Lecture

Basic Methods for the Development of a sustainable Waste Management Concept for Municipal Solid Waste at the local level

demonstrated by the example of Khanty-Mansiysk, Russia

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1. 1. Definition of Terms

Question:

What are the main objectives of Russian laws regarding waste management?

1. 1. Definition of Terms

- ***Key law*** in Russia: The "Federal Law (FL) on industrial and municipal waste" from 24.June 1998 No. 89 (last update 30. December 2008, No. 309-FL)

- ***legal basis*** of dealing with industrial and municipal waste

- ***major aims:***
  - to prevent negative impacts on the health of humans and the environment caused by wrong waste disposal t
  - to implement the recycling of materials from waste as a source for commodities and economic revenues

1.1. Definition of Terms

Question:

- What is the definition of a „sustainable waste management concept“?

1.1. Definition of Terms

- “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

  (Brundtland Commission of the United Nations on 03/20/1987: United Nations General Assembly (1987) *Report of the World Commission on Environment and Development: Our Common Future)*

- Including the reconciliation of ***environmental, social*** equity and ***economic*** demands - the "three pillars" of sustainability

  (United Nations General Assembly (2005). 2005 World Summit Outcome, Resolution A/60/1, adopted by the General Assembly on 15 September 2005. Retrieved on: 2009-02-17)

1.1. Definition of Terms

A sustainable waste management:

- is a strategic and complex approach
- includes all aspects of waste management such as waste generation, collection, transport, recovery and disposal
- is based on waste hierarchy: prevention, reuse/recycling and environmental treatment.
- Is influenced by interests of local authorities and all stakeholders

-> preparing and implementing sustainable waste management concepts is difficult

-> there is no internationally uniform regulations for preparing integrated waste management concepts

-> development of waste management concepts differs worldwide

1.2. Reasons for developing a waste management concept

Question:

- Why is it necessary to develop a sustainable waste management concept?

1.2. Reasons for developing a waste management concept

in the past

- suffering and dying of humans from unhygienic circumstances (i.e. bad food)

19th century

- Analysing the link between lack of hygiene and death
- waste management to protect human health

Today

- further necessities than hygiene to deal with waste disposal: sustainability and environmental protection

Examples for international conferences and agreements

- 2. International Environmental Conference in Rio de Janeiro: waste management - key role in environmental protection (1992)
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)
- Agenda 21, Article 20/21 (1992)

1.2. Reasons for developing a waste management concept

- waste policies alone cannot stop improper waste disposal and environmental pollution
- adequate waste management concepts are essential as the impacts of waste concepts also play a significant role in climatic and natural resource protection as well as waste utilisation of waste as a second resource
- waste management is one of the most important global challenges to deal with today

1.3. Key elements within a sustainable waste management concept

Question:

- What are the key elements of a sustainable waste management concept for municipal solid waste?

1.3. Key elements within a sustainable waste management concept

- Description of the status-quo
- Participation of inhabitants
- Prognosis of waste amount and waste composition
- Development of waste treatment options (scenarios)
- Evaluation of waste treatment options
- Decision making process
- Development of a waste management concept

1.3. Key elements within a sustainable waste management concept

Examples of guidelines for development a waste management concept on international level:

- ***European Commission*** (EC), 2003, Preparing a Waste Management Plan
- ***Organisation for Economic Co-Operation and Development*** (OECD), 2007, Guidance Manual on Environmentally Sound Management of Waste
- ***The World Bank***/ Wilson et al. 2001, Strategic planning guide for municipal solid waste management
- ***United Nation Environment Programme*** (UNEP), 2009, Developing Integrated Solid Waste Management Plan

1.4. Example: Khanty-Mansiysk

1.4.1. Background and aim

Key problems for the waste management situation in Khanty-Mansiysk:

1. Migration boom – insufficient capacity of waste management infrastructure
2. Only landfilling - no reduction of waste amount
3. Illegal landfills in water protected zones

1.4. Example: Khanty-Mansiysk

1.4.1. Background and aim

Aim of the project:

- To discuss and develop a sustainable waste management concept for the town Khanty-Mansiysk to protect human beings and environment
- To reduce the volume of solid waste disposed on the landfill
- To strengthen the waste management and to check the possibility of gaining profit from recycling waste through market analyses etc
- To establish continuous contacts between Russian and German waste disposal companies as well as local municipalities

-> based on key elements for developing a sustainable waste management concept:

Development of timetable and tasks for implementing the project

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

Subdivision into 3 phases:

1. Analysis of data
2. Development of a waste management strategy for Khanty-Mansiysk
3. Development of a phased plan for implementing the waste management strategy and dissemination of project results

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

2010			2011												2012				
10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05
Phase 1: Analysis of data																			
								Phase 2: Development of a waste management strategy for Khanty-Mansiysk							**Phase 3: Development of a phased plan for implementing the waste management strategy and dissemination of project results**				

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

Phase 1:
Analysis of data

2011						
01	02	03	04	05	06	07
Phase 1: Analysis of data						
1.3. Description of the current situation as well as the legal assessment for the development of waste management concepts	1.4. Preparation and implementation of waste analysis - ***winter***		1.5. Preparation and imple-mentation of market analysis	1.6. Preparatio n of disse-mination	1.4. Preparation and implementation of waste analysis - ***summer***	

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

Phase 1 - Results

- Reliable data of waste amount and waste composition
- Requirements for waste treatment plants
- Economic data of market for recycling products
- Initial ideas for dissemination

→ Data = basis for development of waste management concept

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

Phase 2

Development of a waste management strategy for Khanty-Mansiysk

2011					
06	07	08	09	10	11
Phase 2: Development of a waste management strategy for Khanty-Mansiysk					
2.1. Development of scenarios and their costs			2.2. Preparation and implemen-tation of a excursion to Germany	2.3. Reaching a decision	2.4. Completion of the waste management concept

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

Phase 2 – Results

- Waste management concept for the town Khanty-Mansiysk

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

Phase 3

Development of a phased plan for implementing the waste management concept and dissemination of project results

2011	2012				
12	01	02	03	04	05
Phase 3: Development of a phased plan for implementing the waste management concept and dissemination of project results					
3.1. Development of a phased plan			3.2. Dissemination of project results	3.3. Conclusion and evaluation of the project	

1.4. Example: Khanty-Mansiysk

1.4.2. Timetable and expected results

Phase 3 - Results

- Phased plan for implementing the waste management strategy
- Cooperation between Russian and German local administration and waste disposal companies
- Presentations and seminars

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2. Implementation of data analysis

1. Relevant data and tools for analysing the data
2. Analysing relevant data in Khanty-Mansiysk
    1. Implementation of waste analysis
    2. Waste prognosis
    3. Implementation of market analysis

2.1. Relevant data and tools for analysing the data

Question:

- Which data do you need for developing a sustainable waste management concept?

2.1. Relevant data and tools for analysing the data

- Data and information about infrastructure
  - Geographical position and land use
  - Terrains profile, geology and hydrology
  - Climate and Vegetation
  - Transport routes
  - Residential structure and heating system in Khanty-Mansiysk
  - Demographic data
  - Economic development
- Existing waste management structure
  - Collection and transport system of solid municipal waste
  - Waste facilities of municipal solid waste
  - Collection, transport and treatment of waste water
- Waste management policy and legislation in Russia
- Waste generation and prognosis
- Data about a market for recycling products

2.1. Relevant data and tools for analysing the data

Question:

- In which way can you get all this data?

2.1. Relevant data and tools for analysing the data

Possibilities for researching the data:

- Questionnaires to the local administration
- (Internet)-research
- City library
- Tourist information
- Waste analysis
- Market analysis
- Etc.

