Executive summary

Municipal waste management in the Zlin Region is not significantly different from the situation in other regions of the Czech Republic. Exceptions are the Liberec Region, South-Moravia Region and the City of Prague where a significant portion of municipal solid waste is used in waste incinerators with energy recovery (ZEVO). In the rest of the country is municipal solid waste disposed by landfiling. In regions are made preparations for the construction of facilities for the energy use of mixed municipal solid waste. Mostly is it in the form of integrated systems of municipal solid waste management (concurrent support sorting of usable components separately collected municipal waste, construction of facilities for utilization of biodegradable municipal waste-composting, anaerobic digestion, the construction of sorting lines, construction of facilities for energy recovery of waste).

In the Moravian-Silesian Region is the preparation of construction ZEVO (190 thous. T) suspended with regard to withholding financial support from the Operational Programme. In the Olomouc Region are initiated works to find suitable locations for ZEVO.

This study summarizes the recommendations for achieving the objectives of the Waste Management Plan, which respect the current legislative conditions in the Czech Republic and the newly approved the Waste Framework Directive. The study is focused on the very discussed group of waste - mixed solid municipal waste and also marginally on biodegradable waste, which is linked to a number of targets Waste Management Plan.

The basic assumptions for the future well-functioning system of handling these types of waste are:

- Respecting the basic hierarchy of waste management, with an emphasis on minimizing of waste production. Produced waste has to be sorted at source, followed by material or energy recovery. Waste disposal in landfills shall be the last and least favorable option.

- Support and develop media and information campaign to promote waste separation and management of waste according to the waste management hierarchy.

- Support projects that will lead to a reduction in the amount of disposed waste

Therefore we recommend in particular: support the construction of systems of collection of biodegradable waste from households; construction equipment that will use the biodegradable waste from households to produce substrates, compost, or. biogas. It is necessary to consider, in particular efficiency and cost savings by the devices, the sales output material and its relation to other facilities for disposal of biodegradable waste (e.g. biogas).

The main problem areas of the current system of municipal solid waste management in the territory of the Zlín Region:

- The absence of technical facilities for the reuse of municipal waste, both of materials and energy,
- Zero facilities in the region for an alternative way of dealing with municipal solid waste – sorting lines, transfer stations, both of materials and energy use,
- Insufficient capacity of the facility for sorting and recovery of biodegradable waste,

- Absence of tools (administrative, economic), which Zlin Region can significantly affect the waste management system,
- Lack of financial resources to support the collection and use of municipal waste.

In this study, we mainly evaluated the possibilities of the Zlin Region in the treatment of municipal solid waste.

Given the above, we evaluated the following alternatives as the potential for further work on the study:

1) Mechanical-biological treatment (MBT as a system)
2) Burning of RDF in existing large combustion plants
3) Construction of a new source for energy recovery:
   a. Option 1 – Capacity of 110 kt/year
   b. Option 2 – Capacity of 233 kt/year

Brief description of the alternatives

Mechanical-biological treatment of municipal solid waste (MBT as a system, supplemented by incinerator plant – reuse of energy)

Technology

Biological treatment preceding basic mechanical pretreatment of waste, which consists in crushing the waste in homogenous size fraction. This fraction is then biologically treated. Biological treatment consists in accelerating the decomposition of organic waste. Biological treatment process is based on the so-called bio-drying. This process is performed under aerobic conditions, ie with sufficient air supply.

The basic objectives of the mechanical treatment of waste can be defined as follows:

- maximize renewable resources (metals and glass),
- to improve the output of BMT process,
- remove inappropriate ingredients.

Technical equipment used for mechanical treatment:

- sorting drum,
- filters (static, dynamic),
- Ball mills (milling),
- magnetic separators,
- eddy currents (air, wind),
- manual separation,
- Densimetry method.

Incinerator plant (reuse of energy): The basic condition for the location of incinerators for the use of the output from MBT is whether it is in at least theoretically possible to ensure sufficient consumption of heat produced.

