

Regional
Learning Note

#5

Scaling Up Integrated Resource Recovery Centres for Circular Solid Waste Management:

Strategies and Lessons from Asia-Pacific Cities





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Strategies and Lessons from Asia-Pacific Cities

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FOREWORD



It is a great pleasure to present ASPAC Learning Note #5: Scaling Up Integrated Resource Recovery Centres for Circular Solid Waste Management: Strategies and Lessons from Asia-Pacific Cities.

Solid waste management is an increasingly important challenge for cities across Asia and the Pacific. Rapid urbanisation, growing waste generation, limited landfill capacity, and the need to reduce environmental impacts and greenhouse gas emissions are encouraging cities to move

beyond the conventional collect-transport-dispose approach towards more integrated, sustainable, and circular waste management systems.

For the Government of Padang City, this transition is an important part of our efforts to build a cleaner, healthier, resilient, and sustainable city. Padang has developed a number of community-based waste management initiatives and is currently preparing to develop an Integrated Resource Recovery Centre (IRRC) as part of a more integrated municipal waste management system. The proposed IRRC is envisioned not simply as a waste treatment facility, but as a system that connects source segregation, collection, resource recovery, markets for recovered products, and responsible management of residual waste.

The Government of Padang City

has undertaken a series of steps to develop and refine the IRRC concept, with support from the Urban-Act Project. This process has included field-based learning, technical discussions, and 'knowledge exchange to better understand the city's existing waste management system and identify practical approaches for developing an IRRC as part of a more integrated and circular municipal waste management system.

This Learning Note captures Padang's experience alongside lessons from cities and local governments in Indonesia, Malaysia, and Thailand. The experiences presented demonstrate that successful IRRC development depends not only on appropriate technology and infrastructure, but also on source segregation, community participation, effective governance, sustainable financing, partnerships, and viable markets for recovered resources.

I hope this publication will serve as a useful reference and source of learning for local governments, development partners, communities, and other stakeholders seeking to strengthen solid waste management and accelerate the transition towards a circular economy. May the knowledge and experiences shared through this publication inspire further innovation, collaboration, and practical action that responds to the unique context of each city.

On behalf of the Government of Padang City, I would like to express my sincere appreciation and gratitude to all partners, participating cities, and stakeholders preparation of this publications.



Fadly Arman, B.B.A
Mayor of Padang

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INTRODUCTION



Cities across Asia and the Pacific are facing growing pressure to manage municipal solid waste in ways that are more sustainable, climate-responsive, and financially viable. Rapid urbanisation, changing consumption patterns, limited landfill capacity, and the high proportion of organic waste in many cities have made

conventional collect–transport–dispose systems increasingly insufficient. For cities seeking to reduce waste sent to final disposal, Integrated Resource Recovery Centres offer a practical pathway to connect waste reduction, segregation, recycling, organic waste treatment, resource recovery, and circular economy development.

In this Learning Note, an Integrated Resource Recovery Centre refers to a decentralised waste-management facility that recovers value from waste before it reaches landfill. It is not simply a building or treatment plant. It is part of a wider municipal system that depends on household segregation, reliable collection, community-based waste management, waste banks, organic waste treatment, recyclable-material markets, residual-waste management, clear operating arrangements, and sustainable financing. Its success is therefore determined not only by technology, but also by governance, behaviour change, institutional coordination, and business models.

Recognising these needs, the Urban-Act Pairing, Learning and Knowledge Exchange on scaling up Integrated Resource Recovery Centre development for municipal solid waste management was convened in Padang City, Indonesia, from 5 to 7 August 2026.

The activity used Padang City's proposed Integrated Resource Recovery Centre as the central application case, while drawing lessons from Indonesian reference cases and participating cities from Asia and the Pacific that shared solid waste management strategies relevant to future resource-recovery systems.

A key feature of the exchange was its practical orientation. Through field visits, city presentations, gallery walks, thematic discussions, and a recommendation clinic, participants examined how upstream waste management, landfill pressure, proposed resource-recovery infrastructure, financing, institutional arrangements, and community participation are connected. This Learning Note synthesises those experiences for cities that are planning, developing, or scaling up Integrated Resource Recovery Centres as part of a transition from waste disposal towards circular solid waste management.

BACKGROUND



What is Integrated Resource Recovery Centres?

Integrated Resource Recovery Center (IRRC) is a decentralized solid waste management facility that focuses on waste processing and resource recovery. IRRCs are designed to operate close

to waste generation sources, such as traditional markets and residential areas, helping reduce the need to transport waste over long distances to final disposal facilities. The model promotes the principles of the 3Rs (*reduce, reuse, and recycle*) and uses

simple, low-cost, and reliable technologies that are suitable for local conditions.

The IRRC model was pioneered in Asia by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) in collaboration with *Waste Concern*. It emphasizes source separation to ensure that organic waste can be processed into good-quality compost while recyclable materials can be recovered and returned to the economy. The model also encourages community participation and the involvement of informal-sector workers, creating livelihood opportunities while improving working conditions in the waste management sector.

Beyond being a waste processing facility, IRRC is also designed as a resource recovery and circular economy approach, turning waste into products with economic value, such as compost and recyclable materials. It aims to deliver environmental, economic,

and social benefits by reducing the amount of waste sent to landfill, lowering waste management costs, and generating income and employment opportunities.

In Indonesia, Jambi City and Malang Regency have served as pilot areas for the IRRC model.

Scaling Up Integrated Resource Recovery Centres for Circular Solid Waste Management

Municipal solid waste management is becoming one of the most urgent urban sustainability challenges in Asia and the Pacific. Many cities continue to rely heavily on a linear system of collecting, transporting, and disposing waste at landfill sites. This model is increasingly difficult to sustain over time. Waste generation is rising, landfill capacity is becoming more limited, operational costs are increasing, and unmanaged waste contributes to pollution, public-health risks, greenhouse-gas emissions, and declining urban environmental

quality.

The challenge is not only the volume of waste produced, but also the way waste is managed before it reaches final disposal. In many cities, household waste remains mixed at the point of collection. Organic waste, recyclable materials, residual waste, and hazardous household waste are often transported together. This reduces the quality of recyclable materials, increases contamination, raises transport and treatment costs, and places additional pressure on landfills. For cities seeking to move towards circular economy systems, waste must be treated not as a product to be disposed of, but as a resource stream that can be reduced, recovered, reused, recycled, processed, or converted into value.