2.1. Relevant data and tools for analysing the data

Recommendations:

- Calculate between 6 and 12 months for collecting all relevant data for a waste management concept:
  - Calculate between 1 and 2 months for compiling data about infrastructure, existing waste management structure, waste management policy and legislation in Russia
  - Calculate between 6 and 12 months to carry out the waste analysis depending on the number of waste analysis
  - Calculate 1 month to implement the market analysis
- Detailed data collection is essential as the data are the basis for the waste management concept

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Prerequisite for developing a waste management concept:

- Knowledge about waste generation and waste composition
- Selection of an appropriate tool for waste analysis

Tools for solid household waste analysis (1)

- 24 tools available globally
- mainly created on a national basis
- examples:
  - US (7)
  - Sweden (5)
  - Switzerland (2)
  - Great Britain (1)
  - The Netherlands (1)
  - South Africa (1)
  - Finland (1)
  - Germany: a lot of company- and state-level based tools

- 4 international organisations: EU, IEA; ASTMI; ERRA

Overview of tools for waste analysis on international level

(Number of tools)	Tool	Reference/Institution
Intergovernmental organisation		
IEA (1)	Work in harmonising sampling and analytical protocols related to municipal solid waste conversion to energy	Scott (1995), International Energy Agency (IEA)
EU/ EC (2)	REMECOM-European Measurement for Characterisation of Domestic Waste	ADEME (1998), EU-Life-Program
	SWA-Tool, Methodology for the analysis of solid waste	European Commission (2004), EU-5th Framework Program
International organisation		
ERRA (1)	Waste analysis procedure. Reference multi-material recovery	ERRA - European Recovery and Recycling Association (1993)
ASTMI (1)	Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste	ASTM International (2003), American Society for Testing and Materials

Summary of commonalities and differences among the diverse tools for waste analyses:

Commons	Differences
▪ same sequence from the preparation to assessment of data	▪ distribution of stratification ▪ sample level ▪ sample size ▪ numbers as well as subdivision of the sorting catalogue
No internationally scientifically acceptance	

Question:

Which tool of waste analysis is the best tool for my town?

Implementation of SWA-Tool in Khanty-Mansiysk

Methodology for the Analysis of Solid Waste (SWA-Tool)

European Commission, 2004,
5th European framework program

SWA-Tool - decisive factors:

I. Background information

II. Type of waste sampling and stratification

III. Level of sampling and type of sampling units

IV. Calculation of sampling size

V. Generation of random sampling plan

VI. Sorting catalogue

VII. duration of a waste analysis

I. Background information

View of Khanty-Mansiysk

I. Background information

View of Khanty-Mansiysk

II. Type of waste sampling and stratification

- Waste origin
- Residential structure
- Season

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Waste origin: solid household and commercial waste

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Residential structure

Strata 1: Apartment block settlements in Khanty-Mansiysk

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Strata 2: Small houses with gardens

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Strata 3: Business areas

Saison

Winter analysis:

- February 2011
- -30°C, heating period

Summer analysis:

- June 2011
- Between 4°C and 30°C, no heating period

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Collecting of waste containers

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Sorting of waste

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Disposal of waste sorted

III. Level of sampling and type of sampling units

Different waste containers in Khanty-Mansiysk

VI. Calculation of sampling size

1. heterogeneity or variation → ***natural variation coefficient***
   - calculated by pre-investigation

2. value of ***relative accuracy***
   - Recommendation: 10% of random sampling error based on a 95% confidence level and under the assumption that the natural variation coefficient for household and commercial waste is about 40%
   - calculated with view on the accuracy of the waste analysis

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

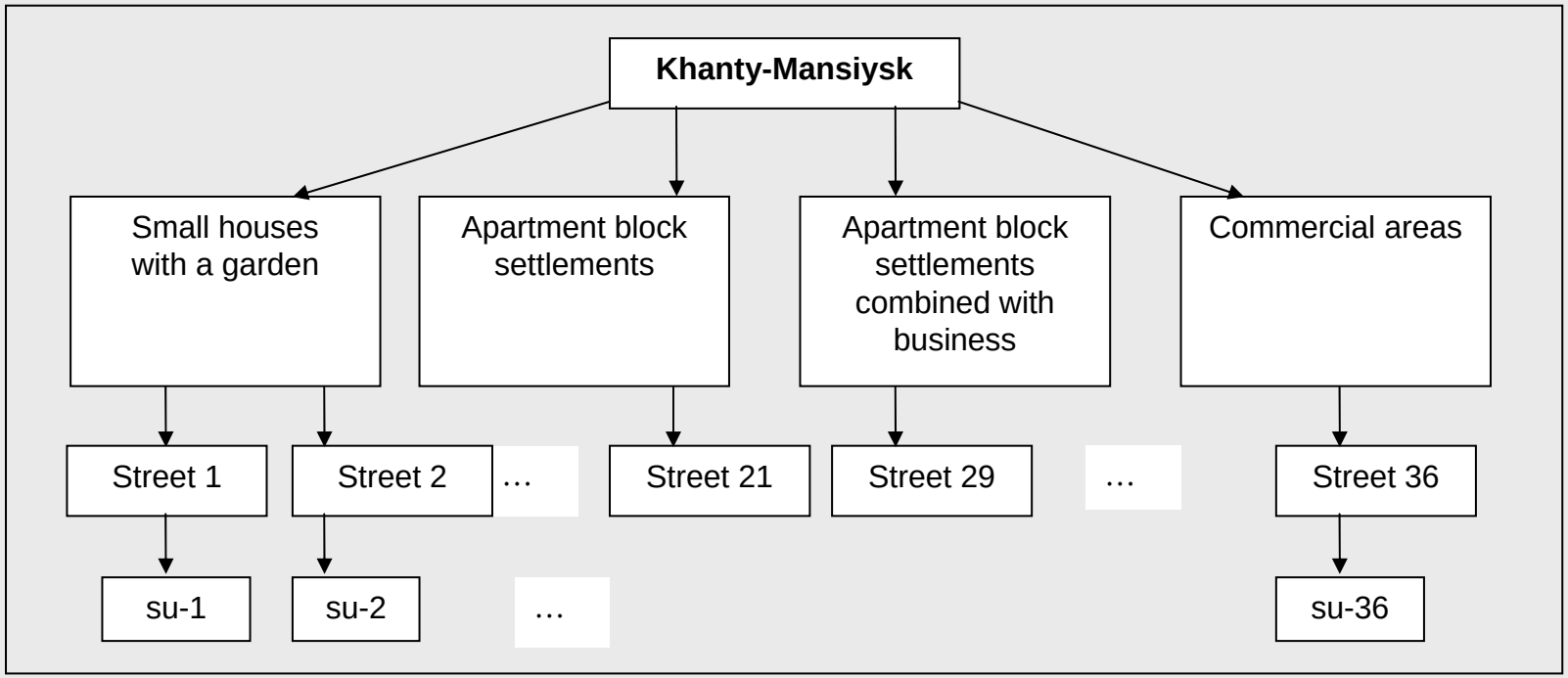
Table 5 Calculation Necessary Number of Sampling Units (95 % Confidence Level)

natural variation coefficient (Gauge for variation in parent population)	necessary number of sampling units n (95 % confidence level) with maximum allowance for random sampling error:					
	2.5%	5%	10%	15%	20%	30%
15%	138	35	9	4	2	1
20%	246	61	15	7	4	2
25%	384	96	24	11	6	3
30%	553	138	35	15	9	4
35%	753	188	47	21	12	5
40%	983	246	61	27	15	7
45%	1245	311	78	35	19	9
50%	1537	384	96	43	24	11
55%	1859	465	116	52	29	13
60%	2213	553	138	61	35	15
70%	3012	753	188	84	47	21
80%	3934	983	246	109	61	27
90%	4979	1245	311	138	78	35
100%	6147	1537	384	171	96	43
120%	8851	2213	553	246	138	61
140%	12047	3012	753	335	188	84
160%	15735	3934	983	437	246	109
200%	24586	6147	1537	683	384	171

Overview of statistical accuracy of annual results in Khanty-Mansiysk

Basis for calculation	Sampling size	Natural variation coefficient	Sampling error at a 95% confidence level
	[m^3]	[%]	[%]
Starting point	36	40.0	13.0

V. Generation of a random sampling plan



su = sampling unit

in total:

72 sampling units

for the waste analysis in Khanty-Mansiysk in 2011

VI. Sorting catalogue

1st category		No	2nd category
1.	Organic	1-1	Biodegradable Kitchen/Canteen Waste
		1-2	Biodegradable Garden/Park Waste
		1-3	Other Biodegradable Waste
2.	Wood	2-1	Wood untreated
		2-2	Wood treated
3.	Paper and Cardboard	3-1	Non-biodegradable paper
		3-2	Paper/cardboard – packaging
		3-3	Paper/cardboard– non packaging
		3-4	Newspapers
4.	Plastics	4-1	Plastic Film – packaging
		4-2	Plastic Film – non packaging
		4-3	Dense Plastic – packaging
		4-4	Dense Plastic – non packaging
5.	Glass	5-1	Clear Glass Packaging
		5-2	Brown Glass Packaging
		5-3	Other Glass Packaging
		5-4	Miscellaneous Non Packaging Glass
6.	Textiles	6-1	Clothes
		6-2	Non-clothing textiles

