



TRAINING MANUAL 2 ISWM TECHNOLOGY APPLICATION

Module 2-3: Recycling



Prepared by the International Consortium
GTZ-ERM-GKW



Recycling is a term that refers to the reprocessing of non-organic waste materials into products. Recycling therefore involves managing discarded materials not as "waste" but as "resources". Recycling falls within a very high rank in the hierarchy of ISWM.



RECYCLING PROCESS

There are two basic forms of recycling processes:

- Material recovery for manufacturing
- Energy recovery to regain the energy

Regardless of the method used to collect the recyclables, the next step is usually the same:

- Recyclables are sent to a recovery facility to be sorted and prepared into marketable commodities
- Recyclables are bought and sold just like any other commodity, and prices for the materials change and fluctuate with the market.

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Recycling is the turning of materials, that would otherwise become waste, into valuable resources and thus generating environmental, financial, and social benefits.

There are two basic forms of recycling processes:

Material recovery for manufacturing

Energy recovery to regain the energy

This Training Module deals only with the material recovery of waste. Therefore within this module recycling is a term that refers to the reprocessing of non-organic waste materials into products. Recycling involves managing discarded materials not as "waste" but as "resources". The benefits of this approach include job creation in the recovery and utilization of recyclable materials, creation of a local resource base for manufacturing and stimulation of new industrial enterprises. In addition, the removal of recyclable materials from the waste stream also serves to remove inorganic materials from the waste stream; this can facilitate the composting of remaining (organic) waste although the removal of remaining non-compostable materials should still be undertaken before composting.

For recycling to work, everyone has to participate in each phase of the loop. From government and industry, to organizations, small businesses, and people at home, everybody can make recycling a part of his daily routine:

Shop smarter. Use products in containers that can be recycled in your community and items that can be repaired or reused.

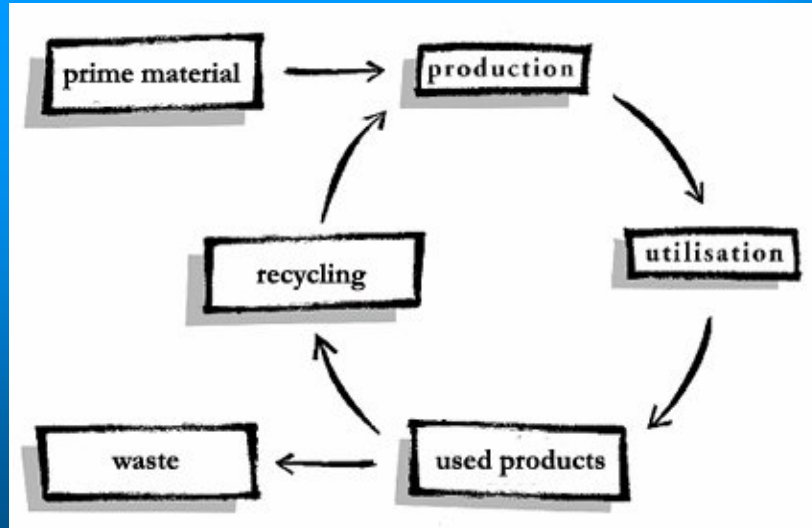
Recycle at home and at the place you work. Find out if there is a recycling program in your community. If so, participate in the program by separating and putting out your recyclables for curbside pickup or taking them to your local drop-off or buy-back centre.

Shop smarter, support recycling markets by buying and using products made from recycled materials.

Source reduction, often called waste prevention, means consuming and throwing away less. Source reduction includes purchasing durable, long-lasting goods and seeking products and packaging that are as free of toxics as much as possible. It can be as complex as redesigning a product to use less raw material in production, have a longer life, or be used again after its original use is completed. Because source reduction actually prevents the generation of waste in the first place, it is the most preferable method of waste management and goes a long way toward protecting the environment.

Source reduction is dealt with in the Training Module 2-1 :“Waste Minimization”

HOW DOES RECYCLING WORK?



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Recycling involves the separation and gathering of waste materials, the preparation of these materials for reuse, reprocessing and remanufacture at MRF, and the reuse, reprocessing and remanufacture of these materials by industries. It is an important factor to reduce the demand on natural resources and the amount of waste requiring disposal by landfilling.

The recycling cycle is as follows:

Extraction and exploitation of prime materials to be ready for processing

Processing and manufacturing of the materials into goods

Utilization of goods by consumer

Separation of the used packaging and the used goods (used products)

Recycling of valuable materials in such a way to turn them into new products and enter the cycle again

Non valuable waste residues are disposed of.

By entering the cycle, used products, which would have otherwise become a waste, will minimize the quantity of waste destined for disposal.

Clearly, not all secondary materials can be recovered in a technically or economically efficient way, and not all secondary materials have a high market value. Materials recovery has to be seen as just one component of an Integrated Municipal Solid Waste Management System. Aluminium (cans) usually lends itself to recovery, if related industry (the most obvious customer for scrap aluminium) is located in the vicinity.



RECYCLING LOOP PROCESS

Step 1. Recovery and Collection

There are several recovery and collection methods, pending also on the living standard of the country

Step 2. Processing

Recyclables are sent to a materials recovery facility to be sorted and prepared into marketable commodities for manufacturing

Step 3. Manufacturing

More and more of today's products are being manufactured with total or partial recycled content.