Integrated Resource Recovery Centres as Part of the Waste System

Integrated Resource Recovery Centres offer a practical pathway for cities to reduce landfill

dependence and strengthen circular solid waste management. An Integrated Resource Recovery Centre is a decentralised facility that supports waste segregation, resource recovery, recycling, organic waste treatment, composting, and residual-waste management before waste reaches final disposal. This may include maggot-based bioconversion, compost production, material recovery, refuse-derived fuel, solid recovered fuel, or other forms of waste-to-resource processing.

However, an Integrated Resource Recovery Centre should not be understood as a stand-alone facility. Its effectiveness depends on the wider municipal waste-management system. A technically well-designed facility will not perform effectively if waste arrives mixed, contaminated, irregular, or unsuitable for processing. The quality of input determines the quality of output. Source segregation, reliable collection routes, community-based waste management, waste

banks, local operators, market access, and clear arrangements for residual waste are therefore core parts of the system.

Scaling up Integrated Resource Recovery Centres requires cities to think beyond construction. The central question is not only where to build the facility or which technology to install, but how the facility will be supplied, operated, financed, maintained, and connected to communities and markets. Cities need to understand waste flows, collection systems, household behaviour, existing community initiatives, institutional mandates, private-sector roles, and financing streams.

From Disposal Dependency to Circular Waste Management

The gradual transition from disposal dependency to circular waste management requires changes across the full waste chain. At the upstream level, households, markets, institutions, hotels, restaurants, schools, and businesses need to separate

waste. Food waste and other organic waste need to be collected and treated differently from dry recyclables and residual waste. Waste banks, community-based waste management groups, and local collection systems can help build public participation and improve the quality of waste entering treatment facilities.

At the midstream level, cities need facilities that can process different waste streams according to their characteristics. Organic waste may be processed through composting, maggot cultivation, biodigestion, or other biological treatment methods. Recyclables need sorting, aggregation, cleaning, and connection to recycling markets. Low-value materials may require further processing before being used as alternative fuel. Residual waste needs safe final treatment or disposal. An Integrated Resource Recovery Centre can help organise these streams if supported by adequate technical capacity and operational discipline.

At the downstream level, cities must ensure that recovered products have users and markets. Compost needs buyers or public-sector users such as parks, urban agriculture programmes, schools, or landscaping units. Maggot products require linkages with livestock, fishery, poultry, or feed markets. Recyclable materials need aggregators and recycling industries. Refuse-derived fuel or solid recovered fuel requires industrial offtakers and quality standards. Without a clear offtaker network, resource recovery may become stockpiling rather than circular economy.

Governance, Financing, and Behaviour Change

The experience of participating cities shows that governance and financing are as important as technology. Sustainable solid waste management requires regulations, operational procedures, institutional coordination, community participation, and reliable funding. Cities need to clarify who owns the facility, who operates it, who pays

for collection and processing, who receives revenues, who maintains equipment, and who is responsible when waste streams are not properly separated.

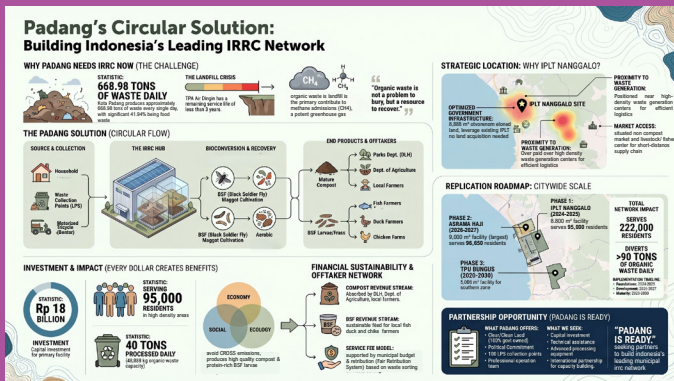
Financial feasibility also needs careful attention. Integrated Resource Recovery Centres may generate revenue from compost, recyclables, maggot products, refuse-derived fuel, service fees, tipping fees, or other mechanisms. However, many facilities will still require public support because they provide public-service benefits that are not fully captured by product sales. These benefits include reduced landfill pressure, lower transport costs, improved sanitation, avoided environmental damage, reduced greenhouse-gas emissions, and better neighbourhood cleanliness. Cities therefore need realistic business models that combine municipal funding, user fees, retribution systems, private-sector participation, corporate social responsibility, development-partner support, or blended financing where appropriate.

Behaviour change remains a decisive factor. Waste separation, collection discipline, payment of waste fees, community participation, and acceptance of new systems cannot be achieved through infrastructure alone. Public education, local leadership, incentive mechanisms, routine services, transparent communication, and visible benefits are needed to sustain participation. Waste banks, community groups, schools, neighbourhood organisations, and local champions can help translate municipal policy into daily practice.

For cities that aim to develop or scale up Integrated Resource

Recovery Centres, the main lesson is clear: the facility is only one part of the system. Successful implementation depends on whether the city can connect upstream behaviour, midstream processing, downstream markets, governance arrangements, financing models, and long-term operation. Scaling up Integrated Resource Recovery Centres is therefore not only a technical infrastructure agenda. It is a transition towards a circular urban system in which waste is reduced, recovered, and returned to productive use wherever possible.

FIELD BASED LEARNING



Understanding Padang City's Waste Management Chain

The field-based learning in Padang City provided participants with a practical view of how an Integrated Resource Recovery Centre must be positioned within the wider municipal waste-management chain. Rather than treating the proposed

facility as a stand-alone infrastructure project, the site visits were designed to show the relationship between upstream community-based waste management, final disposal pressure, and the planned development of resource-recovery infrastructure.

The first site visit focused on a Community-Based Waste Management Institution, or Lembaga Pengelola Sampah. This visit introduced participants to the upstream side of Padang City's waste-management system, where community-level collection, local organisation, and household participation shape the quality of waste entering the wider municipal chain. The visit showed that community-based systems can reduce pressure on final disposal, but their contribution depends on stronger segregation at source, routine collection arrangements, public awareness, and reliable links with downstream treatment facilities.

The second site visit was conducted at Aie Dingin Landfill, which represents the final-disposal end of the current system. Based on

information shared during the field visit, the landfill reportedly receives around 600–700 tonnes of waste per day, covers approximately 18 hectares, is divided into around eight sections, and has operated for about 20 years. It is also expected to reach maximum capacity in 2026. These conditions illustrate the urgency of reducing waste sent to landfill and strengthening upstream recovery before waste becomes a final-disposal burden.

