



***National Academy of Sciences of Ukraine
Institute of Engineering Thermophysics***

Potential of the Ukrainian waste market for Polish companies from the RDF industry

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Waste management reform in Ukraine

- **8.11.2017 – CMU Resolution No. 820-r: The National Waste Management Strategy in Ukraine until 2030** was approved. *Construction of 20 stationary waste thermal utilization facilities is envisaged.*
- **20.02.2019 – CMU Order No. 117-r: The National Waste Management Plan until 2030** was approved.
- **9/07/2023 – The Law of Ukraine "On Waste Management"** entered into force. *The framework law. The actual start of the reform of the waste management system in Ukraine. Implementation of the European rules.*
- **20/10/2023 – CMU Resolution No. 1102: The order of classification and the National list of waste** was approved. *20 groups and 895 types of waste. Both waste classes and terminology meet EU requirements.*
- **28/05/2024 - The draft of the National Waste Management Plan until 2033** is published:
 - *Preparation for reuse and recycling of household waste: by 2025, at least 10% of their mass, by 2030 - 20%, by 2035 - 25%, by 2040 - 35%.*
 - *Implementation of a separate waste collection system by 2033: 100% of the population of large cities, 95% of the urban population, 70% of the rural population .*
 - *reducing household waste disposal volumes by 30% by 2030.*
- **2024 – Plan for construction of 207 new waste processing plants for RDF producing** is claimed by Ministry of Environmental and Nature Resource Protection; for energy recovery of this fuel, 10 Waste-to-Energy CHP plants on RDF/SRF are envisaged to replace natural gas consumption at heat energy producing enterprises.
- **9.05.2024 – The draft of the Rules for technical operation of waste incineration plants in Ukraine** is published. *Developed by Ministry with consulting by EU APENA2 project.*

Amount of MSW in Ukraine

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Amount of MSW, mln t	9.7	9.2	10.9	9.9	9.1	10.4	>10	>10	>7	9.3

Morphological composition of MSW in the largest cities of Ukraine

Parameters	Kyiv	Kharkiv	Odesa	Dnipro	Zaporizhzhia	Lviv
Population, ths. persons	2 967.4	1 443.2	1017.7	990.7	731.9	724.3
MSW components, %						
Food	32.8	41.4	29.3	37.8	29.3	26
Paper and cardboard	11.3	13.4	4.9	6.6	10.8	10
Plastic	17.6	7.7	13.0	7.0	14.4	13
Glass	10.5	7.7	23.7	11.7	11.0	4
Metal	1.8	2.9	3.8	0.5	0.8	1.5
Textiles	3.5	3.8	2.1	3.6	12.9	8
Wood	1.0	1,7	1.6	2.8	10.9	5.5
Unsorted residue	21.5	21.4	21.6	30.0	9.9	32

Expected changes in the morphological composition of MSW

Approximately 60% of the heat released when burning RDF fuel comes from burning plastic products



Directive (EU) 2019/904 of June 5, 2019 "On reducing the impact of certain plastic products on the environment" obliges EU member states to provide 77% by weight by 2025, and 90% by 2029, of separate collection for waste processing disposable plastic bottles from drinks with a capacity of up to three liters.

When implementing this directive into Ukrainian legislation, the calorific value of solid waste will decrease by almost 2/3.

Was founded in 1947. The main directions of the scientific and technical activities at present:

- thermophysical researches of heat and power equipment with using traditional, renewable and alternative energy sources, including MSW and biomass, developing methods for improving efficiency, reliability and environmental safety of this equipment;
- further development of the theory of heat and mass exchange and its application for increasing the efficiency of the processes of heat transfer and heat using in machines and apparatuses of new equipment;
- further development of the theory of heat and mass transfer for the improvement of energy efficiency of existing heat technologies, and for the development of fundamentally new resource-saving heat technologies;
- further development of the theory of measurement of thermal characteristics, and creation of new thermophysical tools and systems for monitoring the state of technical objects and technologies.

❑ 28.11.2023 – CMU Order No. 1093-r: The Concept of the State targeted economic program for the energy modernization of enterprises - producers of thermal energy, which are in state or communal ownership, for the period until 2030, was approved.

