handling across sectors. It is imperative that all stakeholders align with this terminology and classification, drawing inspiration from international standards such as the Basel Convention (16), the European Union Waste Framework Directive (17), and the UNU-KEYS (United Nations University Key Indicators for Sustainable Consumption and Production) (18) proposed for reporting indicators under SDG 12. This not only streamlines data collection and analysis but also contributes to informed decision-making and policy coherence. Such harmonization should also include information on the hazardous or special characteristics of certain wastes, helping identify potential environmental and health risks.

E.2.2. Stakeholder and facilities identification

Thorough identification of ISWS stakeholders is pivotal for crafting a comprehensive inventory. This encompasses industries generating ISWS, waste treatment facilities, regulatory bodies, and non-governmental organizations advocating for sustainable management. By mapping these stakeholders, a detailed list of ISWS facilities in Lebanon, complete with characteristics such as their location, capacity, and waste management practices, can be compiled. Location-specific data will allow a geographic mapping of the waste-generating industries and treatment facilities, which will support spatial analysis and planning. Additionally, a definition of the roles and responsibilities in the management of ISWS needs to be clarified and agreed upon.

E.2.3. Preparation of inventory

Efficient data collection on ISWS requires a standardized and comprehensive form. This form, designed for clarity and completeness, should cover all pertinent aspects of ISWS management including information such as the amount of recoverable material, quantities, import/export, local options, among others. Adequate training for data collectors ensures accurate and consistent information gathering. Subsequently, a meticulous review and verification process guarantees the accuracy and completeness of the collected data from identified stakeholders and facilities. Protocols for ongoing and periodic monitoring, as well as for the evaluation of the effectiveness of the waste management practices need to be designed.



E.2.4. Collection, analysis, and interpretation of data

Rigorous cleaning and categorization of collected data are imperative to eliminate errors and inconsistencies. Once cleaned, data is categorized using the established ISWS classification system. This enables calculations for total quantities of ISWS generated, treated, and disposed of in Lebanon, categorized by industry sector, region, and waste type. Employing statistical analysis unveils trends and patterns, offering valuable insights for decision-making and policy formulation. Data on how the ISWS are treated and disposed such as recycling, landfilling, incineration, or other specialized processes need to be analysed as well. The data collection should support the evaluation of potential environmental and health risks associated with the management of industrial and special wastes, guiding the development of risk management plans. The monitoring should also be compliant with the SDG 12 for Responsible Consumption and Production.

Data collected in the project *Towards a Decentralized Waste Management Integrated Response in Lebanon (TaDWIR)* which is currently being implemented by UNDP (19), and the project *Water and Environment Support (WES) in the ENI Southern Neighbourhood Region: Providing policy support to address single-use plastic items in Lebanon*, implemented by LDK Consultants Global EEIG (20). Additionally, data from the *National E-waste Monitor for Lebanon 2022* (21) funded by the Government of Japan and implemented by The United Nations Institute for Training and Research (UNITAR) provides information relevant for the inventories.





E.2.5. Regulations

A comprehensive review of national, regional, and international regulations pertaining to ISWS management in Lebanon is indispensable. Identifying gaps and inconsistencies in the existing regulatory framework provides clarity on applicable laws. Strengthening and harmonizing this framework is crucial for enhancing the effectiveness of ISWS management, safeguarding both human health and the environment. The data collected in the ISWS inventory plays a crucial role in supporting evidence-based decision-making, policy formulation, and the development of sustainable waste management strategies.



National E-waste Monitor for Lebanon 2022

The *National E-waste Monitor for Lebanon 2022* examined the status of e-waste management in Lebanon and highlighted the growing problem for an environmentally sound management of such waste. The report highlighted that out of the 46 kt of e-waste generated in 2021, only 0.09 kt were managed in such way.

The recommendations for e-waste management include the establishment of a clear legal framework and among other details, it is mentioned that “definitions need to be clear and to ensure that all stakeholders have the same understanding of the main concepts”, as well as the need to have a clarity in the roles and responsibilities of the stakeholders.

An introduction of Extended Producer Responsibility (EPR) is proposed as a recommendation and is considered by Lebanon in its national strategy for integrated solid waste management. For this to be implemented, supporting accurate data needs to be available.

Having a geographical mapping of the ISWS would support the recommendation of developing a network of collection points, as it could be designed according to the real waste generated in the country.