The visit also highlighted that Aie Dingin performs a wider regional function. Bukittinggi City reportedly sends around 140 tonnes of waste to the facility and pays a disposal or retribution fee. Composting activities were also observed, with information shared during the visit indicating that approximately 6 kilograms of organic input can produce

around 1 kilogram of compost. The compost is used for public purposes, including parks, schools, kelurahan offices, and kecamatan offices. These observations show that even within a disposal-oriented system, resource-recovery practices already exist and can be strengthened.

The third site visit took participants to the proposed Integrated Resource Recovery Centre site in Nanggalo District. This visit connected the previous observations to Padang City's future waste-management direction. The proposed site allowed participants to consider practical questions of location, logistics, feedstock, operator arrangements, financing, community linkages, and the

relationship between existing upstream systems and future treatment infrastructure.

The field visits demonstrated that Integrated Resource Recovery Centre development begins before construction. It requires cities to understand waste generation, collection systems, source segregation, community institutions, landfill pressure, regional waste flows, organic-waste treatment, and potential offtakers. For cities planning similar facilities, Padang City's field-based learning reinforces a central lesson: an Integrated Resource Recovery Centre can only function effectively when it is embedded within an integrated, well-governed, and financially viable waste-management system.

■ CASE STUDY

Developing an IRRC concept within an integrated municipal waste system

📍 Padang City, Indonesia



Padang City's experience represents a city in the preparation stage of Integrated Resource Recovery Centre development. Rather than presenting an existing operational IRRC, the Padang case shows how a city can use field observation, technical consultation, and inter-city learning to refine an IRRC concept before implementation.

The city faces increasing pressure to transform its solid waste management system from a collect–transport–dispose model towards a more circular system based on segregation, resource recovery, organic waste treatment, and reduced landfill dependence.

Padang currently generates several hundred tonnes of



- A glimpse into the Padang Mamila programme, where staff of the Waste Management Institution sort waste collected from local neighbourhoods in Padang City.

municipal solid waste per day. The Concept Note records approximately 750 tonnes per day, while the Padang waste-management roadmap presents 668.98 tonnes per day, with food waste forming a major share of the waste stream. These figures underline the scale of the

challenge and the importance of reducing waste before it reaches final disposal. The pressure is particularly urgent because Aie Dingin Landfill is expected to reach its maximum capacity in 2026.

Padang has already introduced upstream initiatives to strengthen community-based waste management. Through the Padang Mamilah Programme, the city established Community-Based Waste Management Institutions, or Lembaga Pengelola Sampah, to support collection and upstream



- Aie Dingin Final Disposal Site in Padang City.



■ The situation at Aie Dingin Final Disposal Site in Padang City, which is projected to reach full capacity within the next four years.

waste handling. The Concept Note records that this initiative diverts around 20.36 per cent of waste, or approximately 50 tonnes per day, before waste is transported to Aie Dingin Landfill. However, source segregation remains limited, meaning that much household waste is still mixed and the system continues to rely heavily on landfill disposal.

The proposed IRRIC in Nanggalo District is intended to respond to this gap. It is positioned

as a decentralised resource-recovery facility that can connect household segregation, LPS collection, waste banks, organic waste treatment, recycling, composting, maggot-based processing, residual treatment, and potential offtaker networks. The field visit to the proposed site helped participants consider practical questions of location, logistics, feedstock quality, operator model, financing, and linkages with existing community-based systems.



CHALLENGES

Padang's main challenge is that the future IRRC must be developed while the existing waste system still depends heavily on mixed collection and final disposal. Limited source segregation, landfill-capacity pressure, organic waste volume, financing needs, technical preparation, and coordination among municipal agencies, communities, operators, and potential offtakers must be addressed before the facility can operate effectively.



STRATEGIES

To address these challenges, Padang is moving through several strategic directions:

- Strengthening source segregation through the Padang Mamilah Programme and community-based waste management institutions.
- Positioning the proposed IRRC as part of an integrated system rather than a stand-alone facility.
- Linking LPS, waste banks, organic treatment, recycling, residual processing, and landfill management.
- Using field visits, technical discussions, and a recommendation clinic to refine the IRRC concept.
- Exploring phased implementation through the Padang Rancak roadmap and proposed IRRC network.

**LESSONS**

Padang offers several lessons for cities preparing to develop an IRRC:

- IRRC planning should begin with a clear diagnosis of the existing waste chain.
- Source segregation must be strengthened before treatment infrastructure is scaled up.
- Community-based institutions are essential to improve feedstock quality and public participation.
- Landfill pressure can create urgency, but technical, institutional, and financial feasibility determine implementation.
- A proposed IRRC should be planned as a system connector between households, operators, markets, and final disposal.

COMPARATIVE CASE STUDIES: LEARNING FROM OTHER PRACTICES

IRRC as a public-service model for resource recovery and landfill reduction

📍 **Jambi City, Indonesia**



Jambi City provides an important reference case for cities that are planning to develop or scale up an Integrated Resource Recovery Centre. Unlike Padang City, which is still preparing its proposed IRRC concept, Jambi has operational experience through the IRRC located at Talang Banjar Traditional Market. The case is particularly

relevant because it shows how an IRRC can be positioned not only as a waste-treatment facility, but also as a public-service model that reduces landfill pressure, recovers resources, and delivers direct benefits to local communities.

Jambi City is the capital of Jambi Province and functions as an economic and service hub in

central Sumatra. The city covers approximately 169.89 square kilometres and has a population of around 627,774 people. Its waste-management challenge is shaped by rapid urbanisation, increasing household consumption, high dependence on landfill disposal, high waste-collection transport costs, limited segregation at source, and significant organic waste generation from traditional markets. The city generates around 423 tonnes of waste per day, with organic waste accounting for around 55 per cent and plastic waste around 16 per cent.

The IRRC at Talang Banjar Traditional Market processes approximately 4–5 tonnes of organic waste per day using anaerobic digestion technology. Its outputs include biomethane for cooking, electricity generation of around 15 kilowatts, and organic compost from digestate. Current

achievements show that the IRRC produces approximately 20 cubic metres of biomethane per day, supplies free cooking gas to nearby households, reduces waste transported to landfill, and serves as a demonstration site for municipalities, universities, and international organisations.

Jambi's experience also shows that IRRC development takes time. The process began with a proposal submitted to United Nations Economic and Social Commission for Asia and the Pacific and United Cities and Local Governments Asia-Pacific in 2014, followed by technical training and capacity building, construction, pilot operation, full operation, and later rehabilitation and equipment upgrades. The Talang Gulo sanitary landfill has also adopted improved landfill-management practices while Jambi continues to reduce incoming waste through diversion initiatives.



