A Road Map to the Circular Economy for Municipalities. Case Study of the Czech Republic

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Content

- Introduction
- Network model of a road map to the circular economy (CE) for municipalities
- Identification of appropriate municipal waste (MW) streams
- Driving forces for municipal MW streams
- Identifying the purpose to governmental intervention
- Municipal Waste Management Plan (MWMP)
- Basic MWMP principles of CE implementation for municipalities
- Transition municipalities to the Circular Economy
- Conclusion

Introduction

- Municipal solid waste (MSW) management (MSWM) in the Czech Republic (CZ) in recent years has seen a *slow transformation* in terms of treatment technology and organization of local municipal waste management system (MWMS).
- The new complex strategy of the CZ in the field of waste management for the next ten-year period is reflected in the *Waste management plan of the CZ for the period 2015 – 2024* (WMP CZ).
- The driving force of WMP CZ (subsidies and taxes) was essentially the EU (e.g. Landfill Directive, Circular Economy) and Czech national legislation forced the MSWM in the CZ towards the desired direction of Circular economy (CE).

Theoretical and legislative background

- If we were to ask ourselves the question: "*What's the role of local authorities and communities in a circular economy*?",
- We would have to answer: "*Local authorities and communities, along with businesses and NGOs, have a huge role to play in challenging and changing the way we think about municipal waste*."
- Municipal expenditure on MWM from 2012 to 2014 was more than 60% of current expenditure on environmental protection, and accounts on average for 3% of total current municipal expenditure in the Czech Republic.
- The Waste Management Plan of Municipality (WMPM) is the basic municipality tool and framework reflecting the CE.

Network model of a road map to the circular economy for municipalities

Consecutive modelling steps:

- Identification of appropriate municipal waste streams using the waste codes of the European List of Waste (ELW) and computational formulas to obtain the amounts of material involved.
- The processing of historical annual municipal waste stream generation and treatment reports (2009–2014) produced by waste generators and facilities, and the analyzing of their data sets.
- Determination of driving forces for municipal waste streams.
- Identifying the purpose of government intervention

Identification of appropriate municipal waste streams

Waste stream	Waste codes of the ELW
Municipal waste other (MWO)	200101, 200102, 200108, 200110, 200111, 200125, 200128, 200130, 200134, 200136, , 200138, 200139, 200140, 200141, 200199, 200201, 200202, 200203, 200301, 200302, 200303, 200306, 200307, 200399, 150101, 150102, 150103, 150104, 150105, 150106, 150107, 150109
Municipal waste hazardous (MWH)	200113*, 200114*, 200115*, 200117*, 200119*, 200121*, 200123*, 200126*, 200127*, 200128, 200129*, 200130, 200131*, 200132*, 200133*, 200135*, 200137*, 150110*, 150111*
Mixed municipal waste (MMW)	200301
Biodegradable municipal wastes (BMW)	150101, 200101, 200108, 200110, 200111, 200138, 200201, 200301, 200302, 200303, 200307
Collected separated paper (Paper)	150101, 200101
Collected separated plastics (Plastics)	150102, 200139
Collected separated glass (Glass)	150107, 200102
Collected separated metal (Metal)	150104, 150111*, 200140
Bulk waste (Bulk)	200307
Packaging waste other (PWO)	150101, 150102, 150103, 150104, 150105, 150106, 150107, 150109,
Wastes from electrical and electronic equipment (WEEE)	200123*, 200135*, 200136, 200121*
Wastes from batteries and accumulators	200133*, 200134

MW streams generation 2009-2014 [tonnes]

