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SUPPORTING INVESTMENTS IN SUSTAINABLE MUNICIPAL MANAGEMENT AND RECYCLING IN UKRAINE

DRAFT MSW STRATEGY

Changing Our Behaviour

A Municipal Solid Waste Strategy for Ukraine

Document Disclaimer

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Please be advised that this document is provided for illustration purposes only.

a) This document is still under development;
b) We reserve the right to enter changes both following comments from stakeholders or as a result of internal discussion;
c) Terminology and translation will be further improved.

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EXECUTIVE SUMMARY

1. Executive Summary

This MSW management strategy, *Changing Our Behaviour,* has been prepared for Ukraine for the period 2017 to 2030. Recognising that the standard of MSW management services and facilities in Ukraine is currently poor, the overall aim of the document is to set out a series of measures that will bring Ukraine closer to adopting an integrated MSW management system which reflects best practice in EU Member States and in line with the EU-Ukraine Accession Agreement, 2014.

MSW shall include:

- Bulky waste from households, garden and park wastes, and solid wastes from households and from commercial (e.g. small businesses and offices), institutional (e.g. schools, hospitals, government buildings, etc.), and industrial sectors (other than production wastes)
- Bio-waste from households (and similar waste)

MSW shall not include liquid waste. In addition, this MSW strategy does not deal with the following streams:

- Industrial and commercial non-hazardous waste;
- Agricultural waste;
- Construction and demolition waste;
- Health care waste; or
- Hazardous waste

SCOPE AND VISION

The purpose of the strategy is to provide a vision for Ukraine on MSW management and to provide a suite of short and medium-term concrete measures to start the process of realising this vision. A single, comprehensive, national MSW strategy will provide a clear strategic direction and will help to create a transparent, stable and predictable business environment, which is a prerequisite for increased private sector involvement in the MSW sector and for realising the related benefits.

This MSW management strategy sets out how MSW should be managed throughout the entire value chain. MSW is defined as household waste and similar waste, where 'household waste means waste generated by households; and 'similar waste' means commercial and institutional waste which is comparable to household waste in nature and composition.

The vision set out in this Strategy is of a Ukraine where there is a move away from sole reliance on landfill disposal for MSW to a situation where certain wastes are sorted and separated into streams for reuse, recycling or recovery with disposal of residual waste in EU-compliant 'regional' landfills. The vision sees the establishment of an integrated municipal solid waste management (IMSWM) system where the private sector is encouraged to participate, both as operators and as investors.

Changing Our Behaviour means transforming the way Ukraine looks at MSW so that it is seen as a valuable resource to be managed, not just as a problem to be dealt with. The strategy is based on a number of key pillars as follows:

- Respect for the EU Waste 'Hierarchy';
- Full cost recovery of waste management operations;

- Implementation of expended producer responsibility (EPR) in relation to packaging waste and waste electrical and electronic equipment (WEEE) in particular;
- Inter-municipal cooperation (IMC) arrangements in relation to MSW Management facilities (e.g. landfill, waste sorting lines, transfer stations, etc.) ; and
- MSW separate collection (i.e. a two-container system, for 'dry' recyclables and residual waste, respectively)

The key goals of the strategy include the following:

- An increase in coverage of organised collection services where practicable;
- A dramatic reduction in the number of landfill facilities, while ensuring that new facilities are based on appropriate catchment areas (i.e. the concept of 'regional' landfills) and comply with the EU Landfill Directive, 1999/31/EC;
- A move up the hierarchy towards recycling and recovery and away from sole reliance on landfill disposal;
- Maintaining costs (and tariffs) at an affordable level for the population

An adequate, national infrastructure to meet modern MSW management needs will be required to facilitate the following targets over the next 13 years:

- A diversion of a significant proportion of municipal solid waste away from landfill;
- Increase the coverage of MSW separate collection of dry recyclables to cover 23% of the total population of Ukraine in the short-term (i.e. by 2022) and 48% in the medium-term (i.e. by 2030);
- The development of about 250 to 300 new waste reception/collection centres and about 90 waste sorting lines.
- Rationalization of municipal solid waste landfills, with progressive and sustained reduction in numbers, resulting in an integrated network of about 100 to 150 state-of-the-art, EU-compliant regional facilities.

CURRENT CHALLENGES

The high number of municipalities in Ukraine (i.e. some 12,000 municipalities), the lack of professional knowledge of MSW management and the lack of cooperation among the municipalities has resulted in a difficult MSW situation across the country.

Gaps in legislation, implementation and enforcement as well as delays in introducing appropriate EU standards amounts to a poor MSW situation and regulatory uncertainty all of which undermine investor confidence. The development of policies and legislation that implements the policies in the waste sector should be guided by the provisions of the Association Agreement (AA) signed between the European Union and Ukraine in 2014.

The quality of data on MSW is poor in Ukraine. There are no systematic studies with official data on MSW composition in Ukraine and available data is spread across different sources and reports, often contradictory in nature.

MSW collected by organised collection services in Ukraine is estimated at 48 million cubic meters or about 9.2 million tonnes in 2015[1]. As only 77.46% of the population in Ukraine is serviced by

[1] Excluding data from the temporarily occupied territory, the Autonomous Republic of Crimea and Sevastopol city

organised MSW collection services, the total amount of MSW generated is actually considerably larger.

The overall level of recovery of MSW is low as only 5.93% in 2015 of MSW generated was recovered. This includes 2.73% (1.3 million m^3) of incinerated municipal waste, 3.2% (1.55 million m^3) of waste directed to recycling plants and about 17,000 m^3 (0.003%) of waste composted. The rest (i.e. about 94%) was directed to landfills.

The main challenges of the waste management system in Ukraine include:

- the lack of an integrated approach to MSW management;
- a lack of inter-municipal cooperation arrangements (IMCs);
- a low level of MSW separate collection and sorting of recyclables;
- the on-going presence of a strong informal sector;
- the very large number of landfills/dumpsites (i.e. in almost every settlement), which typically do not meet environmental standards, as well as the proliferation of unauthorized dumpsites in Ukraine makes the landfilling situation practically uncontrolled;
- the low consumer tariffs for MSW management services that do not stimulate separate collection and sorting.

MUNICIPAL SOLID WASTE MANAGEMENT COMPONENTS

The overall objective of the Strategy "*Changing Our Behaviour"* is to prevent the generation of municipal waste, where this is avoidable, and to minimise the amount of municipal waste generated, where this is practicable.

In relation to **collection and transport** aspects, due to the low level of coverage of organised MSW collection services in Ukraine significant quantities of waste are illegally dumped on backyards and in open areas (i.e. 'wild' dumpsites). It is an objective of the Strategy, to the maximum extent practicable, that all inhabitants in Ukraine will be covered by an organized municipal solid waste collection system. The following targets are proposed:

- An increase in the coverage of the population by organised municipal solid waste collection services to 84% and 90% of the total population by 2022 and 2030, respectively;

The targets will be achieved by implementation of the following measures:

- Purchase of approximately 9,500 additional containers and approximately 150 additional collection vehicles in order to increase the coverage from the current level of 77% to 84% by 2022. Indicative estimate of €15 million;
- Purchase of a further 8,500 additional containers and a further 150 additional collection vehicles in order to increase the coverage to 90% by 2030. Indicative estimate of €23 million;
- Construction of a network of approximately 200 transfer stations related to the construction of regional landfills. Indicative estimate of €183 million.

Separate collection and treatment of much of the household hazardous waste will be addressed by future extended producer responsibility (EPR) schemes. Initial measures for EPR schemes for selected municipal solid waste streams, such as packaging waste and WEEE, will be put in place by 2017 (e.g. by the adoption of special laws on packaging and WEEE and by concluding an agreement on structures, etc.). In order to ensure that the system can be operated effectively the following will be put in place:

- By 2019, a Register of the permitting system in the field of municipal waste management, in line with the respective provisions of the Waste Framework Directive, will be introduced for all companies who provide municipal solid waste collection and transportation services;
- By 2022, reforms in the competitive tender system/procedure for municipal solid waste collection and transport services will be implemented;
- By 2022, an amendment to the Code on administrative offenses to be made in respect of penalties on consumers for not concluding an agreement for municipal solid waste collection and transport services with the designated service provider to be implemented.

In relation to **re-use and preparing for re-use**, it is recognized in the Strategy that re-use and preparation for re-use can, for example, be readily applied to WEEE (Waste Electric and Electronic Equipment), glass bottles and jars, and clothes. The following targets are proposed:

- By 2022, subject to implementation of an EPR scheme for packaging waste, it shall be a priority to implement a deposit/refund system for post-consumer beverage packaging, in particular glass bottles;
- By 2022, centres for "second hand" goods and clothes as well as products in need of repair such as WEEE shall be commonplace

The targets will be achieved by implementation of the following measures:

- By 2022, implementation of a deposit-refund scheme for glass beverage containers, as one of the pillars of the EPR Scheme for packaging waste;
- By 2022, at least 50 new centres for "second hand" goods and clothes as well as products in need of repair, such as WEEE, to be established. Indicative estimate of €7.5 million.

In relation to **recycling and other recovery**, a key challenge is the lack of an organized system capable of efficiently collecting secondary raw materials of high quality. The following objectives are set out:

- Progressive implementation of MSW separate collection and establishing the mechanisms for practical implementation of the EPR principle, in order to in order to improve the quality of secondary raw materials;
- Implementation of home composting in suburban areas in the towns and cities and in the rural areas;

The following targets are proposed:

- By 2022, an overall recycling rate of 7% of total collected municipal waste to be achieved.
- By 2030, an overall recycling rate of 15% of total collected municipal waste to be achieved.
- By 2024, a number of pilot schemes involving bio-stabilisation of the residual MSW stream, to be established;
- By 2022, home composting for 6% of the urban population and 12% of the rural population (i.e. approximately 1.3 million households in Ukraine) to be implemented.
- By 2024, in respect of packaging waste, an overall recovery level of 60%,
- By 2018, the law "On waste" to be amended such that definitions of waste operations are consistent with those in the EU Waste Framework Directive. 2008/98/EC and that incineration is defined as a disposal or recovery operation based on the criteria set out in the EU Waste Framework Directive.

The targets will be achieved by implementation of the following measures:

- Purchase of approximately 36,000 additional containers and approximately 230 additional collection vehicles, together with construction of 42 additional waste sorting lines in order to achieve a 7% recycling rate of household waste by 2022. Indicative estimate of €144 million;
- Purchase of a further approximately 62,000 additional containers and approximately 400 additional collection vehicles, together with construction of a further 49 additional waste sorting lines in order to achieve a 15% recycling rate of household waste by 2030. Indicative estimate of €190 million;
- By 2030, a total of circa. 271 Waste Reception/Collection Centres to be provided in cities with a population greater than 20,000. Basic windrow compost centres to be co-located with these Centres, for green waste. Indicative estimate of €41 million;
- Home composting units for use in individual houses in the suburban areas in the cities and towns and in rural areas (approximately 2.5 million households). Indicative estimate of €105.5 million.
- Refuse derived fuel (RDF)/secondary recovered fuel (SRF) production facilities to be supported, where appropriate, as part of mechanical-biological treatment (MBT) plants, in the initial stage, as pilot projects. The determination on whether or not an RDF/SRF production facility is commercially viable should be made following completion of a Feasibility Study (FS) or Pre-feasibility Study (PFS) in the matter;
- A comprehensive options analysis, as part of a Pre-feasibility Study (FS) or Pre-feasibility Study, to be carried out in order to determine if modernisation of the existing incinerator "Energy", or if replacement of this plant represents the best practicable environmental option (BPEO) for MSW management for Kiev City. Provisional indicative estimate of €212 million.

Addressing the current problems of MSW **disposal** is considered one of the priority areas to be addressed in the Strategy. It is an objective of the Strategy to provide an appropriate network of landfill disposal facilities that comply with the EU Landfill Directive, 1999/31/EC. It is proposed to develop new landfill facilities at a regional level, effecting a transition from the provision of landfills at municipality level. While the population in the larger cities in Ukraine generate sufficient quantities of MSW to justify stand-alone landfills, economies of scale considerations mean that the development of landfills at local self-government unit level cannot be justified in the case of smaller municipalities and settlements. The following targets are proposed:

- By 2024, construction of the first stage of an overall network of regional landfills to be commenced across Ukraine;
- By 2022, preparation of Conditioning Plans for existing landfills, where appropriate, to be completed and implementation of these Plans to be commenced;
- By 2022, achieve full compliance with EU requirements for all procedures for operational landfills (e.g. permits, control and monitoring, enforcement, etc.);
- By 2024, at locations where new regional landfills have been developed and are operational, existing landfills and dumpsites within the catchment area of the respective new landfills to be rehabilitated and closed on a progressive basis;
- By 2020, a mechanism to be established, which ensures that all of the costs for landfill construction, operation, closure, rehabilitation, on-going after-care and monitoring (including financial guarantees) are covered by the tariffs on the landfill of waste;
- By the end of 2017 or at the start of 2018, a national strategy on reducing the amount of biodegradable municipal solid waste going to landfill to be prepared.

The targets will be achieved by implementation of the following measures in relation to landfills:

- Each oblast will develop a plan for the identification of suitable catchments and for the proper location of regional landfills. This will require inter-municipal cooperation arrangements. Conditioning Plans and Closure Plans to be prepared as appropriate;
- Legislation to be modified to ensure full compliance with EU requirements for all procedures for operational landfills;
- By 2024 work, shall have commenced on the first stage of construction of a network of regional landfills across Ukraine. An ideal catchment area might comprise a population of about 400,000;
- Where new regional landfills have been developed and are operational, existing, landfills and dumpsites within the catchment area of the new landfill, and which do not meet environmental safety standards to be progressively rehabilitated and closed, with priority given to landfills which pose the highest risk to human health and the environment. The indicative estimate for this measure is €1.44 billion over the 13-year period of the Strategy.

HORIZONTAL ASPECTS

In relation to institutional aspects, the MENR is to have overall responsibility for overseeing the implementation of the MSW Management Strategy especially with regard to monitoring and evaluating progress of implementation.

The concept of **inter-municipal cooperation** (IMC) arrangements, where a number of local self-government units agree to join forces to collect and treat MSW based on the benefits of economies of scale and geographical considerations rather than political or administrative boundaries is essential for effective MSW management in Ukraine. The MRDC will be responsible for providing guidance to municipalities as well as facilitating and coordinating the process. The MRDC will have overall responsibility for driving the IMC process in Ukraine with regard to MSW management.

A significant increase in the level of the environment tax on disposal of waste, from the current level of €0.14/ton to €3/ton by 2022, is proposed. At the end of 2022, an assessment of the impact of these increases, in terms of a reduction in the rate of landfill disposal and an increase in the recycling and recovery rate, will be carried out.

In *Changing our Behaviour*, the waste producers' responsibility is singled out with the introduction of an **Extended Producer Responsibility** (EPR) approach, that will be fully implemented for certain waste streams, including packaging waste and waste electric and electronic equipment (WEEE), by 2022. Extended Producer Responsibility is a policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products. Assigning such responsibility could in principle provide incentives to prevent wastes at source, promote product design for the benefit of the environment and support the achievement of public recycling and materials management targets.

The overall **financial aspects** of the Strategy are very significant. In relation to MSW separate collection and waste sorting, it should be noted that the revenues from recycling could potentially offset these operating costs (and capital costs, under very favourable conditions). In addition, one of the key pillars of this Strategy is implementation of EPR, in particular in respect of packaging waste. Accordingly, the net costs of MSW separate collection and sorting are not included in the net total costs, which will ultimately have to be covered by the consumer tariff.

The overall net CAPEX (i.e. for construction of landfills and transfer stations, rehabilitation of old landfills and dumpsites, purchase of containers and collection vehicles, etc., but excluding MSW separate collection and sorting) is estimated at €2.5 billion, over the period of the strategy (i.e. up

to 2030). The operational costs i.e. collection, sorting, facility operation, over the lifetime of the strategy is estimated at about €6 billion.

The current average consumer tariff in Ukraine for MSW management services is 0.37% of average household income. It is estimated herein that to recover the costs of implementing of the measures set out in this strategy, the consumer tariff will need to increase to 1.7%, on average, of household income over the 13-year period of the strategy. While this represents a significant increase in the current level of consumer tariffs, it is considered to be within generally accepted limits of affordability.

In relation to financial aspects the following findings are particularly relevant:

- The development of new regional landfills (i.e. approximately €0.73 billion) and the rehabilitation of old landfills and dumpsites (i.e. approximately €1.44 billion) account for approximately 75% of total CAPEX;
- As set out above, net CAPEX accounts for over 70% of total costs;
- An increase in the environment tax on disposal of waste on the deposit of waste from the current level of €1.14/ton to €3/ton by 2022, is proposed. Such a measure would increase the average annual MSW management consumer tariff per resident from €10.47 to €11.25 (i.e. an increase of about 7.5% in the overall tariff in the year 2022).
- Implementation of the progressive increase in the environment tax on disposal of waste, as proposed could generate about €550 million over the 13-year period of the strategy. Such revenues could be used to partially offset the high costs of rehabilitation of old landfills and dumpsites (i.e. approximately €1.44 billion).

The active involvement of the citizens of Ukraine is essential to the success of the Strategy and **education and awareness** are important measures described therein. From the establishment of environmental awards to recovery platforms and forums on certain waste streams and the labelling of environmentally friendly products, the general public is centrepiece and its engagement is crucial for the success of the Strategy.

Waste management needs accurate **data and statistics**, and without a clear understating of the current situation, proper planning is not possible. In order to improve the information available, the strategy sets a series of deadlines up to 2020 to establish a waste data and statistics department in the Ministry of Ecology, and to carry out waste composition surveys at oblast level.

Monitoring and evaluation of the effectiveness of implementation of the measures set out in the Strategy will be an essential part of the process. Monitoring is necessary because the MSW problem and the baseline conditions change over time. Key performance indicators that will be used to monitor performance against the key targets set out in the Strategy are included.

DELIVERING CHANGE

Changing our Behaviour provides the direction to Ukraine in order to address the key challenges that the country faces with regard to providing a municipal solid waste infrastructure that is sustainable, affordable and in line with EU requirements. It is both ambitious in its targets but also realistic in its measures placing specific emphasis upon key internationally accepted principles. In order to deliver the necessary changes, key actions are needed by the main stakeholders. These include:

- The **general public** must embrace recycling schemes and be conscious of the efforts that need to be made to contribute to a cleaner and more sustainable society. These efforts involve changes in behaviour such as re-using items such as supermarket bags, but also a willingness to pay the price in terms of consumer tariffs for an improved collection service.

- The **commercial waste producers** should play an active role in establishing and operating EPR schemes and in meeting the increase in costs to cover the measures in this Strategy to reduce disposal to landfill.
- The **waste management industry** must provide integrated solutions to the management of MSW giving priority to recycling over time and ensure that waste operations do not cause harm to human health or the environment.
- **Local self-government units** must engage in inter-municipal cooperation arrangements as part of a regional waste management planning approach.
- The **Oblast administrations** to become 'oblast' waste management bodies. Their main responsibilities in the field of MSW management to include carrying out an inventory and assessment of existing landfills; identifying appropriate MSW catchment areas within the oblast and, where appropriate, with adjacent municipalities of neighbouring oblasts;
- The **Government of Ukraine** is ultimately responsible for ensuring that this ambitious but yet realistic Strategy is implemented and that real change in behaviour is achieved. Furthermore, it is the duty of the Government to liaise and work closely with the European Commission to ensure that the provisions as outlined in the Association Agreement are met
- The **community and voluntary organizations**, through their active participation in the development and implementation of this Strategy must continue to deliver strong messages with regard to sustainable development and environmental protection and assist in *changing our behaviour* by participating and delivering educational and awareness programs with regard to municipal solid waste management.

This strategy has been prepared with the input of a wide range of stakeholders consulted during the period of September 2016 to January 2017.

SCOPE AND VISION

2. Scope of the Strategy

2.1 Scope

Existing municipal solid waste (MSW) management policy in Ukraine is scattered in different legal and policy documents, some of which relate to environmental protection in general, others specifically to waste management.

The purpose of this document is to provide a vision for Ukraine on MSW management and to provide a suite of short- and medium-term concrete measures to facilitate the realisation of this vision. A single, comprehensive, national MSW strategy will provide a clear strategic direction and will help to create a transparent, stable and predictable business environment, which is a prerequisite for increased private sector involvement in the MSW sector and for realising the related benefits.

Establishing an effective waste management system requires an agreed, long-term and stable policy framework (i.e. a national strategy and an action plan) within which the necessary facilities and infrastructure for proper MSW management can be provided.

This MSW management strategy sets out how MSW should be managed throughout the entire value chain. MSW is one component of the overall national waste strategy for Ukraine. This strategy does not deal with the following streams:

- Industrial and commercial non-hazardous waste
- Agricultural waste
- Construction and demolition waste
- Health care waste
- Hazardous waste

Where any of the above wastes are generated by households (e.g. household hazardous waste, household WEEE, etc.), measures such as separate collection or acceptance in Waste Reception/Collection Centres are included in this MSW strategy.

The MSW strategy addresses a number of topics or themes. For each of the themes, the strategy document, where relevant:

- Describes the existing situation;
- Sets out the objectives and specific targets;
- Indicates the type of initiatives, measures or facilities required;
- Provides guidance or direction on economy of scale considerations for facilities;

2.2 Definition of municipal solid waste (MSW)

While there is broad understanding of what is generally meant by municipal solid waste (MSW), there are some differences in 'official' definitions used.

According to the Ukrainian legislation, the term "**municipal waste**" means waste which is generated in the process of human life and activity in residential and non-residential buildings (e.g. solid, bulky, repair, liquid, except waste related from the production activities of enterprises) and are not used at the place of its storage (Law of Ukraine № 187/98-вр from 05.03.1998 (1998) Art.1: Resolution of the Cabinet of Ministers of Ukraine №1070 from 10.12.2008 (2008));

Solid waste means residue of substances, materials, items, wares, goods, products that cannot further be used for theirs purposes (Law of Ukraine № 187/98-вр from 05.03.1998 (1998) Art.1: Resolution of the Cabinet of Ministers of Ukraine №1070 from 10.12.2008 (2008));

Liquid waste means waste generated in the house in the absence of centralized water supply and water sewage and stored in cesspools (Law of Ukraine № 187/98-вр from 05.03.1998 (1998) Art.1: Resolution of the Cabinet of Ministers of Ukraine №1070 from 10.12.2008 (2008));

Repair waste means residues of substances, materials, goods, products which have been generated during capital and current repairs, re-planning, conversion, additional construction etc., at a residential house, a separate apartment, building for public purposes; (Resolution of the Cabinet of Ministers of Ukraine №1070 from 10.12.2008 (2008));

Bulky waste means solid waste larger than 50 x 50 x 50 centimetres, which makes it impossible to place them in containers of up to 1.1 cubic meters (Resolution of the Cabinet of Ministers of Ukraine №1070 from 10.12.2008 (2008));

Accordingly the term municipal solid waste (MSW), as applied in EU legislation, is broadly similar to the term 'municipal waste' as applied in Ukrainian legislation, subject to the exclusion of 'liquid waste', which is excluded from the scope of this Strategy.

For the purposes of this strategy, the definition of MSW is presented below.

Definition of Municipal Solid Waste

Municipal solid waste (MSW) comprises household waste and similar waste, where 'household waste means waste generated by households; and 'similar waste' means commercial and institutional waste which is comparable to household waste in nature and composition.

MSW shall include:

- Bulky waste from households, garden and park wastes, and solid wastes from households and from commercial (e.g. small businesses and offices), institutional (e.g. schools, hospitals, government buildings, etc.), and industrial sectors (other than production wastes)
- Bio-waste from households (and similar waste)

In this strategy document the term MSW shall not include liquid waste

3. Changing Our Behaviour

3.1 Vision

The objective of the municipal solid waste Strategy for Ukraine **"*Changing our Behaviour*"** is to create a stable framework that will provide confidence for the investment necessary to deliver a modern, sustainable MSW system. It does this by setting a vision for management of municipal solid waste in Ukraine until 2030.

Municipal solid waste management in Ukraine has been based on low level technologies and is landfill-orientated; limited in its approach to integrated solutions; financially under-resourced; and limited in experience and technical expertise in relation to innovative technologies.

It is necessary to address these deficiencies and develop a more informed, efficient and confident approach to municipal solid waste management, which will properly utilise available opportunities and technologies to provide an effective, integrated municipal solid waste management infrastructure.

The vision set out in this Strategy is of a Ukraine where there is a move away from sole reliance on landfill disposal for MSW to a situation where certain wastes are sorted and separated into streams for reuse, recycling or recovery with disposal of residual waste in EU-compliant regional landfills. The vision sees the establishment of an integrated municipal solid waste management (IMSWM) system where the private sector is encouraged to participate, both as operators and as investors. The objective of the strategy is to achieve an IMSWM system in the medium to long-term in Ukraine, that is comparable to best practice in EU member states, and that affords an appropriate protection of human health and the environment.

Integrated Municipal Solid Waste Management System Explained

Integrated municipal solid waste management refers to the strategic approach to the management of solid wastes covering all sources and all aspects such as; generation, separation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency.

Although landfills will continue to play an important role in the future of MSW management in Ukraine, the nature of that role must change over time so that landfills in the long-term become a subsidiary element within an integrated waste management system, catering for the disposal of residual waste which cannot be prevented or otherwise treated.

Changing Our Behaviour means transforming the way Ukraine looks at MSW so that it is seen as a valuable resource to be managed, not just a problem to be dealt with.

Ukraine has the opportunity to do this by:

- Placing greater emphasis on MSW prevention and minimisation, to restrain, stabilise and reverse the growth in MSW generation and landfill disposal;

- Change both its production and consumption patterns, and improve its management of the MSW that is generated;

- Recognise that much unavoidable MSW is a resource, which, if re-used or properly exploited for its materials and energy content, can reduce the use of natural resources and minimise the environmental impacts of waste disposal.

Some resources contained within MSW can be reused or recycled but at present end up lost and disposed of in landfills. Changing the approach of how Ukraine manages MSW away from over-reliance on landfills and dumpsites will provide benefits for the environment; conserve finite natural resources and provide clear opportunities for the economy of Ukraine.

3.2 **Benefits**

By implementing the strategy, Ukraine will benefit from a cleaner and healthier environment, by extending the MSW collection services, preventing open dumping, closing illegal dumpsites and poor standard landfills and constructing sanitary landfills. A healthier environment will be achieved due to the reduction of emissions and discharges of pollutants throughout the waste flow, and also due to the increased capture of the resource potential in the waste stream.

The points below summarize the main benefits of the Strategy to Ukraine as a whole:

- Relieving the pressure on the extraction of raw materials through the reuse of products and recycling of paper, glass, plastic, organic and other material;
- A reduction of greenhouse gas emissions (e.g. through increasing diversion of biodegradable waste to landfill and managing LFG by flaring or utilization);
- An increase in job opportunities in the waste and recycling sector;
- A cleaner and safer place to live and enjoy through reduced litter, best-practice waste management and the provision of safe landfills as an option of last resort;
- An enhanced environment, through the prevention of pollution to ground and surface water, and air;
- A reduction in the risk to human health, through the prevention of illnesses derived from poor management of waste and the closure of illegal dumpsites.

3.3 **Goals**

The MSW strategy *Changing Our Behaviour* addresses the factors and practical considerations that are relevant to achievement of Government policy objectives and for the prevention and recovery of MSW. Accordingly, this strategy document:

- highlights the necessary disciplines that must be imposed within MSW management systems to secure real progress on MSW prevention, re-use and recovery;
- outlines a range of measures that will be undertaken in the interests of minimising MSW generation and ensuring a sustained expansion in re-use and recycling performance; and
- identifies issues and possible actions which require further systematic consideration
- aims to address the main requirements of the EU-Ukraine Association Agreement with respect to MSW management in Ukraine.

The strategy is based on a number of pillars as follows:

- Respect for the EU Waste 'Hierarchy';
- Full cost recovery of waste management operations;
- Implementation of expended producer responsibility (EPR) in relation to packaging waste and waste electrical and electronic equipment (WEEE) in particular;
- Inter-municipal cooperation (IMC) arrangements in relation to MSW Management facilities (e.g. landfill, waste sorting lines, transfer stations, etc.) ; and
- MSW separate collection (i.e. a two-container system, for 'dry' recyclables and residual waste, respectively)

The key goals of the strategy include the following:

- An increase in coverage of organised collection services where practicable;
- A dramatic reduction in the number of landfill facilities, while ensuring that new facilities are based on appropriate catchment areas (i.e. the concept of 'regional' landfills) and comply with the EU Landfill Directive, 1999/31/EC;
- A move up the hierarchy towards recycling and recovery and away from sole reliance on landfill disposal;
- Maintaining costs (and tariffs) at an affordable level for the population

3.4 Targets

A major general objective is to stabilise, and in the longer term reverse, the growth in municipal solid waste generation in Ukraine, though it is recognised that achievement of this objective will require determined and ambitious measures from producers and consumers, as well as local authorities.

In addition, and in the short- to medium-term, more sustainable practices need to be applied in relation to the MSW generated. An adequate, national infrastructure to meet modern MSW management needs should facilitate the following targets over the next 13 years:

- A diversion of a significant proportion of municipal solid waste away from landfill.
- Increase the coverage of dry recyclables collection to cover 23% of the total population of Ukraine in the short-term (i.e. by 2022) and 48% in the medium-term (i.e. by 2030).
- The development of about 250 to 300 new waste reception/collection centres and about 90 waste sorting lines employing environmentally beneficial technologies, as an alternative to landfill.
- Rationalization of municipal solid waste landfills, with progressive and sustained reduction in numbers, resulting in an integrated network of about 100 to 150 state-of-the-art, EU-compliant regional facilities.

Regional Landfills Explained

The concept of 'regional' landfills is an integral part of the MSW management strategy. MSW management in Ukraine is currently characterised by a proliferation of disposal sites which are of a very poor standard. One of the key tenets in the strategy is that residual waste will be disposed of in landfill facilities that have been constructed and that are operated in compliance with the EU Landfill Directive, 1999 (i.e. EU-compliant landfills). Such facilities are expensive to establish and maintain and economies of scale in terms of waste inputs are required. Accordingly waste should be managed within clearly defined catchment areas or 'regions' in order to achieve the appropriate critical mass to achieve a sustainable, affordable solution.

3.5 Private Sector

There is considerable scope for increased participation by the private sector in all areas of MSW management in Ukraine, and competent authorities, within the framework of their powers and responsibilities should encourage and facilitate business involvement in the provision of MSW management services. Participation by the private sector can contribute much needed capital investment in infrastructure, specialist expertise in the application of alternative and emerging technologies, a better understanding of the dynamics of the market place, and in some cases greater operational efficiency and flexibility.