CHALLENGES

Jambi's main challenges relate to operational sustainability. Core operations still depend largely on municipal funding, while equipment maintenance requires specialised expertise. Scaling source segregation also requires sustained community engagement. Organic waste quality varies depending on household and market participation, and revenue streams remain limited compared with fully commercial waste-to-energy facilities.



STRATEGIES

To address these challenges, Jambi applies several strategic directions:

- Operating the IRRC as a public-service facility rather than relying only on commercial revenue.
- Processing market-based organic waste through anaerobic digestion and composting.
- Producing biomethane, electricity, and compost as resource-recovery outputs.
- Combining municipal funding, community participation, and strategic partnerships.
- Positioning the IRRC as a training, demonstration, and knowledge-sharing hub.

**LESSONS**

Jambi offers several lessons for cities developing an IRRC:

- Financial sustainability does not always depend on high commercial revenue.
- IRRC value can come from lower transport costs, reduced landfill pressure, and longer landfill lifespan.
- Organic waste from markets can provide a practical starting point for resource recovery.
- Municipal investment remains important when public-service objectives are prioritised.
- Community participation and strategic

Scaling decentralised waste treatment through IRRC and village-based systems

📍 Malang Regency, Indonesia



Malang Regency provides an important reference case for cities and regencies seeking to scale Integrated Resource Recovery Centre models within a wider solid waste management system. Together with Jambi City, Malang Regency is identified as one of the early IRRC implementation locations in Indonesia. Its

experience is relevant because it links resource recovery with village-based waste management, material recovery facilities, refuse-derived fuel, institutional strengthening, digital governance, and potential green financing.

Malang Regency is a large administrative area with more than 2.8 million inhabitants across

33 sub-districts, 378 villages, and 11 urban villages. The regency generates more than 1,094 tonnes of waste per day, with organic waste forming the largest share of the waste stream. The local waste-management snapshot shows that around 75.82 per cent of total waste is managed, combining waste reduction and landfilling. This context creates both a challenge and an opportunity: the regency must reduce pressure on final disposal while capturing value from the high organic fraction of its waste.

The regency's strategy is described as holistic, sustainable, and collaborative. It combines village-based waste management, household segregation, material recovery facility networks, circular economy approaches, refuse-derived fuel production, landfill mining, off-taker collaboration, institutional strengthening, and exploration of carbon credits and

green financing. This shows that IRRC scaling is not pursued only through one facility, but through a wider system connecting households, local collection, TPS3R, waste banks, composting, material recovery facilities, and industrial offtakers.

The IRRC Pujon model illustrates how organic waste and manure can be converted into biogas and compost. The facility is presented as reducing methane emissions, producing compost, generating renewable energy for local use, and supporting circular economy practices. The broader integrated waste-management model also connects household segregation with TPS3R, waste banks, composting, material recovery facilities, and refuse-derived fuel supply to cement plants. This creates a pathway for treating different waste streams according to their characteristics.



CHALLENGES

Malang Regency continues to face challenges that are common for cities and regencies scaling integrated waste systems. These include low public awareness and behaviour change, limited budget and infrastructure, land availability for facilities, operational cost sustainability, data quality, and monitoring consistency. These challenges show that scaling IRRC requires more than technical design; it also depends on governance, financing, land, and behavioural readiness.



STRATEGIES

To address these challenges, Malang Regency applies several strategic directions:

- Strengthening TPS3R, waste banks, and composting at village level.
- Promoting household segregation through a two-colour system and local collection networks.
- Developing material recovery facilities to improve sorting and resource recovery.
- Linking refuse-derived fuel production with cement-plant offtakers.

- Exploring institutional strengthening, digital governance, carbon credits, corporate social responsibility, and blended financing.



LESSONS

Malang Regency offers several lessons for cities developing or scaling IRRC:

- IRRC works best when connected to village-based and community-level waste systems.
- Organic-rich areas can use IRRC models to produce compost, biogas, and local energy benefits.
- Material recovery and refuse-derived fuel pathways can reduce landfill dependence.
- Offtaker partnerships are essential for turning recovered materials into economic value.
- Scale-up requires strong policy, data, institutional capacity, and financing innovation.

Community empowerment and circular economy in integrated waste management

📍 **Banyumas Regency, Indonesia**



Banyumas Regency provides a strong practice-sharing case for cities and regencies seeking to develop Integrated Resource Recovery Centres through community empowerment and circular economy principles. While Banyumas is not presented as an IRRC reference case in

the same way as Jambi City or Malang Regency, its waste-management system offers practical lessons on how upstream sorting, community-based operation, midstream treatment, downstream processing, offtaker partnerships, and local regulation can support resource recovery.

Banyumas has a population of

around 1.85 million people and generates approximately 738.84 tonnes of waste per day. Its waste-management data show that around 77.76 per cent of waste is managed, while around 22.24 per cent remains unmanaged. The waste composition also highlights why recovery systems are important: food waste accounts for around 35 per cent, plastics 30 per cent, and other fractions include metals, paper, wood, textiles, glass, and rubber. This composition requires a system that can separate organic waste, high-value recyclables, low-value materials, and residues.

The regency's current system is organised across upstream, midstream, and downstream stages. At the upstream level, households are encouraged to sort waste, process waste at source, reduce and reuse materials, and connect with waste banks. Community groups, known as KSM, collect unhandled waste and

bring it to facilities such as TPST, TPS3R, or PDU. This arrangement positions communities not only as beneficiaries, but also as operators within the local waste-management chain.

At the midstream level, waste is segregated into organic high-value, inorganic high-value, inorganic low-value, and residue streams. Organic waste can be processed into compost or maggot-based products, while plastics may be converted into pellets and residues into refuse-derived fuel. At the downstream level, further processing takes place at TPST BLE, including weighing, separation, shredding of RDF materials, paving-block production, and treatment of organic waste slurry. Offtaker arrangements with companies such as PT SBI, PT PLN EPI, and PT Sinar Tambang Artha Lestari support the utilisation of recovered materials.

**CHALLENGES**

Banyumas previously faced a collect–transport–dispose paradigm, landfill overcapacity, limited land for additional disposal sites, pollution, odour, and operational risks such as landslides and fires. These challenges made it necessary to shift from landfill dependency towards community-based sorting, decentralised treatment, and resource recovery supported by regulation, operators, and offtaker networks.