Waste stream [tonnes]\year	2009	2010	2011	2012	2013	2014
MW total	5,728,292	5,688,095	5,574,194	5,303,801	5,323,382	5,523,641
MWO	5,715,317	5,678,664	5,565,109	5,293,582	5,312,898	5,513,419
MWH	12,975	9,43	9,084	10,219	10,484	10,221
MMW	3,236,263	3,090,805	3,015,468	2,889,040	2,822,834	2,911,765
BMW – MMW – Bulk	1,098,024	1,194,066	1,251,678	1,221,992	1,285,674	1,433,115
Paper	731,884	786,470	833,226	795,008	808,572	836,679
Plastics	208,731	226,643	222,045	220,761	225,349	242,280
Glass	206,420	223,184	180,814	157,728	154,619	154,702
Metal	67,503	78,848	69,087	60,298	63,368	61,728
Bulk	506,482	486,444	478,607	448,675	432,797	431,625
PWO total	933,627	1,003,542	989,095	913,293	906,795	944,185
WEEE	10,222	6,923	6,083	6,189	7,911	5,123
Sludges	168,866	162,723	163,739	162,039	154,627	161,278
CDW	16,295,728	16,753,890	15,532,864	15,385,084	16,297,051	17,477,568

MW streams generation 2009-2014 per capita

Waste stream [kg/capita]\year	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
MW total	545.99	540.83	531.04	504.68	506.47	524.82
MWO	544.76	539.94	530.18	503.71	505.47	523.85
MWH	1.24	0.09	0.87	0.97	1.00	0.97
MMW	308.47	293.88	287.28	274.90	268.57	276.66
BMW – MMW – Bulk	104.66	113.53	119.26	116.28	122.32	136.17
Paper	69.76	74.80	79.38	75.65	76.93	79.50
Plastics	19.90	21.55	21.15	21.01	21.44	23.02
Glass	19.70	21.22	17.23	15.01	14.71	14.70
Metal	6.43	7.50	6.58	5.74	6.03	5.87
Bulk	48.28	46.25	45.60	42.69	41.18	41.01
PWO total	88.99	95.42	94.23	86.90	86.27	89.71
WEEE	0.97	0.66	0.58	0.59	0.75	0.49
Sludges	16.10	15.47	15.60	15.42	14.71	15.32
CDW	1,553.23	1,592.99	1,479.79	1,463.95	1550.52	1,660.61

Basic treatment of MW: totals for 2009 – 2014

Treatment \year		2009	2010	2011	2012	2013	2014
Material recycling	[tonnes]	1,206,436	1,302,476	1,661,703	1,576,519	1,561,729	1,849,864
	[%]	22.7	24.3	30.8	30.4	30.2	34.7
Energy recovery	[tonnes]	319,284	475,576	583,614	610,367	614,502	627,234
	[%]	6.0	8.9	10.8	11.8	11.9	11.8
Disposal in landfills	[tonnes]	3,409,772	3,188,722	2,982,745	2,785,555	2,698,737	2,569,965
	[%]	64.0	59.5	55.4	53.6	52.2	48.3
Disposal via incineration	[tonnes]	2,057	2,333	2,246	2,109	2,837	3,949
	[%]	0.04	0.04	0.04	0.04	0.05	0.07

Basic treatment of MMW for 2009 – 2014

Treatment \year		2009	2010	2011	2012	2013	2014
Energy recovery	[tonnes]	292,229	436,197	541,286	572,605	580,383	583,053
	[%]	9.0	14.1	18.0	19.8	20.6	20.0
Disposal in landfills	[tonnes]	2,755,477	2,577,277	2,418,431	2,285,662	2,200,784	2,132,085
	[%]	85.1	83.4	80.2	79.1	78.0	73.2

We can see that 73% of generated MMW was landfilled and 20% was disposed of via energy recovery in 2014. These numbers show the large potential for sorting MMW at the household level or at the new generation of MBT (mechanical biological treatment) facilities.

Material recycling of paper, plastics, glass, metals for 2009 – 2014

WM stream	year	2009	2010	2011	2012	2013	2014
Paper	[tonnes]	317,034	330,507	339,056	326,121	349,568	363,906
	[%]	43.3	42.0	40.7	41.0	43.2	43.5
Plastics	[tonnes]	109,595	113,161	119,433	123,206	128,324	127,338
	[%]	52.5	49.9	53.8	55.8	56.9	52.6
Glass	[tonnes]	133,902	128,886	139,193	157,246	148,331	135,697
	[%]	64.9	57.7	77.0	99.7	95.9	87.7
Metals	[tonnes]	23,663	31,826	34,850	37,576	35,022	38,583
	[%]	35.1	40.4	50.4	62.3	55.3	62.5

Driving forces for municipal MW streams

- *Population* is basic *driving force* of all MW streams.