Step 4. Purchasing Recycled Products

Purchasing recycled products completes the recycling loop

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Step 1. Recovery and Collection, Collecting recyclables varies from community to community, but there are four primary methods: curbside, drop-off centers, buy-back centers, and deposit/refund programs. Regardless of the method used to collect the recyclables, the next step is usually the same.

Step 2. Processing, Recyclables are sent to a material recovery facility to be sorted and prepared into marketable commodities for manufacturing. Once separated, recyclables are bought and sold just like any other commodity, and prices for the materials change and fluctuate according to market demand.

Step 3. Manufacturing, Once cleaned and separated, the recyclables are ready to undergo the second part of the recycling loop. Products are being manufactured with total or partial recycled content. Common household items that are partially or totally made of recycled materials include newspapers and paper towels; aluminum, plastic, and glass soft drink containers; steel cans; and plastic detergent bottles. Recycled materials also are used in innovative applications such as recovered glass in roadway asphalt or recovered plastic in carpeting, park benches.

Step 4. Purchasing Recycled Products completes the recycling loop. By buying goods made of recycled materials, government, businesses and individual consumers, play an important role in making the recycling process a success. As consumers demand more environmentally sound products, manufacturers will continue to meet that demand by producing high-quality recycled products.

ADVANTAGES OF RECYCLING

- Recycling falls within the second highest rank in the hierarchy of integrated solid waste management.
- Every tonne extracted from the waste stream means that there is a tonne less that needs to be managed by the MSWM system.
- Recycling plays a critical role in reducing waste quantities, returning resources back to use, and minimising the financial and environmental burden of MSWM
- Recycling will become even more critical as quantities of waste, and in particular consumer packaging, increase.

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There are many advantages associated with a functioning materials recovery system even if it is located in the informal economy. Naturally, not all systems function in the same way in all cities, and not all cities are equally favourable in their conditions to host a thriving secondary materials economy. There are examples of countries where recycling markets are being saturated by imported materials, undercutting local secondary materials suppliers, and seriously injuring the local recovery economy, but a number of prominent benefits and reasons to support the existing system can be found practically everywhere.

Advantages of recycling are:

Recycling falls within the second highest rank in the hierarchy of ISWM. The hierarchy starts with source reduction at the top followed by reuse and recycling, treatment, and finally disposal. The more we go towards the bottom in this hierarchy chain, the more it becomes difficult and costly to treat and dispose of the waste.

Every tonne extracted from the waste stream means that there is a tonne less that needs to be managed by the MSWM system. Recycling and composting activities (recycling of organic material) prevent tons of material from ending up in landfills or incinerators. The more we recycle, the more we reduce our final disposal bill.

Recycling plays a critical role in reducing waste quantities, returning resources back to use, and minimising the financial and environmental burden of MSWM. Recycling has grown especially for specific materials such as paper, plastic bottles, aluminium cans, steel packaging, and major appliances.

Recycling will become even more critical as quantities of waste, and in particular consumer packaging, increase. With the raising of the living standard also the amount of generated waste raises. Besides some industries, if they are not controlled by corresponding regulations, tend to increase the packaging volume, to make their products appear more attractive.



BENEFITS OF RECYCLING

There are many benefits associated with a functioning materials recovery system:

- Savings through reduction of waste for disposal
- Extension of lifetime of landfills through saving spaces
- Conservation of natural resources
- Reducing emissions of greenhouse gases and of water pollutants from the landfills
- Supplying valuable raw materials to industry and saving of energy to produce new primary material
- Creation of jobs

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There are many benefits associated with a functioning materials recovery system:

Savings incurred through reduction of weight and volume of municipal waste for collection and final disposal: Waste pickers and small scale materials recovery enterprises play an important role in reducing the amount of waste requiring collection, transport and disposal by the local government. This in turn can help the municipality to incur substantive savings in the cost of their services.

Extension of service life of landfills through savings in void space: As a direct result of the reduction of volume of waste for final disposal through materials recovery, the life time of landfills servicing the municipality is extended, which, again, leads to savings to the municipality through a reduced requirement for investment in new facilities.

Conservation of natural resources: Materials recovery reduces the quantity of raw materials needed in the production process of primary industries. Paper, plastics and metals can be returned to the production process and reduce the input of wood, oil and ore for production.

Reducing emissions of greenhouse gases and of water pollutants from the landfills. Emissions of gas, leachate, litter, vermin and others are a big concern for every landfill operator. Every tonne less on the landfill is a tonne less that has the potential to produce emissions.

Recycling of wastes provides secondary raw materials to manufacturing industries and reduces the exploitation level of natural resources and consequently the level of pollutants generated from its processing. Aluminium recycling is the most prominent example, substantial energy savings can be made via recycling of scrap aluminium, which again leads to savings in fuels and other energy resources. **Savings on foreign currency through reduced reliance on materials and energy imports:** In very well functioning nation-wide materials recovery system, where large proportions of secondary materials are recovered, savings in foreign currency can be made as the volume of imports of some of the primary inputs to production can be substituted by internally recovered secondary materials.