**STRATEGIES**

To address these challenges, Banyumas applies several strategic directions:

- Separating the role of local government as regulator and community groups as operators.
- Strengthening waste sorting and processing from the household level.
- Using KSM to collect, manage fees, and operate midstream waste-management activities.
- Processing organic waste, recyclables, low-value materials, and residues through different pathways.

- Linking recovered materials with offtakers, regional enterprises, and product-development partnerships.



LESSONS

Banyumas offers several lessons for cities preparing or scaling IRRC systems:

- Community empowerment is central to reducing landfill dependence.
- IRRC development requires upstream, midstream, and downstream integration.
- Clear division between regulator, operator, and enterprise roles strengthens implementation.
- Offtaker partnerships are essential for turning recovered materials into economic value.
- Replication requires long-term planning, facility development, and multi-sector cooperation.

Policy leadership and collaborative governance for sustainable waste management

📍 Bontang City, Indonesia



Bontang City provides a strong practice-sharing case on how policy leadership, institutional coordination, and multi-stakeholder collaboration can strengthen sustainable solid waste management. While Bontang is not presented as an Integrated Resource Recovery

Centre reference case, its experience is highly relevant for cities planning IRRC development because it shows how regulations, partnerships, community participation, and routine public programmes can create the enabling environment needed for source segregation, waste reduction, and resource recovery.

Bontang is a coastal city in East Kalimantan with a population of around 194,606 people in 2025. The city covers land and sea areas and is administratively divided into three districts and 15 urban villages. Its waste-management performance reflects a relatively strong local system. The city's poster records waste generation at around 107.414 tonnes per day, with approximately 107.14 tonnes per day managed and only around 0.27 tonnes per day unmanaged. Waste processed at source is recorded at around 34.69 tonnes per day, while around 72.72 tonnes per day is sent to landfill.

A key strength of Bontang's approach is its policy framework. The city has issued regional regulations, mayor regulations, circular letters, and implementing instructions related to waste management, retribution, environmental cleanliness, the Clean Friday programme, and public responsibility for waste.

These instruments show that waste management is treated not only as an operational service, but as a governance agenda requiring legal direction, behavioural guidance, and institutional accountability.

Bontang also demonstrates the importance of collaborative partnership. The Environmental Agency acts as a coordination hub connecting districts, urban villages, industries, corporate social responsibility programmes, communities, schools, universities, waste banks, and community-based waste-management groups. This collaboration is supported by a wide facility network, including one sanitary landfill, one integrated waste-processing facility, one main waste bank, hundreds of unit waste banks, 3R waste-processing facilities, organic waste-processing facilities, recycling centres, and informal-sector actors.



CHALLENGES

Bontang's main challenge is sustaining high waste-management performance while strengthening waste reduction at source and expanding resource-recovery practices. The city must maintain coordination across government units, communities, industries, schools, waste banks, and private partners. It also needs to ensure that behavioural programmes are not treated as temporary campaigns, but become routine practices embedded in daily public service and community life.



STRATEGIES

To address these challenges, Bontang applies several strategic directions:

- Strengthening local regulations, mayor regulations, circular letters, and operational instructions.
- Implementing the Clean Friday programme across government agencies, schools, sub-districts, and surrounding communities.
- Promoting the “My Waste, My Responsibility” or GESIT movement to build individual responsibility.

- Expanding waste banks, 3R facilities, organic waste processing, and recycling services.
- Building partnerships with industry, corporate social responsibility programmes, schools, communities, and development partners.



LESSONS

Bontang offers several lessons for cities preparing or scaling IRRC systems:

- Strong policy leadership creates the enabling conditions for integrated waste management.
- Regulations must be supported by routine programmes and operational instructions.
- Multi-stakeholder collaboration helps connect public service, community action, and private-sector support.
- Waste banks and community-based systems are important foundations for future resource recovery.
- Behavioural change campaigns work best when linked to visible services, facilities, and institutional commitment.

Technical integration of source separation, organic treatment, and TPST development

📍 **Mataram City, Indonesia**



Mataram City provides a relevant practice-sharing case for cities seeking to develop Integrated Resource Recovery Centre systems because its approach focuses on technical integration across the waste-management chain. While Mataram is not presented as an existing IRRC reference case,

its experience offers practical lessons on how source separation, organic waste treatment, school-based education, maggot cultivation, integrated waste-treatment facilities, institutional strengthening, and regional landfill governance can support future resource-recovery systems.

Mataram is a compact urban municipality with a population of around 464,566 people and an area of approximately 61.3 square kilometres. The city generates around 311.92 tonnes of waste per day. Its key challenges are similar to those faced by many medium-sized cities: the regional landfill is reaching maximum capacity, while funding and land availability for new waste infrastructure remain extremely limited. These conditions make it necessary for the city to reduce waste before final disposal and maximise recovery from different waste streams.

The city's current initiatives begin with source separation. Mataram promotes waste segregation from the household level as a foundation for reducing contamination and improving the performance of downstream treatment. This is supported by organic waste processing practices, including Black Soldier Fly maggot cultivation, organic composting bins, biopore absorption holes, composters, and fermentation methods. The

city also promotes the Sekolah Lisan programme as a dedicated “Zero Waste School” initiative, showing that behavioural change and environmental education are part of the technical system.

Mataram's technical system also includes the Mataram Maggot Centre, which serves as a specialised facility for organic waste bioconversion, and the Sandubaya TPST, an integrated waste-treatment facility with a processing capacity of around 46 tonnes per day. The facility uses several technologies, including Black Soldier Fly maggot cultivation, plastic waste conversion into paving blocks, solid recovered fuel production, composting, and recyclable raw-material recovery. Future strategies include institutional strengthening through the establishment of a dedicated technical implementation unit and the planned development of Kebon Talo TPST, with a proposed capacity of around 60 tonnes per day.



CHALLENGES

Mataram's main challenges are landfill-capacity pressure, limited land, limited funding, and the need to strengthen source separation before waste reaches treatment facilities. The city also needs to ensure that organic waste, plastics, recyclables, and residual materials are processed through suitable pathways while maintaining operational discipline, institutional capacity, and community participation.



STRATEGIES

To address these challenges, Mataram applies several strategic directions:

- Strengthening source separation to reduce mixed waste before collection and treatment.
- Expanding organic waste processing through maggot cultivation, composting, biopores, and fermentation.
- Using school-based programmes to build zero-waste behaviour from early education.
- Operating Sandubaya TPST as an integrated treatment facility for organic, recyclable, and residual streams.

- Preparing institutional strengthening and future TPST development to expand processing capacity.