The development of the population, together with the relocation of residents with higher purchasing power to cities and agglomerations, also reduces the waste treatment options open to it (e.g. composting) and creates demand for the faster replacement of goods, which affects *household consumption*.

- The number of *pensioners* and the level of *unemployment* are also driving forces

for the amounts of material involved in all MW streams, as families with small children, as well as some students, pensioners and the unemployed, tend to remain near their residence throughout the day where their activities generate waste.

Driving forces for municipal MW streams

- A major driving force behind this MSW production is also *consumer behaviour*, including packaging methods, which are driven by consumer demand and legal regulations, e.g. hygiene and health protection requirements.
- *Municipal expenditure and citizen's waste disposal fees* are other driving forces for all MW streams that may motivate residents to produce less waste, especially in smaller communities where the fee is determined directly by the owner of the house when they purchase a garbage collection container.
- *Way the collection systems* other driving forces for all MW streams. When they are set up effectively, it can motivate residents to minimize their generation of all MW streams and achieve lower MW stream treatment costs.

Identifying the purpose to governmental intervention

A major driving force behind MSW production is also *long-term path for MWM and recycling. Key elements of the EU revised waste legislation proposal include:*

- A common EU target for recycling 65% of total MW by 2030;
- A common EU target for recycling 75% of packaging waste by 2030;
- A binding landfill target to reduce landfill to maximum of 10% of MW by 2030;
- A ban on the landfilling of separately collected waste;
- Promotion of economic instruments that discourage landfilling;

Identifying the purpose to governmental intervention

A major driving force behind this MSW production is also *long-term path for MWM and recycling. Key elements of the revised EU waste legislation proposal include:*

- Simplified and improved definitions and harmonised calculation methods for recycling rates throughout the EU;
- Specific measures to promote re-use and stimulate industrial symbiosis - turning one industry's by-product into another industry's raw material;
- Economic incentives for producers to put greener products on the market and support recovery and recycling schemes (e.g. for packaging, batteries, electric and electronic equipment, vehicles).

Circular Economy implementation in municipalities

- The Municipal Waste Management Plan for the period 2016 – 2024 (MWMP) is the basic municipal government tool supporting the road map to the CE in municipalities in the Czech Republic.
- It consists of analytical, binding and directive parts of MWMP.

The analytical part of the MWMP

It contains an evaluation of the status of MWM, which includes:

- the area of the prevention of MW streams;
- the assessment of generated MW streams and their resources;
- the evaluation of existing municipal collection systems and MWM in the given municipality at least for total MW, MWO, MWH, MMW, BMW, paper, plastic, glass, metals, and packaging waste, and their compliance with the mandatory parts of the RWMP;
- the assessment of the necessary amendments and additions to the municipal system of MW and MWM collection.

The binding part part of the MWMP

It contains measures for waste prevention in accordance with the RWMP and lays down objectives and the means of achieving them within the framework of the MWM and the system of indicators for the evaluation of the fulfilment of the objectives of the MWMP for:

a) the management of MW streams (total MW, MWO, MWH, MMW, BMW, PWO, etc.);
b) CDW, if the MWM includes the management of construction waste;
c) the management of end-of-life products in the case that the municipality operates collection sites for these products within the framework of cooperation with required persons;

The binding part part of the MWMP

It contains measures for waste prevention in accordance with the RWMP and lays down objectives and the means of achieving them within the framework of the MWM and the system of indicators for the evaluation of the fulfilment of the objectives of the MWMP for:

d) preparation of the reuse, recycling, recovery and disposal of MW streams to minimize their negative impact on the environment;

e) reducing the amount of waste going to landfill, in particular BMW;

f) reducing the biodegradable components in MMW.

