Situation and Waste Management Strategy of the Czech Republic and Experience in Planning, Construction and Operation of WtE and SRF Plants

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Waste utilization has the potential of savings in using fossil fuels. In the Czech Republic, three incinerators of municipal waste are operating currently, there are many projects for implementation of others; unfortunately, they usually fail to succeed due to the economic evaluation. Support for the construction of new facilities for thermal treatment of waste is practically non-existent. Apparently, this could be solved through a number of alternative approaches – combined combustion, processing of sorted waste; however, a conceptual solution is still missing. The article aims to present the current situation and potential for the future.

1. Introduction and present situation

Czech Republic has made a commitment to change the management of municipal waste; the biggest challenge will be the treatment of mixed municipal solid waste.

Although its production has decreased in recent years, mixed municipal solid waste (MSW) is the largest group of waste within the group of municipal waste, and with respect to the ban of landfilling in 2024, it will be necessary to use the complete production in a different way.

In 2020, it will be necessary to dispose of about 75 percent of MSW in another way than landfilling; special attention should be paid to gradual reduction in landfilling biodegradable municipal waste (BMW).

Although the Czech Republic has been preparing a strategy for many years, the objective is probably not within view yet; special attention, however, is paid to the ways to utilize MSW environmentally and economically, thus reducing landfilling considerably.

The key issue is which technology of MSW utilization can realistically fulfil the requirement for economic and social acceptability and, at the same time be beneficial for the environment.

Within the findings, which have been obtained by the FITE Company over the past 10 years, elaborating the policy materials relating to MSW in the Czech Republic has led to the conclusion that several technological concepts that either alone or in combination promise to deal with this issue are currently *competing*.

These are the major techno-economic and logistical concepts:

- The method of direct energy use (WtE plant – Waste-to-Energy plant – In the Czech Republic, it is recommended to avoid the term *incinerator*),
- Technology of so called *small incinerators* (20 to 50 kt),
- Mechanical-biological treatment associated with energy use of calorific fraction,
- Gasification technologies (pyrolysis, plasma),
- Exporting MSW for energy recovery abroad (the current legislation does not allow it).

All the technological concepts of MSW utilization are associated with energy recovery; therefore, dealing with this issue should always be conceived in relation to the real conditions of the Czech energy sector, or with the possibility of heat recovery.

The basic prerequisites for a successful transformation of the MSW management in the Czech Republic

- By the year 2024, all MSW, or bulky waste production has to be disposed of in other ways than through landfilling.
- The whole MSW production has to be used at home.
- Regardless of the amount of the fee for landfilling in the future, it is necessary to try not to increase the price for MSW disposal, which is currently based on the price of landfilling (about 1,300 CZK/ton including tax), or only adjust the fee a little bit.
- Solutions must be coordinated between a number of agents (cities and municipalities) and by the selected operator.
- It is necessary to comply with the existing legislation of the Czech Republic and the EU (air, waste, etc.).
- Solutions must be sustainable and acceptable to the population.

Utilization of domestic MSW abroad

One possibility, which is confirmed by the interest of foreign, especially German and Austrian companies, is exporting MSW for energy recovery abroad. This possibility is based on a certain surplus capacity of incinerators in those countries.

This is probably one of the worst scenarios of the Czech waste management, because it would not only mean exporting valuable energy resources, but in the long term, there would be an outflow of funds from the population and ultimately the companies producing the concerned waste. Moreover, there is a conflict with the legislation and the principle that everything that is produced as a by-product in this country should be processed here as well.

This option, however, is quite realistic, given the current opposition of some residents and approval authorities, as well as the economic benefits of technologies for energy recovery from MSW in the Czech Republic.

2. Reality – current situation of operated and prepared WtE plants

Currently, three municipal waste incinerators are operating in the Czech Republic: in Prague, Brno and Liberec. The total capacity is 626 kt of waste (Prague: 310 kt, Brno: 220 kt, Liberec: 100 kt).

In terms of the prepared units, the situation is very confusing, because a grant for the construction of WtE plants has not been obtained even in one locality in the Czech Republic and the construction of WtE plants in the Czech Republic has been virtually suspended or delayed.