Scientific and technical support for the development of the Concept of using MSW as an alternative renewable energy fuel is carried out by specialists of the Institute of Engineering Thermophysics of the National Academy of Sciences of Ukraine, in particular in accordance with the program "Development of technical principles of a new highly efficient technology for burning artificial fuels from solid household waste and biomass in cogeneration power plants using hydrogen, oxygen, synthetic and biomethane, to ensure Ukraine's energy security".

Improvement of technology for combustion of MSW

The main goal is primarily related to ensuring an increase in the temperature of the process. The latter is achieved thanks to "lighting" with biogas, biomethane, hydrogen and artificial gases based on it, the use of oxygen-enriched blowing, preliminary additional heating of air, etc.



Experimental studies of the processes of burning of model solid waste in humid and air-dry state with the use of "lighting" with various gases and the addition of biomass to the composition of solid waste.



Average humidity of a sample, %	The amount of heat released under combustion of a sample, MJ/kg	
27.4	7.3-7.4	Autumn
28.6	7.1-7.2	Summer
33.6	6.8-7.1	Spring
57.4	4.3-4.4	Summer
58.3	4.3-4.4	Spring
67.3	3.2-3.3	Autumn

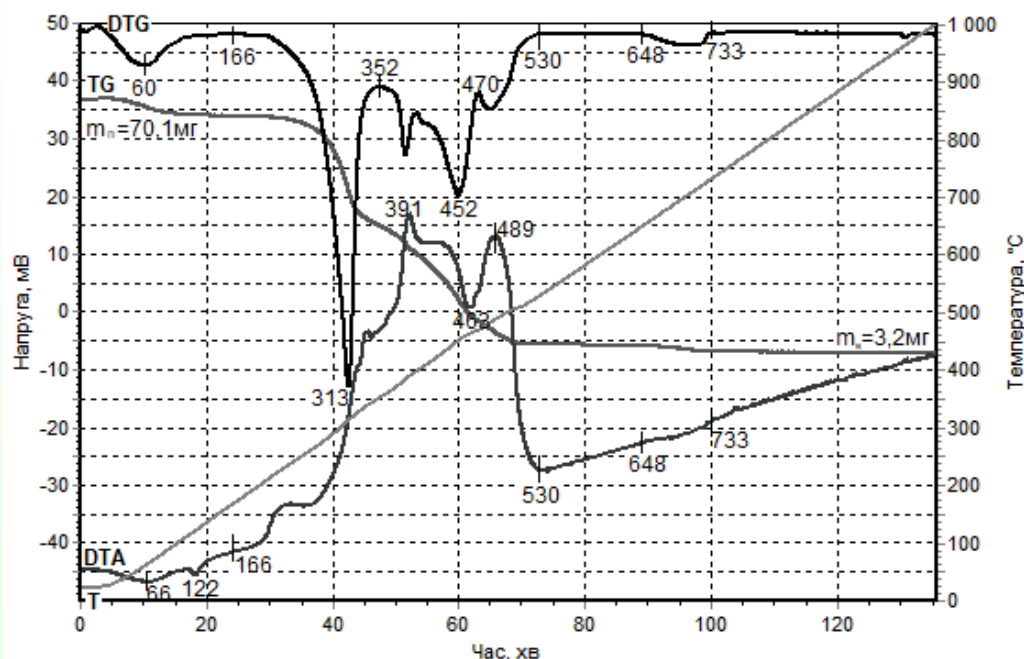
Amount of heat released during the burning of model MSW in an air-dry state is 11.7...13.0 MJ/kg, and the ash content is 12.0...15.0%.

In the case of using biomethane or natural gas for "lighting" its required volume is 0.1 m³/kg of MSW, when "lighting" with biogas - 0.22 m³/kg of MSW, study of "lighting" with hydrogen and other artificial gases is in progress.