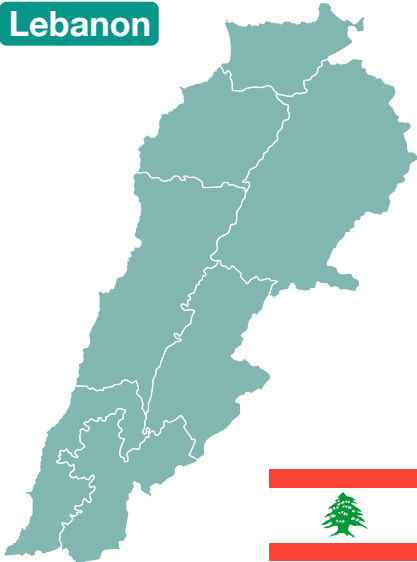
E.3. BENCHMARKING

The benchmarking section delves into recent studies and initiatives concerning e-waste management in Lebanon and other regions. These initiatives offer valuable benchmarks and insights for optimizing waste management strategies. Detailed information on these benchmarks is available in Appendix 1.



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Lebanon



UNIDO

In 2019, a study in a Lebanon identified key e-waste challenges, including inadequate recycling infrastructure, dominance of informal actors, absence of legislation, limited awareness, and insufficient data.

e-Waste Monitor: UNITAR

The 2022 National e-Waste Monitor for Lebanon developed by UNITAR tracks EEE placement and e-waste generation, and emphasizes the need for an effective e-waste management system.

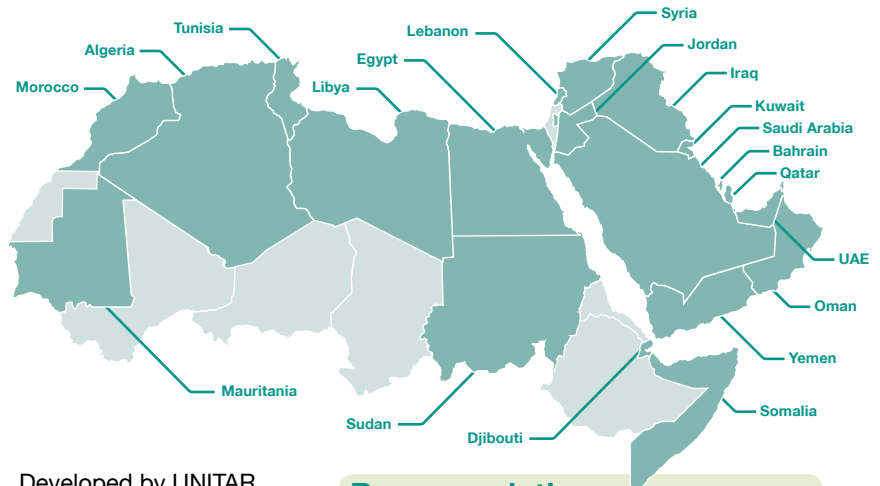
TADWIR

The TADWIR project, initiated in 2022 by EU-UNDP in Lebanon, aims to enhance waste management sustainability and cost recovery strategies, including other initiatives like RDF and green waste assessment, and establishment of an EPR framework.

Legislation

Decree 5606/2019 for
Hazardous Waste Management;
Process of establishing an
EPR based legislation.

2021 Regional E-Waste Monitor for the Arab States



Developed by UNITAR
covers 21 countries,
offers a comprehensive
analysis on e-waste.

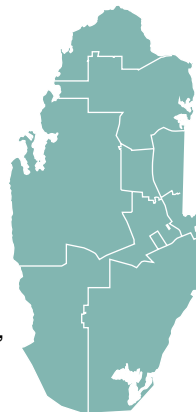
Recommendation

Adoption of an EPR legislation and policies
for improved e-waste management.

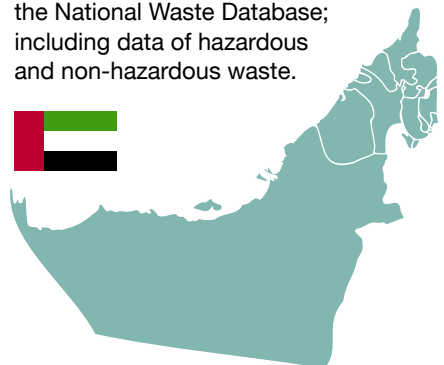
Examples from the Middle East



Qatar's Ministry of Environment collaborates to establish a comprehensive hazardous chemicals and waste database, aligning with international agreements and ensuring timely reporting.