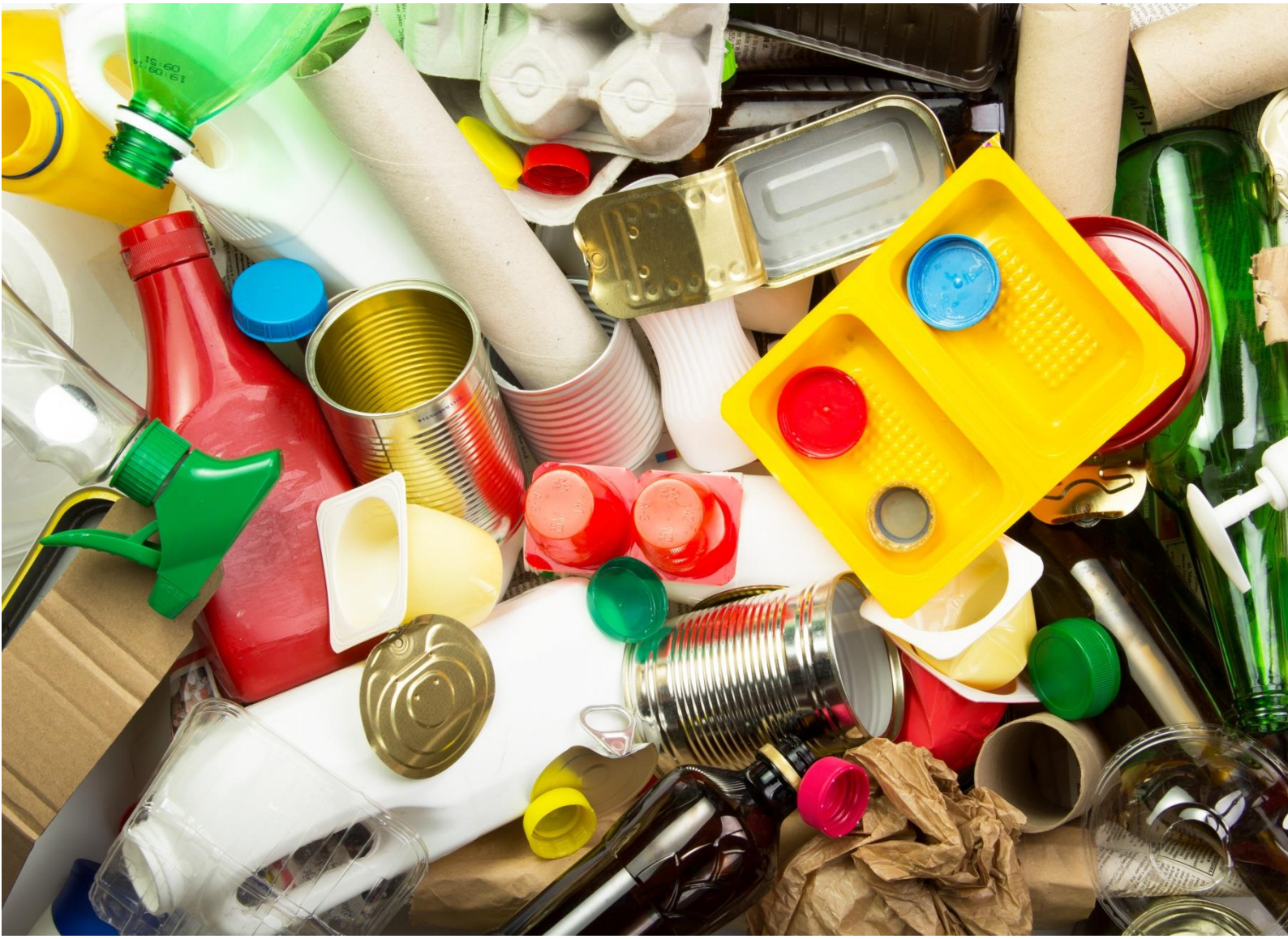
Public-private partnerships are very well established in EU member states and many different models are available. There is now considerable interest by the private sector in investment opportunities in MSW management and the potential for partnership arrangements should be fully explored, in a positive and open-minded way.

By changing our behaviour in how MSW is managed, Ukrainian businesses can reduce their costs and operate more efficiently and cost effectively.

3.6 Economic Impacts

The strategy *Changing Our Behaviour* aims to deliver an efficient and cost-effective MSW management service across Ukraine that provides value-for-money overall. The cost of MSW management is rising in real terms as a consequence of external legal, environmental and financial factors and must be borne by the manufacturer, distributor, retailer and final consumer, in line with the polluter pays principle.

In order to achieve a cleaner environment, all stakeholders must be ready to contribute more to a sound MSW management system. At the same time, Ukraine cannot put a disproportionate burden on the population. This means that if tariffs must increase, measures must be taken to avoid a disproportionate impact on persons in poverty or at risk of poverty.



SETTING THE SCENE

4. Key Challenges – The Necessity for Change

4.1 Introduction

Ukraine has 460 cities, 885 towns and 28,388 villages (and about 500 rayons) that are fully responsible for organising MSW management services on the ground. The high degree of municipal fragmentation (i.e. some 12,000 municipalities), the lack of professional knowledge of MSW management and the lack of cooperation among the municipalities has resulted in a difficult MSW situation across the country. In recent years some steps have been made with regard to decentralisation creating more responsibility at local level but further progress is required. Current reforms are aimed at addressing further these deficiencies and these will have an impact on the MSW management sector.

The main responsibilities for waste management are split between the Ministry for Regional Development, Construction, Housing and Communal Economy and the Ministry of Ecology and Natural Resources.

As of December 2016 the domestic legal framework on waste management is not in line with the EU Waste Directives including those which Ukraine is under an obligation to transpose under the Association Agreement. The basic principles of EU waste management (e.g. waste hierarchy) are not yet implemented. The legal definitions used in the domestic legal framework are not consistent with the definitions in the EU waste regulations. Gaps in legislation, implementation and enforcement as well as delays in introducing appropriate EU standards amounts to a poor MSW situation and regulatory uncertainty all of which undermine investor confidence.

Legal Obligations

In 2014 the European Union and Ukraine signed an Association Agreement (AA) that constitutes a new state in the development of EU-Ukraine contractual relations, aimed at political association and economic integration.

The AA replaced the EU-Ukraine Partnership and Cooperation Agreement as the legal basis and framework for EU-Ukraine relations.

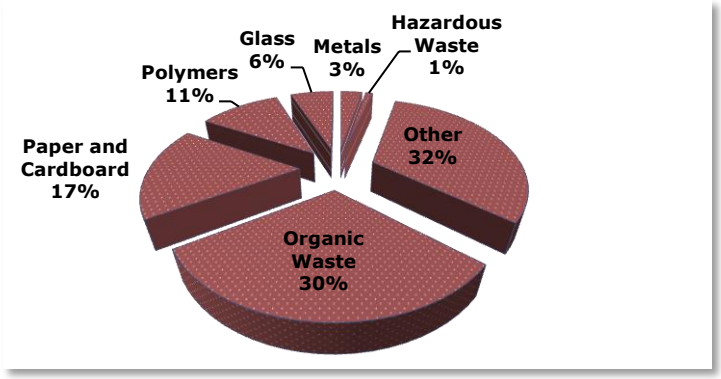
The AA will enter into force once all EU Member States, in addition to Ukraine, have ratified it. However, important parts of the AA were provisionally applied as of 1 November 2014, including the part on cooperation in the environment sector. Provisional application means that (according to Art. 486), for those parts which fall under provisional application, each time when the AA refers to "Entry into force", this should actually be read as "provisionally applied". Thus, if a deadline for fulfilling a condition is 3 years after "entry into force" (and if this part is provisionally applied), then the understanding should be that the implementation should be 3 years after "provisional application". This means that the relevant provisions of the Waste Framework Directive should be implemented by 1 November 2017 and 1 November 2019, while relevant provisions of the Landfill Directive should be implemented by 1 November 2020.

The development of policies and legislation that implements the policies in the waste sector should be guided by the provisions of the AA.

4.2 MSW Generation and Composition

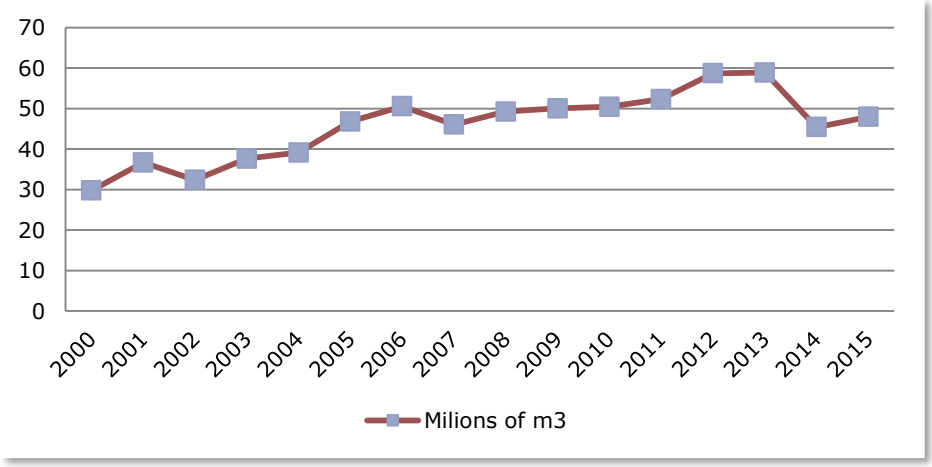
MSW data is poor in Ukraine. There are no systematic studies with official data on MSW composition in Ukraine and available data is spread across different sources and reports, often contradictory in nature. Without accurate and up-to-date statistics and data it is difficult to plan and thus difficult to operate the system effectively. Currently the majority of information is gathered by the Ministry of Regional Development Construction and Housing and Communal Services of Ukraine (MRDC). The lack of a centralised forecasting system is a major shortcoming as is the quality of data submitted. Nevertheless, MSW composition in Ukraine can be estimated as follows.

Figure 4.1 MSW composition in Ukraine (2015)[2]



MSW collected by organised collection services in Ukraine is estimated at 48 million cubic meters[3] or about 9.2 million tonnes in 2015 (excluding data from the temporarily occupied territory, the Autonomous Republic of Crimea and Sevastopol city). As only 77.46% of the population in Ukraine is serviced by organised MSW collection services, the total amount of MSW generated is actually considerably larger.

Figure 4.2 Total generation of MSW in Ukraine 2000 – 2015[4]



[2] According to the data of The Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine (2015)

[3] Data of the Ministry for Regional Development, Construction and Housing of Ukraine

[4] Figures for 2014 and the following years do not include data on the temporarily occupied territories, the Autonomous Republic of Crimea and Sevastopol city

4.3 Population trends

Although the population of Ukraine has been constantly decreasing over the last 20 years[5], the amount of generated municipal solid waste has increased (see Figure 4.2). It is also likely that despite the demographic decrease, generation of MSW will continue to increase as the economy of Ukraine continues to develop.

The amount of generated MSW is increasing every year. In determining the amount of MSW to be managed it is important to factor population increase/decrease and economic growth. The population of Ukraine is currently decreasing. As stated in the IFC Report, 2015: "the volume of MSW generation tends to gradually rise despite the decreasing population[6]. For the purpose of modelling MSW generation into the future it has been assumed that the population of Ukraine will remain as it is in 2015".

In relation to economic growth, according to the World Bank, growth of MSW can be defined as 0.2% of each 1% of GDP growth[7]. The World Bank assessment is that after 2014, GDP growth in Ukraine is expected to stabilise in the range of 4-5% per year. While, according to a more recent report[8], there has been some contraction in 2015 and while growth in the region is expected to increase to an average of 2.6 percent in 2017-18, the GDP growth figure of 4.5% has been assumed for the period up to 2030. At an annual GDP growth of 4.5%, annual waste generation growth of 0.9% is therefore assumed.

On the basis of the assumptions above, the following information can be calculated:

- Total municipal waste generated in 2030 = 13.5 million tonnes;
- Total municipal waste collected in 2030 (90% collection coverage) = 12.25 million tonnes.

4.4 Environmental Awareness

Environmental awareness is low in Ukraine, which results in consumption patterns that do not take account of environmental factors (e.g. when people are purchasing products). This lack of awareness is exemplified by the low coverage of recycling and recovery services, by the open dumping and burning of waste, and by other practices which pose a risk to human health and the environment..

A lack of consciousness and understanding is widespread across all layers of society, including decision makers, legislators, regulators, waste operators and the general public.

4.5 Recovery

In 2015, only 5.93% of MSW generated was recovered[9], including 2.73% (1.3 million m^3) of incinerated municipal waste, 3.2% (1.55 million m^3) of waste directed to recycling plants and

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[5] Official data on population dynamic (1990-2016) issued by the State Statistic Service of Ukraine, http://www.ukrstat.gov.ua

[6] Taking into account the proportion of the population covered by MWS collection services (it was 77.46% in 2015)

[7] Sandra Cointreau, Urban Papers 2, July 2006 Occupational and Environmental Health Issues of Solid Waste Management, Table 3 on page 8

[8] World Bank Group. 2016. *Global Economic Prospects, June 2016: Divergences and Risks*. Washington, DC: World Bank. Washington, DC: World Bank. doi:10.1596/978-1-4648-0777-0. License: Creative Commons Attribution CC BY 3.0 IGO

[9] It should be pointed out that the quantity of MSW incinerated should not, in strict application of EU definitions, be classified as 'recovery'. The Waste Framework Directive 2008/98/EC sets out the criteria for

about 17,000 m^3 (0.003%) of waste composted. The rest (i.e. about 94%) was directed to landfills.

Based on the amount of waste and its composition, Ukraine has a high potential for recycling of secondary raw materials from MSW.

4.6 Waste Management System and Operation

Currently MSW management in Ukraine is based predominantly on low level technologies and is landfill-orientated.

MSW is handled by local self-government units and this sector is financially under-resourced and limited in experience and technical expertise. The main challenges of the waste management system and operation are summarized below:

- ***Lack of an integrated approach to MSW management*** – an overall integrated approach to MSW management - a system that would address all the levels of the waste hierarchy, from prevention to disposal, including recycling and other recovery - is not applied in Ukraine.

- **Lack of cooperation -** Inter-municipal cooperation arrangements (IMCs) in the waste management sector are not developed to an appropriate extent, this creates imbalances between local governments, favouring the bigger cities and the more heavily urbanized municipalities.

- ***Separate collection and sorting of household waste*** – The population lacks awareness and willingness to sort out their wastes. Especially in rural areas, the general levels of organised MSW separate collection is very low.

- ***Informal sector*** – the informal sector plays a significant role within the MSW sector in Ukraine, in particular with regards to recycling. The continuing presence of a strong informal sector can potentially pose challenges to the development of a formal operating market.

- ***Landfill standards*** - the very large number of landfills/dumpsites (in almost every settlement), which typically do not meet environmental standards, as well as the proliferation of unauthorized dumpsites in Ukraine makes the landfilling situation practically uncontrolled.

- ***Tariffs and taxes*** – the low level of consumer tariffs for MSW management services do not stimulate separate collection and sorting. So called "costs for development" are not included in the tariff by the municipal waste service providers (despite the provision in the tariff structure to do so), due to the lack of application of this provision. The costs related to future landfill closure and rehabilitation are also not included in the tariff for landfilling of waste.

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classification of incineration with energy recovery. According to this classification the current incineration of MSW in Ukraine would be classified as 'disposal', rather than 'recovery'.

4.7 Barriers to Public and Private Investment

The potential for private sector involvement in Ukraine is considered to be significant. Nevertheless, there are several barriers to such involvement and in particular to private sector investment.

- ***Tender Process*** – The current tender process does not encourage increased participation of the private sector in MSW management. The current process can be complicated with a low level of capacity at municipal level to carry out the tender process.

- ***Unrealistic tariffs*** **–** As stated above, the tariffs are too low and do not typically incorporate an investment component.

- ***Lack of Monitoring and Enforcement of Legislation*** **-** In many cases the problem is not the absence of legislation (i.e. environmental norms and standards exist), but rather the lack of monitoring and enforcement of such legislation. This applies to collection operations and also to landfill disposal operations.

- ***Lack of Economic incentives*** **-** The relatively "low cost" of landfilling creates distorted incentives for operators and local authorities in their choice between landfilling and recycling.

5. A Framework for Action - Key Drivers for Change and Underlying Principles

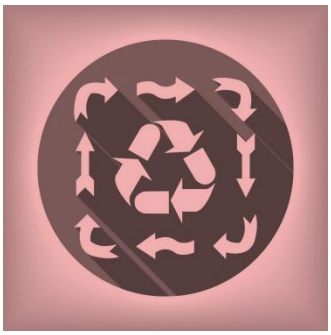
Ukraine currently loses millions of tonnes of materials contained in waste each year, which could potentially be recycled or re-used. Secondary raw materials account for only a very small proportion of production materials used in Ukraine. Converting waste into a resource is an essential part of increasing resource efficiency and moving towards a more circular economy. In a Circular Economy, all discarded materials are resources for others to use.

This MSW Strategy aims to stimulate Ukraine's transition towards a circular economy which will boost competitiveness, foster sustainable economic growth, reduce the environmental impact and generate new jobs. This will bring benefits for Ukrainian businesses, industries, and citizens alike. In doing so, we recognize the current EU policies on the Circular Economy[10] and the UN Sustainable Development Goals[11], which provide the international framework for action.

5.1 Structure of the Strategy

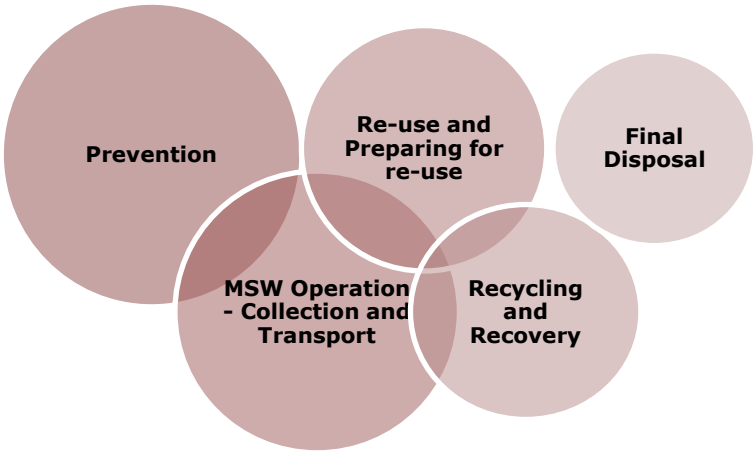
This strategy is firmly grounded in the internationally recognised hierarchy of waste management options, which prioritises, respectively:

- Prevention and minimisation
- Re-use and preparing for re-use
- Recycling
- Other recovery
- Environmentally sound disposal



The strategy includes a chapter on collection and transport after prevention and minimization. In that way it follows the waste flow from its prevention, generation, collection and transportation, to its re-use, recycling, recovery and final disposal.

Figure 5.1 Flow of waste and related management components



[10] the European Commission adopted on 2 December 2015 the EU Action Plan for the Circular Economy
[11] adopted in September 2015 by the United Nations General Assembly

5.2 Key Underlying Principles

The MSW management strategy follows the key guiding principles which underpin environmental policy in general and specifically MSW management policy in EU Member States. The generally accepted environmental principles are set out in the various EU Environmental Action Plans and they are enshrined in respective EU Directives. In relation to MSW management strategy the following Table summarises the key guiding principles to be applied:

Table 5.1 Key Guiding Principles

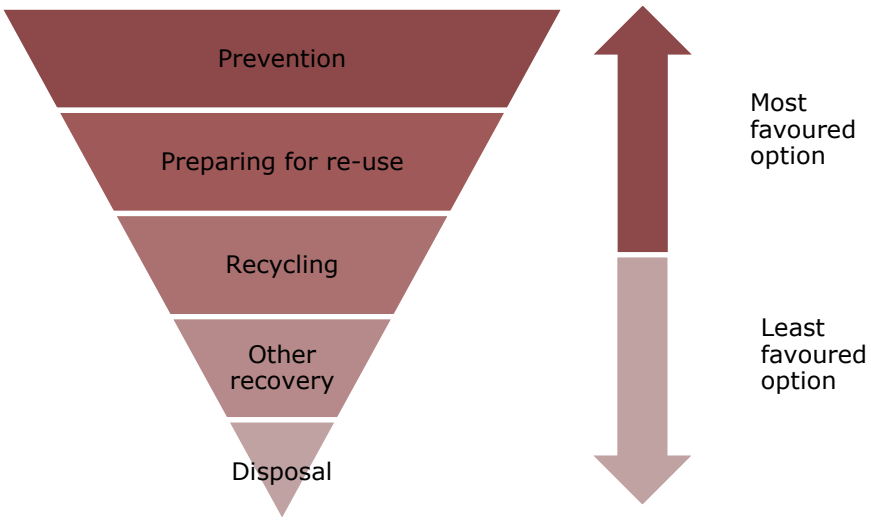
Guiding Principle	Description
Waste Hierarchy (see Figure 5.1 below)	The principle that waste management should show a preference to the 'most favoured' option at the top of the hierarchy rather than to the 'least favoured' option at the bottom of the hierarchy.
Integration Principle	The principle that environmental protection must be an integral part of the development process.
Principle of Sustainable Development	The principle that *"the current generation, in meeting its needs, should not compromise the ability of future generations to meet their own needs*[12]*"*
Polluter Pays Principle (see Note below)	The principle that the cost of pollution should be allocated correctly to the responsible polluters and consumers, rather than to society at large.
Proximity Principle	The principle that pollution generated should be treated as close to its source as possible. In the context of waste management, that waste for disposal should be dealt with in one of the nearest appropriate facilities.
Precautionary Principle	The principle that, where evidence of environmental risk exists, appropriate precautionary action should be taken even in the absence of conclusive proof of causes.
Principle of Shared Responsibility	The principle that the involvement of a broad base of public bodies, private enterprise, and the general public is required in the achievement of environmental policy objectives
Principle of Self-Sufficiency	The principle that an integrated and adequate network of waste installations should be established to enable the Country to move towards being self-sufficient in waste disposal, subject to 'BATNEEC'[13].

Note on Polluter Pays Principle: In the context of MSW management this principle has been translated to mean 'user pays principle'. In other words the charges applied for waste management services (i.e. consumer tariffs) should reflect full cost recovery for those services. In its purest form the application of this principle would mean that consumers would pay for household waste management services on a 'pay-by-weight' basis. While such a measure is not considered appropriate for implementation in Ukraine, other than on a pilot project basis, measures to implement 'pay-as-you-throw' (PAYT) should be considered where practicable.

[12] As defined by the Brundtland Commission in 1987. The Brundtland Commission released Our Common Future, also known as the *Brundtland Report*, in October 1987, a document which coined, and defined the meaning of the term "Sustainable Development". The *Brundtland Commission* officially dissolved in December 1987.

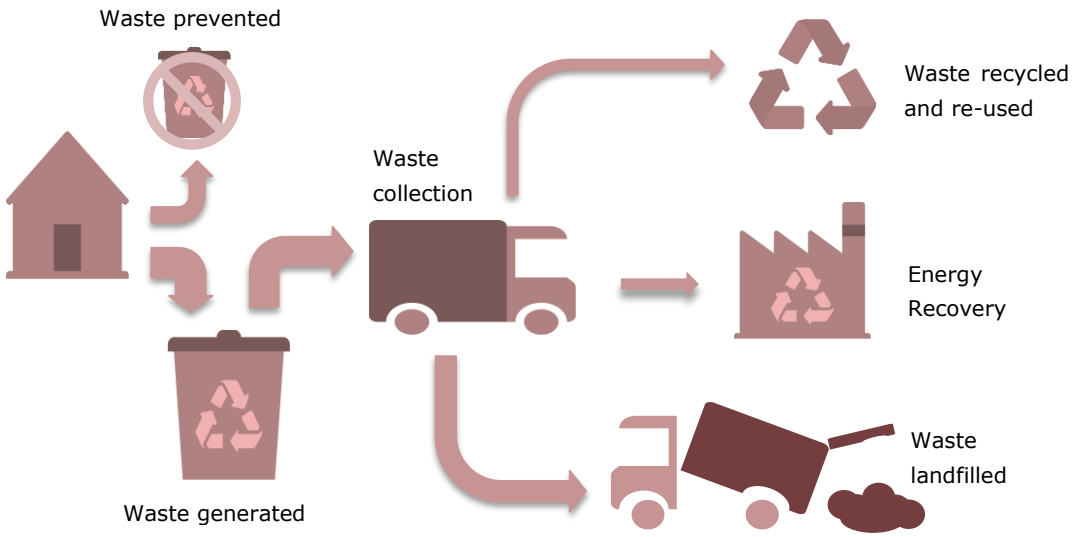
[13] 'BATNEEC' stands for Best Available Technology Not Entailing Excessive Cost.

Figure 5.2 Waste Hierarchy



The "waste hierarchy", as illustrated in **Figure 5.1** above, ranks waste management options according to what is best for the environment. It gives top priority to preventing waste in the first place. When waste is created, it gives priority to preparing it for re-use, then recycling, then recovery, and last of all disposal (e.g. in landfills).The application of the above principles and, in particular the Polluter Pays Principle, will of course need to be tempered by the need to ensure that the new MSW management system is generally affordable.

Figure 5.3 Integrated municipal solid waste management



MUNICIPAL SOLID WASTE MANAGEMENT COMPONENTS

6. Prevention

In a new economic paradigm, economic growth is decoupled from consumption and, in particular, from generation of MSW. Generally, there is a link between municipal solid waste generation and economic growth meaning that generation of municipal solid waste can be expected to increase as the economy of Ukraine develops and as gross domestic product (GDP) increases. This will need a dramatic shift of the traditional mind set in order to view "used" products as valuable materials rather than as waste to be disposed of.

According to the EU Waste Framework Directive, 'prevention' means measures taken before a substance, material or product has become waste that reduces:

1. The quantity of waste, including through the re-use of products or the extension of the life span of products;
2. The adverse impacts of the generated waste on the environment and human health; or
3. The content of harmful substances in materials and products.

There is a problem of built-in obsolescence in goods and equipment manufactured in Ukraine. There is a low level of awareness amongst the population on consumption of products and goods and when choosing what products to buy; the life-cycle of the products and the further possible negative impact of products on the environment are not taken into account. In most cases within the small-to-medium enterprise sector in Ukraine there is no attention given to the sustainable consumption of resources and consumables as evidenced, for example, by the lack of effort generally in reducing the amount of paper used.

The Challenge

Preventing municipal solid waste is a significant challenge and existing practices of municipal solid waste prevention are limited in Ukraine. It will require a dramatic change in behaviour on the part of all actors and this in turn will require a focus on awareness-raising, enabling measures and providing appropriate incentives. The Strategy will address all these three aspects. A greater understanding of the long-term benefits of MSW prevention for the environment and the economy must be achieved.

6.1 Objectives

The overall objective of the Strategy "*Changing Our Behaviour*" is to prevent the generation of municipal waste, where this is avoidable, and to minimise the amount of municipal waste generated, where this is practicable.

6.2 Measures Proposed

To achieve this objective it is necessary to implement the following measures

National Waste Prevention

By 2018, a National Waste Prevention Programme (NWPP) will be developed[14]. The NWPP will highlight the measures that need to be taken in regard to waste prevention, introduce an approach that takes into account the whole life-cycle of products and materials, and focus on reducing the environmental impacts of waste generation and waste management, thereby strengthening the economic value of waste.

The overall objective of the NWPP should be to minimise the generation of waste in the first place and then to maintain the value of products, materials and resources in the Ukrainian economy for as long as possible. In addition, the focus should be on better design of products and equipment in order to mitigate premature obsolescence.

By 2020 the Government of Ukraine will highlight measures that need to be taken in regard to waste prevention, introduce an approach that takes into account the whole life-cycle of products and materials, and focus on reducing the environmental impacts of waste generation and waste management, thereby strengthening the economic value of waste. The following will be addressed:

- Measures to pursue the objective of breaking the link between economic growth and the environmental impacts associated with the generation of waste. These could include for example a tax on lightweight plastic bags, which are deemed to be prone to littering and which can easily break apart, causing damage to the environment.;
- Waste prevention and decoupling objectives covering, as appropriate, the reduction of the adverse impacts of waste and of the amounts of waste generated;
- Measures to promote the reuse and/or repair, as appropriate, of discarded products and/or of their components;
- A requirement, with the support of legislation, that all companies above a certain level of production develop waste management plans, including waste prevention measures;
- Guidance on 'green offices' (with a focus on sustainable consumption and use of resources and materials;

Tools and activities aimed at promoting the reduced use of products/goods, which are likely to have a significant adverse impact on the environment, or for which

It is important that stakeholders, including the general public, should have the opportunity to participate in the drawing up of the NWPP and should have access to the Programme once drawn up[15].

Public Awareness Campaign

Following publication of the NWPP, public awareness campaigns will be launched to ensure that the model of sustainable development, as set out in the Programme, is known and understood across all sectors of society. The campaigns that focus on product lifecycle and the negative impact of different types of products need to be disseminated across all sectors. One of the campaigns should focus on the merits of reusable shopping bags in preference to the use of plastic shopping bags in shops and supermarkets[16]. The experience gained from previous

[14] An NWPP is required according to the EU-Ukraine Association Agreement, 2014.
[15] In line with Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003
[16] In accordance with the amendments to the Packaging Waste Directive 1994/62/EC

awareness programmes will be drawn upon in designing and implementing the relevant public awareness campaigns.

Best Available Technology

By 2020, best practice and efficiency documents (BREFs[17]) for waste management and resource efficiency in targeted industry sectors will be published. BREFs are authoritative documents, which result from an exchange of information organised pursuant to Article 13 of the EU Industrial Emissions Directive, 2010/75/EC.

The Industrial Emissions Directive (IED) 2010/75/EC replaces seven existing directives including the IPPC Directive (2008/1/EC). BREFs are drawn up for defined activities and describe, in particular, applied techniques, present emissions and consumption levels, techniques considered for the determination of best available techniques (BAT) as well as any emerging techniques, giving special consideration to the criteria listed in Annex III to Directive 2010/75/EC. The European IPPC Bureau (EIPPCB) organises and co-ordinates the exchange of information between Member States and the industries concerned on Best Available Techniques (BAT).

[17] BREF or 'BAT reference document' means a document, resulting from the exchange of information organised pursuant to Article 13 of Directive 2010/75/EC

7. Municipal Solid Waste Operation - Collection and Transport

A key challenge in Ukraine is the low coverage levels of organised municipal solid waste collection. Due to low levels of income, certain sectors of the population are unable to afford proper municipal solid waste services, and municipalities are challenged by low budgets to cover those services.

The result is a poor level of municipal solid waste collection and transport services that results in uncollected waste being illegally dumped on backyards and in open areas (i.e. 'wild' dumpsites). This constitutes a serious threat to human health and to the environment as well as blighting urban and rural landscapes. It is important to make a joint effort to increase the municipal solid waste collection coverage throughout Ukraine.

7.1 Objectives and Targets

In *"Changing Our Behaviour"* it is an objective, to the maximum extent practicable, for all inhabitants in Ukraine to be covered by an organized municipal solid waste collection system. This system must be cost-effective, and be efficient at collecting and transporting municipal solid waste.

In order to achieve the above objective the following targets are proposed:

An increase in the coverage of the population by organised municipal solid waste collection services as follows:

- 84% coverage of organised municipal solid waste collection services, including small towns and villages, by 2022;
- 90% coverage of organised municipal solid waste collection services, including small towns and villages, by 2030;

An increase in the coverage of MSW separate collection of dry recyclables. This aspect is elaborated in Chapter 9 below: 'Recycling and Other Recovery'.

In the longer-term it is an objective of the Strategy to change from a volume-based system of municipal solid waste accounting to a weight-based system. However, it is acknowledged that such a change will require a network of weighbridges which has significant cost implications. The progressive incorporation of weighbridge equipment in new municipal solid waste treatment/processing/disposal facilities and transfer stations will facilitate such a change.