Thermal analysis of RDF fuel

RDF A

50% cardboard, 26% polyethylene film,
16% textile, 3.5% leather and 4.5% pine
wood

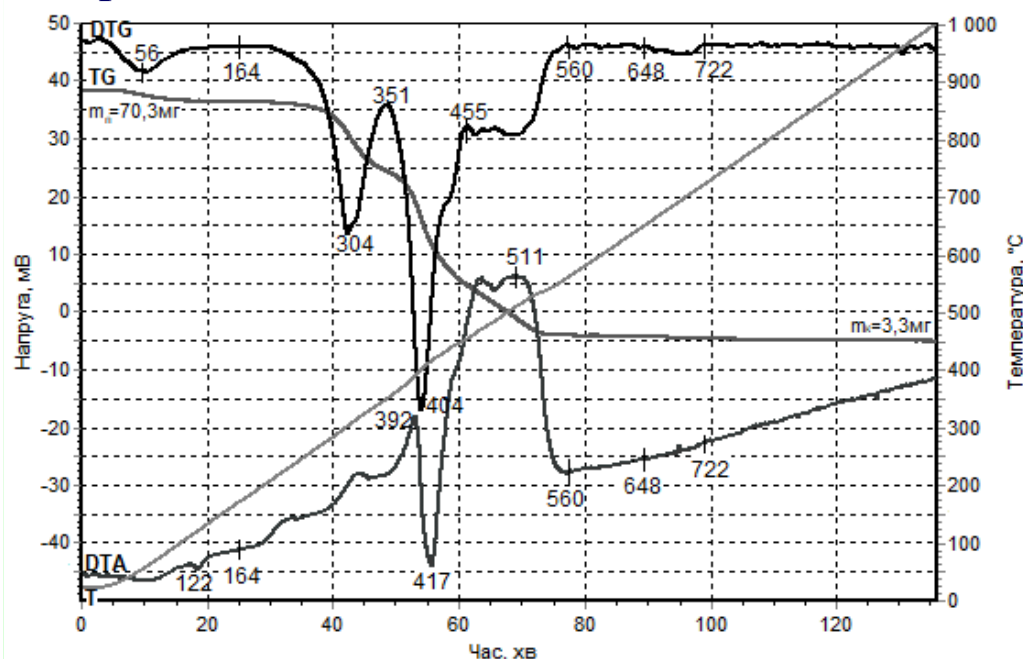


Dehydration
Thermal destruction of organic substances
Max DTG
Ash content

Q_H

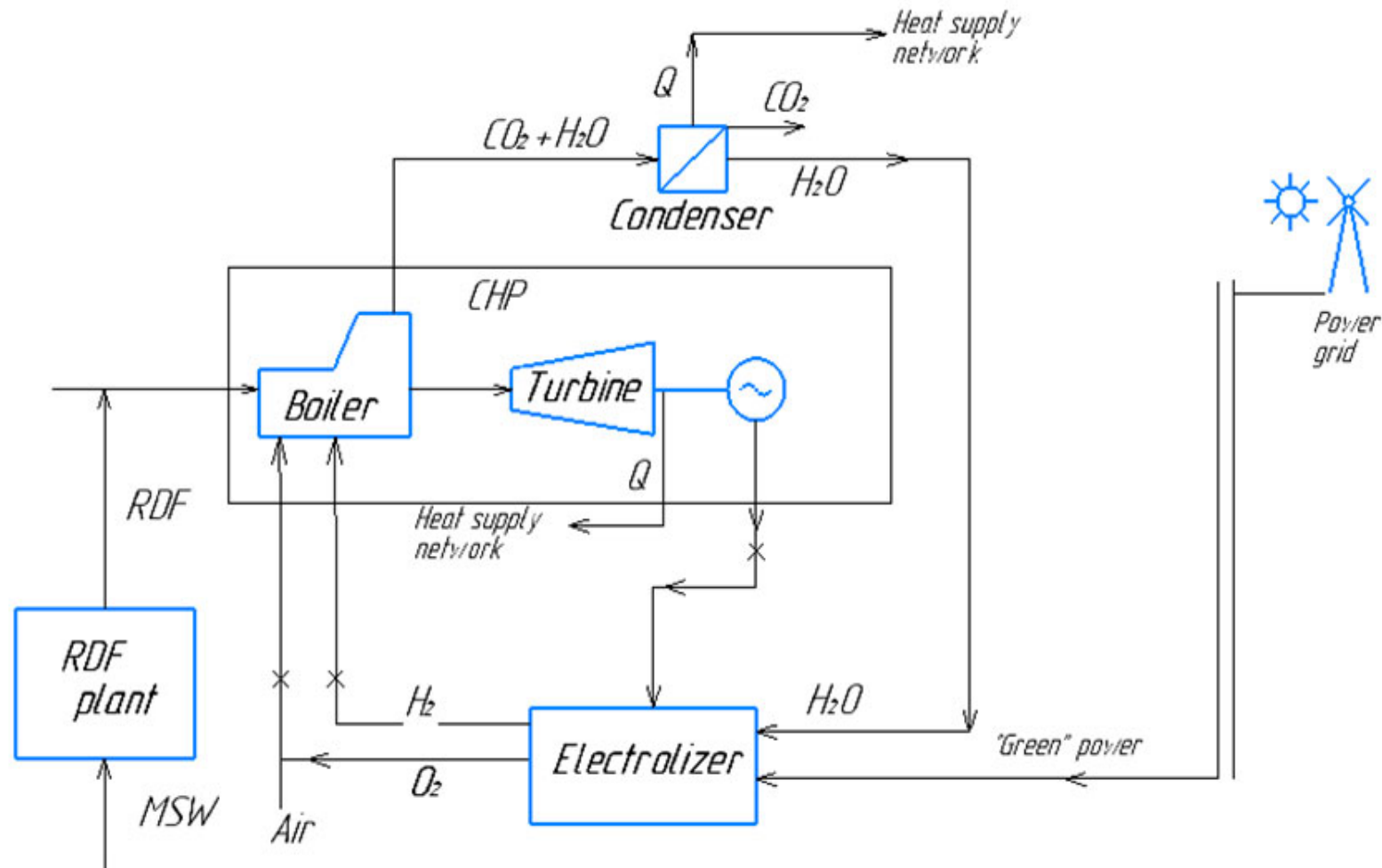
RDF D

25% cardboard, 25% polyethylene film,
25% PET, 16% textile, 4% leather and 5%
pine wood



RDF A	RDF D
20...166 °C	20...164 °C
166...530 °C	164...560 °C
313 °C	404 °C
4,87 %	4,57 %
23,03 MJ/kg	24,60 MJ/kg

Thermal recovery of fuels from MSW