UAE integrates ISWS into the National Waste Database; including data of hazardous and non-hazardous waste.



Aligns ISWS reporting with National Transformation Plan, 2021 Waste Management Law, utilizing a comprehensive data system covering various waste types.



The EU Case



Eurostat reports ISWS categories, excluding hazardous waste treatment data. Incomplete or inaccurate data hinders reporting in some Member States.

F.



Technical Note #4.3 – Central Data Management System

A Central Data Management System is a unified platform or software designed to store, organize, and manage data from various sources within an organization or network. It serves as a centralized repository where data can be securely stored, accessed, and analysed by authorised users. This system typically includes features for data entry, storage, retrieval, sharing, and analysis, providing a comprehensive solution for efficient data management across different departments or functions.

F.1. JUSTIFICATION

The legislation outlined in Law 80/2018, specifically in Articles 18 and 19, anticipated the creation of a database for SWM by the Ministry of Environment (MoE). A Central Data Management System for SWM ensures improved data accuracy and completeness by consolidating information from various sources, rectifying inconsistencies, and addressing data gaps. The comprehensive approach supports trend analysis, identifies inefficiencies, and facilitates informed decision-making, enhancing overall SWM efficiency. Accurate and complete SWM data enables strategic planning for future needs, targeted waste reduction programs, and the identification of illegal dumping, reinforcing accountability.

Moreover, the Central Data Management System enhances monitoring and accountability within SWM by tracking waste collection and disposal services' performance. Making SWM data accessible to the public improves transparency, fosters public engagement, and builds trust. This people-centred approach encourages active participation, contributing to program success and sustainability. Simultaneously, a Central Solid Waste Management System is indispensable for the practical implementation of waste management strategies. Acting as the operational backbone, it centralizes the coordination and execution of waste management processes across Service Zones. This centralization optimizes resources, minimizes redundancy, and streamlines the execution of masterplan frameworks.

The system addresses challenges associated with the informal waste sector uniformly, ensuring equal opportunities and minimizing localized opposition. It also plays a critical role in establishing an integrated waste management system, contributing to the gradual implementation of environmentally sound landfilling options. The centralized framework ensures policies are consistent and strategically aligned with collective waste management



objectives. The tandem presence of the SWM Observatory and the Central Solid Waste Management System offers a comprehensive and symbiotic approach, combining analytical rigor with operational efficiency to realize sustainable waste management strategies.



Perspectives on Centralized Solid Waste Management Systems

In discussions with academia, it was highlighted that a Centralized SWM system could effectively address various research gaps and challenges in waste management. Academic institutions could play a pivotal role in this process by ensuring proper data requirements, systematic data collection procedures, and in-depth data analysis. By collaborating with government and industry partners, academia can contribute to filling research gaps and promoting evidence-based strategies for waste management. Furthermore, having access to data from a centralized system would benefit the academic community, students, and the broader research field by facilitating collaborative efforts, advocating for societal solutions, and disseminating knowledge to all stakeholders involved in waste management.

Similarly, **service providers** expressed their perspective on the transition to a centralized SWM system. While acknowledging potential drawbacks, such as bureaucracy and insufficient resources, there was recognition of the advantages of unifying data sources and streamlining waste management processes. The accessibility of centralized data could significantly reduce the cost of data collection for research projects and enable deeper interpretation and conclusive outcomes.

From the standpoint of NGOs, the establishment of a centralized SWM system emerged as crucial for environmental advocacy. Such a system could offer numerous benefits, including efficient resource allocation, minimization of environmental impact, and promotion of recycling and resource recovery. They highlighted that collaboration between government, industries, and environmental organizations is essential for achieving shared environmental goals within a centralized system. This collaboration could be fostered through policy frameworks, public-private partnerships, knowledge sharing, and multi-stakeholder forums.

Overall, the perspectives from academia, service providers, and NGOs underscore the importance of a centralized SWM system in addressing environmental challenges, promoting sustainability, and fostering collaboration among stakeholders for collective action toward a more sustainable future.