The directive part part of the MWMP

It contains :

a) proposals for improving the MWM system;

b) criteria for the evaluation of changes to the conditions under which the MWMP was prepared.

Basic MWMP principles of CE implementation for municipalities

a) Maintain, support and develop an independent collection system for each separate MW stream (paper, plastic, glass, metal, drink cartons) with respect to the targets set for each material, due to the higher quality of the waste streams collected in this manner.

b) Maintain and develop the availability of separate collection systems for recoverable waste in municipalities.

c) Ensure (establish) the obligatory separate (sorted) collection of recoverable components of MW streams (at least of paper, plastics, glass, and metals) in municipalities.

d) The system of collecting MW streams in the community is established by each municipality with regard to their requirements and the availability of technical waste processing. The collection system is established by the municipality under independent competence by a generally binding regulation.

Basic MWMP principles of CE implementation for municipalities

e) The scope and method of the separate collection of components of MW streams in the community is defined by the municipality with regard to technical, environmental, economic, and regional possibilities, and the existing conditions for the further processing of waste; the arrangements for separate collection must be sufficient to ensure the objectives of the MWMP for municipal waste are met.

f) Reduce the production of MMW via the introduction or extension of separate collection systems for recoverable components of municipal waste, including biodegradable waste.

g) Prioritize environmentally beneficial, economically and socially sustainable MW stream treatment technologies.

Basic MWMP principles of CE implementation for municipalities

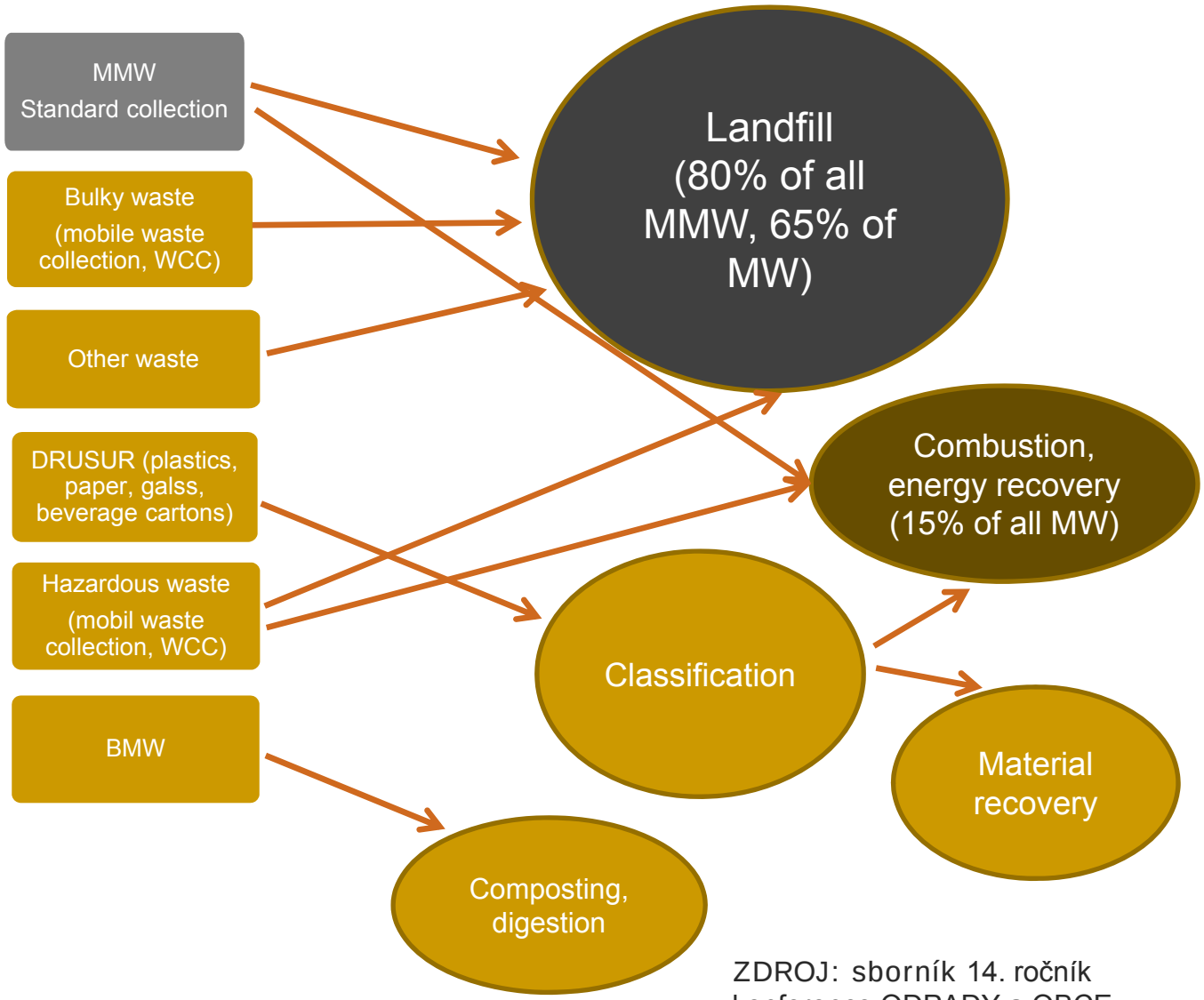
h) Establish a mandatory system for the separate collection of BMW and its waste management, at least for biodegradable waste of plant origin within communities.