Creation of employment and income: Poverty and unemployment are the main reason why people choose to enter the materials recovery sector. The recovery economy gives work to large numbers of otherwise unemployed workers who therefore do not need to resort to begging or crime for subsistence. Additionally, informal recovery systems cautiously moved into "formality" may well become tax-paying enterprises in the medium term future.



RECYCLING IN THE METAP REGION

The focus should be to support and build on the existing informal materials recovery sector. In devising a Strategic MSWM Plan, care needs to be taken to ensure that the growth of the existing recycling system is sustained because:

- In many countries an informal or semi-formal materials recovery and recycling system operates alongside the waste collection service
- Thriving secondary materials markets and recovery schemes are well established in most developing countries.

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Recycling in the METAP-Region needs to focus on the fact that we need to build on the existing material recovery systems and work to improve them. While developing a SWM plan, care should be taken to include formal and informal recycling systems into consideration. Markets for recycled products exist in most countries; consequently, fear from unavailability of market for recovered materials from the waste must vanish.

Recyclable materials comprise in the range of 20 - 30 percent by weight of the wastes generated in METAP RSWMP countries. The materials are diverse: different types of paper and paperboard, various plastics, various metals and glass of different colours make up the majority of recyclable materials, with other materials such as textiles and wood making up smaller percentages.

There are several ways that enhanced recovery of recyclable materials might be achieved in the region:

The provision of incentives (i.e. payment) for specific recyclable materials. This will generally produce the highest quality recyclable materials since only those that meet the standard set to receive the incentive will be accepted.

Install separate collection and sorting systems for specific wastes that can be started at large producers of recoverable waste like supermarkets, commerce, factories, administration buildings and later be extended with drop-off centers in selected residential and commercial areas.

These approaches are not mutually exclusive. The issue of which type of recycling system or combination of approaches may best be suited to a particular city will depend on the level of informal sector recycling activity already being undertaken, and the options available for financing and cost recovery.

Specific urban recycling activities could be enforced by regulations such as:

- construction and demolition waste recycling,
- used motor oil recycling.

These are very interesting recycling market segments, because of the volume the first and the danger for groundwater the second.

However, the value of a material is related to its quality and the market into which it is sold. The highest quality materials are clean and not contaminated with other recyclable or non-recyclable materials, and are materials for which a market exists that requires high quality inputs. Contaminated materials and/or materials sold into markets with low quality specifications command low prices. There are global markets for many recyclable materials.



INFORMAL RECYCLING SYSTEMS

- Newspapers, cardboard and metals are collected from door to door in three-wheeler bicycle carts
- Waste collectors spend perhaps 30- 50% of their time sorting saleable materials from the refuse, both at the collection point and during transport
- Communities of 200 to 500 families on each of the dump sites depend for their livelihood on waste picking
- All of these people sell to dealers, who often perform some simple sorting and clearing of the recycled materials
- Itinerant buyers sell to the wholesalers who distribute up the dealer chain to primary industries.

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Across the region recycling is undertaken by the "informal" sector. Lots of communities in the METAP region depend on informal scavenging activities for their livelihood. Also this informal collection system appears in many cases to be not well organised, somehow it works. Waste pickers sell to small dealers, who in turn sell to large scale dealers that sell the recyclable materials to the recycling industries.

The extent of this activity is not well understood in many countries, and may vary widely within a country. However, in some cities (e.g. Cairo) the recycling activities of the informal sector remove virtually all the recyclable materials from the waste generated from at least some parts of the city. Recovered materials may be sold through a network of dealers before being sold to an end-user.

Opportunities exist to increase the amount or raise the quality of materials recycled in the METAP RSWMP region. However, the design of new initiatives should be sensitive to those who presently earn their livelihoods from recovering and recycling materials in the waste stream. It makes no sense to implement new recovery systems that simply duplicate - at significant expense - what is already being done, and disrupting the livelihoods of those who are already recovering and recycling materials.

Collection and merchandising of recyclable waste could be delegated by the municipalities to private groups, which will therefore become an official character. As the public standing of the informal sector is rather low, the establishment of a Formal Recycling Sector on private basis with a skilled administration will raise their acceptance by large waste producers like institutions, hospitals, industry and commerce.

The collectors are merged into groups based on family structures or in cooperatives which do all activities, from collection to separation and from transportation to selling to reprocessing companies. Different groups should have the possibility to found an official organization which can be the negotiating partner of the municipalities and industries. Besides, the official character brings some protection and rights to the participants and they will also have some duties. Together with the license for the collection of separately placed recyclable wastes, there is an obligation that all ready-placed goods have to be collected and the storage space has to be cleaned.

Generally, the system brings positive income for the groups and has no negative effects on the environment and it can be a source of new employments for youth as well as for skilled jobless. As the participants already are in a functioning self-grown recycling system they know the necessity of quality materials, but they need an organization for management, market logistic and successful selling of the collected goods.