LESSONS

Mataram offers several lessons for cities preparing or scaling IRRC systems:

- Technical integration is essential from source separation to final disposal.
- Organic waste treatment should be diversified according to available feedstock and local capacity.
- Schools can become strategic entry points for long-term waste-behaviour change.
- TPST facilities can support IRRC development when linked to recovery, composting, SRF, and recycling pathways.
- Institutional strengthening is necessary before technical systems can be scaled sustainably.

District-level waste strategy through TPS3R, waste banks, composting, and recycling

📍 North Minahasa Regency, Indonesia



North Minahasa Regency provides a useful practice-sharing case for cities and regencies that are preparing or strengthening Integrated Resource Recovery Centre systems at the district level. While North Minahasa is not presented as an existing IRRC reference case, its waste-management strategy offers

practical lessons on how local governments can organise waste flows from source segregation to temporary processing, waste banks, composting, recycling, and residual disposal. This is relevant for IRRC development because any future recovery facility depends on how well waste

is separated, collected, and channelled before it reaches final disposal.

The regency generates approximately 187 tonnes of waste per day, or around 68,365.70 tonnes per year. Waste generation is distributed across several sub-districts, including Likupang Barat, Likupang Timur, Likupang Selatan, Dimembe, Kema, Kauditan, Airmadidi, Kalawat, Talawaan, and Wori. This distribution shows that waste management in a regency context is spatially dispersed. Unlike compact cities, regencies must consider distance, collection coverage, settlement patterns, service accessibility, and the location of small-scale processing facilities across different sub-districts.

North Minahasa's strategy is organised around a simple waste-management flow. Waste begins at the source, where segregation is expected to take place. It then moves to temporary processing

or management points, including TPS3R and waste banks. Materials with recoverable value can be directed towards recycling and composting, while remaining residual waste is sent to the final disposal site. This flow is important because it shows the logic of resource recovery before landfill, even if the system still requires further scaling and operational strengthening.

The available data also show several local facilities and activities. Composting is recorded in Desa Kinunang, established in 2020, with a capacity of around 0.015 tonnes per day, and Desa Mapanget, established in 2018, with a capacity of around 0.73 tonnes per day. Recycling activities are recorded in Desa Sukur and Desa Serawet, both established in 2022, with small daily capacities. These examples indicate that the regency has localised recovery activities that can become building blocks for a wider integrated waste-management system.



CHALLENGES

North Minahasa's main challenge is scaling relatively small and dispersed waste-recovery activities into a stronger district-wide system. The regency must manage waste across multiple sub-districts with different generation levels, facility capacities, and logistical needs. Small composting and recycling capacities also mean that stronger investment, technical support, community participation, and coordination are needed before significant landfill diversion can be achieved.



STRATEGIES

To address these challenges, North Minahasa applies several strategic directions:

- Organising waste management from source segregation to TPS3R, waste banks, recycling, composting, and residual disposal.
- Mapping waste generation across sub-districts to understand service and facility need.
- Supporting local composting activities in villages such as Kinunang and Mapanget.
- Supporting recycling activities in villages such as Sukur and Serawet.

- Using district-level planning to connect small-scale facilities into a wider recovery system.



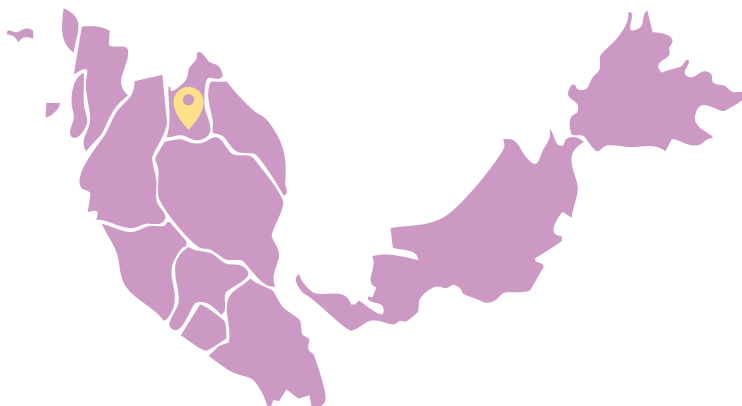
LESSONS

North Minahasa offers several lessons for cities and regencies preparing IRRC systems:

- IRRC development should be informed by the spatial distribution of waste generation.
- Small composting and recycling facilities can become early building blocks for resource recovery.
- TPS3R and waste banks are important connectors between households and larger treatment systems.
- District-scale waste management requires attention to logistics, service coverage, and facility location.
- Scaling resource recovery depends on strengthening local facilities before expanding infrastructure.

Drive-through recycling and incentive-based public participation

📍 Kota Bharu, Malaysia



Kota Bharu provides a useful practice-sharing case for cities developing Integrated Resource Recovery Centre systems because it demonstrates how public participation, recycling access, and incentive mechanisms can strengthen upstream waste segregation. While Kota Bharu

is not presented as an IRRC reference case, its experience is relevant for IRRC scale-up because any resource-recovery facility depends on the quality of materials separated before they enter the municipal waste chain.

Majlis Perbandaran Kota Bharu Bandar Raya Islam is the local authority responsible for Kota

Bharu, the capital city of Kelantan. The city positions itself as clean, green, safe, and liveable, guided by Islamic values and the aspiration of 5KAF: knowledge, compliance, well-being, cleanliness, and welfare. Kota Bharu has a population of around 485,498 people and a municipal area of approximately 196.42 square kilometres. Its waste-management profile records around 350–400 tonnes of waste per day collected and processed.

Kota Bharu's municipal solid waste management system includes domestic waste collection, public cleansing, road sweeping, bulk waste collection, illegal dumping monitoring, recycling programmes, community participation, and environmental awareness campaigns. The key challenges identified include increasing waste generation, low public awareness on recycling, illegal dumping, high operational

costs, the need for efficient waste segregation, and the need to maintain public cleanliness. These challenges are common among cities that seek to reduce landfill pressure and increase recovery rates.

The city's best practice is its Community Recycling System and Drive-Through Recycling Centre. The objective is to make recycling easier, faster, and more attractive for the public by providing accessible drive-through recycling facilities with incentive mechanisms. Residents can drive in with recyclable materials, have their materials weighed and sorted, receive cash or tokens based on the weight and type of items, and allow the materials to be sent to recycling industries. Accepted recyclables include paper, plastic, metal, cardboard, electronic waste, used cooking oil, aluminium, and cans.



CHALLENGES

Kota Bharu's main challenges are changing community behaviour, improving the quality of waste segregation, maintaining consistency of public participation, strengthening the market value of recyclables, and sustaining operations over time. These challenges show that recycling programmes depend not only on facilities, but also on behavioural incentives, routine service delivery, public trust, and stable links with recycling markets.