F.2. DESCRIPTION

The open data Central Data Management System serves as a strategic and centralized tool to align Lebanon's waste management objectives with international standards and regulatory frameworks. Its primary mission is to provide a detailed understanding of the types, quantities, characteristics, and management practices associated with different



solid waste streams across the nation. By implementing the system, Lebanon aims to set realistic targets, make informed decisions, and identify areas for improvement in its waste management practices. The system acts as an essential infrastructure to address emerging challenges in waste management effectively. An important facet of the system is its role in addressing the current scarcity of data sharing between firms, companies, and research institutions in Lebanon. The system is poised to bridge this gap, fostering collaboration and knowledge exchange. By doing so, the system becomes not just a data management infrastructure but a catalyst for collective efforts, innovation, and sustainable solutions in Lebanon's solid waste management landscape. Building from the NSWMISS project (see BOX 5), the key components of the system are.

F.2.1. Data Collection

Establishing a robust data management framework for waste management in Lebanon requires collaborative efforts among municipalities, waste management entities, and recycling centres. This entails the development and implementation of standardised protocols for data collection to ensure consistency and reliability across all stakeholders. Integration mechanisms must be devised to efficiently gather data from diverse sources, considering the decentralized nature of waste-related information. Rigorous validation processes are essential to uphold data accuracy, thereby verifying the integrity of the collected information. Furthermore, the creation of analytical tools and reporting functionalities is crucial to empower stakeholders with meaningful insights, enabling them to make informed decisions based on the data at hand.

In addition to data collection and validation, a monitoring and tracking system should be deployed to oversee waste activities across different regions in Lebanon. This system should be supported by a technology infrastructure that is secure, scalable, and capable of integrating real-time data from facilities equipped with weighbridges or similar equipment. Real-time monitoring and automated reporting features are critical components to ensure the system remains responsive to the dynamic nature of waste management operations. By prioritising user-friendliness in interface design and reporting tools, accessibility and usability can be enhanced for stakeholders across the waste management ecosystem. Through these measures, Lebanon can establish a comprehensive data management system that supports efficient and effective waste management practices throughout the country.

Once data is collected, a meticulous process of cleaning and validation should be set in place to safeguard the accuracy and reliability of information within the System. This essential step involves a thorough cleansing process to eliminate errors, rectify inconsistencies, and address any missing values.

Implementing rigorous validation procedures is essential to ensure that the collected data meets established standards and definitions. By systematically cleaning and validating the data, the system upholds its commitment to providing stakeholders with a trustworthy and accurate representation of waste management activities. This dedication to data integrity is fundamental for informed decision-making and effective planning for SWM.



F.2.2. Integration of solid waste streams

Addressing a critical gap in the National Waste Management Information System (NW-MIS) proposed by the World Bank, focus on expanding coverage beyond municipal solid waste to include other valuable waste streams. Integrate data collection mechanisms for diverse waste types, such as industrial, electronic, or hazardous waste, ensuring a comprehensive representation of Lebanon's waste landscape. This broader scope enhances the system's utility, providing stakeholders with a holistic view of all waste streams and fostering a more sustainable and inclusive approach to waste management.

F.2.3. User Training and Engagement

Prioritize comprehensive training programs tailored to personnel involved in data collection, management, and analysis, with a focus on skill development for optimal system utilization. Rigorously identify key stakeholders within the waste management landscape, encompassing professionals, government officials, and the public. Employ effective engagement methodologies, utilizing workshops, forums, and collaborative platforms to facilitate interaction and knowledge exchange among diverse stakeholders. Develop user-friendly interfaces and reporting tools to ensure seamless access to relevant information, catering to the varied needs of engaged stakeholders. Emphasize the crucial role of ongoing technical support, maintenance, and system upgrades, fostering a culture of continuous improvement through collaborative efforts.





F.2.4. Monitoring, Evaluation, and Continuous Improvement

Developing a reliable waste management data management system requires more than just its initial setup. It demands the establishment of robust monitoring mechanisms to continually assess its performance. Regular evaluations are necessary to assess how effectively the system is meeting waste management objectives. By implementing continuous improvement measures driven by feedback, technological advancements, and evolving waste management needs, stakeholders can ensure the system remains adaptable and responsive. Cultivating a culture of ongoing evaluation and improvement is vital. This approach fosters a proactive stance towards refining the system in line with evolving waste management strategies and practices, ultimately enhancing data accuracy, streamlining decision-making processes, and improving overall accountability.