INFORMAL RECYCLING SYSTEMS

Supporting of the informal sector with infrastructure, proposals and advice can be done by:

- Providing incentives through legislation
- Setting up links with international and national organizations to finance recycling projects
- Voluntary efforts for source separation on behalf of households
- Setting up selective means of collection for different types of materials
- Setting up of adequate infrastructure for collection, treatment and marketing of recovered materials
- Promoting the use of recycled products

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In order to make these informal recycling systems work properly and efficiently, efforts should be made to:

Provide incentives (through legislation if possible) to encourage the construction and operation of recycling facilities, provide guidelines and norms for waste management activities, assist local waste management agencies, issue permits for facilities, etc.

Set up links with international (World Bank, European Union, etc.) and national organizations (local and national NGOs) to finance communities recycling projects

Promote voluntary efforts for source separation on behalf of households. Start improving the system by initiating sorting at source.

Set up selective means of collection for different types of materials (to improve quality)

Set up of adequate infrastructure for collection, treatment and marketing of recovered materials. If one of these components is not available, the system will fall apart.

Promote the use of recycled products.

ADVANTAGES OF SOURCE SEPARATION

In this system, recyclable materials are separated from the rest of the waste at the source of generation. It is an effective way to improve the performance of all the remaining components in the waste management system. The driving force for choosing a source separation option is:

- improved effectiveness of recycling,
- improved quality of the recovered material,
- decreased costs of recycling,
- higher market value

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Source separation is beneficial and essential for the success of an integrated solid waste recycling system. This can be done by separating the waste at the source either into dry and wet components, or separating each component of the waste into an individual storage container.

The practices of source separation improve the recycling process, improve the quality of the recovered materials, decrease the costs dedicated for landfilling, and improve the market values of the recovered material. The separation of solid waste components including wastepaper, cardboard, aluminum cans, glass, and plastic containers at the source of generation is one of the most positive and effective ways to achieve the recovery and reuse of materials .

The municipalities should support the recyclers with advices and infrastructure and urge the public institutions, the administration departments, hospitals and other sectors to separate the recyclable wastes for distinct collection. And the municipalities should as well urge large private waste producers like supermarkets, stores or private companies to place the different wastes separately. There should be an easy access for the groups to collect wastes from where they are stored, same as for the ordinary collection teams. Thanks to those efforts, separation can be easily achieved and the recycled goods are nearly unpolluted.



COLLECTION OF SOURCE SEPARATED RECYCLABLES

Collecting source separated recyclables varies from community to community, but there are five primary methods:

- Curb side collection (Haul system)
- Drop off points or containers (Bring system)
- Drop off centres (Bring system)
- Buy-back centers (Bring system)
- Deposit/refund programs (Bring system)

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To achieve clean and not contaminated materials, wastes should therefore be sorted into recoverable components and non-recoverable residual wastes on the source where they occur, and be collected and channelled separately into the recycling process. There are several primary methods to collect sorted waste such as:

Curb side collection (Haul system). Waste materials are separated at the source. Then they are collected or gathered by collectors at the curbside or by specially designed collection vehicles delivered to the drop-off centres.

Drop off points or containers (Bring system). Drop-off points at shopping centres and supermarkets to encourage the participation of the community.

Drop off centres (Bring system). Requires residents or businesses to separate recyclable materials at the source and bring them to specified drop-off centres.

Buy-back centres (Bring system). Provides a monetary incentive to participate. In this type of program, the residents are paid for their recyclables either directly or indirectly through a reduction in monthly collection and disposal fee.

Especially drop-off centres for valorisable wastes could be a very interesting first step toward separate collection.

Twenty years ago, only one curbside recycling program existed in the United States, which collected several materials at the curb. By 1998, 9,000 curbside programs and 12,000 recyclable drop-off centres had sprouted up across the US and as of 1999, 480 materials recovery facilities had been established to process the collected materials.

While recycling has grown in general, recycling of specific materials has grown even more drastically: 42 percent of all paper, 40 percent of all plastic soft drink bottles, 55 percent of all aluminium beer and soft drink cans, 57 percent of all steel packaging, and 52 percent of all major appliances are now recycled in the US.



SOURCE SEPARATION WITH CURBSIDE COLLECTION

In this system, recyclable materials are separated from the rest of the waste at the source and presented to the collectors at the curbside.

For an Integrated Municipal Waste Management Plan the feasibility and applicability of:

- sorting of waste at source; and
 - collecting sorted waste
- have to be examined.



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In a curbside collection system, source separated recyclables are collected separately from commingled waste at the curbside, alley, or commercial facility. Because residents and businesses do not have to transport the recyclables any further than the curb, participation in curbsides programs is typically much higher than for drop-of programs. Curbsides programs vary greatly from community to community. Some programs require residents to separate several different materials e.g., newspaper, plastic, glass and metals, which are then stored in their own containers and collected separately. Other programs use only one container to store commingled recyclables, or two containers, one for paper and the other for “heavy” recyclables, such as glass, aluminum and tin cans.

SOURCE SEPARATION WITH DROP OFF CONTAINERS

In this system, recyclable materials are separated at the source and brought by the generator voluntarily to a Drop off Point with several containers for different wastes.



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In the drop-off containers system, source separated recyclable materials are brought to a drop off point whereby one or several containers are placed for the deposition of different kinds of wastes. Usually, a container is designated for each specific kind of waste. The openings of such containers are designed to suit the shape of the source separated waste material. For example, newspapers drop off containers have wide horizontal openings whereas glass bottle containers have rounded small sized openings.