7.2 Measures Proposed

To achieve the objectives and targets above it is necessary to implement the following measures:

Increased coverage of Municipal Solid Waste collection services

In order to increase the coverage of the population with organised municipal solid waste collection services from the current level of 77% to 84% by 2022:

- Extend the organised collection service to achieve practically full coverage of the population in the larger settlements in Ukraine in particular. This will require purchase of additional containers and collection vehicles in order to achieve a year-on-year increase of 1% in collection coverage overall. It has been estimated that approximately 9,500 additional containers and approximately 150 additional collection vehicles will be required in this regard;

In order to increase the coverage of the population with organised municipal solid waste collection services to 90% by 2030:

- Extend the organised collection service into the smaller towns and villages in Ukraine. This will require further purchase of additional containers and collection vehicles. It is recognised that, while full collection coverage is an overall aim, it may not be practical to extend organised collection services into the remote, rural areas. Accordingly, a target of 90% collection coverage by 2030 has been set. It has been estimated that a further 8,500 additional containers and a further 150 additional collection vehicles will be required in this regard;

Increased coverage of MSW separate collection of dry recyclables is elaborated in Chapter 9 below.

- In the longer- term (i.e. beyond 2030), apart from isolated rural areas where it is not practicable to extend organised collection services, practically full coverage of organised collection services, including MSW separate collection, will apply in Ukraine.

Household Hazardous Waste and Bulky Waste

While the percentage of hazardous materials in household waste is relatively small (i.e. typically less than 1% by weight), the mixing of such waste with either separately collected 'dry' recyclables, garden waste or even residual waste can adversely impact the proper management of such waste streams. Most of the MSW hazardous components at household level are waste electronic and electrical equipment (WEEE), batteries, fluorescent tubes and oils. Separate collection and treatment of much of the household hazardous waste will be addressed by future extended producer responsibility (EPR) schemes.

For household hazardous waste components which are not covered by EPR schemes, the following measures will be put in place:

- Annual collection of household hazardous waste within a system where householders will be asked to bring such materials to a convenient depot or location on a pre-determined and advertised schedule of seasonal visits by a specialist company using dedicated vehicles. Such a system of household hazardous waste collection should be arranged through the inter-municipal cooperation arrangements that will apply within waste catchment areas or, alternatively, by municipalities on an individual basis; and

- Acceptance of such wastes at the network of Waste Reception/Collection Centres to be established (see Chapter 9 for further details)

Household bulky waste will be dealt with in a similar way (i.e. by scheduled collection by a flat-bed truck and the Waste Reception/Collection Centres where residents will be able to bring their household bulky waste). Bulky waste will be collected within each municipality once or twice per year on a defined collection schedule using a flat-bed truck with skip. Residents will be informed through information campaigns that bulky waste must not be left on the streets at times other than those scheduled as this significantly increases collection costs.

Extended Producer Responsibility (EPR) Schemes for Packaging Waste and WEEE

Initial measures for EPR schemes for selected municipal solid waste streams, such as packaging waste and WEEE, will be put in place by 2017 (e.g. by the adoption of special laws on packaging and WEEE and by concluding an agreement on structures, etc.). The amendments to the law to include provision for producers of packaging waste or the respective producer responsibility organisation (PRO) to cooperate with the municipalities to provide **separate collection of household packaging waste** in particular. The extended producer responsibility system is addressed in Chapter 12 of the Strategy).

Introduction of New Legislation

By 2022, the ownership of waste will be addressed with the introduction of new legislation that:

- Confers ownership of municipal solid waste to the respective municipality once it has been deposited in a container or otherwise presented for collection;

- Makes it illegal for any person, other than the generator of municipal solid waste or a person holding an appropriate Permit/Licence, to handle municipal solid waste. This would make it illegal for brokers to pay for secondary raw materials presented by the informal sector. These measures should significantly mitigate the disruptive impact of the informal sector on the municipal solid waste management services, particularly in relation to municipal solid waste separate collection services.

Introduction of a Register and Improvement of the Permitting System

By 2019, a Register of the permitting system in the field of municipal waste management will be introduced for all companies who provide municipal solid waste collection and transportation services. The permitting system must be improved in line with the respective provisions of the Waste Framework Directive and be made fully operational. Criteria for the issue of Permits and for the inclusion of the companies in the Register to be established. In addition, the normative and legislative base for private operators should be defined. Conditions to be attached to such Permits to ensure international best practice in municipal solid waste collection and transport services, will be proposed.

Reforms in the Tender Procedures

By 2022, reforms in the competitive tender system/procedure for municipal solid waste collection and transport services will be implemented in the following respects:

- Contracts for MSW collection and transport services to be based on detailed operation delegation contracts;
- Contracts for MSW collection and transport services to be for a minimum 5-year period (with scope to extend for a further 2 years) including cases when the tender competition was completed with only one participating company;
- Contracts to include requirements for separate collection of 'dry' recyclables, for the condition of equipment (vehicles and containers) and the frequency of collection;
- Improvements in the procedure of tariff forming to ensure that the "costs for development" are included in the tariff;
- Improvements in the tender process and in the subsequent management of the contracts to ensure that such "costs for development" are included in all tenders submitted (in the

case when such costs for development have been included in the tariff) and that this aspect is enforced in all contracts awarded

Penalties for Consumers

By 2022, an amendment to the Code on administrative offenses to be made in respect of penalties on consumers for not concluding an agreement for municipal solid waste collection and transport services with the designated service provider to be implemented.

Development of a Sanitary Cleaning Scheme

By 2022, a scheme of sanitary cleaning to be developed and implemented for each settlement, and such schemes to be properly enforced, with penalties applicable for failure to comply with the requirements of same.

7.3 Indicative Estimate of Capital Costs

The table below presents an indicative estimate of costs to implement the measures proposed. Chapter 14 (Financial Aspects) discusses in details the affordability and sources of financing.

Measure	Indicative Estimate
Extension of the coverage of organised MSW collection services from 77.46% to 84% by 2022.	€15.4 million
Further extension of the organized collection coverage of MSW collection services to reach 90% of the population of Ukraine by 2030.	€23.2 million
Construction of a network of approximately 200 transfer stations related to the construction of regional landfills	€183.1 million[18]

[18] Based on a CAPEX estimate of €917,400 for a transfer station with capacity 25,000 tons per year

8. Re-use and Preparing for Re-use

The re-use of municipal solid waste is a significant challenge. It will require a dramatic change in behaviour on the part of all actors and this in turn will require a focus on awareness-raising in order to achieve a greater understanding of its long-term benefits for the environment and the economy.

According to the Waste Hierarchy, the preferred waste management option for waste that cannot be prevented is re-use and preparing for re-use. This strategy and the measures outlined herein therefore encourage the re-use of waste.

According to the EU Waste Framework Directive (2008/98/EC):

- 're-use' means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.
- 'preparing for re-use' means checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing;

EU legislation on packaging and packaging waste is designed to encourage producers to consider the reuse of products, in order to achieve reduced costs for producers and consumers and savings in energy and raw materials. It is clear that the resource potential of municipal solid waste is currently being largely ignored in Ukraine.

We should re-use materials, where appropriate, to the greatest extent practicable. Within the framework of the Strategy re-use and preparation for re-use can, for example, be readily applied to WEEE (Waste Electric and Electronic Equipment), glass bottles and jars, and clothes.

Such an approach means that every item of municipal solid waste is seen not only as a source of pollution but also as a potential resource to be exploited and it should assist in the de-coupling of economic growth with the quantities of generated MSW, which is an overarching objective of the Strategy.

8.1 Objectives and Targets

The objectives are:

- to create a base for data collection on the amount of certain types of products which are placed on the market, and on the amount of such products which are subsequently prepared for re-use and re-used;
- to establish the mechanisms for practical implementation of the EPR principle in Ukraine.

In order to achieve the above objectives of the Strategy the following targets are proposed:

- By 2022, subject to implementation of an EPR scheme for packaging waste, it shall be a priority to implement a deposit/refund system for post-consumer beverage packaging, in particular glass bottles.

- By 2022, centres for "second hand" goods and clothes as well as products in need of repair such as WEEE shall be commonplace.

8.2 Measures Proposed

In order to achieve these objectives and targets it is necessary to implement the following measures

Implementation of a deposit-refund scheme for glass beverage containers

By 2022, we will implement a deposit-refund scheme for glass beverage containers.

- This measure will form one of the pillars of the EPR Scheme which is elaborated in Chapter 12.

Establishment of second hand centres

- By 2022, at least 50 new centres for "second hand" goods and clothes as well as products in need of repair, such as WEEE, will be established.

8.3 Indicative Estimate of Capital Costs

The table below present an indicative estimate of costs to implement the measures proposed. Chapter 14 (Financial Aspects) discusses in details the affordability and sources of financing.

Measure	Indicative Estimate
Setting up a deposit-refund scheme for glass beverage containers in Ukraine.	N/A[19]
Establishing 50 centres for "second hand" goods and products by 2022.	€7.5 million[20]

[19] It is assumed that any such deposit-refund scheme for glass beverage containers will be established within the framework of an extended producer responsibility (EPR) scheme for packaging waste.
[20] Assuming a capital cost of €150,000 per centre.

9. Recycling and Other Recovery

According to the Waste Hierarchy, following prevention and re-use/preparing for re-use, recycling and other recovery are the next most favoured options for managing municipal waste. Currently there are no municipal waste recycling targets in Ukraine and the level of municipal waste recycling/recovery is low. In relation to recycling, a key challenge is the lack of an organized system capable of efficiently collecting secondary raw materials of high quality.

According to the EU Waste Framework Directive (2008/98/EC):

Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations

'Other recovery' is any operation meeting the definition for 'recovery' under the EU Waste Framework Directive, but failing to comply with the specific requirements for preparation for re-use or for recycling. Examples of other recovery operations are incineration or co-incineration where the principal use of municipal solid waste is as a fuel or other means to generate energy

The stated level of MSW recovery in Ukraine is currently very low[21].

In relation to recovery, a definition of incineration as a disposal or recovery operation based on criteria of energy efficiency, as set out in the EU Waste Framework Directive, is currently not applied in Ukraine.

9.1 Objectives and Targets

It is an objective of the Strategy to improve the quantity and quality of secondary raw materials captured from the MSW stream by progressive implementation of MSW separate collection and to establish the mechanisms for practical implementation of the EPR principle.

In addition the recycling of appropriate municipal waste fractions will be encouraged and home composting will be implemented for suburban areas in the towns and cities and in the rural areas.

It shall also be an objective to transpose appropriate definitions of the respective waste operations, which are fully consistent with the definitions as set out in the EU Waste Framework Directive, 2008/98/EC, into the law "On waste" and other related regulations.

In order to achieve the above objectives, as set out in the Strategy, the following targets are proposed:

[21] In 2015, according to MRDC data, the official recovery rate was reported as 5.93%, including 2.73% of MSW incineration and 3.2% of MSW directed to collection points and recycling plants

- By 2022, an overall recycling rate of 7% of total collected municipal waste achieved[22]. This is mainly related to separate collection of household waste and will require an extension of MSW separate collection to cover 23% of the total population of Ukraine, together with an appropriate number of waste sorting lines;
- By 2030, an overall recycling rate of 15% of total collected municipal waste achieved[23]. This will require further extension of MSW separate collection to cover almost 50% (i.e. 48%) of the total population of Ukraine, together with an appropriate number of additional waste sorting lines;
- By 2024, establish a number of pilot schemes involving bio-stabilisation of the residual MSW stream[24];
- By 2022, implement home composting for 6% of the urban population and 12% of the rural population (i.e. approximately 1.3 million households in Ukraine. This will be extended to 10% of the urban population and 30% of the rural population by 2030 (i.e. approximately 2.5 million households). This will have a positive impact on the objective of reducing the quantity of biodegradable waste disposed of in landfills;
- By 2024, in respect of packaging waste, an overall recovery level of 60%[25], with;
    - Recycling of 60% of glass packaging;
    - Recycling of 23% of plastic packaging;
    - Recycling of 60% of paper and board packaging;
    - Recycling of 50% of metals packaging;
    - Recycling of 15% of wood packaging;

In addition, the following targets are proposed:

- By 2018, amend the law "On waste" such that:
    - Definitions of waste operations are consistent with those in the EU Waste Framework Directive. 2008/98/EC;
    - Incineration is defined as a disposal or recovery operation based on the criteria set out in the EU Waste Framework Directive;

9.2 Measures Proposed

To achieve these objectives and targets it is necessary to implement the following measures:

Recycling of Municipal Solid Waste

In order to achieve a 7% recycling rate of household waste by 2022:

- Extend separate collection of dry recyclables, particularly in the large cities and towns in Ukraine by providing dedicated containers for collection of paper, metal, plastic and glass and by separate collection by dedicated collection vehicles. It has been calculated that, for the period up to 2022, up to 36,000 additional 1.1m^3 capacity containers and about 230 additional

[22] Considering the target for separate collection of municipal solid waste (i.e. 'dry' recyclables) will cover 27% of the population of Ukraine covered by organised MSW collection services (i.e. 23% of total population)
[23] Considering the target for separate collection of municipal solid waste (i.e. 'dry' recyclables) to cover 50% of the population of Ukraine.
[24] According to the EU-Ukraine Association Agreement, 2014, the Government of Ukraine must develop a strategy for reducing the quantity of biodegradable waste disposed of to landfill within a 6-year period.
[25] The overall recovery target of 60% and the specific recycling targets for particular packaging wastes reflect the key targets in Article 6 of the EU Directive on Packaging and Packaging Waste (94/62/EC), of 20th December 1994. This Directive required compliance by 30th December 2008 (i.e. within approximately 8 years).

collection vehicles[26] will be required, together with an additional 42 waste sorting lines (WSLs)[27]

In order to achieve a 15% recycling rate of household waste by 2030:

- Progressively expand the separate collection of dry recyclables into the smaller towns in Ukraine. In order to achieve this additional level of recycling, it has been calculated that, for the period 2023 to 2030, a further 62,000 additional 1.1m^3 capacity containers and a further 400 additional collection vehicles will be required, together with a further 49 waste sorting lines (WSLs).

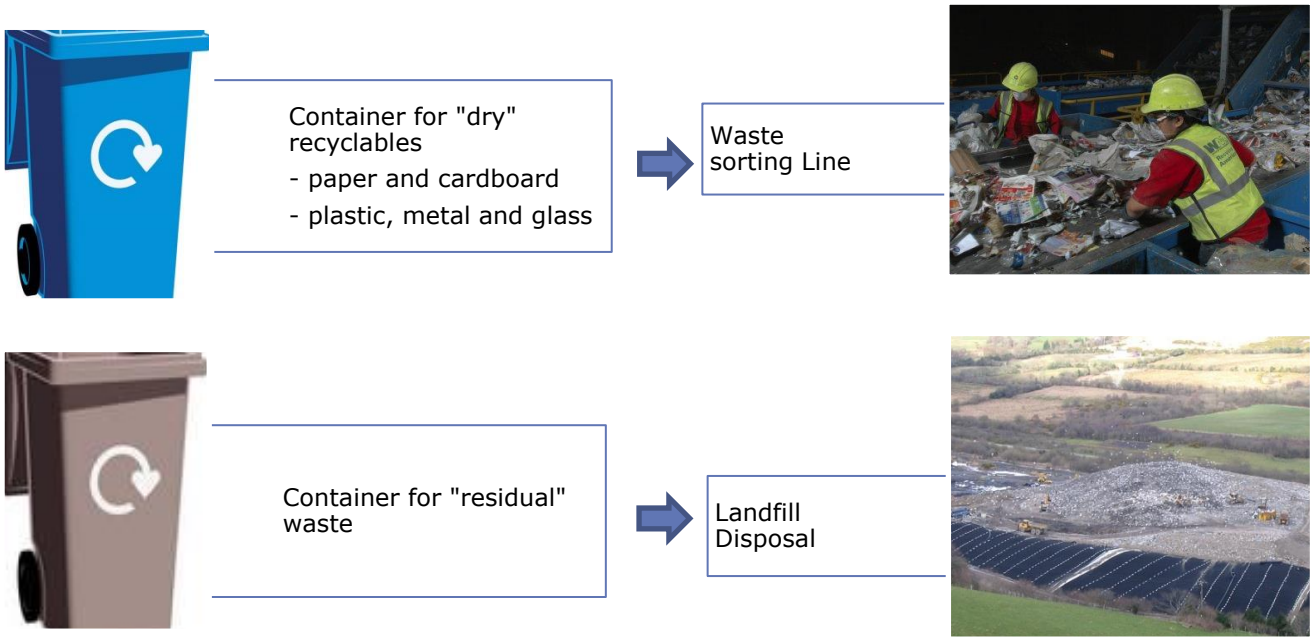
In order to achieve a 53% coverage of the total population with separate collection of 'dry' recyclables by 2030[28]:

- In the follow-up phase (2022 to 2030) MSW separate collection to be extended into the smaller towns and settlements in Ukraine). It has been estimated that a further 62,000 additional containers and a further 400 additional collection vehicles will be required in this regard.

In the areas covered by MSW separate collection a two-container system will operate:

- One container will be dedicated to collection of commingled 'dry' recyclables (e.g. paper, cardboard, plastic, metal and glass); while
- The second container will be for collection of residual waste.

Figure 9.1 Two-container System for MSW Management



[26] Rear-loaded compaction vehicles with 10m^3 capacity assumed.
[27] Amount of additional sorting lines were defined taking into account existing sorting line for dry recyclables (according to the data of Minregion)
[28] This means that, in relation to the population served by an organised collection service (90% by 2022), 53% of that population (i.e. 48% of the overall population) will be served by MSW separate collection.

Development of Waste Reception/Collection Centres

By 2022, a network of Waste Reception/Collection Centres for municipal solid waste is proposed to be developed across all settlements in Ukraine with a population greater than 20,000 persons[29]. These centres to collect and store hazardous components of municipal solid waste; bulky waste (e.g. furniture, large household items, etc.); recyclables and bulky recyclables, such as large packaging; WEEE, including batteries and accumulators; garden waste such as tree pruning, and construction and demolition waste from households.

> By 2030, a total of circa. 271 Waste Reception/Collection Centres to be provided in cities with a population greater than 20,000

Establishment of a Data Collection System

By 2022, it is proposed to establish a data collection system to enable the level of recycling/recovery and compliance with the relevant targets to be determined, together with a method for estimation/determination of the level of reduction of the amount of biodegradable waste landfilled.

Tackling the Impact of the Informal Sector

The disruptive impact of the informal sector in MSW separate collection, needs to be addressed. A significant proportion of the recyclable material content of waste is removed from the containers assigned to MSW separate collection by informal sector workers prior to the bins being emptied. This reduces significantly the quantity of dry recyclables from reaching waste sorting lines, with a consequent reduction in the revenues from the sale of captured secondary raw materials.. This, in turn, can affect cost-recovery of the investment and operational costs incurred in MSW separate collection and waste sorting lines.

The selection and implementation of appropriate measures in this regard will depend on the particular situation in each case and may include one or more of the following options:

- Measures to formalise the informal sector by, as an example, employing a proportion of those currently involved in collection of secondary raw materials, in organised collection or in sorting activities within waste sorting lines;

[29] The number of waste Reception/Collection Centres is calculated on the following basis:

Lower Limit: Population	Upper Limit: Population	Number of Centres/ Settlement	Number of Settlements	Total Number of Centres
20,000	100,000	1	170	170
100,001	500,000	2	36	72
500,001	1,500,000	3	8	24
Kiev City (2.8 million)		5	1	5
Total Number of Centres				**271**

- The progressive installation of underground containers, where appropriate, in city centre areas. A number of operators are already utilising such containers in and close to Kiev City with considerable success[30]; and
- Implementation and enforcement of legislation clarifying that the ownership of municipal solid waste is transferred to the respective municipality once it is placed in a container and making it an offence for an unauthorized person to pay or receive money for secondary raw materials recovered from the municipal solid waste stream, other than in accordance with an approved scheme. The Code on administrative offenses to be amended in this regard to make it an offence for any unauthorised person to capture secondary raw materials by scavenging from containers and/or landfills and dumpsites. Penalties to apply in this regard to individuals involved in such scavenging, to the operator of the respective landfill and to the persons receiving money for secondary raw materials illegally recovered from the municipal solid waste stream.

Biological Treatment

In relation to biological treatment of the organic fraction of the MSW stream, for the initial period of the MSW strategy, it is proposed that the focus will be on home composting of household organic waste and windrow composting of green wastes (e.g. waste from gardens and parks). As part of the Strategy, it is proposed that basic windrow compost centres will be co-located with the Waste Reception/Collection Centres, as set out above. The type of wastes accepted as 'green waste' include grass cuttings, hedge/shrub cuttings, fallen leaves, plant and flower heads, branches, tree stumps and timber.

The windrow centres will comprise a surfaced area on which the green waste will be shredded and then piled into rows. The compost process will include the following:

- The green waste will be shredded using a tub grinder;
- The shredded green waste will be moved into long rows (Windrows), using a loading shovel;
- The rows will be turned on a weekly basis to improve porosity and oxygen content, to mix in or remove moisture and to redistribute cooler and hotter portions of the rows;
- When the temperatures within the rows have reduced, the rows can be screened using a star screener and the resulting compost/mulch can be stockpiled and allowed to mature.

By 2022, it is proposed that home composting be established as a recycling option for single-story households (i.e. individual households) in rural areas and in suburban areas in the towns and cities, through the implementation of pilot projects, and the implementation of an intensive information and awareness-raising campaign. It is proposed that about 1.3 million home composting units be installed in the short-term (i.e. up to 2022), with a further similar amount (i.e. approximately 2.6 million units in total) installed in the medium-term (i.e. between 2022 and 2030),

It is also proposed to establish pilot projects for biological stabilisation of residual waste. A system of certification will be developed for the different categories of compost or compost-like-output (CLO) produced from municipal solid waste or its components.

[30] One Company operating in Kiev City has placed 250 No. 5m^3 capacity semi-underground containers at various sites around the City. Another company, has placed a different type of semi-underground container, with a capacity of 2.5m^3 to 3m^3 at various sites within Bucha City.

Construction of RDF/SRF Production Facilities

Refuse derived fuel (RDF)/secondary recovered fuel (SRF) production facilities will be supported, where appropriate, as part of mechanical-biological treatment (MBT) plants, at locations across Ukraine which are close to cement kilns, in the initial stage, as pilot projects. The exact number and location of such facilities should be related to obtaining agreement in principle from one of the cement companies to pay for RDF/SRF delivered to specification. Appropriate specifications for the composition and characteristics of RDF and SRF will be developed at national level in this regard. The determination on whether or not an RDF/SRF production facility is commercially viable should be made following completion of a Feasibility Study (FS) or Pre-feasibility Study (PFS) in the matter.

Incineration with Energy Recovery

The very high cost of incineration, both in terms of CAPEX and OPEX, means that this is not considered, in principle, to be a practicable or affordable solution generally for MSW management in Ukraine. In addition the development of waste-to-energy/incineration facilities as disposal operations, rather than as recovery operations, will generally not be supported. In order for incineration to be classified as a 'recovery' operation rather than a 'disposal' operation, the emissions must be fully in compliance with the EU Industrial Emissions Directive, and the energy efficiency of the plant must reflect best practice in EU Member States for such recovery facilities.

Given the high density of development in Kiev City it may not be possible to identify a suitable location for an EU-compliant landfill within a reasonable distance from the centre of the City. In such a situation, modernisation of the incinerator "Energy" in Kiev may be the only practicable option for management of residual waste generated within the City, and may accordingly warrant consideration.

However modernisation of the incinerator "Energy" should be sufficient to ensure that the incineration process can be classified as a 'recovery' rather than a 'disposal' operation. This will require that the emissions are fully in compliance with the EU Industrial Emissions Directive, 2010/75/EC and that the energy efficiency reflects best practice in EU Member States for such recovery facilities. In such a case it is considered that, modernisation, in practical terms, will amount to replacement of the existing plant "Energy".

In order to determine whether or not modernisation of the existing incinerator "Energy", or replacement of this plant represents the best practicable environmental option (BPEO) for MSW management for Kiev City, a comprehensive options analysis, as part of a Pre-feasibility Study (FS) or Pre-feasibility Study, should be carried out. A multi-criteria assessment (MCA) approach should be taken in order to determine the BPEO in this case.

While an indicative CAPEX has been estimated in this regard, this has not been factored into the overall MSW financial model, which is based on landfilling of residual waste.

Modifications to Legislation

For 'recovery' operations, the following requirements will be set out in the legislation:

- Requirements consistent with the Directive on Industrial Emissions (IED 2010/75/EC[31], for incineration/waste-to-energy). These requirements are quite stringent and cover the technological processes and emission limits;

[31] EU Industrial Emissions Directive, 2010/75/EC

- Full transposition of Annex I ('Disposal' operations) and Annex II ('Recovery' operations) of the Waste Framework Directive 2008/98/EC (including criteria for the classification of the respective operation)

Best Available Technology on Waste Recovery

By 2020, BREFs[32] for waste recovery technologies will be published.

While descriptions have been provided above in relation to certain waste recovery technologies, it is not considered that it is appropriate, within this MSW strategy, to express a preference for one technology over another, since local circumstances vary significantly in each case. It is not considered helpful to rule out a particular technology in advance, as this unnecessarily restricts options and may result in an increase in the costs involved. Various waste recovery technologies are described in detail in an Annex to this Strategy. Those making investment decisions should consider all of the options available and apply a multi-criteria assessment (MCA) approach in determining the best practicable environmental option (BPEO) in each case.

9.3 Indicative Estimate of Capital Costs

The tables below present an indicative estimate of costs to implement the measures proposed. Chapter 14 (Financial Aspects) discusses in details the affordability and sources of financing.

Recycling – Including Biological Treatment

Measure	Indicative Estimate
Extension of MSW separate collection (i.e. primary source separation of 'dry' recyclables) to 23% of the total population of Ukraine by 2022.	€29 million[33]
Further extension of the MSW separate collection of 'dry' recyclables to 48% of the total population of Ukraine by 2030.	€50 million
Construction of 42 additional waste sorting lines (WSLs) by 2022.	€115 million
Development of further 49 WSLs by 2030.	€140 million
Construction of 271 Waste Reception/Collection Centres	€40.65 million
Home composting units for use in individual houses in the suburban areas in the cities and towns and in rural areas	€105.5 million[34].

Other Recovery

Measure	Indicative Estimate
Construction appropriate facilities for stabilisation of the organic fraction of MSW.	Indicative estimate not provided
Construction of RDF/SRF production facilities, as part of mechanical-biological treatment (MBT) plants, at locations across Ukraine	Indicative estimate not provided

[32] A BREF or 'BAT reference document' means a document, resulting from the exchange of information organised pursuant to Article 13 of the Industrial Emissions Directive (IED) (2010/75/EC).
[33] Assumption of 20% coverage of MSW separate collection of dry recyclables currently in place in Ukraine
[34] This measure will involve purchase of 2.57 million home composting units at a total cost of about **€105.5 million** (at a unit cost of €41). These units could then be sold to the respective households at a 50% discount on the market price.

Provisional: Modernisation of the incineration plant "Energy", so that the incineration process can be classified as a 'recovery' rather than a 'disposal' operation.	€212 million[35].

[35] Based on a waste-to-energy facility with a capacity of 250,000 tonnes per year. The full investment cost for a new facility in this regard would be in the range of €125 million to €300 million. A full Feasibility Study will need to be completed in order to determine the investment cost required.

10. Final Disposal

Ukraine's municipal solid waste management practice is heavily reliant on landfill. About 94% of MSW was disposed of on landfills and dumpsites in 2015[36]. In total, there are 6,064 landfills and dumps in Ukraine and few of the facilities meet the appropriate Ukrainian environmental safety standards[37]. Negative impacts on the environment include groundwater contamination, odours, fires, generation of landfill gas, vermin, dust, adverse visual impact and windblown litter.

Many of the existing landfills in Ukraine are already overloaded while their planned period of operation is for another 5 to 7 years. It is evident that undue reliance on landfills cannot continue to be the basis of MSW management in Ukraine into the future and that a significant change in behaviour in this regard is necessary.

10.1 Objectives and Targets

It is an objective of the Strategy to provide an appropriate network of landfill disposal facilities that comply with the EU Landfill Directive, 1999/31/EC. It is proposed to develop new landfill facilities at a regional level[38], effecting a transition from the provision of landfills at municipality level. While the population in the larger cities in Ukraine generate sufficient quantities of MSW to justify stand-alone landfills, economies of scale considerations mean that the development of landfills at local self-government unit level cannot be justified in the case of smaller municipalities and settlements.

In relation to existing facilities, it is an objective of the Strategy to 'condition' existing landfills, where appropriate, and to close non-compliant sites which pose a significant risk to human health or the environment.

In order to achieve the above objectives of our Strategy the following targets are proposed:

- By 2024, construction of the first stage of an overall network of regional landfills to be commenced across Ukraine;
- By 2022, preparation of Conditioning Plans for existing landfills, where appropriate, to be completed and implementation of these Plans to be commenced;
- By 2022, achieve full compliance with EU requirements for all procedures for operational landfills (e.g. permits, control and monitoring, enforcement, etc.);
- By 2024, at locations where new regional landfills have been developed and are operational, existing landfills and dumpsites within the catchment area of the new landfill in each case, and which do not meet appropriate environmental safety standards to be progressively closed at the territory of the respective landfill catchment, with priority given to sites which pose the highest risk to human health and the environment;

[36] According to the Ministry of Regional Development, Construction and Housing and Communal Services.

[37] Excluding data from the temporarily occupied territory of Donetsk and Lugansk oblasts, the Autonomous Republic of Crimea and Sevastopol city. Data from 2015.

[38] In this context the term *regional landfill* means, for most of the Oblasts in Ukraine, a facility serving a number of municipalities and/or rayons. While it is not the intention that this strategy be used prescriptively in this regard, such landfills should have a minimum capacity of 50,000 tons per year and cover an agglomeration of not less than about 150,000 persons.

- By 2020, a mechanism, which ensures that all of the costs for landfill construction, operation, closure, rehabilitation, on-going after-care and monitoring of the landfill for a period of at least 30 years (including financial guarantees) are covered by the tariffs on the landfill of waste, to be established;
- By the end of 2017 or at the start of 2018, a national strategy on reducing the amount of biodegradable municipal solid waste going to landfill to be prepared[39].

10.2 Measures Proposed

In order to achieve these objectives and targets it is necessary to implement the following measures

10.2.1 Landfill Facilities (i.e. EU-compliant landfills)

The procedures for managing landfill disposal facilities in Ukraine will be brought into line with the requirements of the EU Landfill Directive, 1999/31/EC, in particular in relation to control and monitoring procedures for operational landfills and to closure and after-care procedures for landfills scheduled for closure. Scavenging on landfills will be controlled and strict penalties will be applied for non-compliance.

- Each oblast will develop a plan for the identification of suitable catchments and for the proper location of regional landfills. These catchments or waste management clusters should not be based on administrative borders but rather on the need to achieve appropriate economies of scale in relation to new landfills and to take account of transport logistics. This, in turn, will require inter-municipal cooperation arrangements. The plans to be prepared will identify, where appropriate, the existing landfills for which Conditioning Plans are appropriate and the landfills which are not capable of meeting the relevant environmental standards and in respect of which Closure Plans should be prepared. This assessment will be based on an inventory of existing landfills and an estimation of the level of compliance in each case with the environmental standards[40] (see below). Oblasts should collaborate and coordinate activities on MSW management planning and on identifying suitable locations for such regional landfills.