VI. Sorting catalogue

1st category		No	2nd category
7.	Metals	7-1	Ferrous Packaging
		7-2	Miscellaneous Ferrous
		7-3	Aluminium Packaging
		7-4	Miscellaneous Non-ferrous
8.	Hazardous Household Waste	8-1	Batteries/Accumulators
		8-2	Miscellaneous hazardous waste
9.	Composites	9-1	Composite Packaging
		9-2	Composite Non-packaging
		9-3	WEEE
10.	Other Categories	10-1	Soil and Stones
		10-2	Other inert
		10-3	Nappies
		10-4	Health Care/Biological Wastes
		10-5	Miscellaneous Categories
11.	Fine fraction	11	10mm sieved fraction

in total:

34 categories

VII. Duration of waste analysis

- 6 days with 6 m^3 of sampling unit per analysis with different starting point – to cover one week in total

Day / Saisonal analysis	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Winter analysis	Day 5	Day 6		Day 1	Day 2	Day 3	Day 4
Summer analysis	Day 6		Day 1	Day 2	Day 3	Day 4	Day 5

Waste generation and prognosis

- Solid household waste
- commercial waste - similar to household waste (such as waste from schools, university and public offices/ administration, business offices, hotels, restaurant, shops)
- Bulky waste
- Street cleaning residues including snow and waste from litter bins
- Garden and park waste, market waste
- Construction and demolition waste
- Medical waste
- Waste from veterinary clinics / livestock farms
- Metals/ End-of-life vehicles
- End-of-life tyres
- Hazardous waste
- Wastes from water treatment plants

Waste generation in 2011 (1)

Type of waste	Total amount [Mg]
Solid household waste and commercial waste similar to household waste (such as waste from schools, universities and government agencies / administrations, commercial firms, hotels, restaurants, shops)	**28.946**
Bulky waste	**2.700**
Waste from street cleaning and waste from bins, including garden and park waste, waste market as well as waste from the snow landfill site after snow melting	**143**
Snow	**528.229**
Construction and demolition waste	**710**
Medical waste	**180**
Waste from veterinary clinics / livestock farms and pets	**0.8**
Total	**560.909**

Waste generation in 2011 (2)

Type of waste	Total amount [Mg]
End-of-life-vehicles	**48**
End-of-life tyres	**313**
Hazardous waste	**- no data -**
Waste from waste water companies	**- no data -**

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Analysed amount of waste during waste analyses in 2011 [kg]

	Small houses with a garden	Apartment blocks	Apartment blocks + business	Business	Total
Winter analysis	544	1,113	974	258	2,889
Summer analysis	518	888	623	419	2,448
Total	**1,062**	**2,001**	**1,597**	**677**	**5,337**

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Calculated annual waste amount per stratum and waste category in 2011 [Mg]

1st Category	Small houses with a garden	Apartment blocks	Apartment blocks + business	Business	Total
Organic	2,180	3,149	1,677	1,876	8,882
Wood	115	449	101	103	768
Paper/ Cardboard	322	846	720	871	2,759
Plastics	659	1,120	644	779	3,202
Glass	849	1,309	863	353	3,375
Textiles	183	197	60	62	502
Metals	645	295	115	107	1,162
Hazardous waste	11	66	56	1	134
Composites	152	368	244	96	860
Other categories	529	1,628	592	179	2,927
Fine fraction	289	547	234	145	1,214
Total	**5,933**	**9,973**	**5,306**	**4,572**	**25,785**

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.1. Implementation of waste analysis

Average water content and heating value of waste categories

1st Category	Composition [%]	Water content [%]	Hydrogen content [%]	Calorific value Ho(wf) [KJ/kg]	Heating value Hu(roh) [KJ/kg]
Organic	34	68.7	3.76	13,580	2,315
Wood	3	27.7	6.8	20,630	13,159
Paper/ Cardboard	11	14.9	5.12	16,290	12,542
Plastics	12	29.9	14.5	38,580	24,082
Glass	13	2.0	0.0	0	-49
Textiles	2	27.0	6.4	19,900	12,842
Metals	5	11.9	0.0	0	-290
Hazardous Waste	1	9.9	0.0	0	-242
Composites	3	12.9	9.8	27,435	21,704
Other Categories	11	61.8	1.4	14,000	3,723
Fine fraction	5	43.5	1.8	8,000	3,235
Total	**100**	**40.6**	**4.53**	**15,073**	**6,958**

Ho(wf) – Calorific value of dry example / Hu(roh) – Heating value of untreated example

Conclusions of implementing the SWA-Tool

Strengths

- Detailed description of statistical accuracy → basis for size of waste treatment plants
- Detailed description of implementation of waste analysis
- Consideration of 1st waste analysis in a town/ region

Weaknesses

- level of sampling → containers/ waste disposal trucks

Waste prognosis

- Prognosis of waste quality and quantity is one of the most important tasks in developing a waste management concept but also the most problematic issue.
- Prognoses are essential for the type of future waste disposal, for the size of waste treatment plants as well as for the decision of utilisation of waste such as recycling.
- Several factors influence waste amount and quality, but these factors which include population growth, employment, environmental awareness and policies are difficult to predict.
- Additionally, if there are no historical data the process of prognosis will be even more complicated.
- Large numbers of tools are available to predict the amount of waste and were developed in different contexts such as economics, engineering and administration.
- However, tools for predicting changes of waste compositions are barely developed.

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.2. Waste prognosis

Within the example:

- Prognosis of waste quality and quantity calculated based on economic conditions and development of number of inhabitants.

2.2. Analysing relevant data in Khanty-Mansiysk

2.2.2. Waste prognosis

Prognosis of municipal waste until 2024 [Mg/year]

Waste types	2010	2012	2014	2016	2018	2020	2022	2024
Household Waste & Commercial Waste	25,785	28,737	32,028	35,351	39,019	43,068	46,618	50,461
Household Waste	21,917	24,427	27,224	30,048	33,166	36,608	39,625	42,892
Commercial Waste (similar to household waste)	3,868	4,311	4,804	5,303	5,853	6,460	6,993	7,569
Bulky waste & construction & demolition waste	3,410	3,800	4,236	4,675	5,160	5,696	6,165	6,673
Sum of other waste types	1,922	2,142	2,387	2,635	2,908	3,210	3,474	3,761
Medical waste	180	201	224	247	272	301	325	352
Street cleaning residues and waste from litter bins, Garden and park waste, market waste	1,428	1,592	1,774	1,958	2,161	2,385	2,582	2,795
Veterinary medicine waste	1	1	1	1	1	1	1	1
End-of-life tyres	313	349	389	429	474	523	566	613
Total	**31,117**	**34,680**	**38,650**	**42,661**	**47,087**	**51,973**	**56,257**	**60,895**

Question:

- What is the aim of a market analysis?

Aim of market analysis:

- Determination of current recycling market
- Identification of market value for materials from the solid municipal

-> financial support for the implementation of the new waste management concept

Question:

- In which way would you implement a market analysis?