STRATEGIES

To address these challenges, Kota Bharu applies several strategic directions:

- Providing accessible drive-through recycling centres to make participation easier for residents.
- Using cash or token incentives to encourage continuous recycling behaviour.
- Combining recycling facilities with public awareness and environmental education campaigns.
- Supporting community campaigns, school programmes, private-sector partnerships, and non-governmental collaboration.

- Planning future expansion through digital incentive systems, smart recycling technologies, smart-bin monitoring, and circular economy integration.



LESSONS

Kota Bharu offers several lessons for cities preparing or scaling IRRC systems:

- Upstream recycling access improves the quality of materials entering recovery systems.
- Incentive mechanisms can motivate behaviour change when they are simple and visible.
- Convenient facilities encourage residents to participate more consistently.
- Community engagement and education are essential for sustained recycling behaviour.
- Partnerships with stakeholders strengthen recycling programmes and future circular economy systems.



Inter-municipal cooperation for organic waste management and community

 **Chanthaburi, Thailand**

Chanthaburi provides a relevant practice-sharing case for cities seeking to develop or scale Integrated Resource Recovery Centre systems because it demonstrates how a small municipality can manage a larger waste-service responsibility through inter-municipal cooperation. While Chanthaburi is not presented

as an Integrated Resource Recovery Centre reference case, its experience is highly relevant for IRRC development because it shows how shared facilities, local administrative cooperation, organic waste management, and community participation can reduce the need for fragmented disposal systems.

Chanthaburi Town Municipality is located in Chanthaburi Province in eastern Thailand. The municipality was established in 1935 and covers approximately 10.25 square kilometres, with a registered population of around 20,059 people. Despite its relatively small administrative size, the municipality carries a wider waste-management responsibility. Its central facility handles approximately 296 tonnes of municipal solid waste per day and serves around 48 Local Administrative Organisations through a Memorandum of Understanding.

This cluster model is one of the strongest lessons from Chanthaburi. Instead of each local government operating a separate dumpsite or disposal system, a shared facility provides a more coordinated approach to waste treatment and environmental management. The model helps spread costs, improve service standards, and reduce the risks associated with many small, poorly

managed disposal sites. For cities developing IRRRC systems, this is important because resource-recovery infrastructure may become more viable when several local governments cooperate around one facility, shared operations, and common service arrangements.

Chanthaburi also combines facility management with community-based practices. Its organic waste initiatives include the use of fresh-market vegetable and fruit scraps for fermented bioliquid and bio-fertiliser. Household wet-waste bins encourage residents to separate food scraps at source, while school waste banks build waste-separation habits among students from an early age. Community waste banks, local environmental volunteers, bulky-item collection, Big Cleaning Days, and community care for the Chanthaboon Waterfront heritage quarter further show how municipal waste management can be linked with public participation and place-based stewardship.



CHALLENGES

Chanthaburi's main challenge is managing waste beyond its own municipal boundary while maintaining consistent service quality, public participation, and environmental standards. Serving many Local Administrative Organisations requires coordination, shared commitments, and operational discipline. The municipality must also ensure that community programmes remain routine and that organic waste is separated properly before entering wider treatment and disposal systems.



STRATEGIES

To address these challenges, Chanthaburi applies several strategic directions:

- Operating a central waste facility that serves multiple Local Administrative Organisations.
- Using Memoranda of Understanding to support inter-municipal cooperation.
- Promoting organic waste recovery from fresh markets, households, and community sources.
- Strengthening school waste banks and community waste banks to build separation habits.
- Supporting routine participation through bulky-item collection, Big Cleaning Days, and environmental volunteers.

**LESSONS**

Chanthaburi offers several lessons for cities preparing or scaling IRRRC systems:

- Small municipalities can manage larger waste responsibilities through shared facilities.
- Inter-municipal cooperation can make resource-recovery infrastructure more viable.
- Organic waste management should be linked to markets, households, and schools.
- Routine participation is more effective than one-off awareness campaigns.
- Cooperation itself is infrastructure when it enables shared operations, cost distribution, and higher service standards.

KEY LESSONS



What Cities Need to Consider before Developing an Integrated Resource Recovery Centre

The city experiences presented in this Learning Note show that an Integrated Resource Recovery

Centre is most effective when it is developed as part of a wider municipal waste-management system. For cities planning similar facilities, the main lesson is clear: infrastructure alone will not solve waste-management challenges.

Successful implementation depends on how well cities connect source segregation, collection systems, community institutions, treatment facilities, recovered-material markets, financing, and long-term operation.

An Integrated Resource Recovery Centre cannot function as a stand-alone facility

An Integrated Resource Recovery Centre should not be planned only as a building, machine, or treatment plant. It must be connected to the full waste chain, from households and markets to collection routes, waste banks, community-based waste-management groups, composting, maggot cultivation, recycling, residual treatment, and landfill management. If these links are weak, the facility may receive mixed and contaminated waste, making operations more expensive and less effective.

Source segregation determines technical performance

The quality of waste entering the facility determines the quality of products leaving it. Cities that want to develop resource-recovery facilities need to strengthen household sorting, market waste separation, community collection, and clear waste-stream categories before full operation begins. Without segregation at source, compost, maggot products, recyclables, refuse-derived fuel, and other recovered materials become harder to produce, market, and sustain.

Organic waste is a strategic entry point for landfill reduction

Many cities in the region have a high proportion of organic waste. This makes organic waste management a practical starting point for Integrated Resource Recovery Centre development. Composting, Black Soldier Fly maggot cultivation, biodigestion,

and other biological treatment methods can reduce the volume of waste sent to landfill while creating useful products. However, feedstock quality, processing capacity, odour control, product quality, and market absorption must be planned carefully.

Governance and operator models must be clear from the beginning

Cities need to define who owns, operates, finances, monitors, and maintains the facility. The roles of local government, community groups, public enterprises, private partners, waste banks, informal actors, and offtakers should be clarified before construction. Strong regulations, standard operating procedures, institutional coordination, and accountability mechanisms are essential to

prevent facilities from becoming underused or poorly maintained.

Financial sustainability depends on public value, not only product sales

Integrated Resource Recovery Centres may generate income from compost, maggot products, recyclables, refuse-derived fuel, service fees, or retribution systems. However, many facilities also provide public-service benefits that are not fully captured by revenue. Reduced transport costs, lower landfill pressure, improved sanitation, fewer emissions, and cleaner neighbourhoods should be considered part of the value proposition. Cities therefore need realistic financing models that combine municipal funding, user fees, product markets, private-sector support, and partnerships.