SOURCE SEPARATION WITH DROP OFF CENTRES

In this system, recyclable materials are separated at the source and brought by the generator voluntarily to a Drop off Centre or Dechetterie.

A Drop off Centre is a managed enclosed space to receive, storage and transfer specific types of valorable waste fractions.

Once disposed of by the generator, these valorable materials are sorted, prepared, stocked and packed in order to transfer them to recyclers.

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The drop off center is also called dechetterie. It is a recyclable collection center for the voluntary deposition of materials that are either sorted at source or are not taken away by the door to door collection service.

To encourage public involvement, most successful programs have made drop-off centers conveniently located with respect to the population to make them as useful as possible. For example, drop-off points are located near shopping centers and supermarkets or other convenient and common places.



SOURCE SEPARATION WITH DROP OFF CENTRES

The shown drop off centre consists of containers for the different recyclable materials, an area for green-cut for composting and offers also compost for sell



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Slide showing a drop off center, located on the outskirts of a town and consisting of containers for the different recyclable materials, an area for green-cut for composting and offers also compost for sell (in the centre of the picture).



RECOVERY OF RECYCLABLES FROM THE WASTE STREAM

If for organisational reasons separating recyclable materials at the source is not practicable, the recovery of certain valuable waste fractions from the total waste stream is practiced:

- Informal material recovery and recycling systems operate alongside the waste collection service
- Manuel material recovery is exercised on the dump sides or transfer stations
- Semi manual or mechanised recovery from the waste-stream is practiced in Materials Recovery Facilities

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If for organisational reasons separating recyclable materials at the source is not practicable, the recovery of certain valuable waste fractions from the total waste stream is practiced:

Informal material recovery and recycling systems operate alongside the waste collection service

Manuel material recovery is exercised on the dump sides or transfer stations

Semi manual or mechanised recovery from the waste-stream is practiced in Materials Recovery Facilities (MRF). This can be done at a central processing plant through mechanical and/or hand sorting.

This recovery of recyclable materials from mixed waste following collection will generally produce poorer quality recyclable materials since they are likely to be contaminated with non-recyclable materials, but these materials will still command a value in the market place that will offset the costs of recycling.



MATERIAL RECOVERY AT LANDFILL

- Generally, the only people that should be allowed entry to a landfill site are those employed to manage the site and those bringing waste to the site
- But communities of several hundred families on the dump sites depend for their livelihood on waste picking
- Waste pickers may therefore be allowed entry to the site, in which case a system of licensing waste pickers may be adopted that can require pickers to use basic protective equipment, provide them basic sanitary facilities and a system of preventing accidents between waste pickers and vehicles at the site.

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Generally, the only people that should be allowed to enter a landfill site are those employed to manage the site and those bringing waste to the site. But if communities of several hundred families on the dump sites depend for their livelihood on waste picking, socially acceptable solution must be found and waste pickers may therefore be allowed entry to the site. For such cases a system of licensing waste pickers may be adopted that may also require to provide them:

basic protective equipment,

basic sanitary facilities,

measures of preventing accidents between waste pickers and vehicles.

Also a special area in front of the landfill can be adapted for waste sorting. The remaining waste rejects are afterward hauled away to the filling point at the landfill for final deposition.

Revenues from recyclable materials can vary widely over short periods of time. Contracts with service operators should ensure that waste pickers benefit from high market prices while at the same time ensuring that they do not unduly suffer during times of depressed market prices. Contracts should include formulae regarding how fluctuations in market price will be managed.



MATERIAL RECOVERY AT LANDFILL



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The slide shows waste pickers loading the recovered materials on a truck for transport to the recycling industries.



MATERIAL RECOVERY FACILITY

Material recovery facilities consist of treating and sorting facilities that are important elements of an ISWM as they are designed to separate the waste component into different useful streams which can be used/disposed of in the most environmentally suitable and economical manner.

Operation units used for the separation and processing of waste are designed to remove specific components and contaminants from the waste stream and process and prepare the separated materials for efficient recycling or disposal.

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The term “Material Recovery Facility” (MRF) is used to refer to a facility where recyclable materials are recovered from waste and/or processed prior to being sold to an end-user. The term does not refer to a manufacturing facility where the recyclable material is used to make a product. A wide variety of “recovery facilities” are possible ranging from simple depots to facilities for sorting recyclables. Which types of facility are appropriate for any situation will depend on the recycling system design.

Depending of the purpose of the facility, sorting plants are designed to separate the waste into several components: recyclables, organic materials, and waste rejects. These components will then be used, transformed or disposed of in the most environmentally suitable and economical manner. Processing often includes the separation of bulky items, separation of waste components by size using screens, manual separation of waste components, size reduction by shredding, separation of ferrous metals using magnets, volume reduction by compaction, and combustion.

MRFs are also used for commingled MSW to remove contaminants from the waste and to prepare the waste for subsequent uses such as a fuel for combustion facilities or a feedstock for composting facilities.