Identification of 3 types of companies essential for waste recycling:

- Companies which collect and/ or treat materials recovered from solid municipal waste such as recycling companies
- Factories which use materials from waste in order to produce new products such as a glass manufacturing company and
- Transport companies for transport of waste

Implementation of the market analysis:

- Telephone calls
- Sending questionnaires to companies via e-mail or fax for answering (including deadline)
- expert questionnaire/ interview

Collection of contact data in KMAO-Ugra (1):

- ***"German Trade and Invest"***
  - no contact data of recycling companies in KMAO-Ugra
  - referred to the "Russian Chamber of Commercial and Industry"

- ***"Russian Chamber of Commercial and Industry"***
  - list of almost 140 Russian companies in KMAO-Ugra
  - None of these companies is dealing with waste disposal and/or treatment company
  - Registration on this list - voluntary
  - No reflection of entire situation of existing companies in KMAO-Ugra

- ***"Territorial institution of the federal office for state statistic in KMAO-Ugra"***
  - list on the internet
  - includes more than 40.000 companies in KMAO-Ugra

Collection of contact data in KMAO-Ugra (2):

- ***"Territorial Management of Federal Service for supervision in the sphere of nature management in KMAO-Ugra (Rosprirodnazor)"***
  - awards the licence for waste disposal and/or treatment
  - a list with 59 companies is available (data from 2010 - 2011)
  - list contains no contact data
  - Research all telephone numbers and e-mail addresses via internet

- ***internet researches***

Collecting of contact data in Perm, Yekaterinburg und Irkutsk:

- ***Irkutsk:*** "calendar of waste" (a booklet of recycling companies in Irkutsk) developed within the project "Development of a Waste Management Concept for the Tourist Regions of Lake Baikal"
- ***Perm:*** the branch book "Yellow pages - 2010"
- ***Yekaterinburg:*** provided by the Perm State University. The Perm State University is currently in the process of initiating a co-operation among all waste disposal/ treatment companies in Yekaterinburg and therefore has this information

Results of market analysis:

- current quota of recycling is very small
- existence of recycling companies
- interest of manufacturing companies for recycling materials
- no waste treatment facility in KMAO-Ugra – except a company treating metals in Surgut
- Khanty-Mansiysk = administrational town -> high potential for cardboard and paper recycling

Recommendation for implementation of the market analysis:

- Calculate at least 1 month for implementation
- Get in contact to local authorities to get the contact data
- Use regional infrastructure such as „yellow pages“ etc.
- Identify which information you need before you start
- Prepare a well developed questionnaire

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3. Preparation of the status-quo-report

1. Content of the status-quo report
2. Challenges of the current waste management in Khanty-Mansiysk
3. Recommendation for writing the status quo report

3. 1. Content of the status-quo report

1. Objectives of the project
2. Data and information about infrastructure
3. Existing waste management structure in Khanty-Mansiysk
4. Waste generation and prognosis
5. Market analysis
6. Waste management policy and legislation in Russia and Khanty-Mansiysk Autonomous Okrug – Ugra
7. Conclusions

3. 2. Challenges of the current waste management in Khanty-Mansiysk

- Insufficient capacity of prepared places for waste disposal on the landfill site
- No ecological or economic conditions for a temporary use of a landfill from another town
- Insufficient volume of the waste container
- Limitation of area for waste disposal sites through geological conditions
- Recording of waste amount in m^3 (without pressure)
- No recording of waste composition

3. 3. Recommendation for writing the status quo report

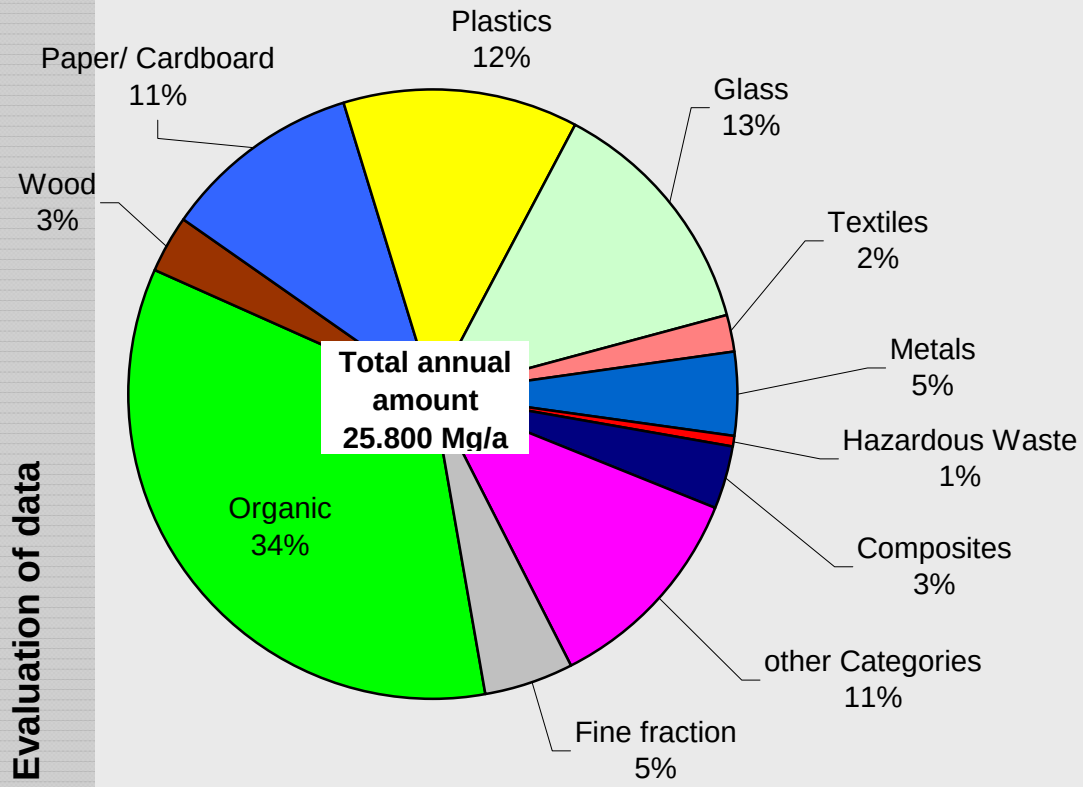
- Write the report in a very detailed way as it is the basis of the sustainable waste management concept
- Include evaluation such as:
  - ***Topic:*** Geographical position and land use - ***Evaluation:*** Central or de-central solution, number and size of the waste treatment plant?
  - ***Topic:*** Geology and hydrology - ***Evaluation:*** Influence of location for landfill site, costs of re-development or new construction of the landfill site?
  - ***Topic:*** Transport routes – ***Evaluation:*** Concept for transport such as location of treatment plant, transfer station etc.
  - ***Topic:*** Demographic data – ***Evaluation:*** Influence of waste amount and composition; type of waste collection, marketing
  - ***Topic:*** Economic data - ***Evaluation:*** Influence of waste amount and composition, financing of waste treatment and disposal

4. Evaluation of data

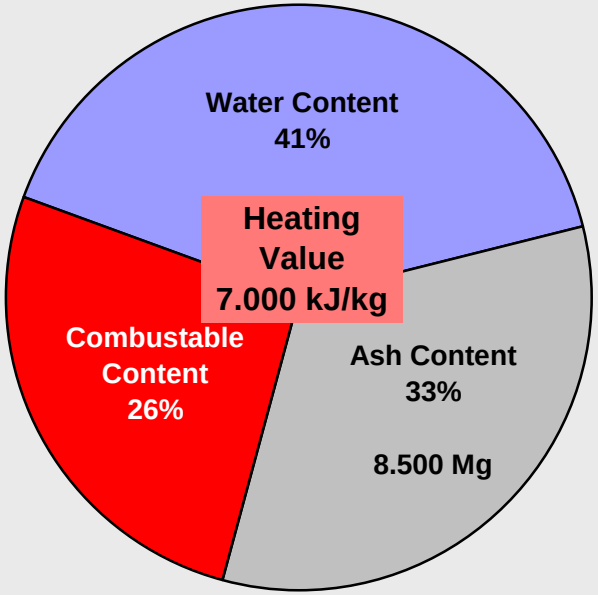
- Waste data
- Waste prognosis
- Environmental indicators
- Infrastructure and climate conditions
- Results of market analysis
- Summary of waste legislation
- Summary