Potential localities:

- DEZA a.s., Valašské Meziříčí,
- Teplárna Otrokovice a.s.,
- Alpiq, Teplárna Zlín

MBT method would be a real alternative only if it is conceived as a complete system: construction of several regional centers, with an annual capacity of about 60 to 65 thousand tons of waste received (or 120 thousand tons). On their construction would follow construction of facilities for energy recovery (ZEVO). This facility was designed exclusively for pre-treated waste by MBT technology. This facility should have a capacity of at least 90 thousand. tons, preferably at least 120 thousand. tons (ie recovery of 2-4 regional MBT facilities). Such a system does not have problems with using the produced "fuel", there is a final sorting reusable and hazardous fractions from mixed municipal waste, there is reducing the overall amount of waste to be transported over long distances (from MBT to ZEVO) and strict parameters for flue gas cleaning in ZEVO are set.

A simplified SWOT analysis alternative **-** MBT as **a** system

Strengths	Weaknesses
Compliance with all legislative requirements at all stages of treatment and recovery. Possibility of obtaining support from the OPE to build the entire system Compliance with WMP for handling biodegradable waste from households Utilization of the energy potential of the municipal solid waste Reducing the amount of emissions of fossil CO_2	Building the complete system is financially and organizationally challenging. These variant can meet expectations only when building the complete system (construction of regional MBT + ZEVO) The collaboration of a large number of entities is necessary and also interregional cooperation in building MBT facilities outside the Zlín Region
Opportunities	Risks
The use of subsidies by OPE. Long-term and stable system for handling with municipal solid waste. Possibility to use the output from the MBT for burning in cement kilns or in existing large combustion plants if these appropriately modified.	Lack of time to prepare the project to obtain support from the OPE. Unconnected neighboring regions to the system - build MBT facilities only in the Zlin Region and thus insufficient amount of waste for ZEVO. Addicted to supply heat to the private district heating system, and the related threat to the heat consumption.

Energy recovery of RDF in existing large combustion plants

Theoretically it is possible to burn the RDF (MBT output) in both types of boilers. As in grate furnaces, and in fluidized bed boilers. However, this option has significant limitations. Limiting factor in grate boilers are mainly material from which the boiler is constructed. In order to prevent sintering ceramic lining of boiler is necessary and specially adapted grids, preferably water-cooled.

Potential energy use RDF is associated with complications not only in legislation, but also with more or less radical interventions into existing technology. Necessary adjustments will require a fuel metering system and the process of combustion. Will also need to invest in additional flue gas cleaning if it is to achieve safe use of RDF under conditions that are close to combustion of waste in incinerators.

A simplified SWOT analysis alternative **-** Energy recovery of RDF in existing large combustion plant

Strengths	Weaknesses
Compliance with WMP for handling of biodegradable waste. Variant without the construction of a separate combustion device - use of existing facilities. Sufficient capacity of existing large combustion plants (LCP).	Burning of RDF in existing large combustion plants Inability pumping subsidy support to modify LCP The combustion / incineration RDF must be met in the same conditions for the air protection as for incinerators. This condition nearly eliminates the implementation of this variant.
Opportunities	Risks
Long-term deliveries of RDF in the implementation of technical and technological measures on LCP. Existing LCP could provide enough (and bigger) capacity to burn RDF in order to meet the requirements of WMP.	Supplying RDF to private entities (operators of LCP). The threat of a disproportionate increase in the costs of treatment with municipal solid waste.

Construction of **a** new facility for direct energy recovery of municipal solid waste

It is necessary to set out the basic constraints.

1) The equipment for energy recovery will have a capacity of more than 110,000 tons of waste per year

   Let us next consider two scenarios: Incinerator with a capacity of 110,000 tons per year, and as a reference scenario incinerator with capacity of 233,000 tons per year (incinerator in Brno).

2) The equipment for energy recovery will be at the corresponding source of central heating system

3) 75% of the waste is within driving distance of 100 km
4) Equipment for energy recovery will be competitive with other forms of waste management; it means the average price for one ton of waste disposal will be 800 CZK.
5) The equipment for energy recovery will also be available at the railway siding.
6) The project will be interested individual municipalities (at least at the level of ODA).
7) It will be supported sort of sorted municipal waste, including biodegradable waste.