To ensure the level of the maximum temperature in the furnace above 1100°C (the condition for the decomposition of chlorine-containing compounds), the scheme provides "lighting" with hydrogen and oxygen obtained by electrolysis, or with synthetic methane

Dust cleaning

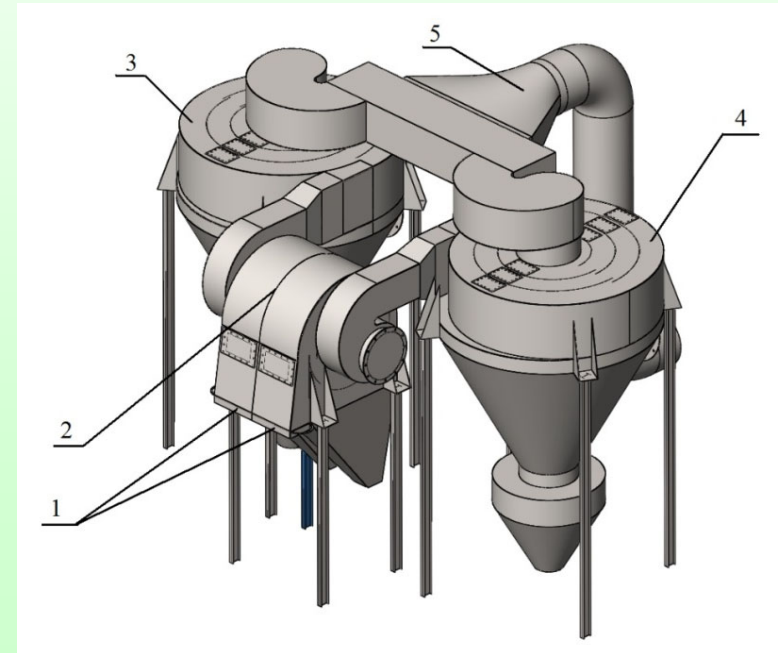
The new highly efficient dust cleaning system ("Cyclofilter") – the alternative to an expensive traditional technical solution - electrostatic filter

Experimental installation for the two-stage cleaning with coagulation of dust particles before the first stage