Within the current planning period, projects for the construction of WtE plants in the locations of Pilsen, Karviná and Komořany have been prepared. The initial planned capacity will be 95 kt for the locality of Pilsen, 195 kt for the locality of Karviná (the Moravian-Silesian Region), and 150 kt for the locality of Komořany (Ústí Region).

Only the project in Pilsen started to be implemented, but due to a legal challenge of the building permit, it was suspended (the administrative decision was challenged).

Direct Energy Recovery – WtE plants

The basic condition for the successful implementation of technology is meeting the requirement for the energy recovery of waste, i.e. the R1 coefficient, i.e. 65 percent utilization of the input energy of waste.

This parameter can be met only if the power supply is operating in cogeneration mode with sufficient sales of heat. The requirement can be fulfilled only in areas with properly sized district heating or in industrial areas with sales of heat in industrial production (e.g. paper mills). These are mostly so called **heating plant localities**.

Currently, with parallel thermal upgrading of buildings (subsidy schemes), heat consumption simultaneously decreases, which has a negative effect on the possibility of using incinerators as *suppliers* of heat.

MSW energy value is currently at a level of lower quality lignite i.e. approximately 8 to 10 MJ/kg.

The choice of the resource capacity – localities where it is possible to place the source with the capacity of at least 300 kt prove to be more economical. Minimum economically sustainable capacity of a WtE plant is about 100 kt of MSW/year.

Environmental benefits – one of the essential conditions for the construction of WtE plants is the possibility of substituting coal resources with the advantage of the possibility to apply environmental benefits resulting from the savings in emissions of both conventional pollutants

and CO_2. WtE plants, or according to the law, incinerators have by far the strictest limits on emissions into the environment, including the need to remove heavy metals and dioxins.

WtE plant economy – WtE plant price sustainability in heating systems is based on the assumption that the majority of sales in the energy comes from heat sales, which represents 40 to 60 percent of all revenues depending on the cost of waste and the current market price of electricity.

Another option that seems realistic is co-combustion of waste, especially in areas where the sources using fossil fuels are at the end of their life, and their renewal towards co-combustion will pay off.

The current situation in designing the units for co-combustion of waste produced from MSW

At present, no unit for the treatment of MSW (MBT – Mechanical-Biological Treatment) is not operating in the Czech Republic is (MBT), therefore, co-combustion of this waste-substitute fuel is not commonly carried out in the existing facilities – fluidized bed boilers in heating plants and power plants.

At a number of locations, combustion tests of similar fuel- waste imported from abroad were conducted, and many localities are considering this option.

After a comprehensive evaluation, combustion tests e.g. at the ČEZ a.s. Company, which owns and operates the fluid units, had negative results.

Other operators, such as Alpig Generation with the unit in Kladno, or Škoda Energo heating plant in Mladá Boleslav are further considering this possibility.

In reality, however, a large amount of *alternative fuel* is being produced, because MSW must be *somehow* treated, and it usually ends up in cement plants.

Legislation and future prospects – Solution basis from WMP (Waste Management Plan) of the Czech Republic and Regional WMP

WMP of the Czech Republic did not set a network of equipment for MSW energy utilization in a directive way, and left this issue to be resolved at the regional level.

Moreover, WMP of the Czech Republic does not prefer any of the offered technologies for energy recovery, whereas it does not reject any of the options either.

The technologies that have been discussed in the Czech Republic so far:

MSW Mechanical-biological treatment (MBT)
associated with the energy use of energy fraction

The technological concept for mechanical-biological treatment of mixed solid municipal waste is based on a series of customizable processes leading to the production of energy-rich fraction and fractions that can be landfilled. The possibility to use the produced fractions for the material recovery are only theoretical, namely including the possibility of producing biologically usable products such as compost or economically sustainable feedstock for biogas production.

The product quality for biogas plants in the Czech Republic has not proven to be useful.

Sales of products from the MBT are not yet available at a sufficient level in the Czech Republic.

Systemic shortcomings of the process

MBT itself in any form is merely a facility for treatment of waste, not for its final utilization. The only used material is iron (other outputs are not recyclable in the Czech Republic conditions due to the quality requirements of the end processors of secondary raw materials).