World Bank and UNOPS project *Developing a National Solid Waste Management Information System (NSWMIS)*

The United Nations Office for Project Services (UNOPS) is in the process of starting the implementation of a project financed by the World Bank on *Developing a National Solid Waste Management Information System (NSWMIS)* which is expected to start in the second half of 2024. The main objectives of the project are to establish a MSWMIS at MoE, develop the legal framework for reporting Municipal Solid Waste (MSW) at a national level, and provide Capacity Building to the focal points reporting in the system. Currently, there is not final Terms of Reference (ToR) for the project and as such, the objectives might suffer changes or might be only partially implemented.

Currently the project aims at focusing on creating the physical and regulatory infrastructure needed for the NSWMIS, and while it is aiming at fully developing the operational system, a few gaps have been identified which can be supported by other donors such as:

- Integration of additional waste streams than MSW which can represent a higher added value if valorised correctly.
- Establish a monitoring, evaluation, and continuous improvement process, including building the necessary local and national capacity to perform it.
- Establish operational protocols for the system including collaboration among stakeholders.
- Support the maintenance of the system in the long-term.

F.3. BENCHMARKING

The benchmarking section provides a review of data collection systems across various regions, offering insights into best practices and strategies for enhancing waste management effectiveness. Further details on the benchmarking initiatives presented are provided in Appendix 1.



Content data management system

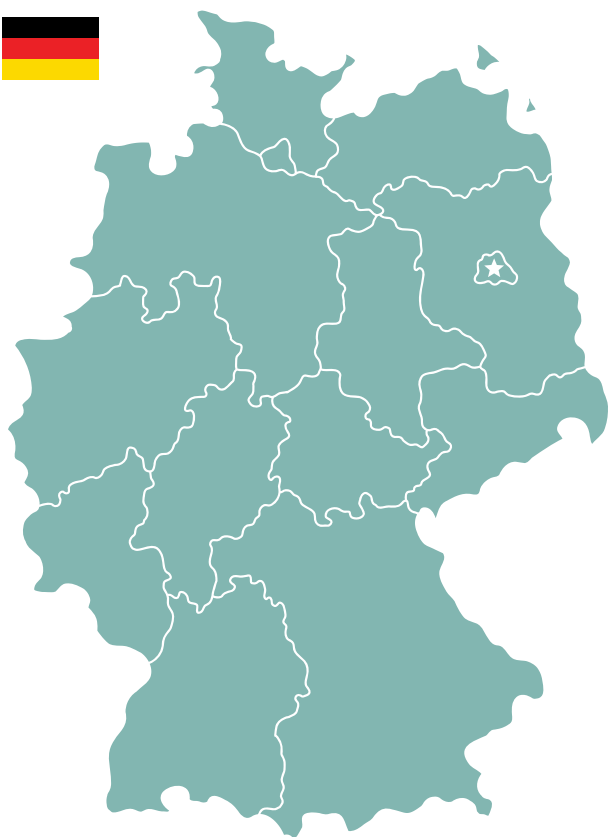
The EU Case

Eurostat compiles waste data from EU Member States, reporting on generation, treatment, and disposal. Various EU Regulations and Directives mandate data submission, covering aspects like quantity, hazardousness, and compliance with targets.

eurostat 

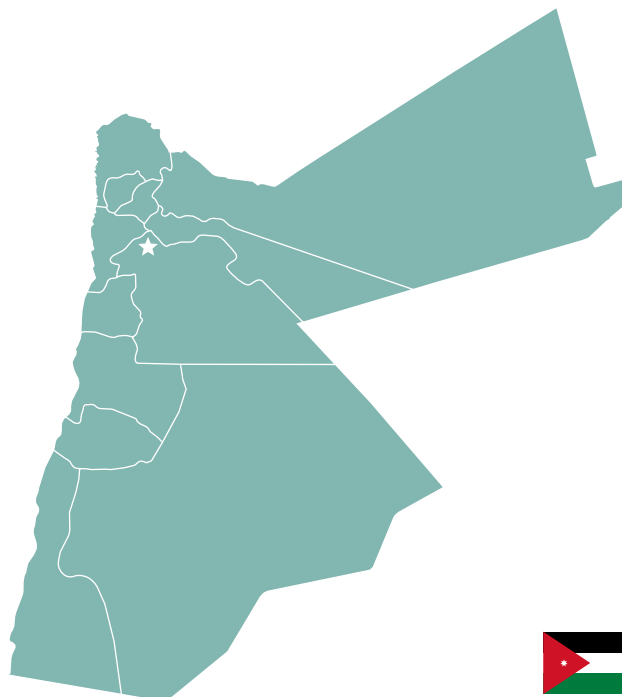
Germany Case

Germany, a leading EU recycler, mandates annual waste data reporting through the MAVG. This law enhances data accuracy, transparency, and efficiency, serving as a model for informed waste management decisions.