- Legislation to be modified to ensure full compliance with EU requirements for all procedures for operational landfills (e.g. permits, control and monitoring, enforcement, etc.);

- Legislation to be modified such that a legally-robust mechanism is put in place which ensures that all of the costs for landfill construction, operation, closure, rehabilitation, on-going after-care and monitoring of the landfill for a period of at least 30 years (including financial guarantees) are covered by the tariffs on the landfilling of waste;

- The Government of Ukraine will prepare a national strategy on reducing the amount of biodegradable municipal solid waste going to landfill[41], having regard to the provisions in the EU Landfill Directive, 1999/31/EC;

[39] As set out in the Plan of implementation of the Landfill Directive Order No. 317 from 15/10/2014
[40] In order to do this the criteria for compliance with relevant environmental standards will need to be established and appropriate questionnaires developed
[41] It will be a matter for the national strategy to clarify the targets dates to meet the progressive reduction in the amount of biodegradable waste landfilled according to the provisions of the EU landfill Directive, 1999

- By 2024 work shall have commenced on the first stage of construction of a network of regional landfills across Ukraine. The location and design capacity of these landfills shall be determined on a case-by-case basis having regard to economies of scale and transportation logistics considerations and within the framework of inter-municipal cooperation arrangements. While it is not the intention of this Strategy to be prescriptive in this regard, it is considered that a network of about 100 operating landfills may be sufficient for disposal of residual MSW in Ukraine. An ideal catchment area might comprise a population of about 400,000. Because of the relatively high CAPEX and OPEX of EU-compliant landfills, such facilities should have a minimum capacity of about 50,000 tons per year and cover an agglomeration of not less than about 150,000 persons;

10.2.2 Transfer Stations

With the significant reduction in the number of landfills envisaged in the Strategy transfer stations will need to be developed across Ukraine. A transfer station is a place where multiple vehicles dispose of waste for consolidation and haulage to distant treatment or disposal facilities. Determination of the need for a transfer station will be made on the basis of a Feasibility Study in each case. As a general rule-of-thumb a transfer station is unlikely to be justified where the haul distance is less than about 40 km and where the population served is less than about 50,000. In cases of shorter haul distances or smaller population catchments, it is likely to prove more economical to transport the waste directly in the collection vehicles.

Transfer stations should only be constructed where they will decrease overall transportation costs from the point where the waste is generated to the new regional landfill (or other waste treatment facility, where appropriate). Careful evaluation shall be done before deciding about the number and location of transfer stations in each catchment area.

While it is not possible to determine the number of transfer stations required for Ukraine, since this depends on the number and location of regional landfills determined, if it can be assumed that 50% of waste will be transported via transfer stations, about 200 such stations, with an annual capacity of 25,000 tons, will be required for Ukraine.

10.2.3 Rehabilitation of Landfills/Dumpsites

The existing database of all existing landfills and dumpsites in Ukraine will be elaborated on an oblast-by-oblast basis and an environmental risk assessment will be carried out on all of these sites using existing developments of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine and the Ministry of Ecology and Natural Resources. The database will include the technical characteristics as well as information on the landfilled waste. In addition, a questionnaire will be developed to define the level of compliance of each landfill with the relevant environmental standards.

- **'Closure Plans'** to be prepared for those landfills which cannot meet the environmental standards
- **'Conditioning Plans'** to be prepared for existing landfills, which are capable of meeting minimum environmental standards, as appropriate

- By 2020, Closure Plans to be prepared for landfills which cannot meet the appropriate environmental standards. Rehabilitation to be applied to sites on a phased basis following

preparation of a Prioritisation Plan, having regard to an environmental risk assessment (i.e. the sites which pose a significant risk to human health or the environment to be rehabilitated in the first instance);

- By 2024, in cases where new regional landfills have been developed and are operational, existing, landfills and dumpsites within the catchment area of the new landfill, and which do not meet environmental safety standards to be progressively closed, with priority given to landfills which pose the highest risk to human health and the environment;
- By 2022, preparation of Conditioning Plans for existing landfills, where appropriate, and implementation of these Plans.

Landfills and dumpsites that are designated for closure shall be rehabilitated on a phased, progressive basis following preparation of a Prioritisation Plan. This Plan will identify those sites that should be closed as a matter of priority, based on the environmental risk assessment carried out (i.e. having regard to the risks to human health and/or the environment)).

Once a new regional landfill has been developed for a defined catchment, measures to be put in place to rehabilitate and close all of the existing landfills and dumpsites, as appropriate, and to prevent further disposal of municipal waste on these sites.

10.2.4 Environment tax on disposal of waste

The level of the environment tax on disposal of waste will be increased in such a way that it can have a significant impact on diversion of MSW away from landfill disposal and towards re-use, recycling and recovery. This issue is addressed further in Chapter 13.

10.3 Indicative Estimate of Capital Costs

The table below present an indicative estimate of costs to implement the measures proposed. Chapter 14 (Financial Aspects) discusses in details the affordability and sources of financing.

Final Disposal

Measure	Indicative Estimate
Construction of 92 state-of-the-art landfill facilities in full compliance with the EU Landfill Directive, 1999.	Investment costs of €0.73 billion for the 13-year period of the Strategy
Rehabilitation and closure of the existing landfills/dumpsites in Ukraine.	€1.7 billion overall[42]. Investment costs of €1.44 billion for the 13-year period of the Strategy

[42] This estimate is based on the following assumptions: Total number of landfills in Ukraine is about 6,064, with an average of approximately 1.5 hectare per landfill. By expert estimation, hardly any of them are in compliance with standards in the EU Landfill Directive, 1999/31/EC. They will therefore need to be either conditioning or closed and rehabilitated. It has been assumed that it will not be practicable to 'condition' a significant number of the existing landfills. It has accordingly been assumed that 99.9% of the existing landfills should be closed and rehabilitated. Closure and rehabilitation of the old and non-compliant landfills will be in parallel with construction of the new regional landfills. The estimate provided is based on rehabilitation of an average of 467 closed landfills per year beginning from in 2020 with an average cost per landfill of about €280,000.

HORIZONTAL ASPECTS

11. Institutional Framework

Different organizational, infrastructure and policy measures must be introduced and managed at specific levels of government, national, oblast and local level, and involve specific responsibilities at each level.

Implementation of the Strategy will require that these institutional responsibilities are clearly assigned at each level and that staff capacities in implementing institutions are strengthened. The latter will be an ongoing process over time. Enforcement agencies dealing with the MSW management sector in particular must be strengthened.

The implementation of the appropriate mix of waste policy instruments will be driven by the Ministry of Ecology and Natural Resources and the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine, in coordination with governmental institutions, agencies or organizations in accordance with their specific mandates and the institutional arrangements defined between them. As such, for the economic instruments, the Ministry of Ecology and Natural Resources and the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine will have to coordinate with the Ministry of Economy. However, the main economic instrument to support prevention and separate collection, which is service-related user charges, must be introduced and managed at local level.

11.1 Institutional arrangements

The MENR is to have overall responsibility for overseeing the implementation of the MSW Management Strategy especially with regard to monitoring and evaluating progress of implementation.

Unless otherwise explicitly stated it shall be assumed that any obligations at national level shall be deemed to be the responsibility of the MENR. MENR and MRDC to remain as the two leading information gathering, planning, regulatory, and permitting authorities in the field of MSW management. Their responsibilities to be divided as follows:

Ministry of Ecology and Natural Resources (MENR) of Ukraine

- Waste Data and Statistics Department to be established in the Ministry of Ecology. The Department to collect information gathered in the course of bi-annual waste composition surveys at oblast level; to publish BREFs in the field of MSW management; administer the Register of the permitting system in the field of MSW management in the long-term; administer the database of all existing landfills and dumpsites in Ukraine;
- MENR to revise and where appropriate to develop regulatory documents in the field of MSW, in particular, on permits and licences on operations with MSW, to develop a methodology for assessment of the existing landfills and to develop criteria for identification of the landfills which should be subject to Conditioning Plans and Closure Plans, as appropriate;
- National Commission on Energy and Utilities shall no longer issue licences for MSW recycling and landfilling. This to be the competence of the MENR.

Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine

- To maintain its leading role in regulating utility services including MSW management services (i.e. including collection, storage, transportation, recycling, recovery, and landfilling).
- To administer the Register of the permitting system in the field of MSW management in the short-term;
- To develop a National Waste Management Plan or Action Plan, a National Waste Prevention Programme (NWPP), a National Strategy on Reducing the Amount of Biodegradable Municipal Solid Waste Going to Landfill and other appropriate policy and planning document in the field of MSW;
- To revise and where appropriate to develop, in particular, standards for construction and operation of new landfills in compliance with the EU Landfill Directive, 1999 (i.e. EU-compliant landfills); tariffs-setting documents for the MSW utility services insuring full cost recovery for these services;
- To publish Guidelines and develop the procedure for development of oblast waste management plans.

The State Environmental Inspectorate

The State Environmental Inspectorate (and its local offices) to be the lead enforcement authority in the field of MSW management. The Inspectorate to have appropriate legal grounds and sufficient human and other resources to be able to fully enforce all of the relevant standards and regulations. The relevant laws and regulations to be amended to allow the Inspectorate to operate effectively in the given field. The proposed role of the State Environmental Inspectorate in the implementation of key measures outlined in this strategy, in particular with regard to enforcement and, if necessary, prosecution, should be taken into consideration as part of the current reform process of the Inspectorate that is currently underway.

Oblast Administrations

Oblast Administrations[43] to become 'oblast' waste management bodies. Their main responsibilities in the field of MSW management to include carrying out an inventory and assessment of existing landfills; identifying those requiring Conditioning Plans and Closure Plans; insuring timely implementation of Conditioning and Closure Plans, identifying appropriate MSW catchment areas within the oblast and, where appropriate, with adjacent municipalities/rayons of neighbouring oblasts; locating regional landfills and transfer stations for identified catchment areas; developing and coordination of implementation of 'Oblast' MSW management plans; guiding and coordinating municipalities in their IMC efforts; issuing permits for collection and transportation of MSW.

Municipalities

Municipalities to retain their responsibility for MSW management on the ground. Municipalities to be responsible for establishing appropriate economies-of-scale through IMC arrangements and to engage in public-private partnerships for cost-effective implementation of the MSW system. Municipalities to organise collection and transportation of MSW within their respective territories, approve tariffs for MSW utility services, and implement Oblast MSW management plans.

[43] In the course of decentralisation reform this responsibility willcould? be passed on to Oblast Councils.

The Laws of Ukraine on waste, on local self-government and on local state administrations as well as other relevant laws and regulations to be modified, as appropriate.

11.2 Inter-municipal cooperation (IMC) arrangements

Municipalities should find the appropriate economies-of-scale for implementing the MSW system through inter-municipal cooperation arrangements. The MRDC will be responsible for providing guidance to municipalities as well as facilitating and coordinating the process. The MRDC will have overall responsibility for driving the IMC process in Ukraine with regard to MSW management and for the arrangements for monitoring and evaluation, during implementation.

Given the high costs involved in developing and operating EU-compliant landfills it is clear that economies of scale considerations mean that all municipalities will benefit from a regional approach. Such an approach will require inter-municipal cooperation (ICM) arrangements. Different models for such arrangements apply:

- One model where the IMC arrangements apply only to regional facilities such as landfills, waste sorting lines and transfer stations, where economies of scale considerations are paramount. In this model waste collection and transport activities are carried out by the participating municipalities;
- An alternative model where all MSW activities, including collection and transport, are carried out by a regional body under an IMC arrangement.

High transport costs incurred by municipalities located at a distance from the regional landfill or a transfer station can potentially put them at a disadvantage relative to those closer to the facility in question. This, in turn could lead to higher costs/tariffs for such municipalities where they continue to provide their own collection and transport services. The parties need to therefore agree if each municipality should continue to fund its own collection and transport services or whether this should be a collective responsibility of the regional entity.

There are two main benefits of inter-municipal cooperation [IMC] arrangements:

- Development and operation of EU-compliant landfill facilities will result in a significant increase in the cost per ton of material being landfilled. For certain MSW management facilities, such as landfills, waste sorting lines and biological processing facilities, fixed costs can be relatively significant. This, in turn, means that smaller facilities will not be economically sustainable. Inter-municipal cooperation arrangements offer significant economies of scale advantages in this regard.
- Smaller municipalities can enjoy the benefits from services they would not have been able to achieve on their own. Municipalities that cooperate may incur lower costs for their waste management services. Cooperation may also help to increase collection frequency and improve the quality of the service, in particular in the case of smaller municipalities.

Proposed Measures

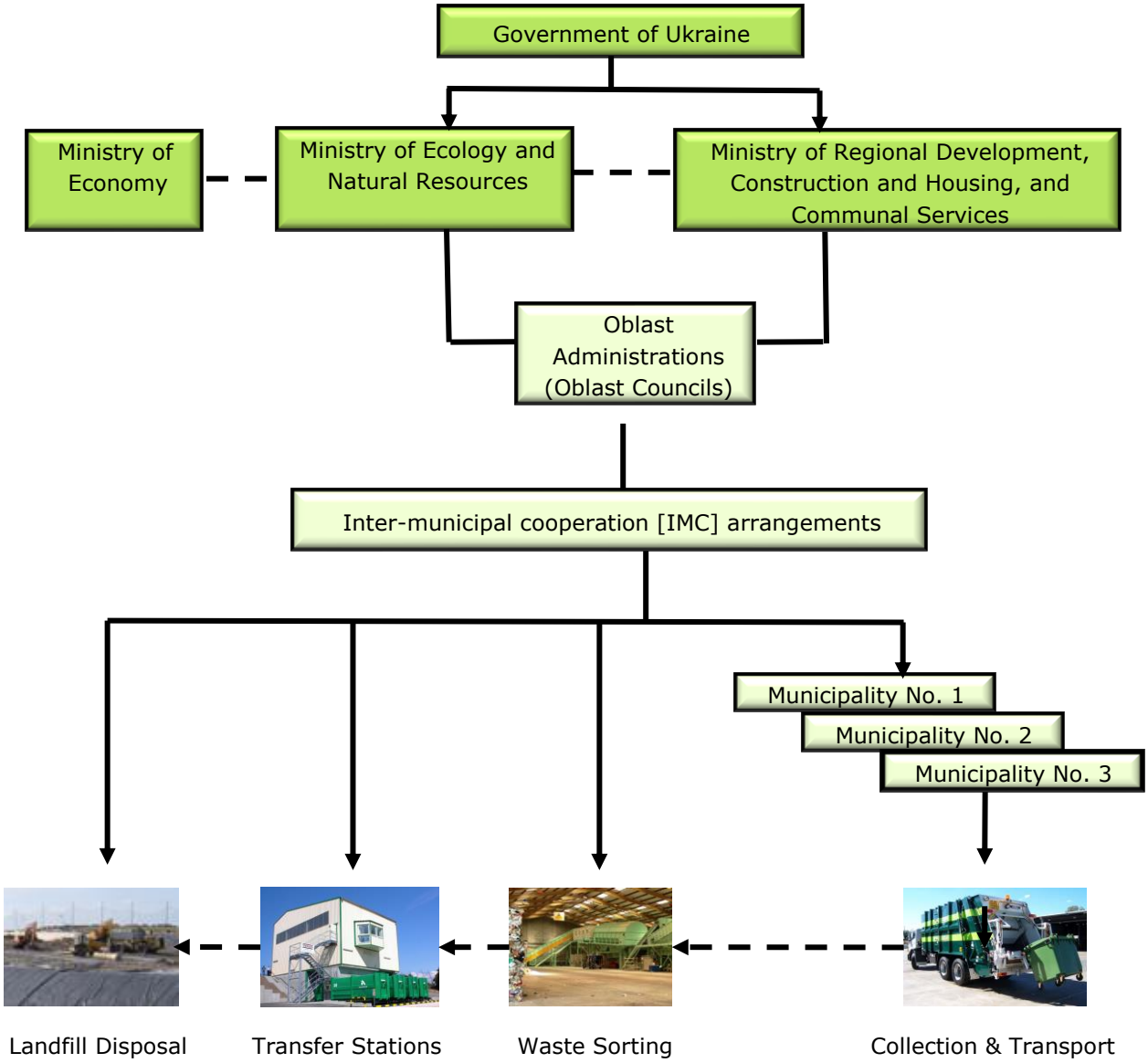
1. **Strategy**: By 2020, the Government of Ukraine will clarify the rights of local self-government units, identifying the benefits and disadvantages of IMC arrangements, setting out the different models that are acceptable in the Ukrainian institutional and

regulatory context, and outlining how and under what conditions the Government of Ukraine will encourage IMC, by providing technical and/or financial support.

2. **Amend Existing legislation:** in order for inter-municipal cooperation to become established, legislation needs to be amended to enable tariffs to be set across Oblasts and municipality boundaries, and to enable tendering processes across administrative boundaries, etc.

3. **Guidance**: Following the adoption of this Strategy, the Government of Ukraine will develop guidance for municipalities on IMC, with a step-wise approach to setting-up an IMC arrangement.

Figure 11.1 Organigram of MSW management in Ukraine



The Fundamentals of Inter-municipal Cooperation (IMC) Arrangements:

Inter-municipal cooperation arrangements involve a number of local self-government units coming together and entering into an agreement to carry out works or activities for which they are otherwise individually responsible. The overall objective of such arrangements is to improve the efficiency and overall effectiveness of the activity or operation in question.

In the case of MSW management there are a number of clear benefits to such IMC arrangements, particularly in the case of construction and operation of infrastructure to modern standards. The new EU standards for landfills (i.e. incorporating bottom liners landfill gas and leachate management systems) means that it simply will not be practicable to construct facilities for the sole use of smaller settlements (i.e. less than 150,000 population). The only solution is the construction of regional landfills which benefit from obvious economies of scale advantages. This solution is outside the scope of such smaller settlements. Inter-municipal cooperation (IMC) arrangements are therefore required in order to exploit the economies of scale advantages associated with MSW facilities such as landfills, waste sorting lines and other recovery infrastructure.

The fundamentals of IMC arrangements for MSW management can be summarized as follows:

- A binding contract between a varying number of local self-government units in order to achieve overall cost efficiencies in specified MSW management elements (e.g. landfills, transfer stations, waste sorting lines and other treatment facilities);
- The selection of the local self-government units should be based on an appropriate catchment area with a critical mass of population (e.g. in the order of 250,000 to 400,000 at the lower end of the scale);
- The units to be included should be based on geographical considerations rather than political or other affiliations;
- Smaller communities should not be placed at any financial disadvantage due to the implementation of IMC;
- Tariffs should be equal or at least equitable across all of the local self-government units within the catchment area defined;
- A regional body should be established to administer the activities covered by the IMC. This body should, in turn be overseen by a board which is representative of the participant units;
- Where the key MSW facilities in question comprise a landfill and a number of transfer stations, smaller local self-government units should not be disadvantaged by their location in relation to the location of the landfill site or nearest transfer station;
- Where costs are incurred by the IMC body or board they should ideally be covered by the MSW management tariff in question. Where any shortfall in costs

11.1 MSW Management Planning

A National Waste Management Plan or Action Plan will be elaborated following the adoption of this Strategy which outlines the short- and medium-term policy objectives, the issues of concern, the scope and the main means to be used in order to achieve the policy objectives.

Following the National Waste Management Plan or Action Plan, regional waste management plans will be developed at oblast level to contribute to the implementation of this Strategy. Where waste catchments within oblasts are defined they should ensure a minimum population of about 150,000 in order to achieve appropriate economies of scale. Municipalities will be encouraged to cooperate with neighbouring municipalities in order to meet this minimum population requirement.

The regional waste management plans must provide an agreed, long-term and stable policy framework within which the necessary facilities and infrastructure for sound waste management can be provided. An adequate waste management plan is a guide, that provides clear direction and that assists public and private decision makers, to take decisions.

Content of regional waste management plans at oblast level (i.e. oblast waste management plans)

- Assessment of the existing situation
- Setting out the responsibilities of all parties within a regional MSW management system, including but not limited to planning, management, collection services, treatment, and disposal.
- Setting out the set of policy measures and actions that will be taken to implement the Strategy
- Defining the catchment areas which can form appropriate regions taking account of economies of scale aspects and having regard to transport logistics
- Identifying the necessary resources for implementation
- Planning MSW infrastructure and operations:
    - The fundamental MSW planning parameters: size, composition and projected changes of the waste stream for the planning area during the life of the plan.
    - Inventory of existing facilities
    - Definition of the collection needs

The regional waste management plans must be approved by the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine. Once they are approved, their priorities and directions will be integrated into the National Waste Management Plan or Action Plan.

Proposed Measures

- **Guidelines for Waste Management Plans:** The Government of Ukraine will publish Guidelines and approve the order of development of oblast waste management plans or regional waste management plans in order to assist oblasts and local competent authorities in preparing waste management plans in line with the requirements of the legislation and of this MSW Strategy. These Guidelines will be non-binding and will promote more coherent and appropriate planning practices in Ukraine.

- **Financial Assistance:** The Government of Ukraine will provide financial assistance to the local self-government units. One of the eligibility criteria for financial assistance from the national government to the local self-government units, will be the presence of a sound regional MSW management plan, based on IMC principles.

12. Policy Instruments

12.1 Introduction

Changing our behaviour is fundamental to achieving sustainable management of MSW. All stakeholders are responsible for delivering change but it is important that an onus is placed upon particular producers (i.e. including manufacturers, brand owners and importers), waste producers, waste management companies and local authorities operating MSW systems to deliver this much-needed change in behaviour.

In order to ensure that a change in behaviour is achieved it is important that all actors, including the general public have the ability to change, an awareness of what change is required and an incentive to change.

Effective Mix of Policy Instruments

Effectiveness is the extent to which a measure is likely to contribute to achieving the goals, objectives and targets of this MSW Strategy. We recognise that to be effective, the proposed mix of policy instruments must:

- be credible, which requires ongoing stakeholder involvement during implementation, respect for timelines, absolute transparency and effective monitoring and enforcement of compliance. We recognise that credible enforcement requires strong and appropriately staffed institutions with sufficient resources, and we will therefore strengthen these institutions
- be feasible with existing human, technical and financial capacities and resources
- take into account existing market realities. As such the due-dates for meeting the recycling and recovery targets take into account that the recycling and recovery infrastructure and viable markets for recyclables must be further developed
- be accepted by the stakeholders whose behaviour must be changed. To be accepted, the measures must take into account the existing attitudes, practices and concerns in Ukraine, must be affordable and must have clear benefits for human health, the environment, employment, innovation and economic growth.

It is recognised that the best way to ensure change is by applying an appropriate mix of policy instruments and by ensuring that the physical infrastructure is in place to effect the change. The three main categories of policy instruments are:

- regulatory instruments, i.e. direct regulation;
- economic instruments, i.e. market-based instruments, providing economic incentives and disincentives; and

- social instruments, which are information-based/ voluntary measures.

This MSW management strategy therefore proposes a coherent, balanced and effective mix of policy instruments to achieve its objectives.

12.2 Regulatory policy instruments

Regulatory instruments involve direct regulation, which relies on the legitimacy, authority and enforcement power of the Government of Ukraine for directing or banning practices, and inducing compliance through enforcement.

Proposed Regulatory Policy Instruments

1. **Standards**: The Government of Ukraine will conduct a comprehensive review of the existing environmental, technology and practice standards and amend them, as required, to meet the objectives of this MSW Strategy

2. **Permits:** The Government of Ukraine will ensure that all companies involved in the collection and transport of municipal waste are appropriately subjected to permits.

3. **Licenses**: The Government of Ukraine will ensure that all companies involved in recovery and disposal of waste are appropriately subjected to licenses (issued by either MRDC or MENR). Applications for licenses will be followed up by a visit of the Environmental Inspectorate to the sites and licenses will only be issued if the operation complies with all relevant standards

4. **Waste management reporting**: A requirement will be placed upon companies that generate and/or manage waste above a certain threshold, to report on a regular basis, according to the list of necessary additional report information (which will be added to the form "1-MSW") on waste management a. Such information should be accessible on a company-by-company basis for Minregion. In order to be able to generate MSW management data at oblast level, an electronic system of data collection should be developed. This information will be used to underpin the implementation and review of the MSW Strategy and will also encourage companies to improve their environmental performance

5. **Plastic bag tax**: A tax will be placed upon the use of lightweight plastic bags, which are deemed to be prone to littering and which can easily break apart, causing damage to the environment.

6. **Materials bans and restrictions:** Materials bans and restrictions will be adopted, to transpose the EC legislation that prescribes the reduction or elimination of hazardous substances in at least the following products: batteries, waste electric and electronic equipment (WEEE) and end-of-life vehicles (ELVs).

7. **Collection agreements**: A mechanism for ensuring agreements between all generators of MSW and registered waste collection companies, for the collection of all MSW waste generated, will be in place and enforced.

8. **Landfill ban**: A ban on the landfilling of the following waste streams will be adopted, for which landfilling is not an appropriate form of disposal or from which resources can be recovered: e.g. separately collected MSW, tyres, batteries, etc.

9. **End-of-waste rules**: The Government of Ukraine will adopt clear rules to determine when a secondary raw material should no longer be legally considered as 'waste'. This will provide operators with more certainty and a level playing field.

10. **Reform of Environmental Inspection & Control**: The Government of Ukraine will adopt a strategy to strengthen the existing enforcement system in particular following construction of the new regional landfills, i.e. monitoring and inspection of (informal) of waste management activities and operational sites, to ensure compliance with the requirements of this MSW strategy and of the policy package that is selected. This will be in line with the current process of reform of the Environmental Inspectorate.

11. **Penalties**. The penalties for offences in the field of waste management will be increased significantly.

12. The Code of administrative offenses of Ukraine will be appropriately amended.

Compliance Approach

The Compliance Approach with regard to environmental inspection and control will focus upon:

- ***Efficiency:*** To enhance efficiency, the Government of Ukraine will require the Environmental Inspectorate to establish annual inspection plans that define the priority sectors for that year and that determine the minimum number of inspections to be carried out. One of the priority sectors will be the MSW management sector.
- ***Financing:*** The Government of Ukraine recognises that monitoring and enforcement can involve costly operations, such as sampling and laboratory analysis. The Government of Ukraine will prescribe that, where these operations are necessary, their cost must be borne by the regulated individuals and companies.
- ***Compliance support:*** The Government of Ukraine will provide compliance support to stakeholders, by developing and widely disseminating a guidance document, which presents the requirements of this MSW Strategy and of the selected policy package of regulatory, economic and social instruments. This guidance will also include the standards that must be included in the licenses of waste recovery and landfilling facilities.

The following table provides an overview of the regulatory instruments, the due-date for adoption, and the category of objectives that they serve:

Policy measures	Due-date	Sustainable municipal waste objectives			
		Performance	Prevention	Collection	Recycling
Standards	2022	X			
Permitting	2022	X			
Licensing	2022	X			
Waste reporting	2022	X			
Compliance strategy	2022	X			
Plastic bag tax	2022		X		
Materials bans/restrictions	2024		X		
Collection targets	2022 and 2030			X	
Separate collection	2022 and 2030			X	
Collection agreements	2022			x	
Treatment agreements	2022	X			
Landfill ban	2024				X
Recovery targets	2024				X
End-of-waste rules	2022				X
Recycled content standard	2022				X

12.3 Economic policy instruments

Economic policy instruments provide incentives to shift from environmental harmful behaviour, towards more sustainable alternatives. The instruments themselves can be the least costly type of effective measures that the Government can take to change our behaviour with regard to MSW management.

Proposed Economic Policy Instruments

Economic policy instruments for sustainable waste management provide incentives or disincentives by influencing directly or indirectly the prices of products of which the end-of-life management is problematic. Economic instruments in MSW management have two major objectives:

- To cover costs of waste management services. To enhance their effectiveness, the revenues should be earmarked for improving service delivery;
- To influence behaviour by means of the pricing mechanism in order to minimise waste, to avoid negative environmental impacts (e.g. from landfill disposal) or to strengthen recycling.

Tariffs

1. **Pay-as-you-Throw (PAYT) schemes**: Local cost recovery mechanisms will be made obligatory. This will require the introduction of cost-covering user charges that are service-related. These charges must be paid by the waste generator to the MSW collection service providers.

   It is generally accepted that PAYT-schemes have a higher potential to influence the behaviour of households than flat-rate charges (per household) or variable-rate charges that are not related to the service level (but that are, for example, based on the size of the building or estate, on the household income or on the number of people living in a household).

   As to the level of cost recovery, we recognise that it may not be possible, at least initially, to recover the full cost of the collection of waste from households. Accordingly local recovery mechanisms must be complemented with economic instruments adopted at national level. However, if local self-government units collect waste that does not originate from households, the full cost of the management of this waste should be recovered from the generators through user charges. A methodology to calculate cost-covering user charges will be developed.

   PAYT can be readily implemented where MSW is collected from individual households in the framework of a kerbside collection system. At a highly sophisticated level pay-by-weight schemes have been implemented in EU Member States. Alternative approaches include pay-per-lift where tags must be purchased in advance.

   It is acknowledged that implementing PAYT in the case of high-rise buildings and HOAs is difficult to implement. However, the incentive effect of PAYT in encouraging primary source separation of recyclables is clearly evident in EU Member States. One relatively low-cost PAYT measure is the use of different colour-coded plastic sacks. Under such a scheme householders would purchase specific black 80-litre plastic sacs for residual waste while clear plastic sacs for dry recyclables would be available free of charge, or at a reduced charge. It is acknowledged that implementation of such an approach would require a significant amount of supervision by HOA supervisors and local self-government unit officers.

Pay-as-you-throw Explained

A user charge is service-related when the charge is based on the level of service, the volume or weight of waste collected and or the level of segregation at source. Schemes with such service-related user charges are referred to as Pay-as-you-Throw (PAYT) schemes. PAYT schemes are one of the main economic instruments and are crucial for local governments to:

- achieve local cost recovery. Regular revenue from PAYT schemes are necessary to cover capital and O&M costs and thus for achieving financial sustainability of MSW services.
- implement the Polluter Pays Principle, another guiding principle of this MSW Strategy
- influence the behaviour of households, by rewarding households for their prevention efforts, as they pay less charges if they offer less waste for collection, and for their segregation efforts, as the rates are differentiated, and are higher for mixed waste than for source-segregated dry recyclable materials.

2. **Cost-covering landfill tariffs**. The existence in Ukraine of low-cost sub-standard disposal options with a high environmental impact is one of the main barriers to increased recycling. Therefore the cost of landfilling, which is currently too low in Ukraine, mainly because it does not comply with recognised standards, needs to be increased.

   There is a clear relationship between higher landfill tariffs and lower levels of MSW generation and lower percentages of MSW being sent to landfill. Accordingly the cost of landfilling will be increased, which will discourage landfilling. It is important to note that the introduction of cost-covering landfill tariffs must be combined with closure of the worst dumpsites. These dumpsites currently create an overcapacity in infrastructure to treat residual, mixed waste, and this is another barrier to recycling.