The possibilities of calorific fraction energy utilization are limited primarily legislatively, i.e. it is necessary to adhere to the co-combustion limits in the case of energy use in so-called standard power engineering (fluidized bed boilers along with coal). In the case of using it as a solid alternative fuel in cement plants, it is necessary to meet relatively strict standards, e.g. for chlorine. A fundamental limitation of the massive use of caloric fraction from MBT, however, is the limited capacity of cement plants (up to 200 kt of energy-utilizable fractions) and their seasonal production depending on the construction cycle min. in the winter mode (exclusions) and the spring, summer, autumn. Cement plants also utilize a variety of other homogeneous and energy-calorific wastes (tires, waste oil, industrial plastics, etc.).

The overall economy of the operation – To assess the overall sustainability of the MBT method, it is necessary to know the total cost of the complex of operations to final disposal or utilization of output fractions.

3. Interesting projects – the current situation of the energy sector in the Czech Republic, especially in the heating industry sector

The situation in the Czech energy sector in the field of heating industry is due to the necessity of the greening of resources in accordance with the amendment to the Clean Air Act, which tightens the limits on the discharge of pollutants by the year 2022 (for exemption), and further to the efforts to secure the fuel base, which is currently under threat, given that the primary fuel is mostly represented by lignite. The future of lignite is uncertain due to the uncertainty in the energy policy of the Czech Republic regarding the so-called breaking the environmental limits in mining in North Bohemia and hysteria about CO_2 emissions, whereas lignite has the highest rate of released CO_2 based on the energy produced.

Substitution of lignite in heating industry with another fuel also represents a problem. Domestic hard coal mining is economically insecure, and there is a similar problem with CO_2 in the case of imports from abroad.

Substitution with natural gas is indeed environmentally advantageous; however, it faces environmental limits as well as geopolitical risks.

With quality biomass (mostly wood-based biomass and wood waste), the problem is represented by production limits and the price stability, or rather the price itself.

These relative disadvantages could be, at least with part of the suitable heating plant capacity, transformed into an advantage, if MSW (and some other suitable waste) utilization is considered.

Suitable heating plants do not correspond to the production in the individual regions, making it necessary in some areas to start inter-regional cooperation. An example may be current supply of MSW from the Olomouc Region to SAKO Brno.

The only relative disadvantage of the transformation of part of heating plants to MSW as the primary fuel is the resistance of the population that is affected by long-term negative and untruthful campaign of so-called green organizations whose negative attitude towards WtE plants represents one of the pillars of the so-called green ideology.

Model for MSW energy utilization

Based on the above findings, a model of MSW energy utilization has been developed for the Czech Republic, which allows variants of solving a number of variables (localization of WtE plants, capacity for individual WtE plants, production or MSW or bulky waste). The model is mostly based on the substitution of existing coal-fired heating plants at suitable localities capable of absorbing the amount of heat produced.

Part of the model is reserved for pilot projects for alternative technology concepts.

With the change of the input variables, consequently, the output variables change as well, such as reducing emissions of conventional pollutants (sulphur, nitrogen oxides, solid municipal waste, etc.), reducing CO_2 emissions, saving of the primary fuel.

Among the many possible variants, the so-called optimum variant is specified, together with its practical outputs and impacts on the economy and the environment. Economic calculation can only be seen as indicative, it being understood that the calculations are made based on the experience of specific projects in selected regions. (Central Bohemia, Olomouc Region). Economic parameters have been used rather conservatively (sale of heat for 130 CZK/GJ) so it is impossible to object that the technology is assessed uncritically.

In terms of the amount of waste in the example, the stated production of mixed municipal waste and bulky waste in 2013 amounts to 3.25 million tons; in the model, the production is lowered by the capacity of the existing WtE plants, and part of the capacity is reserved for alternative systems (MBT, gasification). For bulky waste, only 50 percent is considered, the rest will probably be recycled.