Jordan Case

Jordan's National Green Growth Plan emphasizes a waste management center. The SoWas project, co-funded by EU and BMZ, aims to digitize waste management, implementing real-time monitoring and a comprehensive hazardous waste plan.





G.

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Appendix 1

Benchmarking

Solid Waste Management (SWM) Observatory

Since 2021 in Lebanon, an initiative called *Reducing Marine Litter in the Mediterranean through Waste Wise Cities Lebanon – ReMaL* is currently being implemented by Wuppertal Institute and UN-Habitat, with support from Technische Universität Berlin, and sponsored by BMUV, aims to support the Lebanese coastal Unions of Municipalities (UoMs) in enhancing the municipal Integrated Sustainable Waste Management (ISWM) program to reduce marine litter. Among other objectives, Wuppertal Institute as the lead agency is responsible for conceptualising and implementing the Design Waste Observatory (4,5). The program aligns with the *Integrated Solid Waste Management Law of Lebanon – Law No. 80 (2018)* and aims at supporting the UoMs in its implementation.

In 2015 the United Nations Human Settlements Programme (UN-Habitat) and the Cities Alliance started The Global Urban Observatories (6–8) in response to the growing need for cities to use data for their governance and service delivery. Data observatories help cities make better decisions by providing access to high-quality, reliable and curated data that can promote evidence-based policy and planning while facilitating knowledge sharing and learning. Additionally, they play a crucial role in bridging the gap between data and decision-making.

UN-Habitat's Global Urban Observatories Unit (GUO) coordinates and supports over 374 urban observatories who have been certified under their program and follow the guidelines proposed by them. GUO proposes the use of urban indicators aligned with the New Urban Agenda guidelines and reports such as the State of the World Cities Report, the Global Report of Human Settlements, Water and Sanitation in Cities report, among others. Indicators from the Sustainable Development Goal 11 (SDG 11) on Sustainable Cities and Communities such as SDG 11.6.1. on urban SWM are part of the ones proposed by GUO for the urban observatories under the Environmental Sustainability dimension.

Currently in the Middle East Tunisia and Saudi Arabia have observatories as part of this initiative. In Tunisia the Observatoire National Urbain de Tunisie (Monastir city) is registered and among other topics, they deal with SWM. In Saudi Arabia the registered observatories are: Sharqia Urban Observatory (Sharqia Region), Qassim Urban Observatory (Buraidah city), Riyadh Urban Observatory (Riyah city), National Urban Observatory Saudi Arabia – NUO-SA (9) (country level), with the last three reporting data on SWM.



The European Observatory on Municipal Waste Performances was launched in 2010 by the Association of Cities and Regions for Recycling (ACR+) and the European Committee of Federations of Waste Management Industry (CEFAT). The main goal of the observatory is to improve waste management performance, resource efficiency, and environmental protection across Europe. Some examples of local observatories in Europe are the LIPOR Observatory (10) in Porto, Portugal which provides open, up-to-date data and statistics on waste management of municipal waste, recyclable and undifferentiated waste. Since 2017 it also includes information on waste reduction and reuse. Another example is the Sindra Waste Observatory of Auvergne-Rhône-Alpes Region (11) in France showing a continuously updated database on domestic waste and the waste generated per domestic activity in different scales (municipality, local public authorities, departments and region). Sindra compiles information from 370 entities (public authorities or companies) which represent more than 90% of the actors in the region.

In 2018 the Ministry of Climate Change and Environment (MOCCA) of UAE launched an online National Waste Database connecting the waste management authorities of the country. The database is available in Arabic and English and includes data of both hazardous and non-hazardous waste, including urban solid waste. The system is available at MOCCA and concerned entities and it's aligned with the federal law of the same year on Integrated Waste Management (12). Additionally, the country also has an official open data portal which includes waste data and GIS integrated data (13). Another example in the region is the Amman Urban Observatory (AUO) (14,15) which started producing indicators in 2008 and, among others, includes data and indicators on solid waste at Amman city level.