i) Before changing the system of collection and MWM, always perform a thorough analysis that includes environmental, economic, and social aspects, and subject it to a comprehensive discussion involving all parties concerned.

j) The processing of MMW by sorting may be supported as a complementary waste processing technique prior to material and energy recovery. This processing does not replace the separate collection of recoverable components of MW streams.

Waste management currently

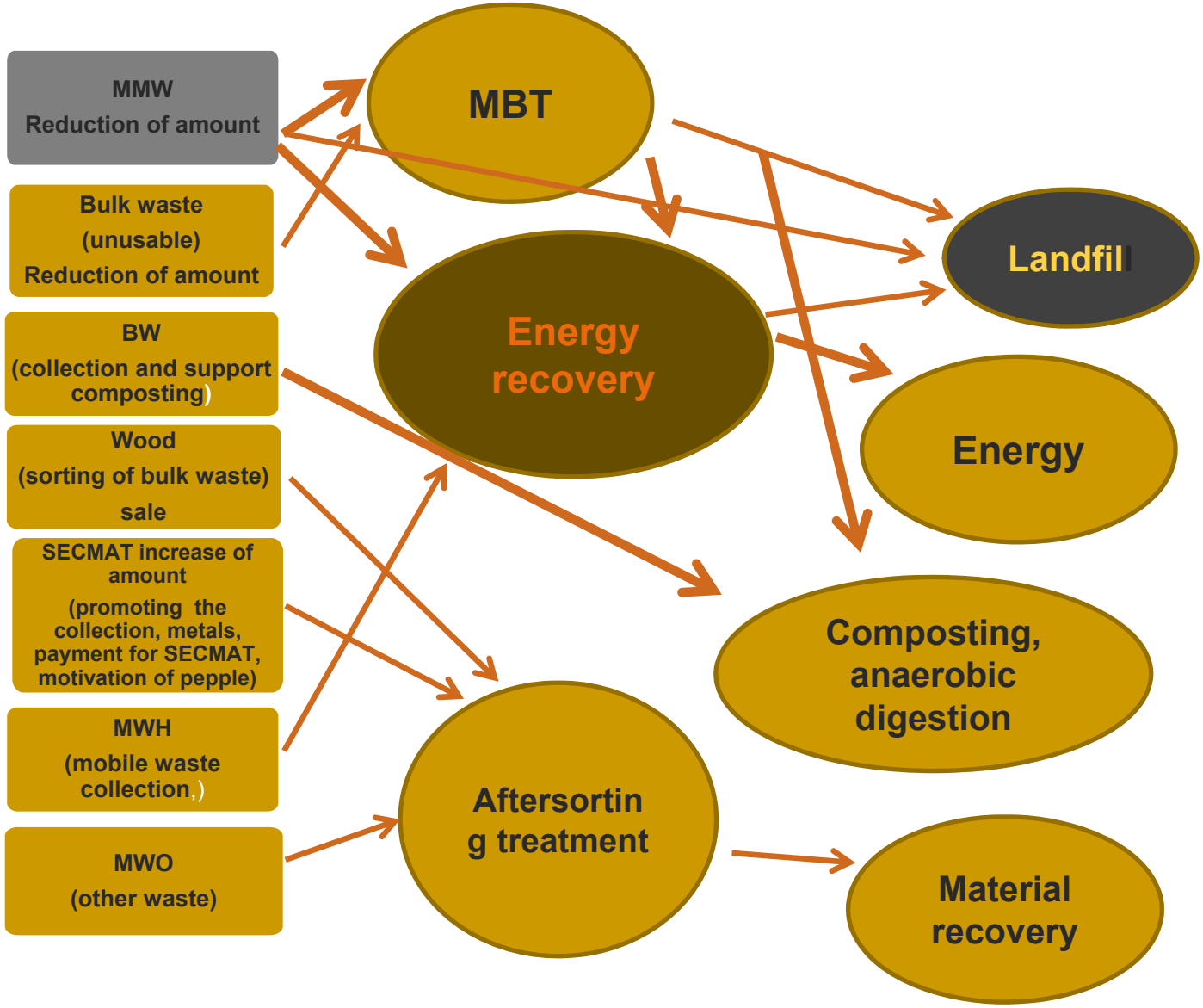
- **80% of mixed municipal waste is disposed in landfills**
- **65% of all MW is landfilled removal**
- **more than 30% recyclable components in mixed waste**
- **more than 30% BW in mixed waste**
- **limited motivation of people to sort**
- **low efficiency of collection of recycable waste from perspective of the income of the village**
- **low availability and efficiency technologies**
- **mixed waste is without further treatment eliminating landfill**