Scenarios

Variant 1 – Incinerator with a capacity of 110,000 tons per year

Variant 2 – Incinerator with a capacity of 233,000 tons per year

A simplified SWOT analysis alternative – Incinerator with **a** capacity of 110,000 tons per year

Strengths	Weaknesses
Compliance with WMP for handling biodegradable waste. Utilization of the energy potential of the municipal solid waste. Reducing the amount of emissions of fossil CO_2. Ensure an economically sustainable treatment of municipal solid waste if the system is set up correctly. Independence from neighboring regions.	Necessary cooperation with the operators of district heating system. Requires cooperation between a large numbers of subjects.
Opportunities	**Risks**
Long-term secured system for waste management of municipal solid waste. Replacement of heat from fossil fuel.	Lack of time to prepare the project to obtain support from the OPE. Addicted to supply heat to the private district heating system, and the related threat to the heat consumption.

A simplified SWOT analysis alternative – Incinerator with **a** capacity of 233,000 tons per year

Strengths	Weaknesses
Compliance with WMP for handling biodegradable waste. Utilization of the energy potential of the municipal solid waste. Reducing the amount of emissions of fossil CO_2. Ensure an economically sustainable treatment of municipal solid waste if the system is set up correctly.	Necessary cooperation with the operators of district heating system. Requires cooperation between a large numbers of subjects. Lack of time to prepare the project to obtain support from the OPE. Construction of transfer stations.
Opportunities	**Risks**
Long-term secured system for waste management of municipal solid waste. Replacement of heat from fossil fuel.	Failure to meet the facility's capacity. Addicted to supply heat to the private district heating system, and the related threat to the

	heat consumption.

For the treatment of municipal solid waste are assessed as real following options:

a) Construction of a functional system of several regional MBT centers and the construction of the facility for energy recovery output from MBT.

b) Construction of a incinerator plant for direct energy use of municipal solid waste.

After assessing alternative solutions we present the following conclusions:

1. It is necessary to promote and expand the usable components of separate collection of municipal waste, including biodegradable waste. Such a system is in many municipalities in the Zlín Region already operated. Construction of facilities for utilization of biodegradable waste is supported from the OPE.

MBT method would be a real alternative only if it is conceived as a complete system: construction of several regional centers, with an annual capacity of about 60 to 65 thousand tons of waste received (or 120 thousand tons). On their construction would follow construction of facilities for energy recovery (ZEVO). This facility was designed exclusively for pre-treated waste by MBT technology. This facility should have a capacity of at least 90 thousand. tons, preferably at least 120 thousand. tons (i.e. recovery of 2-4 regional MBT facilities). Such a system does not have problems with using the produced "fuel" (MBT output), there is a final sorting reusable and hazardous fractions from mixed municipal waste, there is reducing the overall amount of waste to be transported over long distances (from MBT to ZEVO) and there are set strict parameters for flue gas cleaning in ZEVO. The problem seems to be the amount of waste produced in the territory of the Zlin Region. We recommend negotiating with the Olomouc and Moravian-Silesian Region of the possible construction of one or two MBT facilities so that ZEVO capacity is at least 120 thousand. tons.

Such a system:

- no problems using produced "fuel",
- occurs aftersorting reusable and hazardous fractions from mixed municipal waste,
- it is reduced the total volume of waste to be transported over long distances (from MBT to ZEVO),
- strict parameters for flue gas cleaning in ZEVO are set.

The variant with construction of MBT facility with the use of RDF in some of the existing large combustion plants is hardly imaginable. Such a solution would be associated with such necessary equipment modifications that these operators cannot accept.