Industrial and Special Wastes (ISWS) Inventories

A series of recent studies in e-wastes have been done in Lebanon. The first one done by UNIDO in 2019 and Ministry of Industry before the enactment of Decree 5606/2019, revealed several critical issues. These included inadequate e-waste recycling infrastructure, driven largely by high energy costs and the intricate nature of e-waste. Informal actors, notably scrap dealers, dominated e-waste handling, lacking health and environmental safety measures. The absence of specific e-waste legislation, limited awareness at the household level, and the lack of comprehensive records and statistics further compounded the challenges in managing e-waste effectively in Lebanon.

The National E-waste Monitor Lebanon 2022 developed by United Nations Institute for Training and Research (UNITAR) comprehensively monitors the placement of Electrical and Electronic Equipment (EEE) on the market and the generation of e-waste in Lebanon. Notably, the statistics demonstrate improvement and mathematical consistency with EEE stock statistics. The report offers insights into household disposal behaviour, e-waste collection, recycling, and the investigation of elements like iron (Fe), aluminium (Al), and various hazardous substances. Additionally, it provides crucial recommendations for establishing an effective e-waste management system in Lebanon, emphasizing the need for legislation focused on environmental and human health protection. Clear definitions, delineation of stakeholder roles, identification of system design, and robust enforcement provisions are highlighted as key components for successful implementation.



The TaDWIR (Towards a Decentralised Waste Management Integrated Response) project started in 2022 and is being implemented by EU-UNDP is designed to support waste management systems in Lebanon. The project aims at improving the environmental and financial sustainability of the sector by reducing the waste volume that goes to landfills, improving the waste that goes to waste-facilities and upgrading national governance systems and cost coverage of managing municipal solid waste. The project comprises actions in four key areas. Firstly, it focuses on hazardous waste, particularly healthcare waste, E-waste, and batteries, with initiatives such as purchasing a mobile sterilizing facility for hospitals in Beirut and Mount Lebanon, policy development, and exploring storage and export procedures for cytotoxic and pharmaceutical waste. Secondly, in the Municipal Solid Waste (MSW) realm, the project aims to assess the potential of Refuse-Derived Fuel (RDF) and green waste, including quantity, quality, financial considerations, infrastructure upgrades, and pilot programs for green waste treatment. Additionally, a project for optimizing waste treatment facilities in Lebanon has been launched. Thirdly, the project is working on two streams: a national baseline assessment study and a masterplan for both RDF and green waste. Finally, the initiative is dedicated to cost recovery strategies, exploring tools to recover operational, maintenance, and capital costs of waste management activities across EU-funded facilities, addressing factors like energy sources, consumption, and workforce optimization.

While currently all e-waste management in Lebanon falls under a general hazardous waste decree (Decree 5606/2019 Determining the principles of hazardous waste management), the country is in the process of establishing an Extended Producer Responsibility (EPR) framework which is reflected in Lebanon's 2019 national strategy for integrated solid waste management. TaDWIR is also progressing in the tendering phase for a baseline assessment and advising on management strategies for e-waste and batteries using the EPR principle.

Additional to the specific report for Lebanon, in 2021 a Regional E-waste Monitor for the Arab States was developed by UNITAR and funded by the International Telecommunication Union (ITU) and the United Nations University (UNU). This report covers 21 countries and states with Lebanon among them (22). The report not only provides an overview of e-waste in all states, but also studies transboundary movement of e-waste, legislation, management systems, presents common issues and challenges, and provides recommendations for the sector. In line with the TaDWIR project and the general hazardous waste decree in Lebanon, the report presents the adoption of EPR-based legislation and policies as a recommendation. As part of the recommendation to improve the collection and treatment of e-waste, having data collection and system monitoring of quantities and flows was presented as an essential step for monitoring, follow-up, and formulation of policies.

The most common approach for ISWS Inventories is to include them as part of other waste data management initiatives, for example, in UAE the National Waste Database includes data of both hazardous and non-hazardous waste. These include dangerous industrial, medical, and animal waste, as well as waste from industrial and construction operations, agriculture, sewage, among other (23).

