



## MECHANICAL-BIOLOGICAL TREATMENT OF ORGANIC FRACTION OF MUNICIPAL SOLID WASTE WITH BIOGAS AND ENERGY PRODUCTION

### TECHNOLOGY DESCRIPTION

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Mechanical-biological treatment of waste (MBT) is a common approach for all technology versions that involve the treatment of waste with a combination of mechanical and biological methods. The main difference between different approaches is the order of the process stages involved in MBT and the purpose of biological treatment including energy production or material use.

The process is generally carried out in MBT plants for the stabilisation of the organic fraction of the municipal solid waste (MSW) stream. The organic fraction can be subjected to bio-stabilisation (i.e. composting) or anaerobic digestion (also called anaerobic fermentation). Anaerobic digestion is an alternative form of biological treatment with production of biogas and 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 with high methane (i.e. CH<sub>4</sub>) concentration. 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 the energy generation.

#### CURRENT TECHNOLOGY READINESS LEVEL OR COMMERCIAL READINESS INDEX

Even with the adoption of a 'regional' approach in Ukraine (i.e. at oblast level) many of the biological treatment technologies are expensive to establish and operate and may only be widely open to consideration when Ukraine's economic position is stronger. This means that bio-stabilisation of organic waste within an overall MBT facility may be the best practicable option for stabilising the organic fraction of MSW in the medium- to long-term.

Currently there are no examples of MBT plants in Ukraine. However, there are some MBT project developments in Ukrainian big cities based on finance from International Financial Institutions. Thus, technology readiness level for MBT in Ukraine is considered as technology concept formulated, commercial readiness as hypothetical commercial proposition.

#### CLIMATE RATIONALE OF THE TECHNOLOGY

Greenhouse Gas (GHG) emissions in the Waste Sector in Ukraine amount to approximately 12 Mt CO<sub>2</sub>-eq. It's the only sector where the GHG emissions upward trend has been observed since 1990. More than 65 % of GHG emissions in the Waste sector are caused by MSW landfilling due to under developed waste treatment technologies. It is expected that this share will increase constantly in future, if significant changes do not take place in MSW management practice in Ukraine.

Introduction of MBT for municipal solid waste technology results in waste landfilling minimisation with subsequent GHG emissions reduction. Additionally renewable biogas production provides fossil fuel substitution. It means that the combustion of biogas in MBT plants for the production of energy contributes to the reduction of GHG emissions in two ways: (i) MBT with biogas production prevents the release of methane into the atmosphere by minimization of landfilling, and (ii) The electricity subsequently produced by biogas combustion produces less CO<sub>2</sub> emissions than conventional fossil fuel combustion.



According to the Updated Nationally Determined Contribution of Ukraine (published in 2021, available at: <https://bit.ly/3ik1wMQ>) to the Paris Agreement (NDC2), biogas production with the purpose of energy production is one of the key measures to be introduced in the national MSW management system to achieve the target on GHG emission reduction in the Waste sector by 2030.

## AMBITION OF THE TECHNOLOGY

### SCALE FOR IMPLEMENTATION AND TIME-LINE

The proposed level of MSW biological treatment's diffusion including mechanical-biological treatment of waste with biogas and energy production should ensure 5% by 2030, 16% by 2040 and up to 20% by 2050. Such a level of ambition corresponds to the implementation of Waste Sector Target scenario S3G to achieve the sectoral goal stated in the NDC2 as well as to the implementation of the National Waste Management Strategy of Ukraine with ten-year postponement.

Ukraine is in the process of regional waste management plans development. As part of the plans development, each region is divided into 3-5 regional clusters. The modern regional sanitary landfill and waste processing plant should be constructed in each cluster as a core part of waste management system. Thus, it could be expected that 50-75 MBT plants with annual processing capacity of 75,000-100,000 tons of solid waste will be constructed in the country by 2040.

## EXPECTED IMPACTS OF THE TECHNOLOGY

The process of MBT projects development creates jobs associated with the design, construction and the operation of waste treatment and biogas energy recovery systems. MBT projects involve engineers, construction firms, equipment vendors and utilities or end-users of the power produced. Many of these costs are spent locally for materials, construction and operational personnel, helping communities to realize economic benefits from the increased employment and local sales. By linking communities with innovative ways to deal with their MSW, it helps them to enjoy the increased environmental protection, better waste management and responsible community planning.

MBT projects improve groundwater and air quality due to landfilling minimization. The improvement of local air and safety (fewer emissions of SO<sub>x</sub>, NO<sub>x</sub>, and particulates) is achieved through the reduction of landfill gas released into the air and burning less fossil fuel (coal, natural gas) for electricity generation.