2. Construction of incinerator facility for direct energy use of municipal solid waste (incinerator plant) is justified only if the capacity of at least 110 thousand. tons per year. Incinerator must simultaneously produce, in addition to the thermal energy, electricity. There are sites in the Zlin Region that would be able to absorb the amount of produced heat energy. Within a reasonable driving distance would be theoretically possible to obtain the necessary amount of municipal solid waste. Energy produced by incinerator plant from municipal solid waste contributes to the saving of primary energy in a comparable extent as eg. energy produced from biomass. At the same time the amount of emissions and pollutants are significantly lower. It is not easy to secure funds for the construction of such a facility.

3. Cooperation with neighboring regions (Moravian-Silesian and Olomouc) and cooperation on there planned facilities for energy recovery. This solution would probably mean the construction of transfer stations for mass transport of municipal solid waste, however, is likely to be a transfer station had also arise while considering the construction of a separate ZEVO

4. If the inter-regional cooperation should be built incinerator in the Zlín Region, it would actually seemed to be shortlisted sites:

   A) Teplárna Otrokovice

   B) DEZA Valašské Meziříčí

   C) Teplárna Alpiq Zlín

These three sites are only able to absorb the heat produced in their district heating systems, operate or have in the real time ability to run at least some of the equipment needed to operate the incinerator itself. This would reduce its cost. Additionally Valašské Meziříčí has a strategic location on the border of three regions.

TASKS

1. Examine, in collaboration with the above mentioned companies, options for future cooperation on preparing of incinerator construction, if it should become in the Zlín Region.
2. Pave the way for future articulation of the interests of companies who handle with municipal solid waste in the Zlín Region and incinerators.
3. Negotiate with municipalities on future volume creation communities for eventual support of the construction of the incinerator plant.
4. Suggest **a** place for waste separation and its subsequent recovery (composting, biogas etc.).
5. Propose **a** way of closer cooperation with the operators of large combustion plants and their ability to solve problems in waste management.

6. The most important for any scenario (and indeed any of the considered) to ensure separate collection of biowaste - not just **a** green waste, but also kitchen waste should be in all the municipalities of the region separately collected.
7. Feasibility study for the options:
   A) MBÚ + ZEVO, Mechanical-biological treatment + incineration plant
   B) Incineration plant for direct energy use of municipal solid waste with capacity of 110 thousand. Tons.

   Both variants compared with the use of existing or planned incinerators in other regions.

Summary comparison of proposed alternatives

CRITERIA	MBT + ZEVO using RDF	Combustion of RDF in existing large combustion plant	Incinerator VAR. **1**	Incinerator VAR. **2**
INVESTMENT AND OPERATING COSTS	MBT – cca 500 CZK million /piece (assumption of at least 2 units) ZEVO – cca 2,5 CZK billion, assuming an existing connection to the central district heating	Modification of facility: CZK 161 million, Modification of the flue gas treatment technology 1-1.5 CZK billion.	Construction of new facility: CZK 2.3 billion, assuming an existing connection to district heating	Construction of new facility: CZK 2.8 billion, assuming an existing connection to district heating
CLAIMS FOR WASTE TREATMENT FOR **A** PARTICULAR TYPE OF DEVICE.	In the proposed system, the waste is treated in a MBT and incinerated in appropriate facilities.	The waste is treated in a MBT.	Waste is no need to pre-treat.	Waste is no need to pre-treat.
ENERGY BALANCE	MBT energy consumption– 3 – 3,5 thousand. kWh/year Produced by heat:: cca. 1 mil. GJ Supplied heat: cca 400 thousand. GJ (42,2 %) Supplied heat average: 25,81 GJ/hour Electric energy produced: 33 594 MWh (120 tis. GJ by the efficiency of 25%)	Replacement for existing fossil fuel.	Operating hours: 16 345.5 Heat produced: 999 350 GJ (4.32 GJ / Ton MSW) Heat output: 421 774 GJ (42.2%) Heat output diameter 25.81 GJ / hour Electric energy produced: 33 594 MWh (120 938 GJ at 25% efficiency) Electric energy produced 2,15 MW / hour Supplied electricity: 25 250 MWh (75.2%)	Operating hours: 16 345,5 Heat produced: 2 117 268 GJ (9,15 GJ/Ton MSW) Heat output: 893 591 GJ (42,2 %) Heat output diameter: 54,7 GJ/hour Electric energy produced: 71 174 MWh (256 226 GJ at 25% efficiency) Electric energy produced: 4,35 MW/hour Supplied electricity: 53 496 MWh (75,2 %)
ADVANTAGES / DISADVANTAGES	Advantages: a comprehensive system of 2-4 MBT facilities and incineration facility using RDF (ZEVO) - Such a system does not have problems with	Advantages - a variant dispenses with the construction of a new incinerator capacity.	Advantages - the ability to fulfill incinerators capacity y waste produced entirely in the territory of Zlín Region. - existing sites to absorb the	Advantages - existing sites to absorb the emerging heat energy. - proven technology for the treatment of municipal solid