Commingled MSW are discharged in the receiving area. Recyclable, reusable, and oversized materials such as cardboard, lumber, white goods and broken furniture are removed in first stage presorting operation before the commingled waste is loaded on to an inclined conveyor. Additional cardboard and large items are handpicked from the conveyor at the second-stage presorting station as the waste material is transported to the bag opening station. The next step in the process involves the first stage of manual separation of specific waste materials. Materials typically removed include:

- paper,
- cardboard,
- all types of plastic,
- glass and
- metals.

Material remaining on the conveyor is discharged into a trommel screen for size separation. The oversized material is sorted manually a second-time. Depending on the extent of the first- and second-stage sorting operations, the undersized material coming out from the trommel and the material remaining after the second-stage sorting operation are hauled away for disposal in a landfill, combusted, or used to produce compost.

MATERIAL RECOVERY FACILITY



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TRAINING MANUAL 2 – MODULE 2-3



A material recovery facility include the following basic elements:
feeding conveyor,
trommel screen,
conveyor belt, sorting table, and
baling presses.

The slide shows the picking line and dropping points for recyclable materials alongside the conveyor belt.



MATERIAL RECOVERY FACILITY

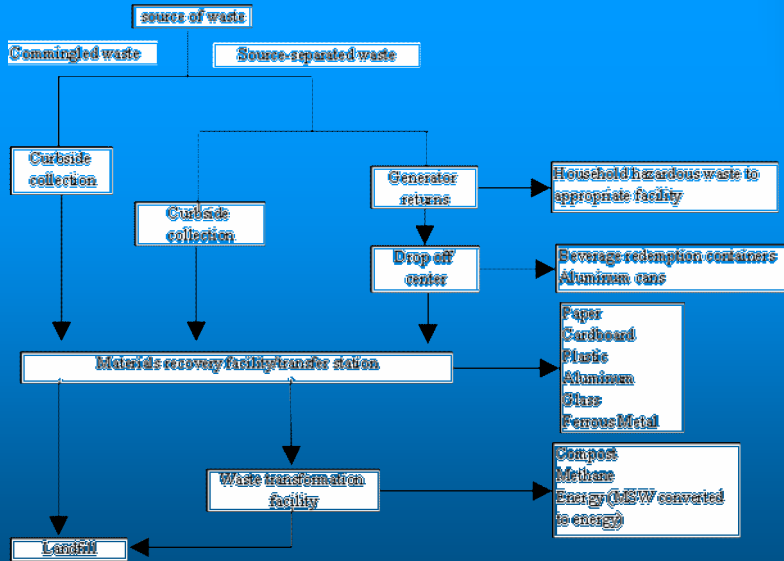


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The slide shows recovered materials (mainly plastics) in the boxes under the dropping points alongside the conveyor belt.

RECYCLING FLOW SYSTEM



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The shown slide is self explanatory. It describes the flowchart or the path for the recyclable materials under two different systems: Commingled waste and source separated waste.

Recycling can take the form of either material recovery (recyclables and organic material) or energy recovery (from the thermal processing of organic material). Recyclable materials will be used as new marketable commodities in reprocessing or remanufacturing industries. The organic fraction can be transformed by a variety of chemical and biological processes either to compost, fertilizer or energy.



QUESTIONS ABOUT THE TECHNOLOGY

- Is the technology proven? In a similar situation? At the same scale?
- What environmental standards will be met? Are these appropriate and acceptable?
- Can long term operations be sustained under the conditions in the country?
- Who will operate the facility – do they have the resources and the capacity required?
- What maintenance is required – can it be afforded?

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Typical questions that need to be asked in the selection of the technology include:

Is the technology proven? Has it been tested extensively? Has it been applied in a similar situation in a country where the composition of the waste is similar? Has it been applied at the same scale?

What are the environmental standards that will be met for the operation of the facility? Are these acceptable by the regulating and monitoring authorities in the country? Are they appropriate?

Can long term operations be sustained under the conditions in the country? Planning of a MRF must be based on long term objectives. Spending a big amount of the capital and closing down the facility during the first few years will be considered as a complete failure.

Who will operate the facility? Does the operator have the qualified and trained personnel to do the work? Does he have the required capacity?

What are the maintenance requirements? Can it be afforded? Are there enough spare parts?



GENERAL REQUIREMENTS OF A FACILITY

- Location of the recycling facility in accordance with urban plans and zoning regulations, downwind from residential areas and in compliance with environmental requirements
- Good professional design of the recycling facility, including prevention of potential environmental impacts such as water pollution, odours, rats and vermin
- Training of management and technical staff
- No entrance of unauthorized persons.

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Precautions should be taken in locating, designing and operating a material recovery facility:

Location of the recycling facility in accordance with urban plans and zoning regulations :

- not be located in residential zones,
- downwind from residential areas and
- in compliance with environmental requirements.

Ideally, to minimize the impact of operation of MRFs, adequate buffer zones surrounding the facility must be maintained;

The design of the recycling facility must be done in such a way to prevent potential environmental impacts on water, air quality, traffic, noise, waste generation, odors, and health and safety of workers. Extreme care must be taken in its operation if its to be environmentally acceptable with respect to traffic, noise, odor, dust, airborne, debris, liquid discharges and vector control. Proper housekeeping practices and proper storage of materials must be ensured to reduce public complaints.