## POLICY ACTIONS FOR TECHNOLOGY IMPLEMENTATION

### EXISTING POLICIES IN RELATION TO THE TECHNOLOGY

The feed-in tariff ("green tariff") for power from biomass/biogas is one of the drivers for the technology development. The FiT for electricity produced from biomass/biogas is fixed in euros until 2030 (0.1239 EUR/kWh without VAT). The main risk of the technology is associated with the lack of local initiative, low activity in legislation development, relatively high cost, unstable financial situation in the country, the lack of funds and grant program.

The introduction of face-out stimulating tariffs for waste disposal and high enough tariffs for waste treatment may support to raise the level of waste treatment to minimise the amount of landfilling.



## PROPOSED POLICIES/MEASURES TO ENHANCE TECHNOLOGY IMPLEMENTATION

In order to achieve the GHG emission target in the Waste sector, which was set up in the NDC2, the following main policies and measures are proposed to be implemented for dissemination of technologies for MBT of waste with biogas and energy production:

### **1. The creation of necessary infrastructure:**

- 1.1. Supporting the development of regional waste management plans on the basis of cluster structure (2021-2028)
- 1.2. The establishment of coordination council for research on waste reuse and processing (2022-2023)
- 1.3. Creation of waste management registers and adoption of the decree of their maintenance (2022-2023)
- 1.4 Supporting of the development of inter-municipal cooperation (2021-2028)

### **2. Creation of economic and financial conditions for MBT with biogas and energy production (incl. electricity, heat and biomethane):**

- 2.1 The introduction of high gate fee/tax for waste disposal and CO2 emission (2022-2024)
- 2.2 The creation of other technical and economic condition for MBT with biogas and energy production (2022-2024)

### **3. Provision of long-term and low-interest loans or grants through state funds, private sources and international funds:**

- 3.1 Explore sources of funding (national and international agencies) (2021-2022)
- 3.2 Training in development of proposal for funding (2022-2024)
- 3.3 The preparation of funding proposals to be submitted (2024-2030)

### **4. The creation of the stakeholder and technical expert networks for technology development and transfer:**

- 4.1 The creation of the platform for national technical experts and stakeholders based on governed or non-government organizations (2022-2024)
- 4.2 The exchange of information and lessons learned (info campaigns for population, workshops and conferences for experts and other interested parties) (2024-2030)

## COSTS RELATED TO THE IMPLEMENTATION OF POLICIES

There is considerable discrepancy in the cost of various MBT plants, because there is no "universal" way for mixed MSW processing. Various solutions can be considered to be the most beneficial for different areas/clusters. Capital expenditures for the implementation of MBT technologies depend on many factors including:

1. Initial MSW content (solid waste after separate collection or mixed solid waste);
2. The availability and type of sorting process before MBT (manual, automatic);
3. Treatment capacity (scale effect).

The cost of MBT projects with a capacity of 85-200 kt/yr, which were implemented in Germany and the UK from 2001 to 2012, was in the range of 20 to 75 M€ with average CAREX around 250 €/t of MSW processed during the year. Typical specific costs for the projects in capacity range of 100-200 kt/yr are from 150 to 400 €/t in countries such as France, Spain, USA, and Australia.

In Ukraine, the project's planned cost could be in the range of 120 to 250 €/t. Operational costs (OPEX) for MBT technology are primarily related to electricity consumption, repairs and maintenance costs, staff remuneration, and cost of residuals disposal. They are typically in the range from 8 to 12% of capital expenditures.



The final cost of MSW processing is determined by CAPEX and OPEX as well as the terms of project financing. If the project's specific capital cost amounts 150 €/t, the final cost of MSW treatment is 30-40 €/t depending on the conditions and share of involved bank capital.

The expediency of biogas generation from MSW with the further production of electricity is determined by the possibility of selling electricity at a fixed green tariff (0.1239 EUR/kWh without VAT).

Financial and economic barriers for technology implementation include low feasibility (low IRR, NPV, long payback period) of MBT projects for mechanical-biological treatment of waste with biogas and energy production because of low tariffs for waste treatment, low tariffs for waste landfilling, low population income, inadequate access to financial resources, and high cost of capital and finance.

## USEFUL INFORMATION

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### LINKS TO TNA REPORTS

Reports prepared within the TNA Project:

- Technology Needs Assessment
- Barriers Analysis and Enabling Frameworks
- Technology Action Plan

Full texts of the TNA reports are available at: <https://tech-action.unepdtu.org/country/ukraine/>

TNA Project page at the web-site of the Ministry of Environment and Natural Resources of Ukraine:  
<https://menr.gov.ua/news/33450.html>