Increasing the cost of Landfilling – Key actions

a) Establishment of environmental, technology and practice standards for landfills, to ensure that the potential environmental and social costs of landfilling (for example, greenhouse gas and air emissions, and leachate creating water and soil pollution) are avoided
b) incorporating the standards into the permits/licenses for landfills
c) Enforcement of the standards
d) Obligatory full cost accounting, to establish the full (real) cost of landfilling (e.g. at a minimum the costs of construction, operation, closure and monitoring during the after-closure phase), according to a model that will be defined by the GoU
e) Obligatory full cost recovery, by calculation and applying landfill tariffs (or gate fees) that reflect the full cost, according to a model, that will be defined by the GoU

Taxes

1. **Tax on the disposal of waste.** The level of the tax will increase in such a way that it can have a significant impact on diversion of municipal solid waste away from landfill disposal and towards re-use, recycling and recovery. Such taxes have been used in EU Member States at varying levels from €4/ton to €26.6/ton to over €100/ton in Spain, Poland and United Kingdom, respectively. In many cases the taxes are directed to an environmental fund which is ring-fenced for use in funding environmentally-friendly waste management practices, including recycling and recovery activities.

   The following schedule for a step-wise increase in the environment tax on disposal of waste is proposed:

Proposed schedule for step-wise increase of the tax on the deposal of waste

Year	Tax for non-hazardous waste	Tax for inert waste
	€/t	€/t
Current Tax	0.14	0
2017	0.4	0.1
2018	0.8	0.2
2020	1.5	0.3
2022	3	0.6
2024	4.5	1
2026	7	1.5
2028	10	2
2030	15	3

   The revision of the rates of the environment tax on disposal of waste related to landfills for non-hazardous waste will require a revision of the overall taxes for deposit of waste (i.e. for the different classes of disposal facility) and the approach to such taxation. Within the framework of implementation of the Waste Framework Directive, 2008/98/EC, Ukraine will adopt the EU classification of waste which will necessitate changes in the relevant environmental taxes.

   At the end of 2022, following implementation of the step-wise increase in the environment tax on disposal of waste, an assessment of the impact of the increases in the Tax in terms of a reduction in the rate of landfill disposal and an increase in the recycling and recovery rate will be carried out. Based on the findings of such an assessment, the Government of Ukraine will determine what, if any, changes to the tax on waste disposal are appropriate for the period from 2023 to 2030.

2. **Waste import tax**: The Government will adopt a tax on the import of paper and cardboard waste and on plastic waste. By increasing their price, the domestic recycling of the collected waste will be supported. To enhance the effectiveness of the tax, relevant revenues will be earmarked to support recycling.

Income tax credits

1. The Government will provide indirect subsidies by providing incentives in direct taxation, in the form of income tax credits. These have the same effect as direct subsidies, the only difference being that they do not provide direct revenue to the beneficiary, but, instead, reduce its outgoings.

Types of income tax credits to be introduced

- ***Recycling equipment:*** A tax credit for the purchase of recycling equipment. The credit will be equal to a percentage (e.g. say 20%) of the purchase price paid for the equipment that is exclusively used to recycle or recover. The tax rules will provide that the total allowable credit may not exceed this percentage (i.e. 20%) of the tax liability computed prior to applying the credit (and/or a certain annual amount). The purchase price may be deducted as a lump sum or on an instalment basis over a period of 3 years. Eligible applicants will have to apply for a tax credit to the ministry responsible for taxation, but it will be a requirement that the Ministry of Ecology and Natural Resources certifies that the machinery and equipment is integral to the recycling/recovery process.

12.3.1 Indirect tax exemptions

1. **Temporary VAT exemption for re-use services**: Services for the reuse, repair, maintenance and sales of second hand/refurbished products will be exempted from VAT

2. **Temporary VAT exemption for material and products to be recycled**: Recycling companies that purchase products or materials to be recycled as well as companies who collect secondary raw materials, will not have to pay VAT for the secondary raw materials purchased/sold, in order to financially support the recycling sector. This VAT should be used for the technical development of the company

3. **Temporary import duty exemption for recycling equipment**: The import of recycling equipment and machinery will be exempted from an import duty

Non-revenue instruments

1. **Deposit refund system**: The Government will require the private sector to set up a deposit refund system for some of the products for which an Extended Producer Responsibility scheme will be implemented. Under such systems, a monetary deposit is paid, at the time a product (such as a re-usable beverage bottles) is sold. The deposit may be mentioned on the invoice. The deposit is eventually refunded when the product is returned.

2. **Green Public Procurement**: The public sector in Ukraine will lead by example and will support the development of a market for environmentally sound products through its own purchasing practices. The Government will develop and implement a Green Public Procurement policy and amend existing legislation, in order to give preference to recycled products or products that pose relatively low environmental risks.

3. **Extended Producer Responsibility**: this instrument is described in more detail in the following section.

Extended Producer responsibility

The necessity to adopt the Extended Producer Responsibility (EPR) approach to contribute to the implementation of the Polluter Pays principle is recognised as one of the main pillars of this MSW Strategy. Under the EPR approach, the producers' responsibility for reducing the environmental impact and managing their products is extended across the whole life cycle of the products, from selection of materials and design to their end-of-life. "Producers" are business entities that put products on the market and can be either manufacturers or importers of products.

The Government will require "producers" to design, set-up, manage and/or finance by 2022:

1. An end-of-life management programme for their products, under which these end-of-life products are collected, recycled, recovered or disposed of in an environmentally sound manner
2. Public information programs, to inform the consumers about their role in reducing product impacts and in the implementation of the end-of-life management programme

The Government of Ukraine will thus give 'producers' a significant financial and/or physical responsibility for the end-of-life management of their products and packaging as a condition of sale.

Scope of EPR Schemes

1. The Government of Ukraine will introduce EPR schemes by 2022 for the following waste streams: ▪ Packaging waste ▪ Waste electric and electronic equipment (WEEE) ▪ Batteries ▪ End-of-life vehicles	2. The Government of Ukraine will consider the introduction of EPR schemes by 2030 for the following additional waste streams: ▪ Textiles ▪ Furniture ▪ Tyres ▪ Waste oil ▪ Paper and card board ▪ Farm plastics ▪ Medicines and medical waste

In relation to this MSW strategy, the full implementation of an EPR scheme for packaging waste is considered critically important if the recycling/recovery targets set out for this waste stream are to be achieved. In addition, having regard to the high proportion of biodegradable waste in the packaging waste stream[44], recycling and recovery of packaging waste will have a significant impact on reducing the amount of landfill disposal of biodegradable waste. This, in turn, will contribute to reducing the level of greenhouse gas emissions in Ukraine. Accordingly, in relation to this MSW Strategy, implementation of an EPR scheme for packaging waste is considered a priority.

Practical arrangements to meet EPR obligations

There are some key considerations that must be both considered and adhered to in order to introduce EPR into Ukraine in a sustainable fashion. As stated above, the importance of EPR is acknowledged and it is widely accepted as a mechanism that will be central to tackling the MSW management problems in Ukraine. Some keys issues that will need to be addressed by the Government, producers and all relevant stakeholders are summarised herein. The EPR schemes should ideally be producer-managed systems, with minimum government involvement, but with government oversight.

- **Transparency** - The Government will set minimum conditions on transparency and cost-efficiency, to make EPR schemes effective.

- **Performance Goals** – The Government will also define the performance goals, including, among other aspects, recycling and recovery targets per waste stream, but the EPR schemes will be results-orientated. Producers will have the flexibility to design the end-of-life management programme to meet the performance goals. The end-of-life management programme must ensure the separate collection and treatment of the end-of-life products.

- **Control** – The Government will establish a system for controlling the EPR schemes. The system will, among other aspects, include the use of independent auditors for verification of the achievement of recycling and recovery levels as appropriate.

- **Responsibility** - Producers will be given the choice to meet their EPR obligations either individually or collectively with other producers. Collective responsibility can be taken up by establishing or joining a producer responsibility organisation (PRO), which handles the EPR obligations of its member companies. The PRO will organise separate collection and recycling for groups of companies and will be financed through contributions/fees paid by member companies.

- **Fees** - The fees paid by the member companies, must reflect the true end-of-life management costs of the products covered by the PRO.

- **Fairness** – It is recognised that there must be a level playing field: all producers within a particular product category should have the same requirements, whether they choose to meet their obligations individually or collectively.

- **Stakeholder cooperation** - An effective EPR scheme requires the producers to cooperate with other stakeholders, in particular, with retailers and final users of products, who must

[44] Paper and cardboard account for 17% of the MSW stream, according to data for 2015 from the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine, and much of this fraction is packaging material.

return the end-of-life product to the designated collection points. The Government will also prescribe its own obligations.

- **Utilisation of existing infrastructure** – The Government will encourage 'producers' to cooperate with and use existing municipal and other collection and recovery infrastructure. The Government will oblige the producers to cover the full cost of this cooperation and of the use of this infrastructure. The cooperation may include supporting the extension of the activities of the existing collection and treatment companies and the upgrading of their environmental standards. Fully transparent methods to attribute the correct market costs for the use of public infrastructure are necessary and will avoid dysfunctional behaviour on the part of PRO's.

- **Finance** - Producers may choose to finance the EPR scheme by an advanced waste management fee that the consumer pays for its products at the point of sale. However, the rate of the fee will have to be agreed with the Government. The fee must be based on the estimated costs of collection, recycling and disposal. The fee could be set per unit of the product sold, but can also be set on a weight basis.

- **Tracking & control of products/packaging** – The Government will require the 'producers' to establish an effective mechanism to track and control the quantities of products/packaging that producers or importers place on the market. This is also in the interest of the "producers" that comply with their EPR obligations, as such a system is key to avoid the problem of 'free-riders'. Otherwise, some producers might declare fewer products than they actually issue (or none at all) and thus evade financial contributions while benefiting from the end-of-life management system that is established and financed by a PRO.

The Fundamentals of Extended Producer Responsibility Schemes

Extended Producer Responsibility is a policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products. Assigning such responsibility could in principle provide incentives to prevent wastes at source, promote product design for the benefit of the environment and support the achievement of recycling and recovery targets.

The fundamental principles of EPR schemes can be summarized as follows:

- Above a stipulated threshold all producers of products (i.e. the 'obligated companies') are responsible for reducing the environmental impacts from such products and for managing their products across their entire life-cycle (i.e. design, use of materials in manufacturing and end-of life aspects);
- 'Producers' are business entities that put products on the market and they can be either manufacturers or importers of products;
- There are generally two broad management models within EPR schemes:
    i. A Single Producer Responsibility Organisation (PRO), that is owned by the obligated companies: competition is organised by the PRO (through public calls for tenders) at the operational level (e.g. for waste collection, sorting or/and treatment operations and sales of the recycled materials); and
    ii. Several competing PROs, privately owned (by the obligated companies or other entities), among which the obligated companies are free to choose in order to fulfil their responsibility obligations; competition exists also at the PRO level.
- In the case of several PROs, all actors should be able to compete fairly, within a clear and stable framework, in order to avoid cherry-picking (e.g. practices that target only the most valuable wastes or the most convenient geographical areas);
- All obligated producers should be treated equally in terms of tariff per ton of product placed on the market;
- Obligated producers should be given the opportunity of self-complying or joining a PRO;
- Appropriate control and enforcement measures, including the imposition of penalties, need to be put in place in order to avoid the problem of 'free-riders';
- PROs should be established on a not-for-profit basis;
- The activities of PROs should be carefully monitored by their public sector counterpart in order to ensure that the tariffs paid by the obligated producers are set on a cost-covering basis and that the PROs operate efficiently and effectively;
- An adequate regulatory and administrative capacity needs to be established at the national level to ensure that no anti-competitive practices emerge;
- In the case where there is an overlap of responsibility between the PROs and local self-government units (e.g. management of household packaging waste), measures should be put in place to ensure an appropriate level of cooperation between the PROs and the local self-government units in relation to the design and implementation of the source separation system and the collection and transport system for the respective wastes;

Summary of Measures - Economic Policy Instruments

The following table provides a summary of proposed economic policy instrument, the due-date for adoption, and the specific objectives that they serve

Policy measures	Due-date	Sustainable MSW objectives				
		Performance	Prevention	Collection	Recycling	Financing
Tariffs						
Pay-as-you-Throw	2022		X	X	X	X
Taxes						
Waste imports	2022				X	X
Landfill	2017 - 2030		X	X	X	X
Direct Subsidies						
Municipal grants	2020			X	X	X
Income Tax Credits						
Recycling equipment	2020				X	X
Recycling jobs	2020				X	X
Indirect Tax Exemptions						
VAT for re-use services	2019		X			X
VAT for products to be recycled	2019				X	X
Import levy for recycling equipment	2018				X	X
Non-Revenue						
Deposit refund system	2022			X	X	
Green Public Procurement	2022		X		X	
EPR	2017 - 2022	X	X	X	X	X

13. Education and Awareness

Education and Awareness is based on the idea that the provision of information on the environmental impacts, both positive and negative, might encourage companies and individuals to change their behaviour on a voluntary basis. However, it takes more than just providing information to change people's attitude and behaviour. Interaction between government institutions and the other stakeholders, engaging with communities, and leading by example are equally important.

We as individuals are the main producers of MSW and therefore it is us that must, first and foremost, change our behaviour. Education and raising awareness is, therefore, a central component of this strategy.

Outlined below are a number of priority measures which are required in order to foster the correct environment within which all previously discussed measures can be carried out. If the general public and those who own or operate commercial enterprises have a poor understanding of MSW management issues and are unaware of the negative impact that waste generation currently has upon the environment of Ukraine then it will be difficult to implement all previously discussed measures. Understanding and awareness is therefore central to changing our behaviour as a nation.

13.1 Measures that will be taken by the Government of Ukraine

1. **A national awareness-raising campaign**: The Government of Ukraine will undertake a national awareness-raising campaign to make key stakeholders aware of what constitutes a sustainable MSW management system, of their necessary contribution to the system and of the benefits of sustainable MSW management practices.

2. **Municipal Guidance**: The Government of Ukraine will develop and adopt guidance on

Municipal Guidance

- Model by-laws on waste management to cover:
  - Separate collection of household waste and waste from institutional, commercial and small industrial enterprises which is comparable to household waste.
  - Waste management charging and the introduction of PAYT-schemes.
  - Removal of illegally dumped waste, allowing the municipality to recover the removal costs from the respective polluter
- Guidance on the necessary arrangements for improved MSW management.
- Guidance on how to set-up PAYT schemes.
- Practical guidelines for the environmentally sound storage, collection, transport and recycling of MSW.

Such guidance will help to build the capacity of the municipalities and will ultimately help to reduce the risks to human health and the environment of waste management.

MSW management for local self-government units. The guidance will address the following issues:

3. **MSW Awards**: Excellence in MSW management performance will be recognised by establishing a system of "Municipal Waste Awards", to be presented annually to the best performing municipality in each oblast. Such public recognition will encourage improvement in performance and the dissemination of good local waste management practices. The system will be widely publicized, not only to inform potentially interested municipalities, but also to make it known to the wider public.

4. **Recycling industry certification:** Establishing a voluntary certification scheme for collectors, sorters and recycling facilities, in order to encourage the recycling sector, will be encouraged. Under such a scheme, such facilities will be certified against Best Available Techniques (BAT) requirements, which bring the lowest environmental impacts and which result in high-quality recyclables that meet the specifications of their end-users.

5. **Recovery platforms & forum**: Recovery platforms for a selection of priority waste streams, such as: plastic, food waste, metal and paper, will be established. These platforms will bring together the Government of Ukraine and all actors of the product value chain, to help define the measures needed to increase collection and recycling/recovery rates and in particular to create markets for recycled waste and to share best practice and results achieved.

6. **Product labelling**: Labels on products are a means for the brand owner to provide information to consumers on:

   - environmentally conscious purchase choices (e.g. favouring products with a high recycled content or a longer life time),
   - the potential health and environmental hazards of products if not properly handled, and
   - the collection and recycling options and the consumer's role in the separate collection of the product.

In consultation with the industry sectors concerned a product labelling system will be established, including a list of products that must be labelled, the information that the labels must provide and the requirements that the labels must meet. Government action will make product labelling effective and avoid a situation where consumers are faced with a profusion of labels, for example with dubious environmental claims. A mechanism, to control whether the information provided is reliable, accurate and clear, will be established.

Summary of Measures – Education and Awareness

The following table provides an overview of the selection of social policy instruments that the Government will apply to achieve the objectives of this MSW strategy, with an indication of the due-date for implementation and of the objectives they serve.

Policy measures	Due-date	Sustainable MSW objectives			
		Performance	Prevention	Collection	Recycling
Raising Awareness					
National campaign	2018	X	X	X	X
MSW Awards	2019	X	X	X	X
Capacity Development					
Municipal Guidance	2020	X	X	X	X
Recycling industry certification	2020	X		X	X
Market Development					
Recovery Platforms	2020			X	X
Product labelling	2022	X	X	X	X

14. Financial Aspects

14.1 Introduction

Cost recovery in the waste sector is insufficient in Ukraine. The low level of the municipal waste fees (i.e. the tariffs for municipal waste management services) does not cover all of the costs for waste collection, transportation, treatment and/or landfilling, and in many cases some of the costs are subsidised by the respective municipalities. Moreover, the weak economic situation of companies, the lack of affordability and willingness to pay on the part of a significant number of households, the lack of enforcement of legislation on municipal waste management activities, and the difficulties in accessing loans, all result in substandard waste collection services and the generally poor condition of the technical equipment due to low levels of investment.

> The MSW tariffs and charges are not set at realistic levels. Taking inflation into account there has been no real increase in the average MSW tariff from 2004 to 2015

As a result of all of the above, the financial base of many of the companies involved in MSW management in Ukraine is relatively weak and the costs of providing an integrated MSW management service are not covered. The low level of tariffs does not stimulate MSW separate collection and sorting and the investment component in the tariff is rarely considered.

Cost recovery reflects the polluter pays principle and should be applied to both the household and non-household sectors in relation to the waste management services provided. Full cost recovery implies that the costs for construction of municipal waste management infrastructure in Ukraine as well as the associated operational costs should be borne by the producers of MSW i.e. the households and commercial/industrial enterprises.

The capital & operational costs for implementing the Strategy are outlined herein. The overall capital expenditure (i.e. construction of landfills and transfer stations, rehabilitation of old landfills and dumpsites, purchase of containers and collection vehicles, etc.) is estimated at 2.8 billion EUR, over the period of the strategy (i.e. up to 2030). The operational costs i.e. collection, sorting, facility operation, over the lifetime of the strategy is estimated at about 6.6 billion EUR.

Full cost recovery thus implies that the combined estimated capital and operational costs of approximately 9.4 billion EUR should be borne by the waste producer i.e. the household and commercial/industrial enterprises. The current charges that households and commercial/industrial enterprises currently pay will therefore need to be increased over the lifetime of the Strategy. For the purposes of this strategy the term "consumer tariff" will be used to describe the charge borne by the consumer for MSW services. When discussing affordability and cost recovery it is the "consumer tariff" that will be assumed i.e. the cost to the household and **not** the tariff agreed between the waste operator and the respective municipality.

The current average consumer tariff in Ukraine for MSW management services is 0.37% of average household income. It is estimated herein that to recover the costs of implementing of the measures set out in this strategy, the consumer tariff will need to increase to 1.7%, on average[45], of household income over the 13-year period of the strategy.

[45] The indicative range is 1.34% to 1.92% of average household income

14.2 Affordability

The average consumer tariff for the population for MSW management services in 2015 in Ukraine was 48.3 UAH/m^3, with on average 30% of the consumer tariff for landfill disposal. The average payment per person/year in 2015 was 90.1 UAH (i.e. €3.72/person/year[46]). This amounts to 0.29% of the average per capita disposable income (or 0.37% of the average household income). It is considered that the consumer tariffs could be increased significantly and still be at an affordable level[47].

14.3 Indicative Estimate of Capital Costs

Many of the measures set out in Section C: Waste Management Components will require investment, either in items of equipment, in vehicles or in development of facilities. An indicative estimate of the capital costs of the key measures are set out in the following tables:

Table 14.1 MSW Collection Services

Measure	Indicative Estimate	Comments/ Cost Recovery Aspects
Extension of the coverage of organised MSW collection services from 77.46% to 84% by 2022.	€15 million	This measure is applicable in particular to the larger settlements in Ukraine Costs relate to purchase of containers and collection vehicles. Cost recovery via MSW management tariffs.
Further extension of the organized collection coverage of MSW collection services to reach 90% of the population of Ukraine by 2030.	€23 million	This measure is applicable to the small towns and villages in Ukraine. Costs also relate to purchase of additional containers and collection vehicles. Cost recovery via MSW management tariffs.
Construction of a network of 200 transfer stations related to the construction of regional landfills	€183 million[48]	The exact number and respective capacity of the required transfer stations can only be determined following determination of the number and location of regional landfills Cost recovery mainly via consumer tariffs for MSW management services.

Table 14.2 Re-use and Preparing for re-use

Measure	Indicative Estimate	Comments/ Cost Recovery Aspects
Setting up a deposit-refund scheme for glass beverage containers in Ukraine.	N/A	This measure will be part of a comprehensive EPR Scheme for packaging waste.
Establishing 50 centres for "second hand"	€7.5	Savings can be made by co-locating

[46] Based on an exchange rate of 1 EUR = 24.2 UAH as of average for 2015 year
[47] Ukraine is classified by the World Bank as a lower-middle-income economy and therefore payments for MSW management services in Ukraine should not exceed 1% of the average disposable income per household (David Wilson, et al, 2012).
[48] Based on a CAPEX estimate of €917,400 for a transfer station with capacity 25,000 tons per year

Measure	Indicative Estimate	Comments/ Cost Recovery Aspects
goods and products by 2022.	million[49]	these centres with the Waste Reception/Collection Centres as set out in Chapter 9. Costs to be covered from state, oblast and local environmental funds

Table 14.3 Recycling – Including Biological Treatment

Measure	Indicative Estimate	Comments/ Cost Recovery Aspects
Extension of MSW separate collection (i.e. primary source separation of 'dry' recyclables) to 23% of the total population of Ukraine by 2022.	€29 million[50]	The costs of this measure relate to purchase of containers and collection vehicles. Cost recovery mainly via revenues from recyclables and EPR scheme for packaging waste.
Further extension of the MSW separate collection of 'dry' recyclables to 48% of the total population of Ukraine by 2030.	€50 million	The costs of this measure also relate to purchase of containers and collection vehicles. Cost recovery mainly via revenues from recyclables and EPR scheme for packaging waste.
Construction of 42 additional waste sorting lines (WSLs) by 2022.	€115 million	Cost recovery via revenues from recyclables and EPR scheme for packaging waste.
Development of further 49 WSLs by 2030.	€140 million	Cost recovery via revenues from recyclables and EPR scheme for packaging waste.
Construction of 271 Waste Collection/ Reception Centres	€40.65 million	To be developed in the cities with a population greater than 20,000[51]. Costs to be covered in part from state, oblast and local environmental funds/environment tax on disposal of waste as well as local budgets.

[49] Assuming a capital cost of €150,000 per centre.
[50] Assumption of 20% coverage of MSW separate collection of dry recyclables currently in place in Ukraine
[51] Based on the following:

Lower Limit: Population	Upper Limit: Population	Number of Centres/ Settlement	Number of Settlements	Total Number of Centres
20,000	100,000	1	170	170
100,001	500,000	2	36	72
500,001	1,500,000	3	8	24
Kiev City (2.8 million)		5	1	5
Total Number of Centres				**271**

Measure	Indicative Estimate	Comments/ Cost Recovery Aspects
Home composting units for use in individual houses in the suburban areas in the cities and towns and in rural areas	€105.5 million[52].	This will apply to about 1.3 million households in Ukraine by 2022 and about 2.6 million households by 2030. 50% of costs for containers to be covered by the population and the other 50% to be covered by municipalities from special local budgets, together with the general budget.

Table 14.4 Other Recovery

Measure	Indicative Estimate	Comments
Construction of appropriate facilities for stabilisation of the organic fraction of MSW.	Indicative estimate not provided	The roadmap in this regard will be outlined in a National Strategy for reducing the amount of biodegradable waste to landfill - to be developed by 2017.
Construction of RDF/SRF production facilities, as part of mechanical-biological treatment (MBT) plants, at locations across Ukraine	Indicative estimate not provided	The exact number and location of such facilities will be related to obtaining agreement in principle by respective cement companies to pay for RDF/SRF produced.
Provisional: Modernisation of the incineration plant "Energy", so that the incineration process can be classified as a 'recovery' rather than a 'disposal' operation.	€212 million[53].	This will require that the emissions are fully in compliance with the EU Industrial Emissions Directive, 2010/75/EC and that the energy efficiency reflects best practice in EU Member States for such recovery facilities**.**

Table 14.5 Final Disposal

Measure	Indicative Estimate	Comments
Construction of about 100 state-of-the-art landfill facilities in full compliance with the EU Landfill Directive, 1999.	Investment costs of €0.66 billion for the period of the Strategy – 13 years	The indicative estimates are based on 92 'regional' landfill facilities, as follows: - 3 landfills with capacity 400,000 tons per year; - 7 landfills with capacity 200,000 tons per year; - 82 landfills with capacity 100,000 tons per year Cost recovery via consumer tariffs for MSW management services.
Rehabilitation and closure of	€1.7 billion overall[54].	Once a new sanitary landfill has been

[52] This measure will involve purchase of 2.57 million home composting units at a total cost of about **€105.5 million** (at a unit cost of €41). These units could then be sold to the respective households at a 50% discount on the market price.

[53] Based on a waste-to-energy facility with a capacity of 250,000 tonnes per year. The full investment cost for a new facility in this regard would be in the range of €125 million to €300 million. A full Feasibility Study will need to be completed in order to determine the investment cost required.

Measure	Indicative Estimate	Comments
the existing landfills/dumpsites in Ukraine.	€1.44 billion for the period of the Strategy – 13 years	developed for a defined catchment, these measures will be put in place as appropriate, to rehabilitate and close the respective sites and to prevent further disposal of MSW on the closed facilities. Costs to be covered from state, oblast and local environmental funds/environment tax on disposal of waste (i.e. environmental tax on

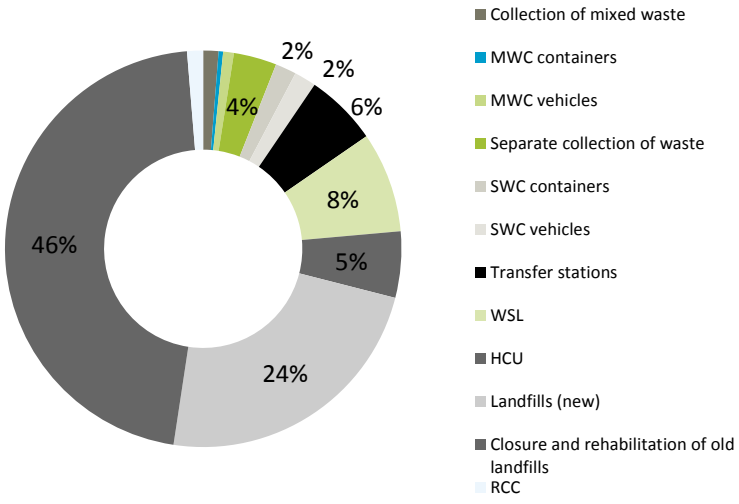
14.3.1 Level of investment and consumer tariffs

Level of investment

The level of investment for the proposed measures, are significant and will pose an implementation challenge for Ukraine. One of the overarching objectives of this strategy is to maintain consumer tariffs at an affordable level for the population. A preliminary assessment of the impact of the measures shows that the overall cost will be increased to an average of approximately 1.7% of average household income (i.e. the range is between 1.34% and 1.92%) in Ukraine. While this represents a significant increase in the current level of consumer tariffs, it is considered to be within generally accepted limits of affordability.

The indicative overall CAPEX of the measures proposed, for the 13-year period of the strategy, is approximately **€2.8 billion**. The breakdown of CAPEX is illustrated in Fig 14.1 below:

Figure 14.1 Breakdown of CAPEX of measures set out in the strategy



[54] This estimate is based on the following assumptions: Total number of landfills in Ukraine is about 6,064. By expert estimation, hardly any of them are in compliance with standards in the EU Landfill Directive, 1999/31/EC. They will therefore need to be conditioning or closed and rehabilitated. It has been assumed that it will not be practicable to 'condition' a significant number of the existing landfills. It has accordingly been assumed that 99.9% of the existing landfills should be closed and rehabilitated. Closure and rehabilitation of the old and non-compliant landfills will be in parallel with construction of the new regional landfills. The estimate provided is based on rehabilitation of an average of 467 closed landfills per year beginning from in 2020 with an average cost per landfill of about €280,000.

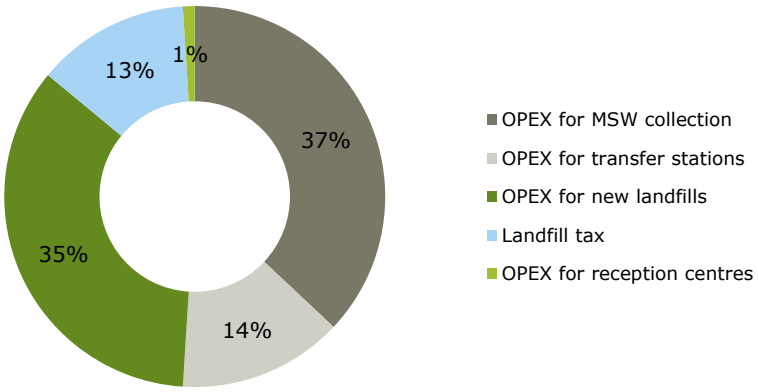
As illustrated in Fig 14.1 above, the development of new regional landfills (i.e. approximately €0.73 billion) and the rehabilitation of old landfills and dumpsites (i.e. approximately €1.44 billion) account for approximately 75% of total capital expenditure. The high level of investment attributable to the rehabilitation component is due to the large number of landfills and dumpsites across Ukraine. It should be noted that this CAPEX figure (i.e. for rehabilitation) is indicative in nature and is subject to detailed investigations and risk analysis of the existing landfills and dumpsites.

While the CAPEX required is significant, overall OPEX is much higher. For the period 2017 to 2030, indicative figures for overall CAPEX and OPEX are approximately €2.8 billion and €6.6 billion respectively.

Having regard to the polluter pays principle and on the basis of full implementation of an EPR scheme for packaging waste, it is considered that the full costs of MSW separate collection and sorting should be covered by a combination of revenue from recyclables and EPR. Accordingly these costs have not been included in the net costs of implementing the MSW Strategy.

Over the period 2017 – 2030, the indicative OPEX is approximately **€5.8 billion** (i.e. not including MSW separate collection and sorting). The breakdown of this OPEX is illustrated in Fig. 14.3 below.

Figure 14.3 Breakdown of OPEX of measures set out in the strategy (excluding MSW separate collection and sorting)



Residual (i.e. mixed) MSW collection services and operation of landfills and transfer stations account for 99.5% of net OPEX (i.e. excluding the costs of MSW separate collection and sorting and the environment tax on disposal of waste over the 13-year period of the strategy.