Training of management and technical staff on the operating procedures at the facility. Special attention must be devoted to materials flow and worker involvement at each stage of the process. Careful attention must be given to health and safety, process monitoring, pollution prevention, instructions on the use of protective clothing, etc.

Entrance of unauthorized persons must be avoided. Persons that are not involved in any of the activities of the MRF should not be permitted on site mainly for health and safety reasons.



DESIGN OF A RECYCLING FACILITY

The engineering design must address the following:

- Separate entrances should be provided for incoming or outgoing trucks;
- Unloading and loading areas which should be constructed of concrete or asphalt paving with drainage to handle surface water runoff;
- Weighbridge for measuring and record keeping of all solid waste accepted as well as of outgoing materials;
- Sufficient storage areas for the incoming solid waste;
- Processing and treatment areas should be located within a paved, enclosed building or covered area;
- Adequate storage capacity for recyclables materials and un-recyclable residue.

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The planning and design of a recycling facility involves three basic steps:

Feasibility analysis. The purpose is to decide whether the facility should be built

Preliminary design. The preliminary design includes development of the materials flow diagram, development of materials mass balances and loading rates for the unit operations (conveyors, screens, shredders, etc.) that make up the facility and the layout of the physical facilities. The cost estimate developed in the feasibility study is refined in the preliminary design report using actual price quotations from vendors. Final design.

Final design includes preparation of final plans and specifications that will be used for construction. A detailed engineer's cost estimate is made based on materials take offs vendor. The cost estimate will be used for the evaluation of contractor bids.

The engineering design must address the following:

Ingress and Egress. The plans should show the flow of traffic into and out of the facility. Separate entrances should be provided for incoming or outgoing trucks if necessary and a separate entrance provided for employees, customers, and visitors;

Unloading and loading areas must be constructed of concrete or asphalt paving material equipped with drainage structures sized to handle surface water runoff; Impermeable floor can avoid soil pollution resulting from on site degradation and leaching of water from received organic material;

Weighbridge for measuring and record keeping of all solid waste accepted at the facility; A record keeping system must be ensured at the entrance of the site to register every single transaction of waste transport and handling. Record keeping can vary a simple handwritten logbook to a more sophisticated computerized system,

Processing, tipping, sorting and treatment areas. Such areas for putrescible materials must be located within a paved, enclosed building or covered area to prevent the spread of odors;

Sufficient internal temporary storage areas for the incoming solid waste to avoid waste accumulation on operational areas. Usually, a two day storage capacity at the reception area is sufficient for handling the waste,

Adequate storage capacity is required at the facility for all solid waste handled and for those recyclables that will be stored before being removed and sold to recycling customers.



EQUIPMENT CONSIDERATIONS

Typical equipment in material recovery facilities that receive commingled MSW include:

- pre-sorting,
- bag breaking or opening,
- manual sorting,
- screening with a cylinder or size separation,
- magnetic separation for the removal of ferrous metals,
- eddy-current separator for the removal of non-ferrous materials such as aluminum and plastics.

The oversized materials passing the screen will be sorted manually, while the undersized materials can be either sent to a disposal site or further processed.

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The typical equipment in material recovery facilities that receive commingled MSW include:

Manual pre-sorting: for the separation of bulky items and cardboard from wastes

Bag breaking or opening: such as flail mills, shear shredders, and screw augers

Manual sorting: for the sorting of paper, cardboard, plastics, glass, aluminum cans, and tin cans.

Screening using a cylinder or size separation: sorting of oversized materials such as paper, plastics, glass, aluminum cans and tin cans. Materials are separated by size and shape characteristics. Used to separate mixtures of materials of different sizes into two or more size fractions by means of more screening surfaces. The principle applications of screening include: removal of oversized materials, removal of undersized materials, separation of the waste into light combustibles and heavy non combustibles, recovery of paper, plastics, and other light materials from glass and metal, separation of glass, grit and sand from combustible materials, separation of rocks and rocks and other oversized debris from soil excavated at construction sites, and the removal of oversized materials from combustion ash.

Magnetic separation: ferrous metal are separated from other waste materials by utilizing their magnetic properties. Magnetic separation is used to recover ferrous materials from source separated, commingled and shredded MSW. Magnetic separation is commonly used to separate aluminum cans from tin cans in source-separated waste where the two types of metals are mixed. It is a typical multistage belt system designed to operate at the end of a conveyor formed of three magnets. The first magnet is formed to attract the metal. The transfer magnet is used to convey the attracted material around a curve and to agitate it. When the attracted metal reaches an area where there is no magnetism, it falls away freely, and many non ferrous metals trapped by the ferrous metal against the belt also falls. The ferrous metal is then pulled back to the belt by the final magnet and is discharged to another conveyor or into storage containers.

Eddy-current separation: if a conductor such as aluminum is placed in a time-varying magnetic field, a voltage will be generated in the material. This voltage will cause a current to flow and induce a magnetic field that is opposite in the polarity to the applied time-varying field, thus producing a magnetic force, which will repel the conductor out of the magnetic field. This magnetic effect is used in a number of electromechanical devices, including the rotary induction motor and the linear induction motor, which may have application in future mass transit systems. Eddy current separators are used for the sorting of plastic materials.