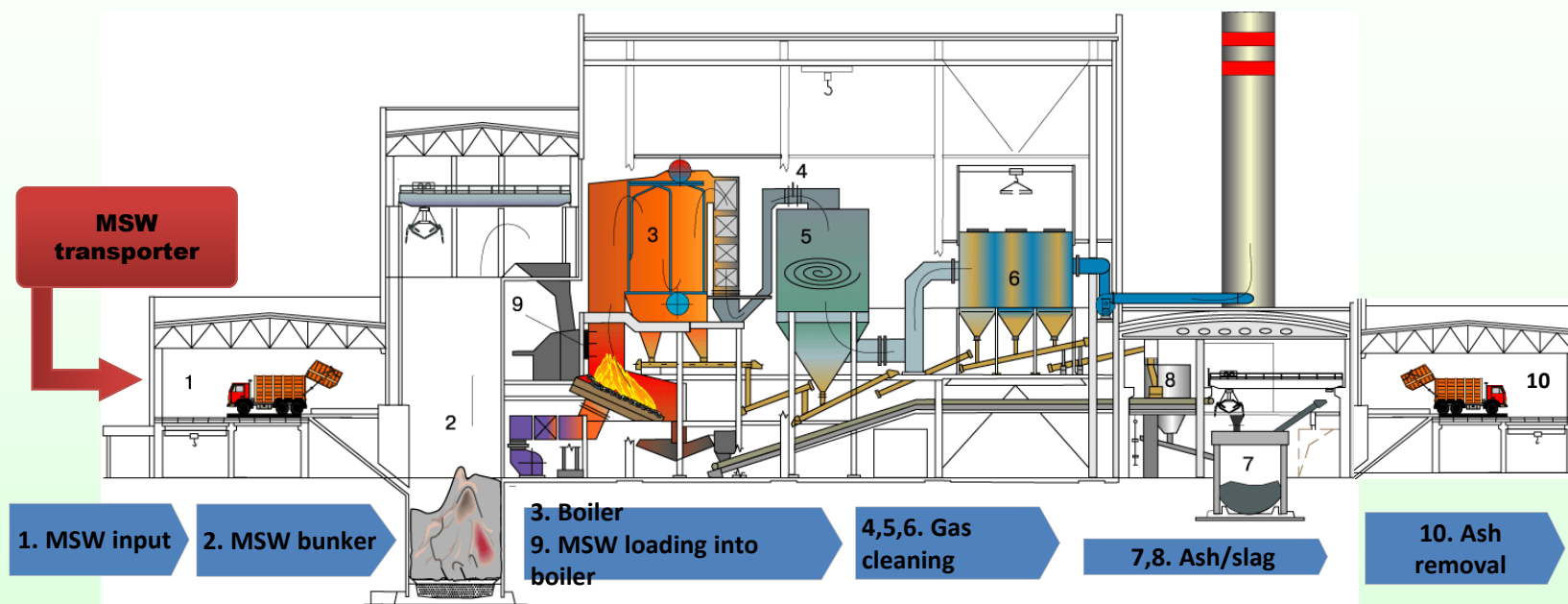


Capture efficiency:
 with one stage..... 92%
 with two stages.....99%

Calculation model of the complex dust and gas purification system from ash and SO₂



Kyiv waste incineration plant "Energia"



Brief specification:

Commissioning: 1987

MSW incineration capacity: 250 thousand tons/year

Installed heat capacity: 25 Gcal/h

Number of boilers: 4 pcs

Need for development:

Solid waste in Kyiv – up to 1 million tons per year.
 "Energia" plant burns no more than 25%.

Two new plants are planned:

- Waste incineration plant: 400-450 thousand tons/year
- Sorting/RDF/Incineration plant: 300-350 thousand tons/year

Prospects for construction of Waste-to-Energy CHPs in Ukraine

- Construction of the new waste processing plants for RDF/SRF producing:
207 plants grouped into clusters, placed in all regions of Ukraine.
Estimated needed total investments - about 4 bln USD.
- Construction of the new Waste-to-Energy CHP plants which will use fuel from MSW (RDF/SRF) produced at the above plants:
 - **10 CHP plants:** 2 - in the city of Kyiv, and one plant in each of the cities of Kharkiv, Dnipro, Lviv, Odesa, Zaporizhzhia, Ternopil, Zhytomyr and Chernivtsi.
 - Total planned capacity: over 2 mln tons per year.
 - Replacing natural gas consumption at heat energy producing enterprises:
Over 10% of the natural gas used for heating and domestic hot water supply in Ukrainian cities with a population of over 300,000 citizens.