Municipal Solid Waste Composition and Potential for Waste Incineration

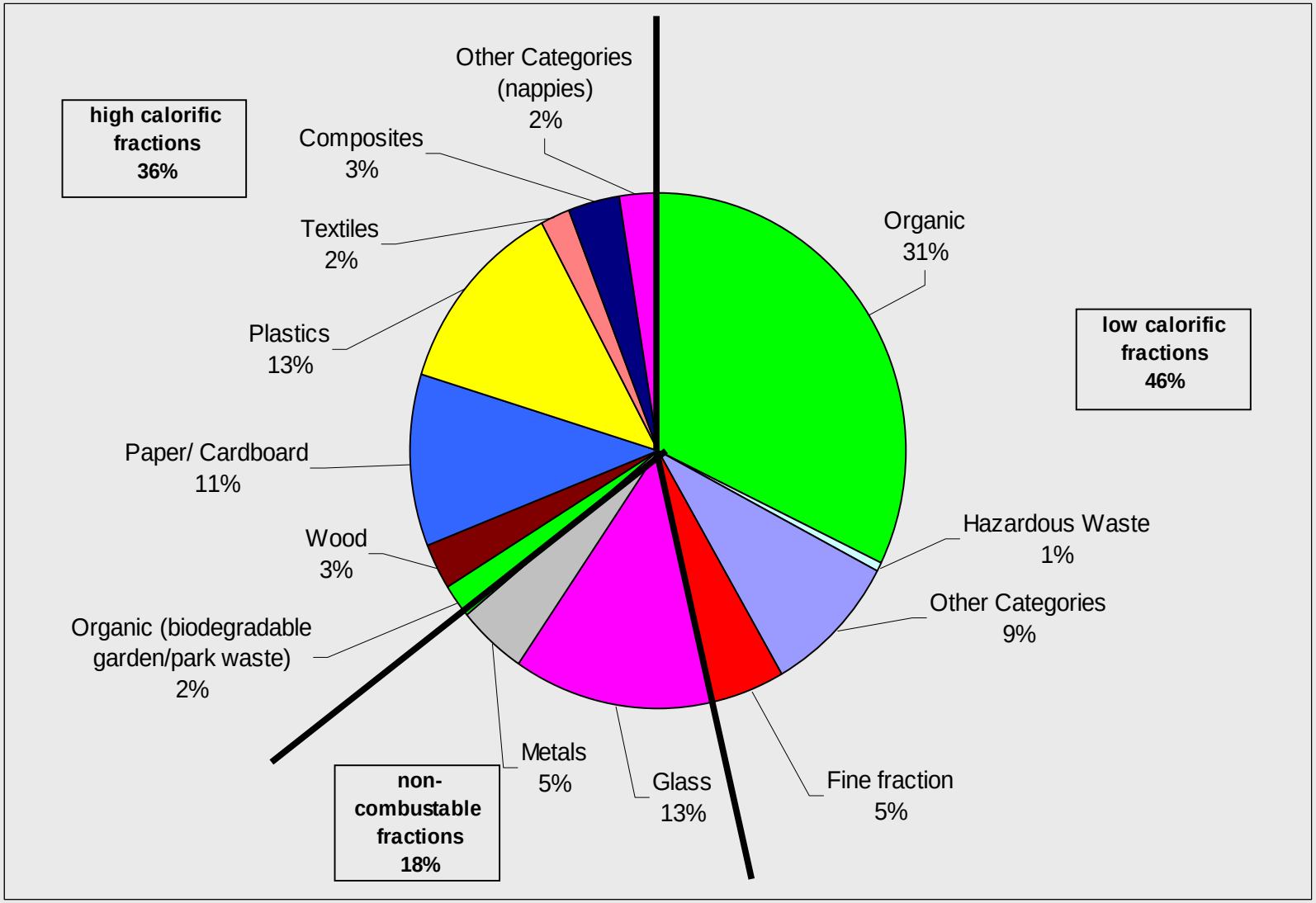
Composition of Municipal Solid Waste



Relevant parameters for waste treatment (burnable Municipal Solid Waste)

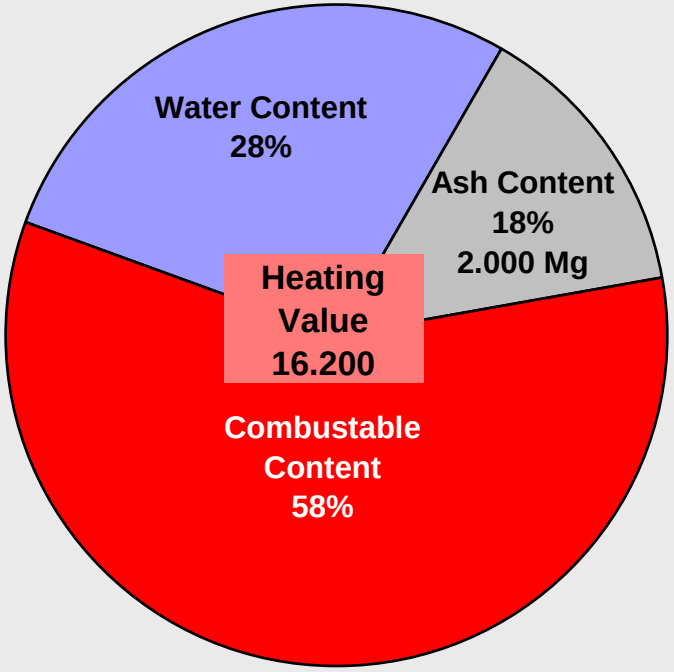


Potential for Co-incineration from burnable fractions



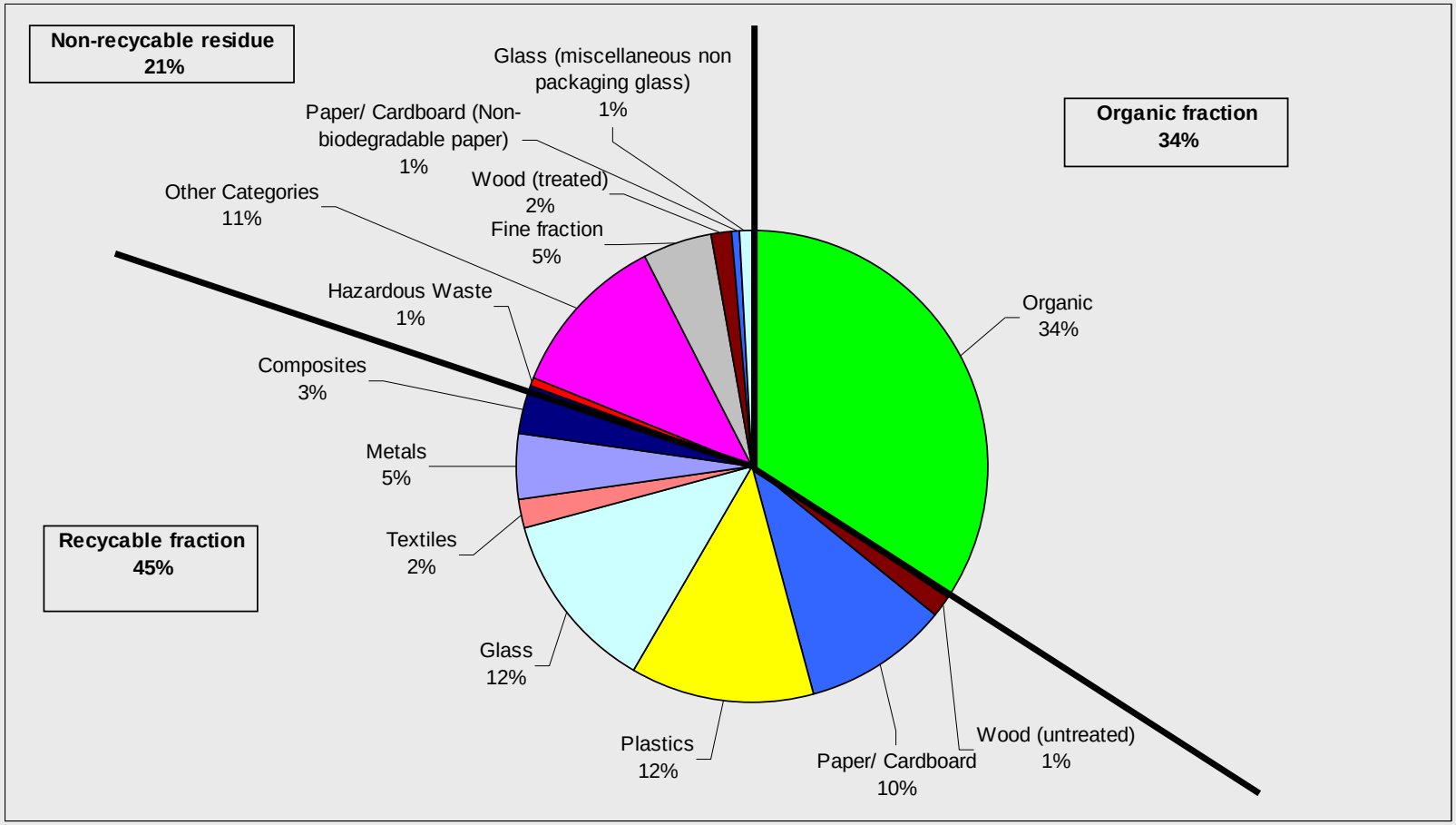
Potential for Co-incineration from burnable fractions