OPERATIONAL CONSIDERATIONS

The operation of the facility shall comply with minimum operational requirements:

- Personnel requirements, their training and responsibilities;
- The entry of unauthorized or prohibited persons and materials shall be prevented,
- Measures to identify and control wastes and materials;
- Entrance recording of quantities received and materials taken out from the facility;
- Equipment for shredding, sorting, screening and handling;
- Safety equipment and protective gear, personal hygiene facilities;
- Fire fighting procedures and equipments, including availability of water for fire fighting.

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The operation of the facility shall comply with minimum operational requirements:

The number of personnel required must be adequate to ensure good operation. Personnel should be trained on their role and each given a certain responsibility.

The entry to the site must be controlled. Unauthorized persons must not be allowed to enter the site. Hazardous and infectious materials must not enter the site as well. An inspection officer should be present to inspect the entering materials and to give an approval for material to get in.

Measures to identify and control wastes and materials. Measures that will be taken to identify and control undesirable wastes that could contaminate or pose unusual health hazards and risks to employees (such as infectious medical waste and hazardous waste).

Entrance recording of quantities received and materials taken out from the facility. At the entrance of the site, the inspector must maintain either a logbook of very single transaction of waste transport (in or out) or must be entered directly to a computer. The records should include information such as:

- the source, volume, weight, and category of waste received;
- volume, weight and type of recyclables recovered;
- volume or weight of waste rejects taken out from the facility and their destination,
- volume or weight of waste transferred for composting.

Equipment for shredding, sorting, screening and handling. All of these equipment must be present for processing and sorting of the waste.

Safety equipment and protective gear, personal hygiene facilities. Description of potential safety hazards, availability of safety equipment and protective gears (such as showers, eye wash, fire extinguisher, hoses, hard hats, safety goggles, respirators, hearing protection and toilets).

Fire fighting procedures and equipments, including availability of water for fire fighting.

A contingency plan must be at hand outlining the corrective or remedial measures that will be taken if unapproved wastes are delivered to the facility, and in the event of odors, surface, or ground water contamination, spills, equipment breakdown, and other undesirable conditions, such as fires, dust, noise and vectors;



RECYCLABLE MATERIALS

- Aluminum recycling is made up of 2 sectors: aluminum cans and secondary aluminum (window frames, storm doors, siding and gutters).
- Paper consists of several qualities: newspaper, cardboard, high-grade paper, and mixed paper .
- Plastics can be classified into two general categories: clean commercial grade scrap and post-consumer scrap .
- Glass is a commonly recycled material. Container glass, flat glass, and pressed, amber and green glass are the three principal types of glass found in MSW .

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There is a well established market in each of the Mashreq and Maghreb countries for the following types of recyclables:

Paper and cardboard

Plastics

Glass

Ferrous and non ferrous metals

Construction and demolition wastes: market varies from country to country

The prices vary from country to country depending on market demand.

In detail the following types of recyclables have their market:

Aluminum: these include aluminum cans (Coke, Pepsi, beer, etc. containers) and aluminum from the industry and construction sector (aluminum scrap, window and door frames)

Paper and cardboard: These include old newspaper, corrugated cardboard (bulk packaging etc.), high grade paper (computer, white ledger paper, etc.), mixed papers (newsprints, magazines, white and colored long fiber paper, etc.)

Plastics: include PETE (soft drink bottles, photographic films, oil bottles, etc.), HDPE (milk jugs, water containers, detergent bottles, etc.), PVC (irrigation piping, food packaging, bottles, etc.), LDPE (thin film packaging and wraps, nylon bags), PP (caps, closures and labels for bottles and containers, battery casings, bread and cheese wraps, cereal box liners, etc.), PS (packaging for electronic and electrical components, foam cups, fast food containers, etc.), multilayer and other (multilayered packaging, ketchup and mustard bottles).

Glass: clear, green and brown glass containers and bottles from soft drinks and beer



RECYCLABLE MATERIALS

- Ferrous Metals (Iron and Steel).The largest amount of recycled steel come from large items such as cars, home appliances and steel cans .
- Nonferrous Metals are recovered from common household items, from construction and demolition projects, from large consumer, commercial, and industrial products .
- Construction and demolition wastes are processed to recover marketable items such as wood chips, aggregate, ferrous and non ferrous metals and soil .

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Continuing the types of recyclables which have a market:

Ferrous metal: These include iron and steel: steel cans, tin cans, white goods from home appliances, car carcasses, and other metals

Non ferrous metals: These include aluminium (door and window frames, or from industries), copper, lead, etc

Construction and demolition wastes: soil, asphalt, concrete, wood, drywall, shingles metals, etc

Wood: packing, materials, pallets, scraps, and used wood from construction projects

Waste oil: automobile and truck oil

Tires: automobile and truck tires

Lead acid batteries: automobile and truck batteries

Household batteries: potential recovery of zinc, mercury and silver.



KEY MESSAGE:
Source segregation brings
clean material, better chances
on the market and better prices



Thank you for your attention!

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KEY MESSAGE:

Source segregation of recyclable materials brings better chances on the market and better prices.

Thank you for your attention!