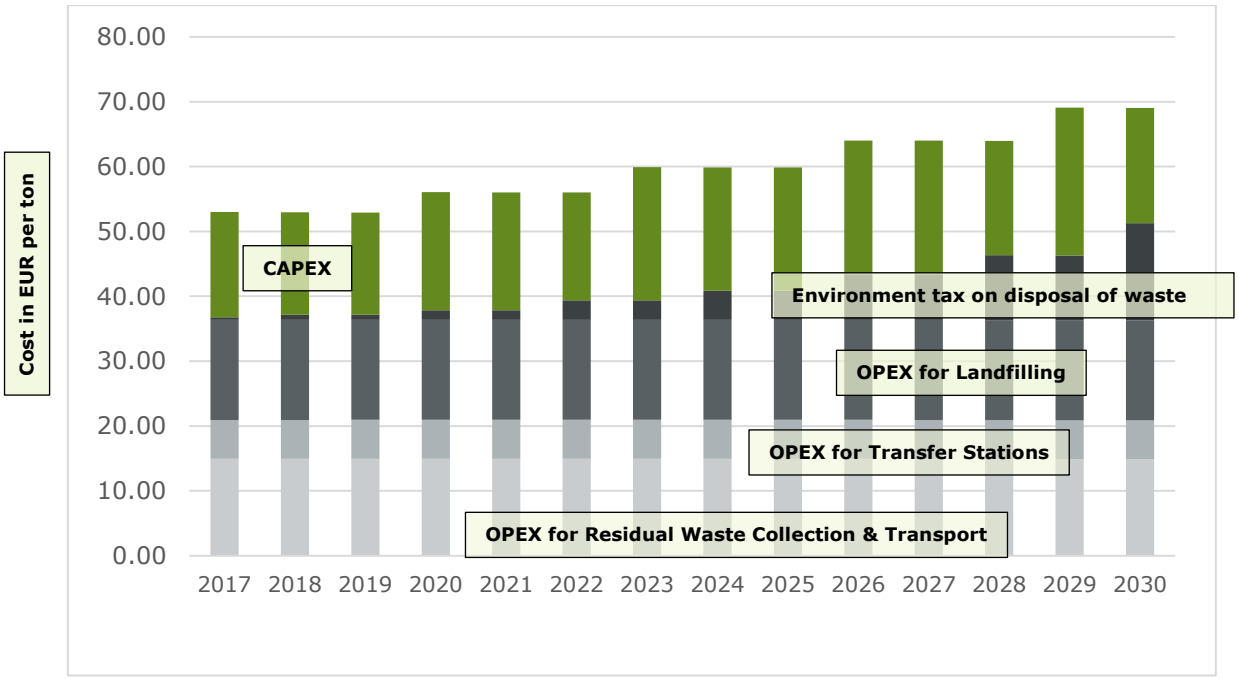
In relation to the OPEX for MSW separate collection and waste sorting, it should be noted that it is anticipated that the revenues from recycling and EPR will potentially offset these operating costs. However this scenario is dependent on market prices for secondary raw materials and does not take into account the impact of the informal sector in this regard.

Consumer Tariffs

Central to this Strategy is full cost recovery for MSW management services through consumer tariffs. Full cost recovery means that consumer tariffs provide the means to recover all cash expenditures and provide the financial means for construction and replacement of equipment,

Figure 14.4 provides an overview of the overall costs (both CAPEX and OPEX) per tonne over the life time of the strategy that will need to be covered by the consumer tariff.

Figure 14.4 Cost per tonne MSW for the period 2017 – 2030 (excluding MSW separate collection and sorting)

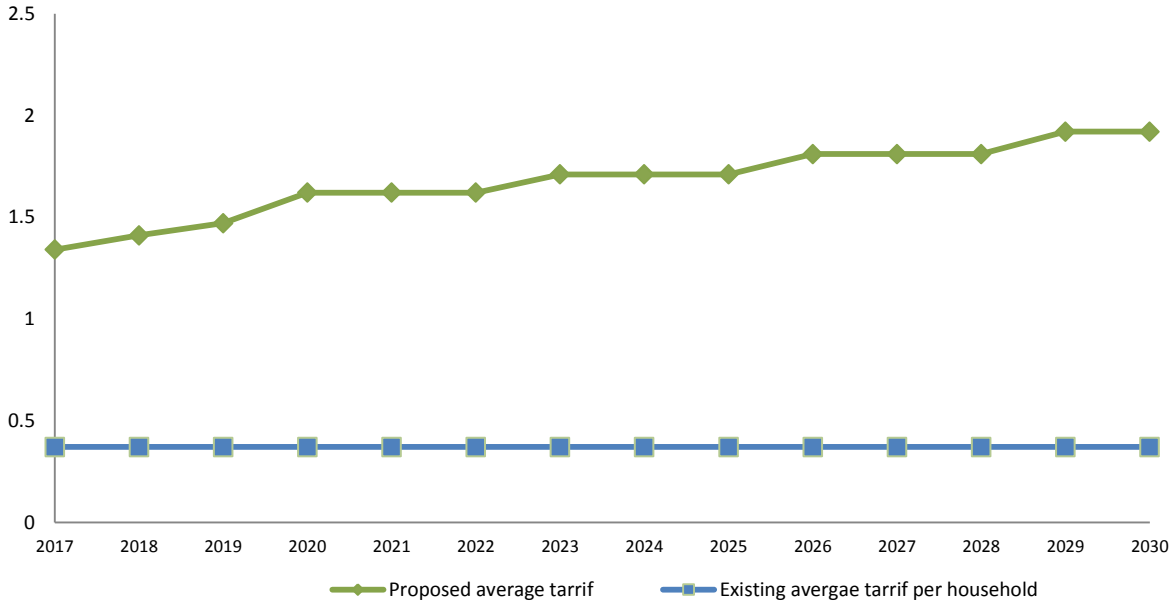


Taking into consideration the low starting point in relation to the current level of consumer tariffs, it may not be possible to make an immediate transition to full cost-recovery via consumer tariffs in one step, but a transitional period of gradual increase in the consumer tariffs may be warranted.

It has been shown, under favourable conditions, that revenues from captured recyclables can potentially offset the costs of MSW separate collection and sorting. It is therefore considered that a combination of revenue from recyclables and the establishment of an EPR scheme for packaging waste should cover the net costs, if any, of MSW separate collection and sorting, such that these costs do not have any direct impact on consumer tariffs for MSW management services. Accordingly the costs of MSW separate collection and sorting are not included in the costs which will have to be recovered via consumer tariffs for MSW management services.

On this basis, as indicated above, a preliminary assessment indicates that the consumer tariff will need to be increased to an average of approximately 1.7% of average household income (i.e. the range is between 1.34% and 1.92%) in Ukraine (see Figure 14.5 below). While these are indicative figures they are also at the conservative end of the spectrum as no allowance for any grant assistance has been taken into account.

Figure 14.5: Percentage change in Consumer Tariff per household income over the period 2017 – 2030



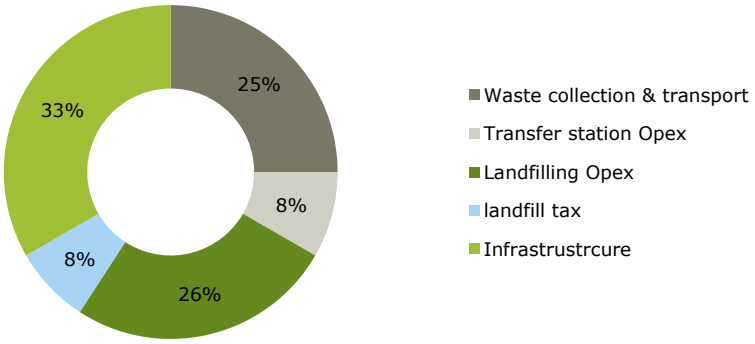
An increase in the tax on the disposal of waste of €3/ton is proposed for 2022. The existing tax is €0.14/ton. Given that the amount of MSW disposed of at landfill in the year 2022 is projected to be 272 kg. per capita, such an increase in the tax would increase the average annual MSW management consumer tariff per resident from €10.47 to €11.25 (i.e. an increase of about 7.5% in the overall tariff in the year 2022).

Implementation of a progressive increase in the tax on the deposal of waste, as set out in Chapter 12, could generate circa. €550 million over the 13-year period of the strategy. Such revenues could be used to partially offset the high costs of rehabilitation of old landfills and dumpsites (i.e. approximately €1.44 billion).

At the end of 2022, the impact of the increases in the environment tax on disposal of waste will be clear, in terms of a reduction in the rate of landfill disposal and an increase in the recycling and recovery rate. Based on these impacts the Government of Ukraine will consider what changes to the environment tax on disposal of waste are appropriate for the period from 2023 to 2030.

To illustrate how the consumer tariff is broken down or "itemised" the year 2025 is taken as an example in Figure 14.6 below. In 2025 the consumer tariff per tonne of MSW will be 60 EUR. This equates to, approximately, a household of three people for one year. How this 60 EUR is spent or allocated is illustrated below.

Figure 14.6 Anticipated Percentage breakdown of consumer tariff – 2025 – per tonne of waste produced



14.4 Sources of financing

The needs for investments in the MSW management sector in Ukraine include improvement of the present system of waste collection and transport (mostly relating to containers and vehicles), investments for rehabilitation and further monitoring of existing landfills and dumpsites, as well as construction of regional, EU-compliant landfills as well as recycling/sorting facilities.

The indicative estimates set out in Section 14.3 above clearly illustrate that both the capital and operational costs associated with implementing this MSW strategy are significant. This Strategy proposes that such costs be recovered fully via an increase of consumer tariff to circa 1.7 % of average household income over the period 2017 to 2030. Such an increase in consumer tariff, most importantly, is considered to be affordable.

The development and operation of a sustainable and environmentally-sound waste management system requires an assured and reasonably predictable revenue that is sufficient to service or repay acquired loans, to recover the operating costs of the system, to meet the costs for closing, restoration and aftercare of landfills and in the case of private investments, to provide a return on investors' capital.

However, it is important to note that the ability to recover costs via an increase in consumer tariff will not provide the significant "up-front" capital expenditure that will be required to construct the required infrastructure and the rehabilitation costs of the existing facilities.

"Sources of financing", therefore, are defined as sources that will provide the initial capital expenditure with the assumption that the increase in consumer tariff will enable such initial outlay and costs to be recouped in the coming years (i.e. enable a municipality to pay back a loan for landfill construction or fleet replacement). *An increase in consumer tariff will not provide the required up-front investment.*

Outlined herein are potential sources of financing, but also potential sources of investment, in order to soften the overall financial burden which the initial capital expenditure will give rise to.

14.4.1 Debt Instruments/Loans

Loans can potentially be issued by:

- The Government of Ukraine;
- Ukrainian Commercial banks; and
- International financial institutions (IFIs).

Loan transfers from the regular state budget (and from municipality budgets where appropriate) shall be used mainly for starting projects and for the preparation activities of the priority investments identified.

The investment costs for construction of new MSW facilities, such as regional landfills or waste sorting lines are typically covered by the state mainly through loans from International Financing Institutions and in some cases bilateral financial institutions, IFIs can also leverage funds for investment by the private sector (see below) related to the development of MSW facilities and/or purchase of plant and equipment.

14.4.2 Grants

Grant co-financing (i.e. on a non-repayable basis) may be available from international or bilateral donors.

Under the European Neighbourhood Instrument (ENI), planned EU grant assistance for Ukraine may total up to €1 billion in the period 2014-2020. This figure is indicative. As for all Neighbourhood countries, final allocations will depend on the country's needs and its commitment to reform.

Grants may also be available from bilateral donors. Some donors are already involved in providing development assistance to Ukraine in relation to its adjustment the EU. One of the areas supported is the environment. The following areas are considered particularly appropriate for such grant assistance:

- Development of information and awareness-raising programmes on integrated solid waste management; and
- Programme of rehabilitation and closure of existing landfills and dumpsites which pose a risk to human health and the environment.

14.4.3 Environmental Fund

In former years one of the key sources of financing for waste management was the Environmental Protection Fund (i.e. at state, oblast and local level). The revenues from environmental taxes (including the environment tax on disposal of waste are directed towards this Fund. Expenditure in the environmental area was financed from these funds. However, as a result the budget deficit in Ukraine in 2014, part of the proceeds of environmental tax revenues, initially at a level of 31.6%, and subsequently at 53.5%, were redirected to the general fund of the state budget. This measure has had the effect of reducing the level of financing of investment in the environmental area in general and in the waste management area in particular. In 2014, the total revenues transferred from the environmental fund to the accounts of the general budget were around 140 million EUR[55].

[55] This relates to the figure of 2.69 billion UAH transferred to the general fund, applying an exchange rate of 1EUR = 19.14609 UAH (i.e. the rate as of 31/12/2014)

On the basis of the proposed increases in the tax on the disposal of waste to €3/ton and €15/ton in 2022 and 2030, respectively, the total amounts that could potentially be transferred to the environmental fund from this source are €29 million and €158 million, respectively.

Accordingly it is recognized that the Government can play a significant role in the investment process through the allocation of resources from the Environment Fund towards improved MSW management.

Consideration will be given towards allocating a significant proportion of the Environment Fund for capital grant schemes aimed at the following:

- Meeting the costs or portion of the costs required for rehabilitation of the existing landfills and dumpsites in Ukraine;
- Development of recycling and recovery infrastructure, such as waste reception/collection sites, transfer stations facilitating recovery activities, and materials recovery and biological treatment facilities; and/or
- Meeting planning and procurement costs incurred by local self-government units or IMC bodies, related to the provision of regional waste infrastructure by way of Public Private Partnerships (PPP's).

14.4.4 Private Sector Participation (PSP)/Public Private Partnership (PPP)

Globally, there has been an increasing trend in the participation of the private sector in areas traditionally controlled by the public sector. Private sector participation can satisfy a number of goals, including bringing investment capital, advanced technical and management capacities, etc.

It is clear that there is scope for increased participation by the private sector in all areas of waste management in Ukraine, in terms of capital investment in infrastructure, specialist expertise in relation to new technologies and a better understanding of the dynamics of the marketplace, particularly in relation to recyclables.

While there is evidence of private sector involvement in the MSW management sector in Ukraine, there is no clear policy on public-private partnership arrangements in place.

The adoption of this MSW Strategy will open up significant commercial opportunities in MSW recycling, recovery and disposal activities.

Private sector participation requires the establishment of a partnership between the public sector and the private sector for the purpose of development of investment projects or carrying out of MSW management services traditionally provided by the public sector. Such partnerships should exploit the strengths and advantages of both sectors in the performance of specific tasks, allowing each sector to do what it does best so that the infrastructure and public services can be provided and operated in the most economically efficient manner.

Private sector participation can take a number of forms, several of which involve up-front investment on the part of the private sector partner:

<u>Model Form 1: Services Sold to the Public Sector as Purchaser and User.</u>

Under this arrangement, the private sector is responsible for the procurement and operation of the capital asset, which is employed to provide services, which in turn are then purchased by the public sector. In the case of MSW management services the local self-government units (or an IMC Body acting on their collective behalf) are obliged to make unitary payments to the private

sector on the basis of specific services provided in accordance with an Output Specification. This model is referred to as a design, build, finance, and operate (DBFO) project whereby the private sector provides the up-front capital investment and the public sector purchases the services from this entity.

Model Form 2: Financially Free-Standing Projects (Concession).

Under this model, the private sector undertakes the design, building, operation and financing (DBOF) of the project while entering into an appropriate contractual concession. The private sector recovers its project costs through direct charges on the ultimate end-user rather than on the public sector entity/entities (i.e. 'end-user charges' or 'gate fees'). An example of this type of project would be a landfill site which relies on gate fees payable by users of the facility in order to generate the necessary income to cover the investment costs, operational costs and a certain level of profit. In some cases a base level of fees or inputs in terms of tons per year is guaranteed by the local self-government units (or an IMC Body acting on their collective behalf), in what is referred to as a 'put-or-pay' arrangement.

Model Form 3: Joint Ventures.

Joint ventures are projects where there is a mix of end-user charges and public subsidy or contribution. The State provides an effective subsidy to the end user charges in order to achieve 'broader policy objectives'. This public subsidy or contribution can take several forms including direct subsidy (e.g. capital grants) or the contribution of assets (e.g. surplus land or income generating assets) or a combination of both.

In this case the capital asset is procured by the private sector and is provided at a reduced rate to users. Revenue is derived from the public sector partner based on usage according to formulae, which usually allocate demand risk between the public partner and the private partner. The basic principle of usage payments is that it is the public sector partner, as Contracting Authority, and not the user, who makes the payment to the private sector partner, as Contractor. This is often done in accordance with a banded payment mechanism.

Model Form 4: Hybrid Form of PPP.

The Hybrid Form of PPP includes Design and Build (DB) and Design, Build and Operate (DBO) projects and represents a more traditional public sector approach to private sector involvement in public projects. This form of private sector participation can bring the benefits of private sector skills to bear in delivering essential public services in terms of management, financial and technical aspects, although the assets are typically funded directly by the public sector.

Model Form 5: Operation Delegation Contracts.

At its most basic level, private sector participation is limited to the provision of specific services, while the public sector retains ownership of the assets and is responsible for capital investments. Operation delegation contracts are entered into for defined periods while the risks involved are shared between the two parties. This type of contract is typically entered into by municipalities following a public tender procedure.

Whatever model of private sector participation is followed effective private sector participation in the delivery of public services requires the following:

- A proper, predictable regulatory framework;

- Strict, open and competitive bidding procedures;
- Clarity on tasks, risks and cost recovery (including who has the authority to set the tariff rates); and
- A competent public partner, who can negotiate with the private partner and effectively monitor its performance.

Carefully negotiated and drafted performance based contracts between the private firm and the government (i.e. operation delegation contracts) should provide that potential benefits from efficiency gains result in lower fees for the citizens.

15. Management of Waste Data

Accurate municipal solid waste data and statistics is central to understanding the actual problem. Without a clear understanding of the current situation it is very difficult to plan for the future. Ukraine has struggled to provide clear and accurate waste data and thus has struggled to fully grasp the challenges that we all face in tackling municipal solid waste management in Ukraine.

Many of the measures proposed throughout will require accurate data to ensure that any proposed initiatives or infrastructure are accurately scaled and sized. Key challenges that Ukraine currently faces with regards waste data and statistics are outlined below.

Key Challenges

- **Lack of information – composition:** whilst some data exists on waste composition, overall there is not a clear understanding of the composition of municipal solid waste in Ukraine including waste from both households and commercial enterprises. Without a clear understanding of composition it is difficult to determine accurately the quantity of biodegradable waste, recyclates, anticipate residual waste, etc. Accurate date on composition is the key to future planning and a continuing lack of accurate municipal solid waste composition impedes progress significantly
- **Lack of information – quantities:** linked to the above, understanding the actual quantities of municipal waste being produced is central to any decision making process with regards municipal solid waste management in Ukraine. Accurate quantities are required at municipal and oblast level as well as nationally.
- **Lack of information – waste streams:** information on individual waste streams, particularly paper, metal, plastics and glass is required to determine EPR schemes, recycling infrastructure etc. Yet data on individual waste streams is currently very limited
- **Quality of information:** The information that does exist is unreliable and in certain instances contradictory. If data is deemed unreliable then planners face a significant challenge in determining both scale of the problem and current needs
- **Management of data:** currently there is no single responsible national body for managing all waste data. This leads to contradictory information, lack of ownership resulting in lack of effort to ensure up to date and accurate data
- **Reporting:** the current level of reporting is insufficient in terms of both depth/coverage and quality.

15.1 Key Objectives

It is an objective of the Strategy to improve the information available on municipal solid waste. An overall goal is that key decisions with regards municipal solid waste in Ukraine are based upon facts rather than estimates. Although that is an extremely challenging ambition, it nevertheless is where we wish to be in the coming years.

The overall objective of an improved waste data and statistics system is to:

- Give an improved understanding of what municipal solid waste is produced and how it is managed.
- Provide information to support the development of new business opportunities including the development of new municipal solid waste management infrastructure.
- Allow businesses and local self-government units to benchmark their municipal solid waste management performance
- Aid policy development and support the successful implementation of Ukraine's Municipal Solid Waste Strategy – *Changing Our Behaviour*
- Monitor the progress towards both Ukrainian domestic and European targets.
- Raise public awareness of municipal solid waste management issues.

15.2 Proposed Measures

- By 2018 commence waste surveys annually at municipal level with regard to waste arising's and quantities.
- By 2018 carry out waste composition surveys at oblast level bi-annually (to cover seasonal changes)
- By 2018 revise the guidance document and methodology for relevant surveys and analysis for municipal and oblast employees to reflect best practice in EU Member States
- By 2020 establish a department in Ministry of Ecology for waste data and statistics
- By 2020 improve the map created by MENR of illegal dumpsites as well as landfills such that all existing waste facilities are mapped with all relevant site information attached
- By 2019 introduce municipal solid waste management as a separate detailed subchapter as part of Ukraine's National Report – *State of Environment for Ukraine*
- By 2020 have an efficient and detailed data management information system operational in the Ministry of Ecology designed to sufficient detail that all key reporting requirements on municipal solid waste both nationally and as part of the Association Agreement are met
- By 2020 introduce a detailed quality control system and methodology including a feedback mechanism to oblasts and municipalities on quality of data being gathered

16. Monitoring and Evaluation of Progress in MSW Strategy Implementation

Monitoring and evaluation of the effectiveness of implementation of the measures set out in the Strategy will be an essential part of the process. Monitoring is necessary because the MSW problem and the baseline conditions change over time.

Monitoring will allow the implementing institution:

- to evaluate whether the mix of policy instruments applied, are achieving the targets effectively. If they are not achieving the targets they should either be modified or eliminated, to reduce administrative costs.
- to track whether the criteria that have determined the composition of the policy package continue to be met. These criteria are discussed in Chapter 12 of this MSW strategy and include effectiveness, cost efficiency and stakeholder acceptance.
- to assess whether the policy is implemented as planned, and if not, what the reasons are. Reasons for failing implementation may include for example: lack of political support, insufficient resources, underdeveloped institutional capacity, lack of cooperation from the primary stakeholders.
- to address questions from stakeholders and provide continued updates of resistance to the implementation of the respective policies.

The monitoring and evaluation procedures will be described in detail in the Action Plan.

16.1 Performance indicators

A simple and effective monitoring framework will be developed to monitor implementation of the main elements of the MSW Strategy and to monitor the effectiveness of the Strategy (i.e. performance against the key targets set out in the Strategy). This framework will include reliable and meaningful indicators in the following areas: repair and reuse, waste generation, waste management, trade in secondary raw materials in Ukraine and with other countries and use of recycled materials in products.

It should be acknowledged that identifying appropriate targets or performance indicators, and devising a representative methodology for the measurement of national performance in relation to waste prevention and minimisation in particular is quite a challenge.

The MSW-IS that will be developed and that will include the already existing official data, should provide the relevant data that will form a basis for this monitoring.

The following is a non-exhaustive list of key performance indicators that will be used to monitor performance against the key targets set out in the strategy

Heading/ Indicator	Unit of measurement	Associated Target(s) and/or Measures Set	Comments
Prevention			
MSW generation in Ukraine	Tonnes of MSW generated per annum. Tonnes of MSW collected per annum (i.e. as part of an organised MSW collection service) Tonnes of MSW collected per capita per year	National Waste Prevention Programme to be developed by 2020. publication of NWMP	NWPP to include measures to pursue the objective of breaking the link between economic growth and the environmental impacts associated with the generation of waste.
		Public awareness campaigns to be disseminated across all sectors of society following publication of the NWMP.	Objective of the campaigns is to ensure that the NWMP is fully understood. Campaigns to focus on product lifecycle and the negative impact of different types of products on the environment.
		BREFs[56] for waste management and resource efficiency to be published by 2020	BREFs to be targeted at specific industry sectors
Collection & Transport			
Coverage of the population by organised MSW collection services	% of population covered[57]	83% by 2022	This should apply in particular to the larger settlements in Ukraine.
		90% by 2030	This will require extension of the MSW collection service into the small towns and villages in Ukraine.
Coverage of the total population by MSW separate collection	% of population covered[58]	23% by 2022	The initial focus will be in relation to 'dry' recyclables, in particular paper & cardboard, plastic and metals
		48% by 2030	
Involvement by	% of population covered by	Reforms in the competitive tender	The current situation does not encourage increased

[56] Best Practice and Efficiency Documents. A number of BREFs have been prepared in recent years by the European Commission.
[57] The current level of the population covered is 77.46% (2015)
[58] The lack of accurate data means that it is difficult to determine the current level of the population covered by MSW separate collection. A figure of 20% has been assumed for 2015.

Heading/ Indicator	Unit of measurement	Associated Target(s) and/or Measures Set	Comments
the private sector in providing MSW collection and transport services	organised MSW collection service provided by the private sector	system/procedure for MSW collection and transport services to be implemented by 2022.	participation of the private sector in MSW management, but rather reflects a complicated contractual framework for selection of service providers for collection and transport of MSW which inhibits access to the market.
Separate accounting system for MSW management services at municipality level	% of municipalities with separate accounting system for MSW management services.	Changes in the accounting system for MSW management services at municipality level to be implemented by 2022.	There is a lack of transparency in the tariff-setting process, which in turn relates to the lack of a proper accounting system for the cost of the MSW management services at local level.
Number of persons not availing of the service where there is an organised MSW collection service in place	% of the population covered by an organised MSW collection service	Amendment to the Code on administrative offenses in respect of the penalties on consumers for not concluding an agreement for MSW collection and transport services with the designated service provider – to be implemented by 2022.	There is an element of 'free-rider' syndrome in relation to some households who will not conclude such an agreement with a designated service provider and who therefore do not pay for the collection services which are carried out in any case. Such practice is contrary to the polluter pays principle.
Re-use and Preparing for Re-use			
Centres for 'second-hand' goods	Number of centres	At least 50 centres for "second hand" goods and products to be in place by 2022	These centres to focus on goods and clothes as well as products in need of repair, such as WEEE.
Deposit-refund scheme for glass beverage containers	Deposit-refund scheme in place in Ukraine	Deposit-refund scheme for glass beverage containers to be implemented by 2022	This to be coordinated with the EPR scheme for packaging waste and to be one of the pillars of the scheme
Recycling – Including Biological Treatment			
Amount of MSW recycled	As a % of total MSW generated	Recycling rate of 7% to be achieved by 2022	This is linked to the extension of MSW separate collection services in the larger settlements in Ukraine in particular.
	As a % of MSW collected (i.e.	Recycling rate of 15% to be achieved	This is linked to the extension of MSW separate

Heading/ Indicator	Unit of measurement	Associated Target(s) and/or Measures Set	Comments
	as part of an organised MSW collection service)	by 2030	collection services into the small towns and villages in Ukraine.
		Measures to address the disruptive impact of the informal sector to be implemented by 2022	These include: as one of the - the progressive installation of underground containers in city centre areas; and - modification of legislation (i.e. the Law "On waste") on the ownership of MSW and the introduction of various offences related to inappropriate handling of MSW.
Amount of packaging waste recycled	% recycling of material-specific packaging waste placed on the market	The following material-specific packaging recycling rates to be achieved by 2024: • 60% recycling of glass packaging; • 23% recycling of plastic packaging; • 60% of paper and board packaging; • 50% of metals packaging; and • 15% of wood packaging;	This measure to be coordinated with the implementation of the EPR scheme for packaging waste.
Waste Collection/ Reception Centres	No. of Waste Collection/ Reception Centres	271 Waste Reception/Collection Centres to be provided in cities with a population greater than 20,000.	These Waste Reception/Collection Centres will complement the MSW separate collection schemes. In addition they can be co-located with the Centres for 'second-hand' goods. Further, 'green' waste collected at the Centres can be composted.
Home composting in households	No. of home composting units	Home composting for 2,566,300 households in Ukraine to be implemented by 2030.	The focus will be on establishing home composting as a recycling option for single-story households (i.e. individual households) in rural areas and in suburban areas in the towns and cities. This should be implemented initially through pilot projects, accompanied by intensive information and awareness-raising campaigns

Heading/ Indicator	Unit of measurement	Associated Target(s) and/or Measures Set	Comments
Biological treatment of organic fraction of MSW	- No. of pilot schemes for stabilisation of the organic fraction of residual waste	National Strategy for reducing the amount of biodegradable waste to landfill to be developed by 2017	This is one of the provisions of the EU-Ukraine Association Agreement, 2014.
		Pilot projects for biological stabilisation of residual waste to be in place by 2022.	Proper sorting of MSW and stabilisation of the organic fraction of MSW is one of the key challenges for Ukraine. There are two main options in this regard: 1. Separate collection and treatment of the bio-waste fraction of MSW ; and 2. Bio-stabilisation of the organic fraction of the residual waste stream Either of the above options will be relatively costly with Option 1 significantly more costly than Option 2. It is important to promote the setting up of appropriate pilot projects for biological processing of the organic fraction of residual waste so that lessons can be learned and the best practicable option for Ukraine determined.
		System of certification for the different categories of compost or compost-like-output (CLO) produced from MSW to be developed by 2022.	
Other Recovery			
Amount of packaging waste recovered	Overall % recovery of packaging waste placed on the market	Overall recovery rate for packaging waste of 60% by 2024	This is related to the EU Directive on Packaging and Packaging Waste and this rate includes the material-specific packaging waste targets for recycling as set out above.
Amount of MSW recovered	Overall % other recovery of MSW	RDF/SRF production facilities to be constructed, as part of MBT- plants, at locations across Ukraine	The indicator to mean the amount of MSW recovered net the amount of MSW recycled (i.e. the amount of 'other recovery')
		Modification of the legislation to make the requirements for incineration/ waste-to-energy facilities consistent with the EU Industrial Emissions Directive (IED)	

Heading/ Indicator	Unit of measurement	Associated Target(s) and/or Measures Set	Comments
		BREFs for waste recovery technologies to be published by 2020	A BREF or 'BAT reference document' means a document, resulting from the exchange of information organised pursuant to Article 13 of the Industrial Emissions Directive (IED) (2010/75/EC).
		Provisional: The incineration plant "Energy" in Kiev to be modernised, to ensure that it can be classified as a 'recovery' operation and that that the emissions are in compliance with the EU IED by 2024	Modification of the legislation to include transposition of Annex 1 ('Disposal' operations) and Annex II ('Recovery' operations) of the Waste Framework Directive, 2008, (including criteria for the classification of the respective operation).
Final Disposal			
MSW disposal in EU-compliant landfills	Total % of MSW landfilled % MSW disposed of in EU-compliant landfills No. of EU-compliant landfill facilities in operation	Each oblast to develop a plan for the proper location of 'regional' landfills by 2018.	This plan to identify, where appropriate, the sites for which 'Conditioning Plans' are appropriate and the sites which are not capable of meeting the relevant environmental standards and in respect of which 'Closure Plans' to be prepared. As part of the 'regional' plan a Prioritisation Plan to be prepared in respect of those sites that should be closed as a matter of priority, based on an environmental risk assessment;
		Conditioning Plans to be prepared for existing facilities, where appropriate, and implementation of these Plans by 2022.	
		A network of between 100 and 150 state-of-the-art, 'regional' landfill facilities to be developed across Ukraine	Such 'regional' facilities to have an average intake of approximately 100,000 tonnes per year (minimum 50,000 tonnes per year)
		Legislation to be modified by 2022 to ensure full compliance with EU requirements for procedures for operational landfill facilities (e.g. permits, control and monitoring, enforcement, etc.);	

Heading/ Indicator	Unit of measurement	Associated Target(s) and/or Measures Set	Comments
		Environment tax on disposal of waste to be increased on a step-by-step basis to a rate of €3/tonne and €15/tonne by 2022 and 2030, respectively, for non-hazardous MSW	This will require revision of the overall taxes for deposit of waste for the different classes of disposal facility. The relevant tax for inert waste to be €0.6/tonne and €3/tonne by 2022 and 2030, respectively.
Closure of sites which do not meet the appropriate environmental standards	No. of remaining landfills and dumpsites, which do not meet the appropriate environmental standards.	Closure Plans to be prepared for sites which cannot meet the appropriate environmental standards by 2020.	The strategy to be prepared by 2018 at oblast level for the proper location of 'regional' landfills to identify those sites which are not capable of meeting the relevant environmental standards and in respect of which 'Closure Plans' to be prepared.
		Rehabilitation and closure of all landfills and dumpsites which do not meet environmental safety standards by 2024	

In order to be able to evaluate the success or otherwise of the measures set out in this Strategy and in order to justify the need for changes to the approach taken, implementation of the Strategy will need to be closely monitored in the short- and the medium-term.