Relevant parameters for waste treatment (burnable Municipal Solid Waste)

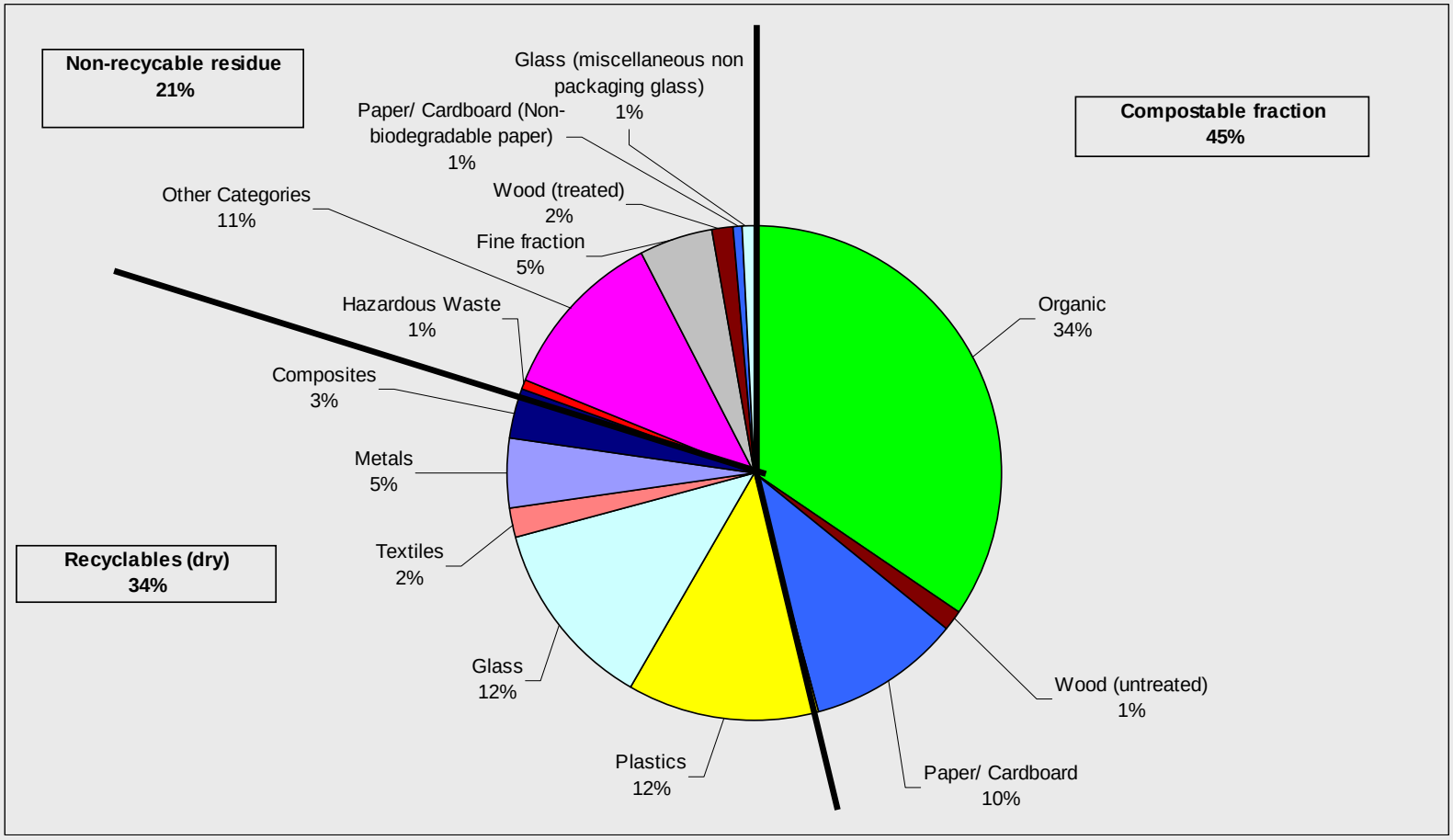


4. 1. Waste data

Potential for recycling



Potential for compost / anaerobic digestion



4. 2. Waste prognosis

Prognosis of waste amounts

Waste types	2010	2012	2014	2016	2018	2020	2022	2024
Household Waste & Commercial Waste	25,785	28,737	32,028	35,351	39,019	43,068	46,618	50,461
Household Waste	21,917	24,427	27,224	30,048	33,166	36,608	39,625	42,892
Commercial Waste (similar to household waste)	3,868	4,311	4,804	5,303	5,853	6,460	6,993	7,569
Bulky waste & construction & demolition waste	3,410	3,800	4,236	4,675	5,160	5,696	6,165	6,673
Sum of other waste types	1,922	2,142	2,387	2,635	2,908	3,210	3,474	3,761
Medical waste	180	201	224	247	272	301	325	352
Street cleaning residues and waste from litter bins, Garden and park waste, market waste	1,428	1,592	1,774	1,958	2,161	2,385	2,582	2,795
Veterinary medicine waste	1	1	1	1	1	1	1	1
End-of-life tyres	313	349	389	429	474	523	566	613
Total	**31,117**	**34,680**	**38,650**	**42,661**	**47,087**	**51,973**	**56,257**	**60,895**

4. 2. Waste prognosis

Prognosis of waste amount for selected treatment options

Waste treatment options	type of disposal	2010 [Mg/a]	2014 [Mg/a]	2018 [Mg/a]	2024 [Mg/a]
Deposition		25,785	32,028	39,019	50,461
MSW incineration [1]	landfill	7,598	9,437	11,497	14,869
	recovery	18,187	22,591	27,522	35,592
RDF co-incineration [2]	landfill	17,798	22,108	26,933	34,831
	recovery	7,987	9,920	12,086	15,630
Composting [3]	landfill	18,336	22,776	27,747	35,884
	recovery	7,449	9,252	11,272	14,577
Anaerobic digestion [4]	landfill	18,336	22,776	27,747	35,884
	recovery	7,449	9,252	11,272	14,577
MBT [5]	landfill	13,547	16,826	20,499	26,511
	recovery	12,238	15,202	18,520	23,950
Separate collection [6]	landfill	19,846	24,652	30,032	38,839
	recovery	5,939	7,376	8,987	11,622
Separate collection + MBT [7]	landfill	11,845	14,713	17,924	23,181
	recovery	13,940	17,315	21,095	27,280

[1] 80 % of metals recycled from slag

[2] 80% of burnable fractions are separated for RDF, 80 % of metals recycled

[3] 60% of organic is separat collected, 55% are recycled

[4] 60% of organic is separat collected, 55% are recycled

[5] 80% of metals and glass are recycled,75% of burnable fractions are recovered

[6] 60% of recyclables are separat collected, 50% are recycled

[7] 60% of recyclables are separat collected, 50% are recycled, 80% of remaining metals and glass are recycled,75% of remaining burnable fractions are recovered

4. 3. Environmental indicators

Waste treatment options		Deposition rate	Energy recovery rate	Recycling rate	carbon emission production [8]
Deposition		100%	-	-	17.879 t CO2 Eq
MSW incineration	[1]	29%	-	-	7.735 t CO2 Eq
RDF co-incineration	[2]	64%	36%	-	2.396 t CO2 Eq
Composting	[3]	71%	-	29%	-
Anaerobic digestion	[4]	71%	-	29%	-
MBT	[5]	53%	16%	32%	1.227 t CO2 Eq
Separate collection	[6]	77%	-	23%	-
Separate collection + MBT	[7]	46%	8%	46%	613 t CO2 Eq

[1] 80 % of metals recycled from slag

[2] 80% of burnable fractions are separated for RDF, 80 % of metals recycled

[3] 60% of organic is separat collected, 55% are recycled

[4] 60% of organic is separat collected, 55% are recycled

[5] 80% of metals and glass are recycled,75% of burnable fractions are recovered

[6] 60% of recyclables are separat collected, 50% are recycled

[7] 60% of recyclables are separat collected, 50% are recycled, 80% of remaining metals and glass are recycled,75% of remaining burnable fractions are recovered

[8] Emission faktor for incineration of MSW: 0,3 t CO2 Eq / Mg waste; substitution effects not considered

CO_2-eq = Carbon dioxide equivalent indicates how much a given amount of greenhouse gas contributes to global warming. The functionally equivalent amount or concentration of carbon dioxide (CO2) is the reference.