Regarding the possibility of replacement of the existing heating plants defined in this way in the above-mentioned localities, significant savings of the primary fuel and a significant reduction of emissions of both conventional pollutants and the equivalent CO_2 emissions can be expected.

the existing capacities		
ZEVO Malešíce	t	310,000
SAKO Brno	t	220,000
Termizo a.s.	t	96,000
total	**t**	**626,000**
capacities for energy utilization of MSW + other wastes		
Mělnik	kt	500
Plzeň	kt	200
Komořany	kt	250
Karviná – Barbora (ču)	kt	300
Opatovice nad ladem	kt	350
Přerov (ču)	kt	250
Otrokovice		
České Budějovice		
Žďar nad Sázavou		
Příbram		
Brno – rozšíření	kt	100
Praha Malešice – rozšíření	kt	100
Papírenský závod + ZEVO		
Další lokality		
Trmice		
total	**kt**	**2,050**
the available amount of MSW and other wastes	kt	2,413

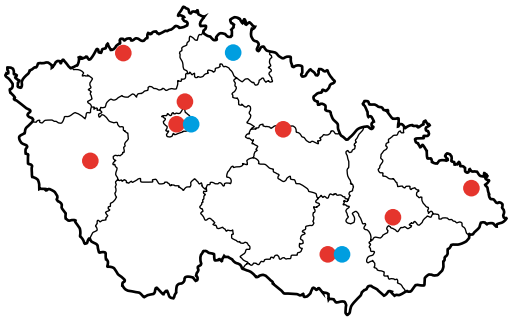

Figure 1: Existing combustion and potential co-combustion installation

4. Outlook and summary

The Czech Republic has a unique opportunity to transform part of the existing municipal waste management to a supplier of valuable energy commodities for the Czech heating industry.

The Czech heating industry is facing a fundamental change of the fuel base and a wrong set of the future fuel mix may significantly downsize or even subvert the entire system, which is among the few comparative advantages that have remained in the Czech economy. The Czech heating industry represented a model for the entire EU.

Not much time is left for the realization of the proposed MSW system - based on partial substitution of coal as the primary fuel in heating industry with municipal waste. Given the long lead time necessary for permitting procedures, and also due to the complicated negotiating processes between potential suppliers of fuel and the concerned heating plant operators, it is necessary to clarify the procedure as soon as possible.

In case of failure of integration of energy utilization of waste in the whole MSW management system, the costs of mixed municipal waste management may substantially increase, in the worst scenario depending on foreign buyers and the associated price uncertainty.

The negative side-product of *non-implementation* of at least part of the proposed system may also be unused environmental benefits and lost opportunity for providing part of heating industry with long-term supply of available energy resource in the form of mixed municipal waste.

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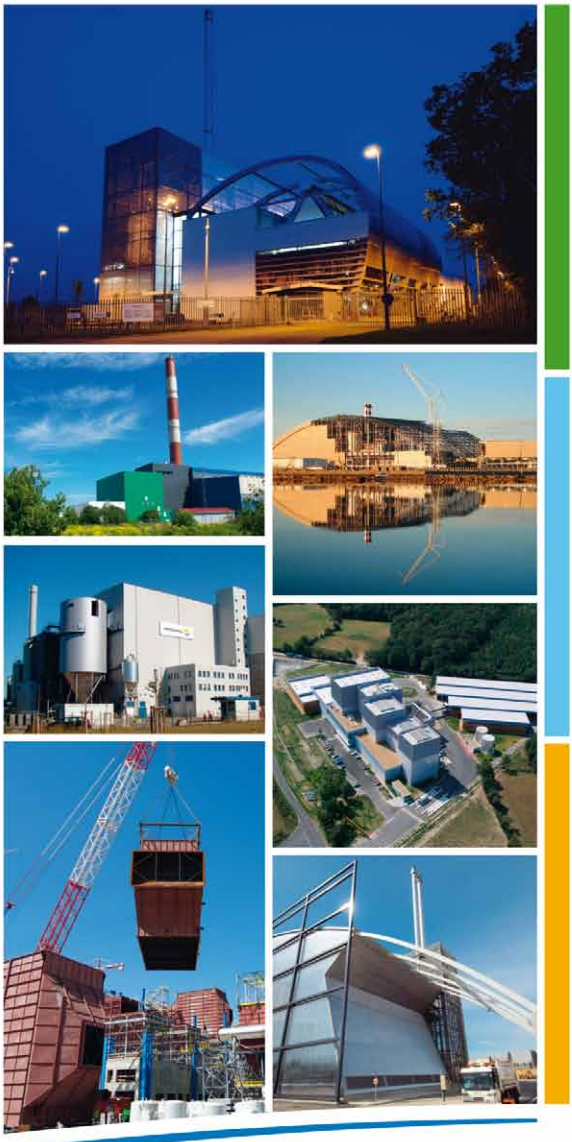

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