THE WAY AHEAD



A Roadmap for Cities Developing Integrated Resource Recovery Centres

The experiences presented in this Learning Note point to a clear direction: cities that want to develop Integrated Resource Recovery Centres must begin by looking at the whole waste-management system, not only at the facility they plan to build. An

Integrated Resource Recovery Centre can help reduce landfill dependency, recover materials, process organic waste, and support circular economy development. However, it will only work if it is connected to source segregation, collection

systems, community institutions, technical operations, offtaker markets, financing, and long-term governance.

The way ahead is therefore not simply to construct more waste-processing infrastructure. Many cities already have parts of the system in place: waste banks, community-based waste-management groups, composting facilities, maggot cultivation, 3R facilities, material recovery facilities, recycling actors, landfill operators, public campaigns, and local regulations. The main challenge is to connect these parts into a coherent system that allows waste to be separated, collected, processed, recovered, reused, and safely managed. For cities planning an Integrated Resource Recovery Centre, the first task is to understand what already exists and where the gaps remain.

First, cities need to map their waste system before deciding on the design of the facility. This includes the amount of waste generated, the composition of

waste, major generation points, collection routes, existing community initiatives, landfill capacity, available land, potential operators, and possible markets for recovered products. Without this baseline, cities may build facilities that are too large, too small, poorly located, or disconnected from the actual waste flow. Mapping should also identify which waste streams are suitable for composting, maggot cultivation, biodigestion, recycling, refuse-derived fuel, solid recovered fuel, or final disposal.

Second, cities need to strengthen segregation at source before scaling up treatment capacity. An Integrated Resource Recovery Centre cannot perform effectively if most waste arrives mixed and contaminated. Household segregation, market-waste separation, institutional waste management, hotel and restaurant participation, school programmes, and community collection systems should be developed before full facility operation. Clear categories are needed, especially for food waste, dry recyclables,

residual waste, and household hazardous waste. The better the segregation system, the more reliable the facility's output will be.

Third, cities should build strong links between the Integrated Resource Recovery Centre and community-based systems. Waste banks, community groups, neighbourhood operators, informal workers, schools, local volunteers, and village or ward-level institutions are not secondary actors. They are part of the operational foundation. They can support public education, collection discipline, waste sorting, local monitoring, fee collection, and behaviour change. Cities should therefore design Integrated Resource Recovery Centres as part of a community-connected system rather than as isolated municipal infrastructure.

Fourth, organic waste should be treated as a strategic entry point. In many cities, organic waste forms a large share of the municipal waste stream and contributes significantly to odour, leachate, landfill pressure,

and greenhouse-gas emissions when unmanaged. Composting, maggot-based bioconversion, biodigestion, and other biological treatment methods can reduce the volume of waste sent to landfill while producing useful outputs. However, these systems require stable feedstock, good handling practices, odour control, quality assurance, and clear users for compost, maggot products, digestate, or other outputs.

Fifth, cities must define the right scale and location. Not every city needs a large facility at the beginning. Some contexts may require a small pilot linked to a market, a neighbourhood, a group of villages, or a high-density waste-generation area. Others may need a city-scale facility or an inter-municipal model serving several local governments. Location should be based on access to waste sources, available land, transport efficiency, environmental safeguards, community acceptance, and proximity to potential users or offtakers. A facility that is technically sound but poorly

located may create high transport costs and operational difficulties.

Sixth, governance and operator arrangements must be clarified early. Cities need to determine who owns the facility, who operates it, who maintains equipment, who pays operational costs, who collects fees, who manages product sales, and who is accountable for performance. Local governments may act as regulators, owners, financiers, or service providers, but these roles should not be confused. Community groups, public enterprises, private operators, cooperatives, and technical partners may also be involved. Clear mandates, contracts, standard operating procedures, performance indicators, and monitoring systems are essential.

Seventh, financial planning must be realistic. Product sales alone are rarely enough to sustain an Integrated Resource Recovery Centre. Compost, maggot products, recyclables, refuse-derived fuel, or solid recovered fuel may generate income, but the

wider public value is often more important. Cities should calculate avoided transport costs, reduced landfill pressure, improved sanitation, lower emissions, cleaner neighbourhoods, and longer landfill lifespan. A practical financing model may combine municipal budget support, waste retribution, tipping fees, product sales, private-sector partnerships, corporate social responsibility, development-partner support, climate finance, or blended financing.

Eighth, offtaker networks should be prepared before production increases. Resource recovery only becomes circular economy when recovered products are actually used. Compost needs farmers, parks departments, landscaping units, schools, or urban agriculture programmes. Maggot products need livestock, poultry, aquaculture, or feed-sector users. Recyclables need aggregators and recycling industries. Refuse-derived fuel and solid recovered fuel need industrial users with quality requirements. Without offtakers, recovered materials may

accumulate without economic value.

Ninth, cities should start with pilots and scale gradually. Pilot facilities or demonstration sites can test feedstock quality, technology choice, operating procedures, community participation, cost structure, market demand, and environmental safeguards. These pilots should be evaluated honestly before expansion. A successful pilot can then inform replication across neighbourhoods, districts, markets, tourism areas, or inter-municipal clusters. Scaling up should be based on evidence, not only ambition.

Finally, cities should use regional learning for adaptation, not imitation. The experiences of Padang, Jambi, Malang, Banyumas, Bontang, Mataram, North Minahasa, Kota Bharu, Chanthaburi, and other participating cities show that there is no single model for Integrated Resource Recovery Centre development. Each city

has different waste composition, land availability, fiscal capacity, institutional structure, community behaviour, and market access. The value of regional learning lies in understanding how different cities solve specific problems, then adapting relevant elements to local conditions.

For cities seeking to move from disposal dependency towards circular solid waste management, the Integrated Resource Recovery Centre should be seen as a system connector. It links households with operators, organic waste with productive use, recyclables with markets, residual waste with safer treatment, and municipal services with community participation. The future of urban waste management in Asia and the Pacific will depend on whether cities can make this connection work. When planned carefully, an Integrated Resource Recovery Centre can become more than a waste facility. It can become a practical platform for cleaner cities, lower emissions, stronger communities, and a circular urban economy.





Regional
Learning Note

#5

Scaling Up Integrated Resource Recovery Centres for Circular Solid Waste Management:

Strategies and Lessons from
Asia-Pacific Cities