4. 4. Infrastructure and climate conditions

- Pick-up system with waste container on public streets
- Landfill site
- No other recycling facilities beside of scrap branch
- Long distances to other waste management infrastructure
- Next railway station in Py`tach und Surgut (250 km)
- Transport possibilities via ship
- Harsh winter with permafrost

4. 5. Results of recycling market

- No separate collection of recyclables at the source
- No recycling facilities with exception of scrap branch
- Next paper mill for paper-recycling in Yekatarinburg (1.500 km)
- Next glass melt factory in Surgut (250 km)
- No plastic recycling activities in the region
- No collection system for electric and electronic equipment (WEEE)
- No collection system for used textiles
- No infrastructure for compost used as fertiliser

4. 6. Summary of waste legislation

- No specific waste law which regulates responsibilities, management, environmental standards and the inspection and control
- Waste management finance system is tax oriented. No incentives for waste reduction

4.7. Summary

- Organic is the biggest category (34%)
- MSW is burnable without supplementary firing
  (Heating value: 7.000 kJ/kg)
- 36% of MSW is suitable for the production of refuse derived fuel (RDF)
  (Heating value: 16.200 kJ/kg)
- 46% of MSW is recyclable
- 47% of MSW is compostable
- Incineration has best reduction rate of deposition
- Separate collection and MBT is most environmentally friendly
- Recycling marked has to be established
- Waste management infra-structure has to be improved
  (collection system, landfill site, …)

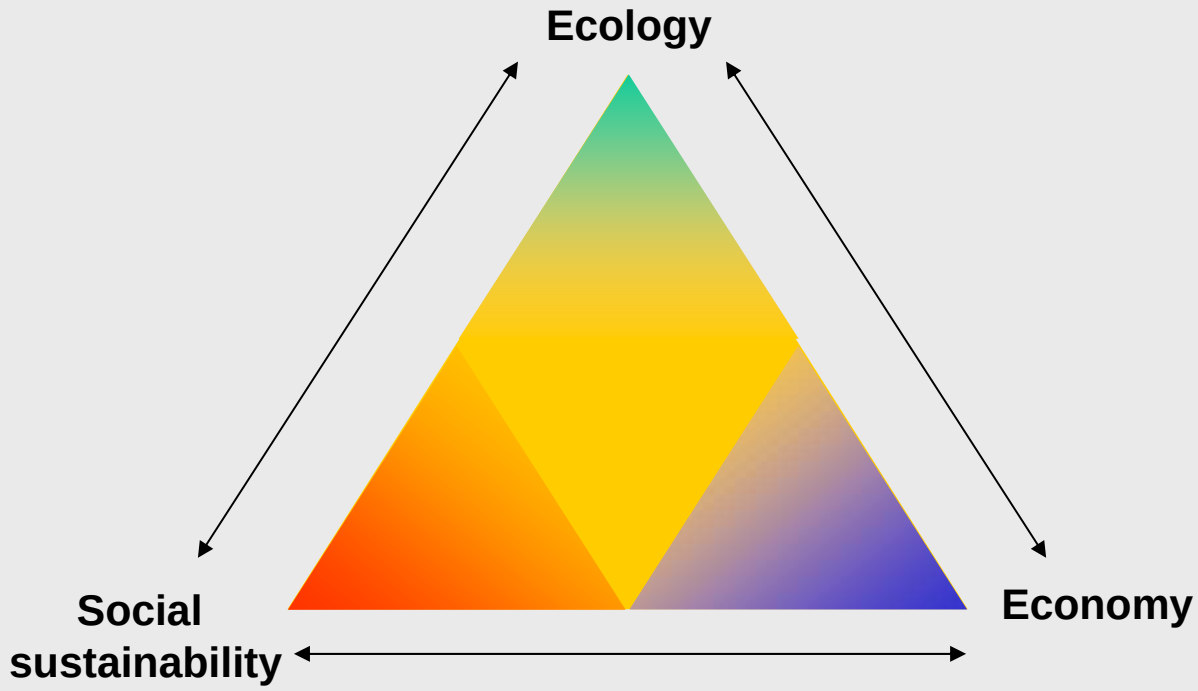
5. Development of scenarios

1. Objectives of the sustainable waste management concept
2. Waste management options
3. Scenario 0: Baseline
4. Scenario 1: Recycling
5. Scenario 2: Biological treatment
6. Scenario 3: Incineration

5.1. Objectives of the sustainable waste management concept

Overall objectives:

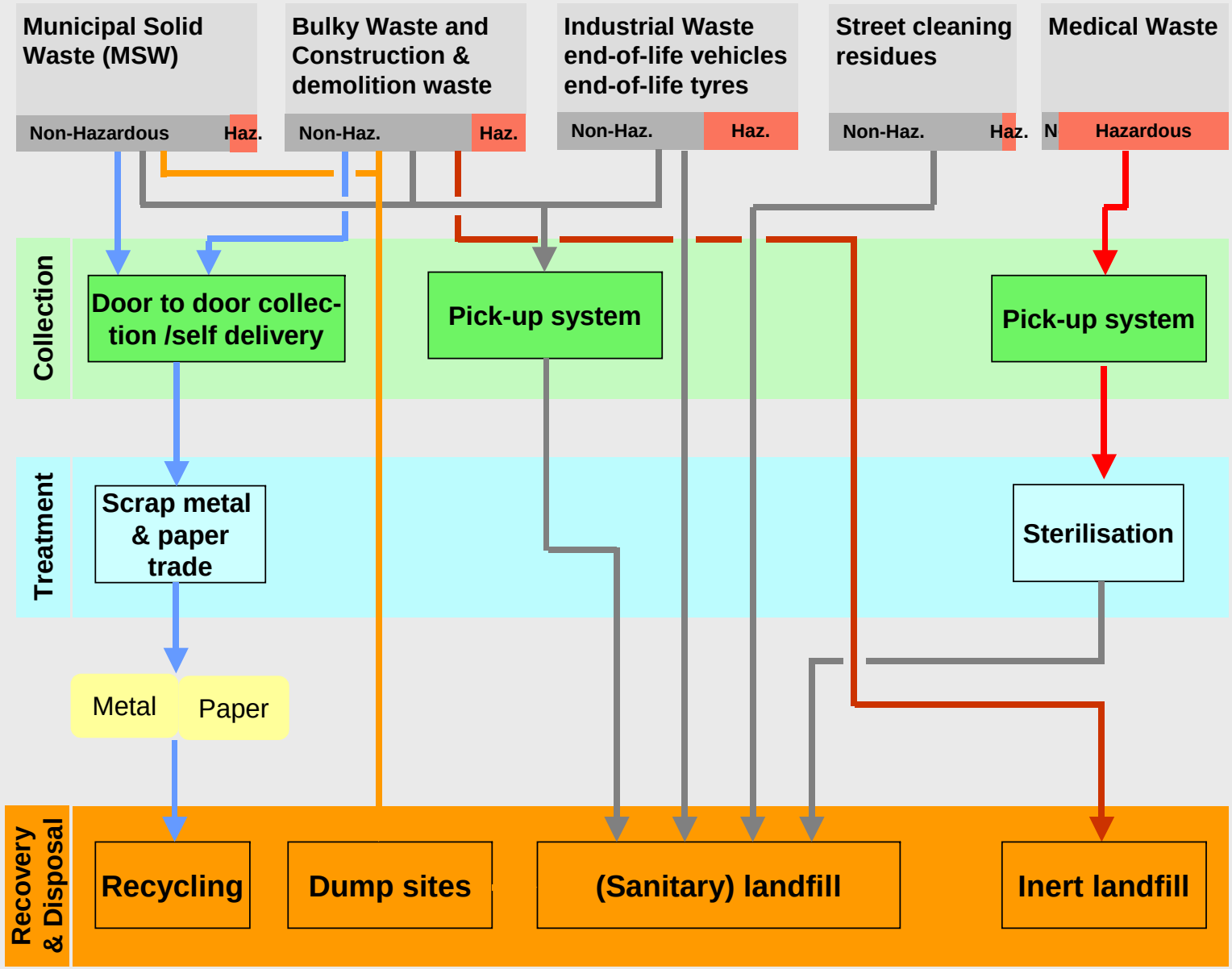
- Protection of human resources, nature and environment
- Waste disposal security
- Financial sustainability and cost efficiency
- Resource efficiency
- Social sustainability