CRITERIA	MBT + ZEVO using RDF	Combustion of RDF in existing large combustion plant	Incinerator VAR. **1**	Incinerator VAR. **2**
	using the produced "fuel", there is a final sorting reusable and hazardous fractions from mixed municipal waste, there is reducing the overall amount of waste to be transported over long distances (from MBT to ZEVO) and strict parameters for flue gas cleaning in ZEVO are set. Disadvantages: the output of the MBT is considered as waste and is therefore usable only in secure facilities in terms of emissions as the incinerator - the need agreements with the operators of central district heating - classic incinerators are unable to burn RDF, because of high calorific value - the amount of waste produced in the Zlin Region is not sufficient for the construction of more than two MBT facilities, and for this reason should be consulted on the construction of MBT in Olomouc or Moravian-Silesian Region. - in the Czech Republic is not yet this technology installed - the necessary cooperation of many entities	Disadvantages: the output of the MBT is considered as waste and is therefore usable only in secure facilities in terms of emissions as the incinerator. For this reason, this alternative is practically excluded.	emerging heat energy. - proven technology for the treatment of municipal solid waste. - known procedures for flue gas cleaning and handling of the final products of combustion. Disadvantages: - the need agreements with the operators of central district heating, - the necessary cooperation of many entities - the necessity of obtaining funds from public funds / private investor - potential risk to the consumption of heat energy - district heating systems are operated by private operators	waste. - known procedures for flue gas cleaning and handling of the final products of combustion. Disadvantages: - the need agreements with the operators of central district heating, - capacity of the plant can not be used only by waste produced in the Zlín Region. - the necessary cooperation of many entities - the necessity of obtaining funds from public funds / private investor - potential risk to the consumption of heat energy - district heating systems are operated by private operators

CRITERIA	MBT + ZEVO using RDF	Combustion of RDF in existing large combustion plant	Incinerator VAR. **1**	Incinerator VAR. **2**
	- the necessity of obtaining funds from public funds / private investor			
IMPACTS OF AIR AND RESIDUAL PRODUCTS	All outputs are controlled in accordance with legislative requirements and characteristics of BAT. Residual products are potentially useful as a building material, there is a separation of usable components (metals, glass) and minimization of hazardous components (battery) within the separation device in MBT.	The burning of the output from the MBT in the existing large combustion plants should be provided with flue gas cleaning as incinerators. Emissions should thus correspond strictly set limits. The amount of burning waste should not significantly affect the quality of the final products, which are currently utilized in construction.	All outputs are controlled in accordance with legislative requirements and characteristics of BAT. Residual products are potentially useful as a building material, there is a separation of usable components (metals).	All outputs are controlled in accordance with legislative requirements and characteristics of BAT. Residual products are potentially useful as a building material, there is a separation of usable components (metals).
IMPACT ON EMPLOYMENT	Impact on employment will not be too significant - MBT facility operation requires 5 people, ZEVO operation requires about 10-15 people.	Impact on employment will not be too significant - MBT facility operation requires 5 people, in the existing facilities would not increase the number of employees.	Impact on employment will not be too significant - ZEVO operation requires about 10-15 people.	Impact on employment will not be too significant - ZEVO operation requires about 10-15 people.