Saudi Arabia has a similar approach to reporting ISWS. The country through its National Centre for Waste Management and aligned with the National Transformation Plan and



the Waste Management Law launched in 2021, has a data management system in place which besides municipal solid waste also has information on construction debris, medical waste, hazardous waste, asbestos, used oils, among others (24,25).

In Qatar, the Ministry of Environment and Climate Change holds the responsibility of establishing and maintaining a comprehensive database on hazardous chemicals and waste in collaboration with relevant entities. Furthermore, the ministry is mandated to develop and execute a tracking system for hazardous chemicals and waste, working closely with administrative units and government agencies. This initiative aligns with their commitment to fulfil the technical obligations and pledges of the State of Qatar to international agreements aimed at protecting the ozone layer and its subsequent agreements. Additionally, the ministry strives to stay abreast of plans adopted and implemented by international bodies and their subsidiaries, ensuring the timely submission of accurate reports and figures on these chemicals (26).

At a European level, ISWS categories such as hazardous waste, non-hazardous industrial waste, and waste from industries such as mining, agriculture and construction are reported in Eurostat (27)⁴. This information is used to compile reports at an EU level and identify trends and develop policies. However, not all ISWS data is reported in Eurostat. For example, data on hazardous waste treatment and disposal is not currently reported in Eurostat either due to lack of accurate or complete data on generation and disposal, or due to the lack of capacity of some Member States to collect and report ISWS data according to Eurostat standards.

Central Data Management System

In 2017 the National Green Growth Plan of Jordan prepared by the Ministry of Environment (MoEnv) was approved by the Cabinet, and an action plan 2021-2025 (28) has been prepared and approved. The Priority Action #4 advocates for “*Establish a national center for excellence on waste management and circular economy to promote innovation, training, R&D, investment and policy work*” and one of the implementation milestones is the *Establishment of a comprehensive database on waste management, with data compiled consistently across governorates and shared openly*.

Supporting this action, the Solid Waste Management in Jordan Project (SoWas) (29) co-financed by the EU and BMZ, and implemented by GIZ, is aiming at digitalising waste management in Jordan. The project is supported by MoEnv, The Ministry for Local Administration (MoLA), and the Greater Amman Municipality (GAM), and is to be implemented between 2023 and 2026. SoWas involves establishing a real-time monitoring system that interconnects landfills, sorting stations, and transfer stations, alongside formulating a comprehensive hazardous waste management plan for Jordan. The program in Lebanon also includes real time monitoring.

At a European level, all EU Member States are required to have a national system to manage waste data. This is mandated by the EU Waste Statistics Regulation (30), which requires Member States to collect and report information on waste generation, treat-

⁴ For more information, go to F.3 Benchmarking



ment, and disposal. Eurostat (31) compiles annual data on waste generation and management, with data collected every second year based on the Regulation on waste statistics. These data, available in Eurostat's database, contribute to the production of indicators and are featured in web publications for accessible information for citizens and policymakers. Member States are obligated to report data to the European Commission under various EU Regulations and Directives, covering aspects such as waste quantity, hazardousness, shipments, and compliance with targets. The Waste Framework Directive, Packaging Directive, End of Life Vehicles Directive, Waste Electrical and Electronic Equipment Directive, and Batteries Directive are among the regulations involved. Additionally, joint data collection with OECD focuses on municipal waste, and indicators encompass municipal waste generation and treatment methods, waste excluding major mineral wastes, recycling rates of e-waste, and material prices for recyclates.

Considered the leading recycler of Municipal Waste in the EU, Germany has established the Müllaufkommens- und Verwertungsnachweisgesetz (MAVG), or Waste Generation and Disposal Reporting Act, which mandates waste producers to annually report their data to the Federal Environmental Agency (UBA). This information is compiled into a nationwide database (32), facilitating the tracking of waste generation, treatment, and disposal throughout the country. The MAVG serves various purposes, including monitoring compliance with waste legislation, planning waste management strategies, supporting research and innovation, and providing public information and education. Key benefits of the MAVG include improved data accuracy due to comprehensive reporting, increased transparency through online publication of data, and enhanced waste management efficiency and effectiveness. Serving as a model for other nations, the MAVG demonstrates how collecting and utilizing data on waste generation and disposal can inform decision-making, improve waste management, and contribute to environmental protection.