Monitoring will involve a systematic and ongoing collection, processing and collation of good-quality, representative data, including:

- Quantitative data, or figures related to the respective indicators in the above table; and
- Qualitative data. For example, information about the implementation of the prescribed measures, the drafting of the recommended modifications to the legislation and the application of the policy instruments set out.

The results of this monitoring will provide insight into the extent to which targets and objectives are being met and the measures, as set out, are being complied with. They can be used to validate or revise assumptions, to revise scenarios and/or to assist in identifying those areas which require further enforcement of legislation. This is particularly important in the application of economic instruments such as the environment tax on disposal of waste where it is important to strike an appropriate balance between achieving more environmentally sustainable MSW practices (e.g. reducing the amount of waste being landfilled) and providing an affordable, cost-effective service to the population.

Monitoring can therefore be used for both diagnosis (i.e. reviewing the past and current situation) and prognosis (i.e. projecting into the future and forecasting developments and their consequences).

DELIVERING CHANGE

17. Actions for All

Ukraine is making progress in reforming the municipal solid waste management sector. *Changing Our Behaviour* sets out ambitious targets that will require action and participation from all sectors of society.

Changing our Behaviour provides the direction to Ukraine in order to address the key challenges that are faced with regard to providing a municipal solid waste infrastructure that is sustainable, affordable and in line with EU requirements. It is both ambitious in its targets but also realistic in its measures placing specific emphasis upon key principles.

Actions for the General Public

Changing our behaviour must start with all of us at home and will need the support of the general public as waste producers and consumers by reducing the amount of household waste going to landfill by:

- Re-using items such as supermarket bags
- Segregating recycles and embracing recycling schemes
- Be willing to pay for an improved collection service
- Recognising the need for local waste management facilities to increase disposal charges and deal with the waste according to the best environmental practice
- Purchasing products with minimum packaging, that can last longer or with a high recycled content
- Being conscious and aware that even the smallest effort made at home to use less or recycle more will contribute to a cleaner and more sustainable Ukrainian society

Actions for Commercial Waste Producers

Commercial enterprises are a significant contributor to municipal solid waste and thus the expectations that we will place upon commercial entities will be similar to that of the general public. Furthermore commercial enterprise will be expected to:

- Play an active role in both establishing and operating EPR schemes as outlined in this Strategy
- Identify and report waste arising's in line with the recommended waste data measures
- Actively promote waste minimisation, reuse and recycling within its commercial and trade organisations
- Self-educate and heighten awareness among all commercial organisations on the importance of diverting commercial waste from landfill
- Seek advice from relevant local government and state bodies on waste minimisation, reuse and recycling
- Illustrate a clear willingness to meet the increase in costs to cover the measures in this strategy to reduce disposal to landfill

Actions for the Waste Management Industry

The waste management industry is central to all components of this Strategy including recycling and reuse facilities, waste collection companies, landfill operators, etc. All members of the waste management industry are expected to change their behaviour and be central in delivering change with regard to the municipal solid waste management sector. The Government will look to the waste management industry to:

- Develop solutions that actively engage the public
- Provide integrated solutions to the management of municipal solid waste giving priority to recycling over time
- Provide a complete waste service to all members of the community
- Ensure that waste operations do not pollute the environment or cause harm to human health
- Provide the Government with comprehensive and accurate information on types, quantities and origins of waste handled
- Work closely with local communities and be transparent in all dealing and operations
- Be an active and visible leader in the implementation of this Strategy
- Illustrate a clear willingness to embrace change

Actions for Local Self-Government Units

Local government in Ukraine has a significant role to play with regard to changing how we all deal with municipal solid waste and how we implement the measures outlined in this Strategy. Reform at local government level in how municipal solid waste is managed is fundamental to facilitating a change in behaviour and is the foundation upon which the future municipal solid waste system will be built. Furthermore, local government has a responsibility to ensure that both the physical and social environment in which its communities live is continuously improved. In the coming years local government will be expected to:

- Cooperate with one another. Inter-municipal cooperation is essential to provide the necessary framework within which a truly integrated municipal waste management system can be developed. It requires extensive dialogue, debate and consultation to get there but we expect local self-government units to commence this process now
- In line with the above develop regional waste management plans
- Ensure that waste arisings and composition are measured on an annual basis and that the correct reporting channels are followed. Local self-government units are expected to place a specific emphasis upon the accuracy of the date supplied
- Tackle illegal dumping of waste via the imposition of financial penalties and, if necessary, prosecution
- Implement a transparent contractual framework for municipal solid waste collection
- Ensure that all waste facilities are operated in a fashion that places an emphasis upon protecting both human health and the environment
- Promote waste minimisation to all aspects of the community
- Work with schools in developing and delivering education and awareness programmes
- Roll out recycling programmes for home owners in line with the targets set out in this Strategy
- Ensure that the recycling programmes and initiatives are both clearly explained and effectively managed

- Work in partnership with national government and relevant state organisations to deliver change via the development and delivery of practical solutions to improve all aspects of municipal solid waste management in Ukraine

Actions for Oblast Administrations

The success of the strategy will depend on inter-municipal cooperation arrangements in order to achieve the economies of scale required for cost-effective integrated MSW management. This process will need to be overseen by the oblast administrations in each case. Oblast administrations will be expected to:

- Become an 'oblast' waste management bodies. They will identify appropriate MSW catchment areas within their respective oblast and, where appropriate, with adjacent municipalities/rayons of neighbouring oblasts;
- Carry out an inventory and assessment of existing landfills, including identifying those requiring Conditioning Plans and Closure Plans, and ensuring timely implementation of the Conditioning and Closure Plans;
- Locating regional landfills and transfer stations for identified catchment areas;
- Developing and coordinating the implementation of 'Oblast' MSW management plans;
- Guiding and coordinating municipalities in their efforts to establish IMC arrangements; and
- Issuing permits for collection and transportation of MSW.

Actions for the Government of Ukraine

The expectations placed upon the Government of Ukraine are significant. The Government is ultimately responsible for ensuring that this ambitious but yet realistic Strategy is implemented and that real change in behaviour is achieved. Furthermore, it is the duty of the Government to liaise and work closely with the European Union to ensure that all of the provisions as outlined in the Association Agreement are met. In order to deliver real change the Government of Ukraine, as a priority, will:

- Make local cost recovery mechanisms obligatory (i.e. tariff setting and Pay as you throw systems)
- Increase landfill tariffs thus increasing the cost of landfilling
- Permit/Licence all companies for collection, transport, recovery and disposal of municipal solid waste
- Introduce a ban on the use of lightweight plastic bags
- Prescribe mandatory agreements between all generators of municipal solid waste and authorised waste collection companies for the collection of waste generated
- Prescribe mandatory agreements between waste collection and treatment companies
- Introduce a landfill ban on specific waste streams
- Develop and adopt a strategy to strengthen the existing enforcement system with regard to monitoring and inspection of municipal solid waste management activities to ensure compliance with the requirements of this Strategy
- Develop and implement a national awareness and educational campaign to run in conjunction with the launch and implementation of this Strategy
- Take clear responsibility for ensuring that waste data and statistics are accurately measured and reported

- Consolidate and simplify waste legislation
- Provide a legislative environment that is conducive to change i.e. drafting laws, polices and proceeds that are not overly-ambiguous, that are clear in their goals and in line with the targets and measures as set out in this Strategy
- Work closely with the European Commission in agreeing dates and targets that are realistic for Ukraine
- Lead the process of reviewing and updating this Strategy every three years
- Provide clear and strong leadership in changing our behaviour in how we manage municipal solid waste in Ukraine
- Enforce all relevant laws

Actions for Community & Voluntary Organisations

Ukraine has a number of vibrant voluntary and non-governmental organisations that play a key role in pushing for improvements with regard to environmental protection and sustainable development. To date such organisations have played a key role in urging Ukraine to change its behaviour, in particular with regard to safe and environmentally sustainable disposal of waste. Both voluntary and non-governmental organisations are encouraged to play their role in changing our behaviour by:

- Continuing to deliver strong messages with regards sustainable development and environmental protection
- Assisting in changing our behaviour by participating and delivering educational and awareness programs with regards municipal solid waste management
- Playing a key role in working with schools in influencing change at a young age with regards waste management practices
- Contributing to ensuring that responsible bodies at both local and national government carry through with their responsibilities in delivering change with regard to municipal solid waste management in Ukraine

The policies and measures contained in this Strategy will be subject to a published review and report at 3 year intervals. It is imperative that that the Strategy remains flexible, responsive to developing needs and open to further enhancement and development.

ANNEXES

ANNEX I - Abbreviations

AA	Association Agreement
BAT	Best Available Technique
BREF	Best Available Technique Reference
CHP	Combined Heat and Power
CLO	Compost Like Output
EC	European Commission
EPR	Extended Producer Responsibility
EU	European Union
HCU	Home Composting Unit
IED	Industrial Emissions Directive
IFC	International Finance Corporation
IMC	Inter Municipal Cooperation
IMSWM	Integrated Municipal Solid Waste Management
MBT	Mechanical Biological Treatment
MENR	Ministry of Ecology and Natural Resources
MRDC	Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine
MRF	Materials Recovery Facilities
MSW	Municipal Solid Waste
NWPP	National Waste Prevention Programme
O & M	Operation & Maintenance
PAYT	Pay As You Through
PRO	Producer Responsibility Organisation
RDF	Refuse Derived Fuel
RLF	Regional Landfill Facility
SRF	Secondary Recovered Fuel
VAT	Value Added Tax
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive 2008
WSL	Waste Sorting Lines

ANNEX II - Glossary of Terms

Biological Treatment of Mixed MSW	This is generally carried out in a mechanical-biological treatment (MBT) plant. The term MBT covers a wide-range of processes but it typically incorporates capture of recyclables and some form of biological treatment of the organic fraction of MSW. In some cases the 'dry' fraction of MSW is converted to refuse-derived fuel (RDF) or solid-recovered fuel (SRF), while the 'wet' fraction is converted to a compost-like-output (CLO).
Bio-waste	Biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants
Compost	The stable, sanitised and humus-like material rich in organic matter and free from offensive odours resulting from the composting process of separately collected biowaste, which complies with specified minimum standards of environmental quality.
Composting	The autothermic and thermophilic biological decomposition of separately collected biowaste in the presence of oxygen and under controlled conditions by the action of micro-and macro-organisms in order to produce compost.
Composting (i.e. aerobic treatment)	This can vary from basic, relatively low-cost, open air windrow composting, which is suitable for green wastes (e.g. waste from gardens and parks) to sophisticated, relatively high-cost, in-vessel composting which is suitable for the separately-collected organic fraction of the MSW stream
Container	Any receptacle used to accumulate waste from residential, commercial and industrial sites. Containers vary in size and type according to the needs of the customer or restrictions of the community.
Digestion (i.e. anaerobic treatment)	Anaerobic digestion (or anaerobic fermentation) refers to a process in which biodegradable material (e.g. the organic fraction of MSW) breaks down in the absence of oxygen to produce biogas[59] with high methane (i.e. CH_4) concentration. The biogas produced can be refined by removing the carbon dioxide and water vapour and it can then be used in a combined heat and power (CHP) plant to produce electricity and heat
Disposal	Any operation which is not recovery even when the operation has a secondary consequence the reclamation of substances or energy.
Dry Recyclables	Dry recyclables is the modern description of waste that is free from contaminants such as construction, food or garden waste. Leaving clean materials such as paper, cardboard, plastic bottles, drinks cans and glass bottles to be sorted and recycled
End-of-Life Vehicles	A vehicle which is waste within the meaning of Article 1(a) of Directive 75/442/EEC on Waste
Environmental Inspectorate	A central governmental authority (and its local offices) formed to ensure the implementation of state policy and state control (oversight) in the field of environmental protection, rational use, reproduction and protection of natural resources[60]
EU Association	A treaty between the European Union, its Member States and a non-EU

[59] Biogas consists of methane (CH_4), carbon dioxide (CO_2) and and traces of other gases

[60] the Decree of the President of Ukraine On the Regulations on the State Environmental Inspectorate from 13.04.2011 N 454/2011

Agreement	country that creates a framework for co-operation between them.
Extended Producer Responsibility	A policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products.
Green Waste	Vegetable waste from gardens and parks, tree cuttings, branches, grass, leaves (with the exception of street sweepings), sawdust, wood chips and other wood waste not treated with heavy metals or organic compounds.
Incineration	Incineration is a waste treatment process that involves the combustion of waste materials. Incineration and other high-temperature waste treatment systems are described as "thermal treatment". Incineration of waste materials converts the waste into ash, flue gas, and heat.
Informal Sector	Individuals or enterprises that are involved in recycling and other waste management activities but are not recognised or authorised by the authorities. They can be organized by private persons or they can operate independently.
Integrated Municipal Solid Waste Management System	The strategic approach to the management of solid wastes covering all sources and all aspects such as; generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency.
Integration Principle	The principle that environmental protection must be an integral part of the development process.
Landfills	Any areas of land in which waste is deposited. Landfills are often located in ready-made voids, however where these are limited waste is deposited above ground and the landscape is countered.
Materials Recovery Facility	A central facility where discarded recyclable waste materials may be taken for segregation and pre-treatment.
Municipal Solid Waste	This is household waste and similar waste, where 'household waste means waste generated by households; and 'similar waste' means commercial and institutional waste which is comparable to household waste in nature and composition. It includes: • Bulky waste from households, garden and park wastes, and solid wastes from households and from commercial (e.g. small businesses and offices), institutional (e.g. schools, hospitals, government buildings, etc.) and industrial sectors (other than production wastes) • Bio-waste from households (and similar waste)
Other Recovery	Any operation meeting the definition for 'recovery' under the EU Waste Framework Directive, but failing to comply with the specific requirements for preparation for re-use or for recycling
Packaging	Shall be defined in accordance with the definition in the EU Directive on Packaging and Packaging Waste, 1994/62/EC and shall include any material, container, or wrapping, used for or in connection with the containment, transport, handling, protection, promotion, marketing or sale of any product or substance.
Pay as you throw	A usage-pricing model for disposing of municipal solid waste. Users are charged a rate based on how much waste they present for collection to the municipality or local authority.
Polluter Pays Principle	The principle that the cost of pollution should be allocated correctly to the responsible polluters and consumers, rather than to society at large.

Precautionary Principle	The principle that, where evidence of environmental risk exists, appropriate precautionary action should be taken even in the absence of conclusive proof of causes.
Preparing For Re-use	Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing.
Principle of Self-Sufficiency	The principle that an integrated and adequate network of waste installations should be established to enable the Country to move towards being self-sufficient in waste disposal, subject to 'BATNEEC'.
Principle of Shared Responsibility	The principle that the involvement of a broad base of public bodies, private enterprise, and the general public is required in the achievement of environmental policy objectives
Principle of Sustainable Development	The principle that *"the current generation, in meeting its needs, should not compromise the ability of future generations to meet their own needs*[61]*"*
Private Sector	The part of the national economy that is not under direct state control
Producer Responsibility	A requirement to take steps for the purpose of the prevention, minimisation, limitation or recovery of waste as respects the class or classes of product to which the requirement relates and may include a requirement to include specified targets in relation to those matters.
Proximity Principle	The principle that pollution generated should be treated as close to its source as possible. In the context of waste management, that waste for disposal should be dealt with in one of the nearest appropriate facilities.
Public Private Partnerships	A public–private partnership is a cooperative arrangement between one or more public and private sectors, typically of a long term nature.
Recovery	Any operation the principal result of which is waste serving a useful purpose by replacing other materials which could otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.
Recycling	Any operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.
Refuse Derived Fuel	Produced from combustible components of municipal solid waste. The waste is shredded, dried and baled and then burned to produce electricity,
Residual Waste	The fraction of the waste remaining after the source separation of waste fractions, such as food and garden waste, packaging, paper and cardboard, metals, glass and unsuitable for the production of compost because it is contaminated with potentially polluting products or materials.
Reuse	Any operation by which products or components that are not waste are used again for the same purpose for which they are conceived.
Secondary Raw Materials	Waste materials that have been identified for their potential for recycling or reprocessing to generate raw materials (potentially displacing the use of primary materials), for example: mining wastes, manufacturing and processing waste, including scrap, and contents of landfill.

[61] As defined by the Brundtland Commission in 1987. The Brundtland Commission released Our Common Future, also known as the *Brundtland Report*, in October 1987, a document which coined, and defined the meaning of the term "Sustainable Development". The *Brundtland Commission* officially dissolved in December 1987.

Secondary Recovered Fuel	Produced commercial/industrial and municipal wastes, typically the dry light fraction comprised of non-hazardous waste paper, cardboard, wood and plastic. It is a more highly refined fuel product in comparison to Refuse Derived Fuel.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs
Sustainable Economic Growth	Sustainable economic growth means a rate of growth which can be maintained without creating other significant economic problems, especially for future generations
Waste Broker	Someone within the waste industry who acts as middle man between other waste industry parties.
Waste Electrical and Electronic Equipment	Any equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields falling under certain specified categories and designed for use with a voltage rating not exceeding 1000 Volt for alternating current and 1500 Volt for direct current and which is waste within the meaning of Article 1(a) of Directive 75/442/EEC including all components, sub-assemblies and consumables which are part of the product at the time of discarding.
Waste Hierarchy	The principle that waste management should show a preference to the 'most favoured' option at the top of the hierarchy rather than to the 'least favoured' option at the bottom of the hierarchy.
Waste Minimisation	Any technique, process or activity that either avoids, reduces or eliminates waste at its source or results in re-use or recycling of the waste.
Waste Prevention	Measures aimed at reducing the quantity and the harmfulness to the environment of waste and the materials and substances contained therin.
Waste Sorting Line	The process by which waste is separated into different elements.
Waste Treatment	According to EU Waste Framework Directive - Recovery or disposal operations, including preparation prior to recovery or disposal According to the EU Landfill Directive - The physical, chemical, thermal or biological processes, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery
Waste-to-Energy	The process whereby waste is burned and heat from the combustion process is converted into high-pressure steam, which can be used to generate electricity for sale.
Windrow	An elongated heap in which bio-waste is placed for the purpose of composting, and which is periodically turned by mechanical means in order to increase the porosity of the heap and homogeneity of the waste.

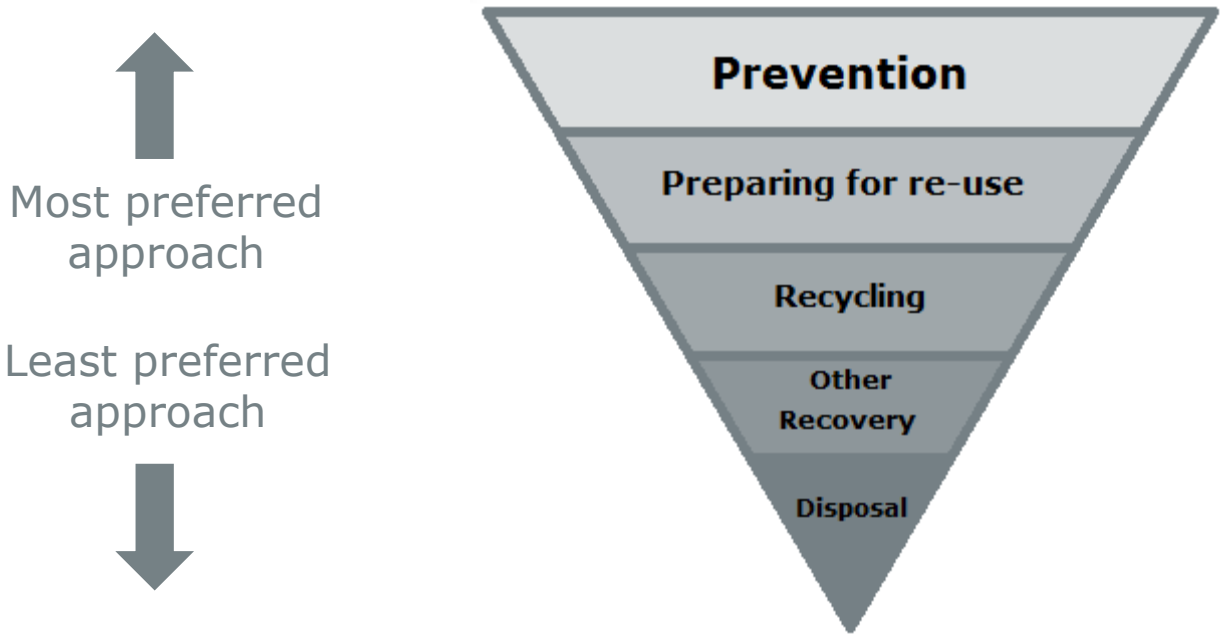
ANNEX III – Waste recovery Technologies

In moving from a situation which is heavily reliant on landfill disposal to a new paradigm where the focus will be on prevention, re-use and preparing for reuse, recycling and other recovery a number of recovery technologies will present themselves.

At its most basic level, MSW management consists of collection of mixed waste and landfill disposal.

In the more developed economies there is a move towards what is referred to as "integrated solid waste management (ISWM)". This involves a move up the waste 'hierarchy' (see below) away from sole reliance on landfill (i.e. the 'least preferred option') and towards recycling, re-use and prevention (i.e. the 'most preferred options').

Figure A0-1: The Waste 'Hierarchy'



Moving up the waste hierarchy, away from sole reliance on landfill disposal, usually takes place gradually, with a number of steps. The first step is typically the implementation of primary source separation of recyclables and capture of secondary raw materials in waste sorting lines (Section 1 below).

In some cases the first step may be bypassed with a move towards mechanical biological treatment (MBT) – see Section 4 below.

This Annex describes the principle recovery technologies for MSW management and provides a conclusion on which, if any of the technologies presented and considered appropriate for Ukraine in the short-to medium term (i.e. up to 2030)

1. Waste Sorting Lines

Waste sorting lines (WSLs) separate waste into secondary raw materials which can be sold on the market. There are two main types, 'clean' and 'dirty'.

1.1 'Clean' Sorting Lines

Such facilities typically receive mixed 'dry' recyclables from MSW separate collection, such as paper, cardboard, plastic, metals and glass and these materials are separated or sorted into the different fractions after which they are typically baled for transfer to industrial plants that can use the secondary raw materials captured. Waste sorting lines can use a combination of manual and mechanical handling operations. Depending on the level of awareness of the public the level of efficiency achieved in such plants can be quite high (i.e. in the order of 80%) and the captured materials tend to be 'clean' and readily marketable.

Most WSLs will incorporate conveyors and elevators and a cabin where manual sorting takes place. Items of mechanical equipment may be incorporated such as an over-band magnet (i.e. electromagnetic separator for collection of ferrous metals, such as steel food cans), an eddy-current separator (ECS) for collection of aluminium cans (e.g. used beverage cans – UBCs), and most WSLs will incorporate a baler for consolidating the captured secondary raw materials.

At a more sophisticated level WSLs may incorporate other sorting technologies such as air splitters and near infrared (NIR) separators.

Figure A1-1: Front End of Waste Sorting Line

Figure A1-2: Front End of Waste Sorting Line

1.2 'Dirty' Sorting Lines

Such facilities typically receive mixed 'residual' MSW with recyclables, such as paper, cardboard, plastic, metals and glass mixed with organic and other wastes. Sorting lines for such waste streams predominantly use manual handling techniques and the materials separated or sorted into the different fractions are also typically baled for transfer to industrial plants that can use the secondary raw materials. Some mechanical components, such as bag opening devices and over-ban magnets, may also be included The level of contamination of the captured recyclables can be significant which will reduce the revenue from the sale of recyclables and the level of efficiency achieved in such plants is typically quite low (i.e. in the order of 10% of waste input).

1.3 Conclusion on Waste Sorting Lines for Ukraine

Because of the low level of capture of useful recyclables, sorting lines handling mixed residual waste are not considered an appropriate, sustainable solution and do not reflect current best practice in the EU Member States. The use of waste sorting lines to process clean, 'dry' recyclables from MSW separate collection is considered to be an effective and cost-efficient option to improve recycling levels, in particular from the household waste stream. Depending on the extent of public participation in source separation of recyclables, the purity of the recyclables collected, the efficiency of sorting, and the market for secondary raw materials, the operational costs of MSW separate collection can potentially be recovered by revenues from the captured secondary raw materials.

Waste sorting lines should be developed on the basis of inter-municipal cooperation arrangements serving a catchment with an appropriate critical mass. It is considered that a minimum capacity of 10,000 tonnes of 'dry' recyclables should apply to new waste sorting lines in Ukraine. For the larger catchment areas in Ukraine (e.g. cities with a population greater than 640,000) WSLs with a capacity of 50,000 tons per year may be appropriate, while facilities with a capacity about 30,000 tpa may be appropriate for catchments/regions with a population of between 250,000 and

640,000. For settlements with a population less than 250,000 a capacity of about 20,000 tpa may be appropriate. The following table provides an indicative estimate of CAPEX and OPEX for WSLs:

Table A1-1: Indicative Cost Estimates for Waste Sorting Lines

Capacity of WSL in tons per year	Population Served	CAPEX	OPEX	
			Annual Cost[62]:	OPEX Cost per ton
50,000	More than 640,000	€5,000,000	€625,000	€12.50
30,000	250,000 – 640,000	€3,000,000	€400,000	€13.00
20,000	200,000 – 250,000	€2,500,000	€300,000	€15.00
10,000	Less than 200,000	€2,000,000	€220,000	€22.00

While the estimates in the above table are indicative only it is clear that economies of scale factors are significant and for that reason it is considered that WSLs should generally be developed at a regional level, except in the case of the larger cities.

[62] In calculating the OPEX the following annual salaries have been applied:
Manager: €4,000
Supervisor: €3,000
Workers: €2,000

2. RDF/SRF Production Facilities

Some treatment facilities are configured to produce refuse derived fuel (RDF) or solid recovered fuel (SRF). This generally entails diversion of materials for energy recovery from the residual MSW stream through mechanical sorting.

While some capture of secondary raw materials is associated with RDF/SRF production facilities, the main difference between waste sorting lines and RDF/SRF production facilities is that the former generally processes source-separated recyclables while the latter processes residual waste[63]. RDF/SRF production is also typically a component of a mechanical-biological treatment (MBT) plant - see Section 4 below.

The term refuse derived fuel (RDF) has no strict technical definition and could be deemed to include a wide variety of material that is capable of being burned. RDF consists largely of plastic and fibre waste with an amount of organic waste and it is produced by mechanical sorting, shredding and drying. Such material is typically sent to combined heat and power (CHP) Plants in Europe and this can offset the use of fossil fuels in such facilities.

By contrast, solid recovered fuel (SRF) can be defined as a "solid fuel prepared from non-hazardous waste to be utilised for energy recovery in incineration or co-incineration plants, and meeting the classification and the specification requirements laid down in EN15359."

The term solid recovered fuel (SRF) accordingly relates to a high quality fuel from waste which is produced to specification. Within the EU, a CEN Technical Committee (TC 343) has developed standards on solid recovered fuels prepared from wastes. SRF is classified by a number of characteristics, including calorific value (CV), moisture content (MC), chlorine content, etc. Where the SRF produced has a relatively low moisture content (i.e. less than 15%) and a high calorific value (i.e. between 17 and 22 mega joules per kg.), SRF is suitable for use in facilities such as cement kilns.

The technologies involved for the most efficient production of SRF vary depending on the proposed infeed material and the market for the final product but generally involve dosing, screening by trommel screen (see Figure A2-1 below), air separation, metal separation, near infra-red (NIR) sorting, and shredding. Depending on the specification of the proposed material required by the cement kilns, a NIR sorter may be required to achieve the removal of chlorine contaminants (i.e. generally PVC which consists of approximately 60% chlorine). Where the production facility is largely configured for RDF/SRF production only, the residual waste is initially run through a trommel screen where organic fines (i.e. material ≤ 60mm) fall through the screen while the larger, lighter material combustible material (i.e. the 'overs') is captured at the end of the screen. The overs are further processed and shredded to produce an SRF (i.e. approximately 30% of the total infeed by weight) for use off-site (e.g. in cement kilns). Some recyclables are recovered (e.g. ferrous, non-ferrous and plastic, accounting for approximately 10%) and the mixed residues (i.e. 60% fines) are either further treated (i.e. in an MBT configuration) or disposed of to landfill.

A plant with an infeed capacity of 100,000 tons per year of raw incoming mixed waste will typically produce an estimated 30,000 tons of finished SRF and residues containing approximately 45,000 tons of a wet biomass fraction (depending on the respective morphological composition of the

[63] In a two-container/bin system, 'dry' commingled recyclables are collected on one bin while residual waste is collected in the second container/bin.

waste stream).

Cement kilns typically co-incinerate RDF/SRF with virgin fuels in various proportions depending on their operating parameters. Although cement kilns specify the minimum quality requirements and various parameters of the fuel that can be accepted, European Standard EN 15359:2011[64] can be applied to define the quality of SRF.

Figure A2-1: Trommel Screen Used to Separate Lighter, Combustible Material (i.e. 'Overs') from 'Organic Fines'

SRF should meet the specification requirements based on the classification system set out in the European Standard EN 15359:2011. The specification for Class 4 SRF covers what would generally be regarded as mid- to low-quality material (i.e. closer to RDF), while the specification for Class 2 SRF is aimed at high-quality SRF which is typically required by the market (e.g. the cement industry). For ideal conditions of co-incineration SRF should have a calorific value of at least 20 MJ/kg and a moisture content of less than 15%.

SRF should therefore to be distinguished clearly from all other fuels derived from waste. In general these other fuels are referred to as refuse derived fuel (RDF). A main distinction between SRF and RDF is that SRF is intentionally produced with respect of quality criteria, whereas RDF is usually a remaining fraction from waste treatment operations. Producers of SRF control the production process so that their fuels meet the desired specifications. RDF is a non-specified waste. Its quality and environmental features are not analysed using acknowledged methods.

1.1 [64]EN 15359:2011 Solid recovered fuels. Specifications and classes, http://shop.bsigroup.com/ProductDetail/?pid=000000000030202007

Table A2-1 Specification for Class 2 and Class 4 SRF (Key Parameters)

			Class				
Parameter	**Statistical Measure**	**Unit**	**1**	**2**	**3**	**4**	**5**
Net calorific value (NCV)[65]	Mean	MJ/kg (ar)	≥25	**≥20**	≥15	≥10	≥3
Chlorine (Cl)	Mean	%	≤0.2	**≤0.6**	≤1.0	≤1.6	≤3
Mercury	Median 80th percentile	Mg/MJ	≤0.02 ≤0.04	**≤0.03** **≤0/06**	≤0.08 ≤0.16	≤0.15 ≤0.30	≤0.30 ≤1.00

SRF should generally be less than 30mm or 35mm in size. It should be noted that it can be quite a challenge to produce high-quality (i.e. Class 2) SRF[66]. It should also be noted that, for EU Member States, co-incineration of waste in a cement kiln comes within the ambit of the EU Industrial Emissions Directive 2010/75/EU (i.e. integrated pollution prevention and control), which sets out the framework of within which the basic requirements for emissions from waste-to-energy/incineration plants are set.