Main basic concepts of organizing the combustion process

- **The main basic concepts of organizing the combustion process in dependence on the calorific value of a fuel** under analysis:
- **For unsorted MSW:** burning on roll grates or tilt-and-push grates with mandatory "lighting". The disadvantage: rather narrow temperature range below which molten plastic can enter the roller mechanism, and an increase in temperature can lead to jamming of the rollers.
- **For pre-RFD fuels:** burning on bricked grate with the use of an adiabatic afterburning chamber and additional "lighting".
- **For RDF** (Refuse Derived Fuel): burning on movable grate of the "Kablitz" type with re-feeding of fly ash into the combustion chamber and additional "lighting".
- **For SRF** (Solid Recovered Fuel): combustion in a fluidized bed using the "Valmet" technology or combustion on a moving grate with 3-stage heated air supply and enrichment of the 1st-stage air with oxygen.



Potential opportunities for Polish companies on the Ukrainian waste market

In Poland, the 11 plants for the thermal processing of household waste are in operation, and one more will be commissioned this year.

Significant experience of Polish companies in implementation of the various technologies for waste treatment, as well as for waste incineration and thermal recovery of the fuels from MSW would be very interesting and useful for Ukraine, for choosing the technologies to be applied.

We hope that the companies that represent these technologies are interested in entering the Ukrainian market. Ukrainian municipalities are interested in these technologies and their implementation, to include the energy potential of fuels from waste as energy resources into the energy balance of Ukraine.

We invite Polish colleagues to take part in this activity.

The recent example:

October 12, 2023 – cooperation agreement between Sumitomo SHI FW Energia Polska and LLC "Zaporizhzhia Heat and Energy Project", - creation of scientific and technical conglomerate to solve the tasks of development, production and installation of non-standard specialized equipment for industrial flue gas purification, regarding construction of waste incineration plants and implementation of environmental protection projects for it.

According to this agreement, LLC ZTEP is the exclusive representative of Sumitomo SHI FW Energia Polska in Ukraine.



Our partners

LLC “Institute of Engineering Ecology”: founded in 1992, the independent professional research and engineering organization. It deals mainly with the energy saving and environmental protection issues in municipal, commercial and industrial sectors.



- Since 1998 - the issues related to global climate change, reducing greenhouse gas emissions. Development of the first of the presented from Ukraine JI project on reduction of the GHG emissions by decreasing of fuel consumption as a result of rehabilitation of district heating in Chernihiv region (2003), and one of the first projects on collection and utilization of landfill gas at Chernihiv landfill. In total over 30 JI projects.
- Since 2019 - development of the new Heat Supply schemes (HSSs) for several cities in Ukraine, including the cities of Kyiv, Odesa, Zhytomyr, at present – Cherkasy, Kovel, Chernihiv. In particular: for the cities of Kyiv and Odesa – construction of complexes for the full cycle treatment of the municipal solid waste from mechanical-biological treatment up to SRF-fired CHP plants, for the city of Zhytomyr - construction of SRF and biomass fired CHP plant.
- During over 30 years the Institute of Engineering Ecology together with the Institute of Engineering Thermophysics holds annual international conference «Problems of ecology and operation of energy objects», on topical issues of energy engineering, energy efficiency, efficient fuel combustion, thermal recovery of MSW, reduction of GHG and toxic emissions, etc.



LLC "ATON ENGINEERING“: is providing services in the field of waste management since 2013:

- development of the schemes for sanitary cleaning of populated areas (52 schemes have been developed, including for the cities of Lutsk, Cherkasy, Kherson, Chernivtsi),
- development of the regional waste management plans (Volyn region in 2020 – is the first in Ukraine),
- development of the local waste management plans (the city of Kovel – is the first in Ukraine),
- development of the standards for the provision of waste management services (standards for solid waste generation - for the cities of Kherson, Cherkasy, etc.).

Thank you for attention!

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