ZDROJ: sborník 14. ročník konference ODPADY a OBCE

Transition municipalities to the Circular Economy

- reducing the amount of MMW and treatment of residual MMW
- Increasing the amount of sorted secondery raw materials from mixed municipal waste
- BW sorting of mixed municipal waste
- Introducing separate collection of metals
- Motivation of people to reduce the amount of MMW, addressable records of waste production
- Concept technology and logistics in the region – cooperation between regions
- Increase revenue for municipalities for graded secondary materials



Optimising WM systems according to the regional conception

Standard collection company

Waste collection

Dump

Basic processing

Handing over to another use

Increase in the cost of waste disposal by at least 140 CZK per citizen

Sophisticated, modern company

Cooperation with municipalities on an analysis of the current state of waste management and solution design

Cooperation with municipalities to optimize WM systém in regional concept

Waste collection, waste sorting support, educational activities, co-financing projects

Energy recovery

Composting a. digestion

Processing SECMAT

Other technologies

MBT

Long-term sustainable costs of MWM. Treatment with MW streams corresponding to modern trends in WM.

Introducing smart waste collection using new intelligent containers

Wireless data collection to optimize waste collection at voluntary drop-off points

- Control centre
- Real-time monitoring of fill rates
- Clients invoiced on the volume of waste generated
- Adapted waste treatment center planning

75 to 80%
the average fill rate at which intelligent containers are emptied

Leverage the potential of connected objects & big data to rethink waste collection systems

- improved collection routes
- reduced costs
- better management of municipal fleets

Conclusion

- Circular Economy makes the best use of MW streams and resources, which is a high priority for Czech local municipal authorities as key delivery agents for municipal waste collection, reuse, recycling and disposal services.
- Combination of the CE with the use of MWMP and Smart Cities and Communities (EIP-SCC) ideas represents a fundamental alternative to the take-make-consume-dispose economic model that currently predominates.
- Model of a road map to the CE for municipalities in the Czech Republic is based on the assumption that resources in MW streams are available, abundant, easy to access and cheap to recycle.

Thank you

for you attention

Question?

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