Key factors in achieving success in energy from waste (i.e. 'recovery') projects, in particular the use of RDF/SRF, include the following:

- Good market with agreed outlet volumes and reasonably secure prices for at least for the short-term (i.e. up to 2022) and preferably longer;
- Low fossil content – high biogenic content in the RDF/SRF, leading to the energy use being (more) renewable and attracting lower greenhouse gas emission charges (requirements for carbon credits, when applicable to Ukraine);
- Direct use of heat - One of the keys to achieving the environmental and financial benefits is finding a direct outlet for heat generated by combustion of waste-derived fuels rather than the use of heat to generate steam and then electricity;
- Minimising the costs of production; and
- Meeting the CEN standard specification for SRF

Given that RDF/SRF production is typically part of a mechanical-biological treatment (MBT) plant operation, it is difficult to find CAPEX and OPEX examples of stand-alone RDF/SRF production facilities. In addition the market is changing from a situation where cement kilns have previously charged gate fees for RDF/SRF delivered to a one where these companies are prepared to pay for such material. Changes in this regard in EU Member States may be related to the EU Emissions Trading Scheme. Table A2-2 sets out indicative CAPEX and OPEX estimates for RDF/SRF production facilities.

[65] www.eps.rs The coal from open-cast mines is lignite having an average calorific value of 7.5 MJ/kg
[66] According to research carried out on SRF production in Poland in 2012, fewer than 15% of facilities produced SRF with CV ≥ 20 MJ/kg (http://www.sae.tu.kielce.pl/10/S&E_NR_10_Art_5.pdf)

Table A2-2: Indicative Cost Estimates for RDF/SRF Production Facility[67]

Infeed Capacity in tons per year of mixed waste	Population Served	CAPEX		OPEX		OVERALL Cost/ton
		CAPEX	CAPEX Cost/ton	Annual Cost[68]:	OPEX Cost/ton	
100,000	350,000	€6,500,000	€15[69]	€856,000[70]	€10.25	**€25.25**
250,000	900,000	€9,250,000	€10[71]	€1,638,000[72]	€8.25	**€18.25**

The above costs are indicative only and the actual costs of an RDF/SRF production facility depend on a number of factors, in particular the quality of the material being produced.

Co-incineration of RDF/SRF is very often the best first step towards waste-to energy.

2.1 Conclusion on RDF/SRF Production for Ukraine

Although it is not yet applicable in Ukraine, it should be noted that the biomass fraction of RDF/SRF has a monetary value under multiple greenhouse gas protocols, such as the EU Emissions Trading Scheme.

A number of conclusions can be drawn in relation to RDF/SRF production in Ukraine:

- The financial viability of an RDF/SRF facility is wholly dependent on the market for the material produced. Since this is likely to be the cement kiln industry, a long-term binding agreement or contract between the cement kiln and the RDF/SRF facility should be a prerequisite for investment;
- An RDF/SRF plant of less than 100,000 tonnes per year of infeed capacity is generally not considered optimal as the full capacity of the equipment would not be achieved;
- While RDF (i.e. lower grade SRF) may be accepted by cement kilns at the moment, it is clear that the trend is towards production of higher-grade material (i.e. Class 2 SRF) with higher calorific value and lower moisture content;
- Where possible, the biomass fraction of the RDF/SRF to be produced should be determined. This can be done by the manual sorting method and the selective dissolution method[73];
- A full waste composition analysis should be carried out of a representative sample of the residual waste within the catchment area in question in order to determine in particular:
    - The overall moisture content of the un-dried material;
    - The amount of the non-combustible fraction of the waste is its moisture content and the amount of the biomass fraction and its moisture content.

[67] Figures based on personal research by Billy Moore carried out in 2011 for a private client in relation to possible development of an SRF production facility in Ireland, with labour costs adjusted downwards by 90% to reflect the comparable labour pay rates in Ukraine.

[68] In calculating the OPEX the following annual salaries have been applied:
Manager: €4,000
Supervisor: €3,000
Workers: €2,000

[69] Including €1.5 million for building cost, €5 million for equipment, land cost of €300,000 per year and 5% loan charges.

[70] Including €675,000 energy costs, €160,000 maintenance costs and €21,000 labour costs.

[71] Including €1.75 million for building cost, €7.5 million for equipment, land cost of €300,000 per year and 5% loan charges.

[72] Including €1,350,000 energy costs, €250,000 maintenance costs and €38,000 labour costs.

[73] Staber et al, 2008: "Methods for Determining the Biomass Content of Waste" by Wolfgang Staber, Sabine Flamme and Johann Fellner, Sage Journals, February 2008.

Any proposal to develop an RDF/SRF facility should be subject to a full Feasibility Study in order to ensure the long-term bankability of the respective project. RDF/SRF production has increased significantly in EU Member States over the past two decades in particular due to the EU landfill Directive, 1999/31/EC and the implementation of significant levels of landfill taxes.

3. Biological Treatment

Biological treatment or the organic fraction of waste can either be aerobic treatment (i.e. composting),which is classified as recycling, or anaerobic digestion (AD) (which is classified as recycling or recovery, as appropriate)[74]. In relation to MSW streams the following biological processes typically apply:

- Home composting
- Composting of green waste
- Stabilisation of the organic fraction of the residual waste stream; and
- Primary source separation of bio-waste and biological processing of this fraction

3.1 Home Composting

While composting is defined as a recycling activity, home composting may be considered as a waste prevention action since it is applicable on a home basis, prior to the material in question entering the MSW stream. Home composting typically involves the use of dedicated bins or vessels into which the user gradually adds organic matter over a period of time. All green wastes, such as yard wastes (e.g. fallen leaves, grass clippings, weeds and the remains of garden plants, also food waste, make excellent compost. This material naturally decomposes to form compost. The high temperature will kill most weed seeds and speed up the decomposition process so that the compost may be ready in about 3 months. Home composting can be practiced in most backyards in a variety of manufactured composting bins, which differ in shape, size and price. Home composting can be implemented in the individual households in the suburban areas in the towns and cities and in the rural areas in Ukraine.

Home composting bins are commercially available from a number of manufacturers in a variety of sizes from 300 to 400 litres. A high degree of effort and commitment is required on the part of participants because home composting requires households to separate and compost their own kitchen and green waste and to handle the compost produced in their own garden.

The unit price of a typical home compost bin, capacity between 300 and 400 litres is in the range €30 to €50. Units are usually made from recycled plastic (i.e. post-consumer recycled plastic), to have a wide base, to be fitted with a Push-fit windproof lid with integrated handle and to have an integrated wide hatch door, (minimum 350mm in width), to allow easy removal of compost material.

[74] According to Article 3.17 of the of the EU Waste Framework Directive, 2008/98/EC: "'recycling' means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations"

Figure A3-1: Example of Home Composting Unit

While there is considerable variation in the efficacy of home composting schemes in diverting MSW from landfill, it can be assumed that a figure of 14.5% of household waste may be applicable[75].

3.1.1 Conclusions on Home Composting for Ukraine

As a strategic tool, home composting is limited to people living in rural areas and suburban areas of towns and cities. The rural environment is more conducive for home composting given the lack of garden space and with the potential nuisances that can arise. It is not particularly feasible for those living in apartments. Individuals participating in home composting need to be "keen recyclers" as considerable effort and commitment is required. Home composting should ideally be implements through pilot projects, which should be accompanied by an intensive information and awareness-raising campaign in each case. Successful implementation of a home composting scheme in an area will require considerable effort on the part of the respective municipality in disseminating information and awareness measures and in supervising and monitoring the use and effectiveness of the scheme.

The following are considered 'lessons learned' in relation to home composting schemes:

- Initial implementation of home composting into an area or sub-region should be executed on a 'pilot scheme' basis;
- The pilot home composting schemes need to be fully and actively supported by the municipalities in question;
- A user guide to be provided to users with each home composting unit;
- The home composting units should not be given out free of charge but rather should be offered at a subsidised or discount price[76];

[75] Based on WRAP, 2009: Final Report: Home Composting Diversion: Household level Analysis, WRAP, UK, September 2009

[76] Where home composting units are purchased by a municipality, as part of a supply tender, the unit price will be at a substantial discount to the market price for an individual purchaser.

- Subsidised or discounted home composting units might be offered to citizens on a 'first-come/first-served' basis following a public launch in the municipalities in question.

Some 30.8% of the population in Ukraine is rural and 69.2% is urban. With a high level of efficiency of use, overall coverage of 28% of the rural population and 10% of the urban population in Ukraine home composting could achieve an overall reduction in the order of 2.3% of the total waste MSW stream by 2030. This level of coverage would require 2.6 million HCUs at a total cost of approximately €105.0 million.

3.2 Composting of Green Waste

Small windrow composting operations can be readily applied to handle separately collected green waste. The types of waste classified as 'green waste' include grass cuttings, hedge/shrub cuttings, fallen leaves, plant and flower heads, branches, tree stumps, timber, etc., and include garden waste from households and from the maintenance of parks and gardens. Such wastes can be collected separately at waste collection/reception centres (also referred to as "recycling yards" or "civic amenity sites") and can be composted locally in simple windrow centres located adjacent to the waste collection/reception centres.

The windrow centres typically comprise a surfaced area on which the green waste is shredded and then piled into rows. The simple compost process includes the following:

- Shredding of the green waste using a mobile tub grinder (such an item of equipment could be hired, as appropriate or could operate on a rota between the various centres);
- Piling the shredded green waste into long rows (i.e. windrows) using a loading shovel;
- Turning the windrows with the loading shovel on a weekly basis to improve porosity and oxygen content, and to redistribute the cooler and hotter parts of the windrows ;
- Once the temperatures within the windrows have reduced, screening the windrow material using a star screener; and
- Stockpiling the resulting compost/mulch and allowing the material to mature.

In the case of green waste composting can be carried out outdoors, since odours from the biological processing of this material are minimal.

Figure A3-2: Windrow Composting of Green Waste

In relation to costs, by far the dominant component of start-up costs for establishing a green waste composting facility is surfacing of the compost centre. On a per-input-ton basis, composting costs range from €2.35 to €6.85 per ton handled[77]. An average cost of €4.5 per ton is assumed[78]. Collection of 160 tons per year of green waste per site is assumed. Assuming 271 green waste composting sites

3.2.1 Conclusions on Green Waste Composting for Ukraine

Based on a coverage of 271 reception/collection centres in Ukraine where green waste composting sites could be co-located and based on collection of 160 tons per year of green waste per site[79], the annual cost of green waste composting per site would be in the order of €1,,000. While it may prove difficult to organise for a mobile shredder and turning machinery to be used on a rota basis across a number of centres, it is considered that green waste composting associated with Waste Collection/Reception Centres is a viable, sustainable option for Ukraine.

It is considered that, where possible, windrow compost centres should be co-located with the waste collection/reception centres, as set out in the MSW management strategy. The setting up of a small number of pilot projects will be encouraged in this regard, so that lessons learned can be applied to the wider roll-out of such facilities[80]. However, the application of the compost produced from such facilities should be determined in advance, as well as standards (i.e. certification) since such compost typically has limited application.

3.3 Stabilisation of the Organic Fraction of the Residual MSW Stream

This is generally carried out in a mechanical-biological treatment (MBT) plant (see Section 4 below). The residual MSW fraction is initially run through a trommel screen (see Figure A2-1 above) where the heavier organic fines (i.e. material ≤ 60mm) fall through the screen while the larger, lighter, combustible material (i.e. the 'overs') is captured at the end of the screen. The organic fines can comprise 45% of the infeed material. These organic fines can then be subjected to bio-stabilisation (i.e. composting) or anaerobic digestion (AD).

Bio-stabilisation typically takes place in an enclosed tunnel system with forced aeration (i.e. in-vessel composting - IVC) or in a closed dynamic system (e.g. windrow composting with automated turning). The intense composting phase can take up to 4 weeks and the material then needs to be matured or cured for a further 8 weeks. A relatively large building is required to house the intense composting units (i.e. tunnels) and the refinement or maturation phase. The atmosphere within the composting area is highly corrosive.

[77] Based on ARE, 1993: A Cost Analysis of Municipal Yard Waste Composting, Mitch Renkow, Charles Safley, and Jeff Chaffin, Department of Agricultural and Resource Economics, North Carolina State University, December, 1993.
[78] Based on windrows placed over an asphalt surface.
[79] Based on figures from the National Waste Report for 2012, Environmental Protection Agency, Ireland, 2014. This Report shows 19,118 tons of household organic waste (mainly green waste) separately collected at 118 civic amenity sites in Ireland in 2012 (i.e. 195 tons collected per site).
[80] While it is, in theory, possible to estimate the required capacity of such compost centres based on the size of the catchment covered, the actual quantities of such green wastes directed towards such centres will vary significantly depending on a number of factors (e.g. participation rate, respective location, hours of operation, etc.).

Figure A3-3: In-Vessel Composting (IVC) System

Composting plants can give rise to intense odours and require the incorporation of a bio-filter (i.e. filter with moist organic material such as compost, wood chips, sea shells, etc.) to adsorb and biologically degrade the odorous compounds.

An alternative form of biological treatment is anaerobic digestion (AD) with the production of biogas. Anaerobic digestion (or anaerobic fermentation) refers to a process in which biodegradable material (e.g. the organic fraction of MSW) breaks down in the absence of oxygen to produce biogas[81] with high methane (i.e. CH_4) concentrations. It is usually undertaken in large vessels where the process can be controlled in order to speed up reactions and harvest the resulting biogas, which has a high-methane content and which can be used for energy generation. The biogas produced can be refined by removing the carbon dioxide and water vapour and it can then be used in a combined heat and power (CHP) plant to produce electricity and heat. AD still produces an organic residue called digestate which is similar in nature to compost. The digestate often requires a brief stage of aerobic treatment to fully stabilise any remaining biodegradable content and it can be used in similar applications as compost. Table 3-1 below provides indicative estimates of the costs of biological treatment of mixed MSW.

Table 3-1: Indicative Estimates of Treatment Costs for Mixed Wastes (courtesy of JASPERS/ Byström, 2010)[82]

Type	Cost per Tonne, €		
	Investment Cost	O&M Cost	Total Cost
MBT – bio-stablisation	100 – 200	10 – 25	20 - 40
MBT – Bio-drying	200 – 350	20 – 35	40 - 70
Anaerobic Digestion	200 - 400	25 - 50	50 - 90

3.3.1 Conclusions on Stabilisation of the Organic Fraction of the Residual MSW Stream for Ukraine

[81] Biogas consists of methane (CH_4), carbon dioxide (CO_2) and and traces of other 'contaminant' gases
[82] JASPERS, 2010:Staff Working Papers, Mechanical Biological Treatment Plants, Jonas Byström, Jaspers Solid waste and Energy Division, August 2010.

There are significant opportunities for such uses in Ukraine given the large number of non-engineered waste disposal sites that require restoration/rehabilitation (i.e. in excess of 6,000 sites overall) where compost like output (CLO) can be used, and the emerging number of fully-engineered sanitary landfill sites to EU standards which will require such material as daily cover for the working face to reduce wind-blown litter, vermin and odour.

Composting of residual waste which has not been subject to appropriate pre-processing to remove non-biodegradable components results in a mixed substance referred to as bio-stabilised waste[83]. In essence this is a poor-quality CLO with an even larger amount of contamination. It is not suitable for direct use. However, the waste is treated and is reduced in biodegradable content, making it suitable for landfill disposal in compliance with the requirements in the EU Landfill Directive, 1999.

Taking an investment cost of €150 per tonne (i.e. mid-figure for bio-stabilisation), the total investment required for treatment facilities for wet material suitable for bio-stabilisation would be in the order of €0.5 billion[84] for Ukraine. Annual operation and maintenance costs (not including capital replacement costs, would be approximately €87.5 million[85]. The level of costs involved are not considered affordable for Ukraine in the current economic situation.

3.4 Primary Source-Separation of Bio-waste and Biological Treatment of this Fraction

Implementation of primary source separation of organic waste (i.e. 'bio-waste') involves introduction of a third container/bin (i.e. a three container/bin system) where:

i. 'Dry' recyclables are collected in one container/bin;
ii. Organic waste (i.e. bio-waste or 'wet' recyclables are collected in another container/bin; and
iii. Residual MSW is collected in the third container/bin.

The separately collected bio-waste is then biologically treated, generally by composting. Composting is a well-tried and tested process for the treatment of source-separated bio-waste. However, it must be recognised that source separation is never perfect and that the more contaminated the input, the more contaminated (and less valuable) the output. In addition, more frequent separate collection of this bio-waste fraction is needed in order to avoid odour and other negative effects, etc.

In considering this option it should be noted that:

- A number of countries have adopted standards for compost produced from source-separated biodegradable materials;
- An EU standard is currently being negotiated; and
- End-of-waste criteria derived from these standards will be applicable under Article 6 of the Waste Framework Directive

[83] Also referred to as 'stabilised bio-waste'.
[84] Assuming 12.5 million tons per year of MSW collected (by 2030), 30% organic fraction and 90% collection efficiency = 3,375 million tons.
[85] Calculated at 5 million tons x €17.5/ton = €87.5 million.

If pre-processing of the waste has been sufficiently stringent and the majority of the non-biodegradable material has been removed then the output of the composting process is referred to as 'compost-like-output' (CLO).

There is no protocol or 'product standard' in general use for compost-like-output (CLO). Therefore it remains waste. Moreover, many countries will not permit the use of such material on agricultural land, and most land owners would not accept it even if it were permitted.

CLO can be put to direct beneficial use, but the outlets are restricted and fewer in number than for compost from source-segregated bio-waste. For example CLO can be used:

- In the restoration of contaminated land sites and the rehabilitation of landfill sites and dumpsites, particularly as a sub-soil substitute; and
- As daily cover or intermediate cover at operational non-hazardous waste landfill sites.

Composting of the source-segregated bio-waste fraction is also generally carried out in composting units (tunnels – see Figure A3-3 above).

Table A3-2: Indicative Estimates of Treatment Costs for Source-Separated Bio-waste (courtesy of JASPERS/ Byström, 2010)[86]

Type	Cost per Tonne, €		
	Investment Cost	O&M Cost	Total Cost
In-vessel composting	150 – 300	15 - 30	30 - 60

It should be noted that the indicative treatment costs involved, as set out in Table A3-2, are substantially higher (i.e. in the order of 30% to 50% higher) than the stated indicative costs of bio-stabilisation of the residual MSW fraction. However, such costs will apply to a reduced infeed amount, say 15.6%[87] of total MSW in question. It should be borne in mind that the additional costs of separate collection also have to be taken into consideration.

3.4.1 Conclusions on Primary Source-Separation of Bio-waste for Ukraine

In a composting facility the organic fraction of municipal solid waste is biologically treated to produce compost, which, in theory, can have an application in horticulture or agriculture. In practice, there is no universally-recognised standard for compost and it can prove extremely difficult to produce a high-quality product from the organic fraction of MSW which can then be used in horticulture or agriculture. However, there may not be a ready market for this product. The strength of any such market will be a key factor in determining whether or not source separation of biodegradable waste and its composting are ultimately viable for Ukraine.

In many cases the organic material which has been biologically stabilised (i.e. referred to as 'stabilised bio-waste') is typically used as landfill cover material.

Taking an investment cost of €225 per tonne (i.e. mid-figure for bio-stabilisation), the total investment required for treatment facilities for wet material suitable for bio-stabilisation would be

[86] JASPERS, 2010:Staff Working Papers, Mechanical Biological Treatment Plants, Jonas Byström, Jaspers Solid waste and Energy Division, August 2010.
[87] Based on Bipro, 2015: Assessment of separate collection schemes in the 28 capitals of the EU Final Report prepared for the European Commission, November 2015.

in the order of €0.400 billion[88] for Ukraine. Annual operation and maintenance costs (not including capital replacement costs, would be approximately €40 million[89]. While these costs are substantially lower than the processing costs for organic fines (Section 3.3 above) the additional costs of separate collection of bio-waste will result in higher overall costs for this option. An indicative estimate of the capital costs of containers and vehicles required in this regard fir Ukraine is €85 million. On-going collection costs would also apply. Accordingly source separation of bio-waste is not considered a widespread option for Ukraine, at least in the short-term, and in the absence of a significant increase in the environmental tax on the deposit of waste.

3.5 Overall Conclusions on Biological Processing of MSW for Ukraine

Even with the adoption of a 'regional' approach (i.e. at oblast level) many of the biological treatment technologies are so expensive to establish and operate that they may only be open to consideration when Ukraine's economic position is stronger. The most significant progress towards national targets and standards can be met initially with lower-cost solutions (e.g. MSW separate collection of recyclables, home composting, green waste composting, etc.).

The EU-Ukraine Accession Agreement, 2014 requires compliance with Article 6 of the Landfill Directive, 1999. Accordingly stabilisation of the organic fraction of MSW will ultimately be required for Ukraine.

However, given the high costs involved, biological treatment of separately collected bio-waste or of the organic fraction of the residual MSW stream is not considered viable, on a widespread basis, in Ukraine, at least in the short-term and in the absence of a significant increase in the environmental tax on the deposit of waste. Accordingly, in relation to biological treatment, it is considered that the initial focus should be on home composting and windrow composting of green wastes (e.g. waste from gardens and parks), at least in the short-term (i.e. up to 2022). In the medium- to long-term, bio-stabilisation of organic waste within an overall MBT facility may be prove to be the best practicable option for stabilising the organic fraction of MSW.

[88] Assuming 12.5 million tons per year of MSW collected (by 2030), 15.6% separately collected bio-waste fraction and 90% collection efficiency = 1.76 million tons.
[89] Calculated at 1.76 million tons x €22.5/ton = €87.5 million.

4. Mechanical-Biological Treatment (MBT)

The term MBT covers a wide-range of processes but it typically involves capture of recyclables and some form of biological treatment of the organic fraction of MSW. In some cases the 'dry' fraction of MSW is converted to refuse-derived fuel (RDF) or solid-recovered fuel (SRF), while the 'wet' fraction is converted to compost-like-output (CLO).

RDF/SRF production is addressed in Section 2 above while biological processing of the organic fines from the residual MSW stream is addressed in Section 3.3 above.

A key advantage of MBT is that it can be configured to achieve several different aims. In line with the EU Landfill Directive and in order to achieve certain recycling targets, typical aims of MBT plants include:

- The pre-treatment of waste prior to disposal on landfill;
- Diversion of non-biodegradable and biodegradable MSW going to landfill through the mechanical sorting of MSW into materials for recycling and/or energy recovery, such as refuse derived fuel (RDF) or solid recovered fuel (SRF);
- Diversion of biodegradable MSW going to landfill by stabilisation of MSW into a compost-like-output – CLO (i.e. also referred to as 'stabilised bio-waste') for use as landfill cover material or in the rehabilitation of landfills and dumpsites; and
- Drying materials to produce a high calorific fraction for use as RDF/SRF.

The mass balance for a typical MBT plant producing CLO and RDF/SRF is set out in the following table:

Table A4-1: Mass Balance for MBT Facility[90]

Material	Percentage of Input Waste Stream
Recovered Metals	4%
Plastic containers	3%
Compost Product	18%
Mass lost from composting	20%[91]
RDF/SRF	50%
Residues to Landfill	5%
Total	100%

Table 4-2 provides indicative estimates of the cost of MBT for residual MSW with energy recovery.

[90] Based on a New earth Solutions' MBT facility at Avonmouth, Bristol, UK, designed, built and commissioned by Syngas Products, in 2011

[91] This relates to 'process losses' because the composting process drives off a significant amount of H_2O and CO_2.

Table A4-2 Indicative Estimates of Treatment Costs for Mixed Wastes (courtesy of JASPERS/ Byström, 2010[92])

Type	Cost per Tonne €		
	Investment Cost	O&M Cost	Total Cost
MBT – energy recovery	250 – 450	25 – 45	60 – 90

4.1 Overall Conclusions on Mechanical-Biological Treatment Plants for Ukraine

The same conclusions apply to MBT plants as apply to stabilization of the organic fraction of the residual MSW stream, as set out in Section 3.3 above. Given the high costs involved, it is considered unlikely that MBT will be a viable widespread option for Ukraine, in particular in the short-term and in the absence of a significant increase in the environmental tax on the deposit of waste.

5. Thermal Treatment

Thermal treatment (i.e. incineration or waste-to-energy) is a waste treatment process widely used throughout the world, particularly in developed countries (i.e. Sweden and Denmark are particularly notable in this regard). The main purposes of thermal treatment/incineration are sterilization and reduction of hazardous matter contained in the waste. The total volume of the waste input is reduced to ash, which comprises 10 – 30% of its original size. This ash is either deposited in a landfill or used for other purposes. Energy production, a highly significant benefit of the incineration treatment, improves with an increase in the calorific value of the incinerated waste.

Fig A5-1: Modern Waste-to-Energy Plant

Table A5-1 provides indicative estimates of the costs of recovery options for mixed MSW.

[92] JASPERS 2010, Staff Working Papers: Mechanical Biological Treatment Plants, Jonas Byström, JASPERS Solid Waste and Energy Division, August 2010

Table A5-1 Indicative Estimates of Costs of Incineration with Energy Recovery for Mixed Wastes (courtesy of JASPERS/ Byström, 201093)

Type	Cost per Tonne €		
	Investment Cost	O&M Cost	Total Cost
Incineration – energy recovery	500 – 1,200	25 – 45	100 - 200

In order to be deemed to be a 'recovery' activity rather than a 'disposal' activity, a new MSW incineration facility (or any existing facility) would have to achieve an energy efficiency equal to or above 0.65, using a formula[94] to be applied in accordance with the reference document on Best Available Techniques for waste incineration[95].

In addition, any new incinerator will be required to comply with the EU Industrial Emissions Directive, 2010/75/EU which imposes strict limits on the emissions to air, among other pollutants, of nitrogen oxides (NO_x), sulphur dioxide (SO_2) and dust.

Other forms of thermal treatment (also referred to as 'advanced thermal treatment') include pyrolysis and gasification:

- Pyrolysis involves the thermal degradation of organic material in the absence of oxygen; and
- Gasification can be considered a process between pyrolysis and combustion in that it involves the partial oxidation of organic substances (i.e. by contrast with incineration which comprises full oxidative combustion) to produce gases that can be used as a feedstock, or as a fuel.

Pyrolysis and gasification plants follow a similar basic structure to waste incineration installations, but differ significantly in detail. The main differences include the following:

- More extensive pre-treatment to provide a narrow profile feedstock;
- Additional equipment for handling/treating/storing the rejected material;
- Greater attention required for sealing the loading of infeed material;
- The need for a thermal reactor;
- The need for handling, storage and possible further treatment of gaseous and solid products; and

[93] JASPERS 2010, Staff Working Papers: Mechanical Biological Treatment Plants, Jonas Byström, JASPERS Solid Waste and Energy Division, August 2010

[94] The formula (Ep - (Ef + Ei))/(0.97 × (Ew + Ef)), in which:

Ep means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 (GJ/year);

Ef means annual energy input to the system from fuels contributing to the production of steam (GJ/year);

Ew means annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year);

Ei means annual energy imported excluding Ew and Ef (GJ/year); and

0.97 is a factor accounting for energy losses due to bottom ash and radiation.

[95] European Commission, 2006: Reference Document on Best Available Techniques for Waste Incineration, European Commission, August 2006. A BREF or 'BAT reference document' means a document, resulting from the exchange of information organised pursuant to Article 13 of the Industrial Emissions Directive (IED) (2010/75/EU). BREFs are drawn up for defined activities and describe, in particular, applied techniques, emissions and consumption levels, techniques considered for the determination of best available techniques (BAT) as well as BAT conclusions and any emerging techniques, giving special consideration to the criteria listed in Annex III to Directive 2010/75/EU

- The possible need for a separate combustion stage with energy recovery and subsequent gas/water/solid treatment and management.

The technological risk associated with gasification and pyrolysis technologies for many wastes remains significantly greater than that for more proven, incineration-type, thermal treatments. These technologies, although they are being implemented in recent years, are also less mature and their implementation entails significantly higher operational risk, especially as the market for the fuels from these facilities is not well developed in Europe in general or in Ukraine in particular. Pyrolysis and gasification treatment is typically applied to specific waste streams such as mixed plastic wastes. Thermal treatment by pyrolysis and/or gasification is rarely applied to MSW, in particular to MSW which has not been pre-treated[96].

There is a limited track record of commercial-scale pyrolysis plants accepting municipal derived wastes in the world[97]. Moreover, like incineration, the specific costs (€/T) of these technologies are very high.

5.1 Overall Conclusions on Thermal Treatment/Incineration for Ukraine

Although incineration of MSW at the incineration plant 'Energy' in Kiev is included in the recovery figures for Ukraine, this activity as currently in place, should more correctly be classified as a 'disposal' activity according to the definitions in the EU Waste Framework Directive, 2008/98/EC.

Given that the stringent requirements in the EU IED 2010/75/EU will apply in any event, it is considered that any new incineration facility in Ukraine should be configured as a 'recovery' operation rather than a 'disposal' operation.

Given the very high investment costs, mass burn waste-to-energy plants (i.e. incinerators with energy recovery) are generally not considered to be economic unless above a minimum intake of 150,000 tons per annum (i.e. population in excess of about 500,000). In this regard, thermal treatment/waste-to-energy recovery facilities would be open to consideration only in respect of the largest cities in Ukraine.

The very high cost of incineration, in terms of both CAPEX and OPEX, means such an approach is not considered, in principle, to be a practicable or affordable solution, generally, for MSW management in Ukraine.

The investment cost required to implement waste-to-energy as the applied solution for overall residual MSW management in Ukraine would be in the order of €8.76 billion[98]. The total costs of incineration with energy recovery are well in excess of €100 per ton. Such costs are not considered generally sustainable or affordable for Ukraine.

Waste-to-energy recovery may be considered an option for residual MSW in a limited number of situations where, for example, there is a very high population density,, a feasible grid connection,

[96] Table 2.5 in European Commission, 2006: Reference Document on Best Available Techniques for Waste Incineration, European Commission, August 2006. The table points out that pyrolysis and/or gasification is rarely applied to MSW.
[97] DEFRA, 2013: Advanced Thermal Treatment of Municipal Solid Waste, Department for Environment Food, and Rural Affairs, United Kingdom, February 2013
[98] Applying the mid-point figure from Table A5-1 (€850/tonne) and assuming €10.3 million tons of residual waste (2030 figure).

a ready outlet for the waste heat generated (i.e. such as greenhouses, etc.) and, in particular, where there is a lack of available land for the development of an appropriate landfill.

In relation to advanced treatment technologies, such as pyrolysis and gasification, the limited track record of commercial-scale plants and the high specific costs of these technologies lead to the conclusion that such plants would generally not be affordable for Ukraine in the short- to medium- term.

As a first step, prior to implementation of pilot thermal treatment projects, all of the relevant environmental as well as energy efficiency requirements should be transposed into Ukrainian legislation. In the absence of such legislation, there is a risk that old technologies will come into Ukraine as a country with lower legal standards.