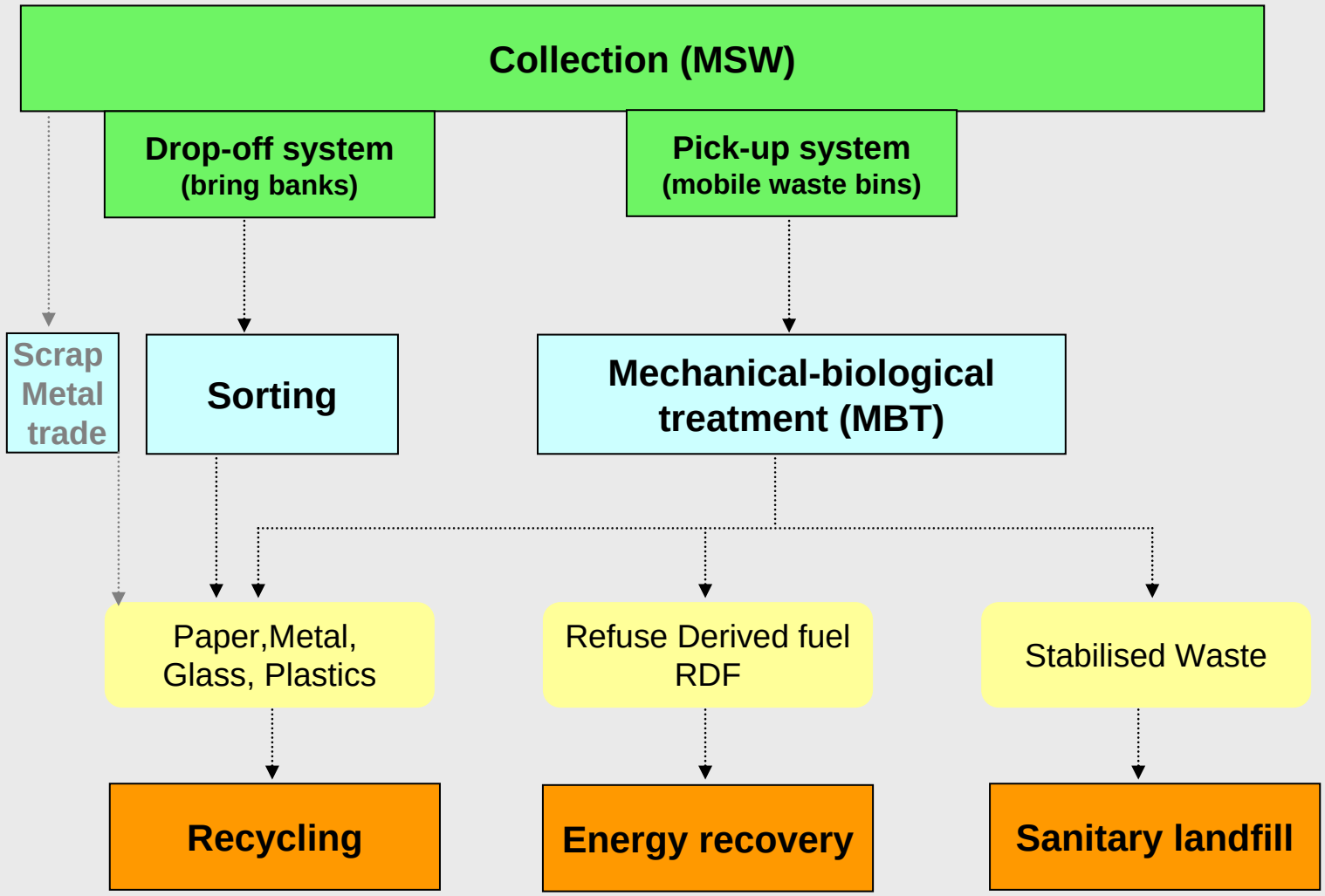
5.2. Waste management options

Process	Sub area	Specification
Waste collection & transport	Pick-up system	Mobile waste container & rear-end vehicle
	Drop-off system	Bring bank & collection vehicle with crane
Waste treatment	Mechanical	Comminution, sorting, classification, …
	Mechanical-biological	Composting, anaerobic digestion
	Biological	Neutralisation, Sterilisation,
	Physical	Pyrolysis
	Thermal	Incineration
Recovery & disposal	Deposition	Inert landfill, sanitary landfill, hazardous landfill
	Recovery	Recycling of metals, paper, glass, plastics
		Energy recovery by co-incineration

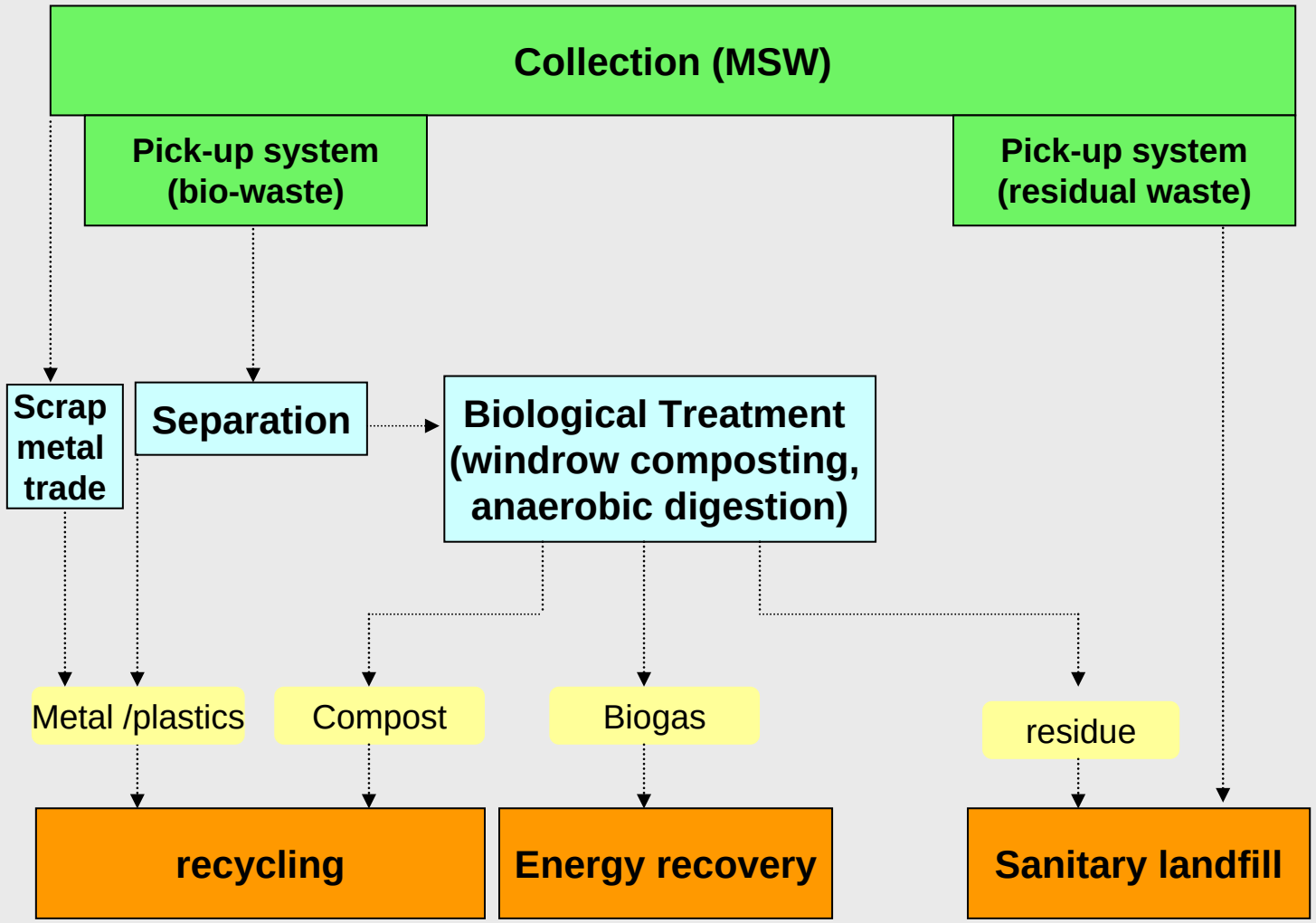
5.3. Scenario 0: Baseline



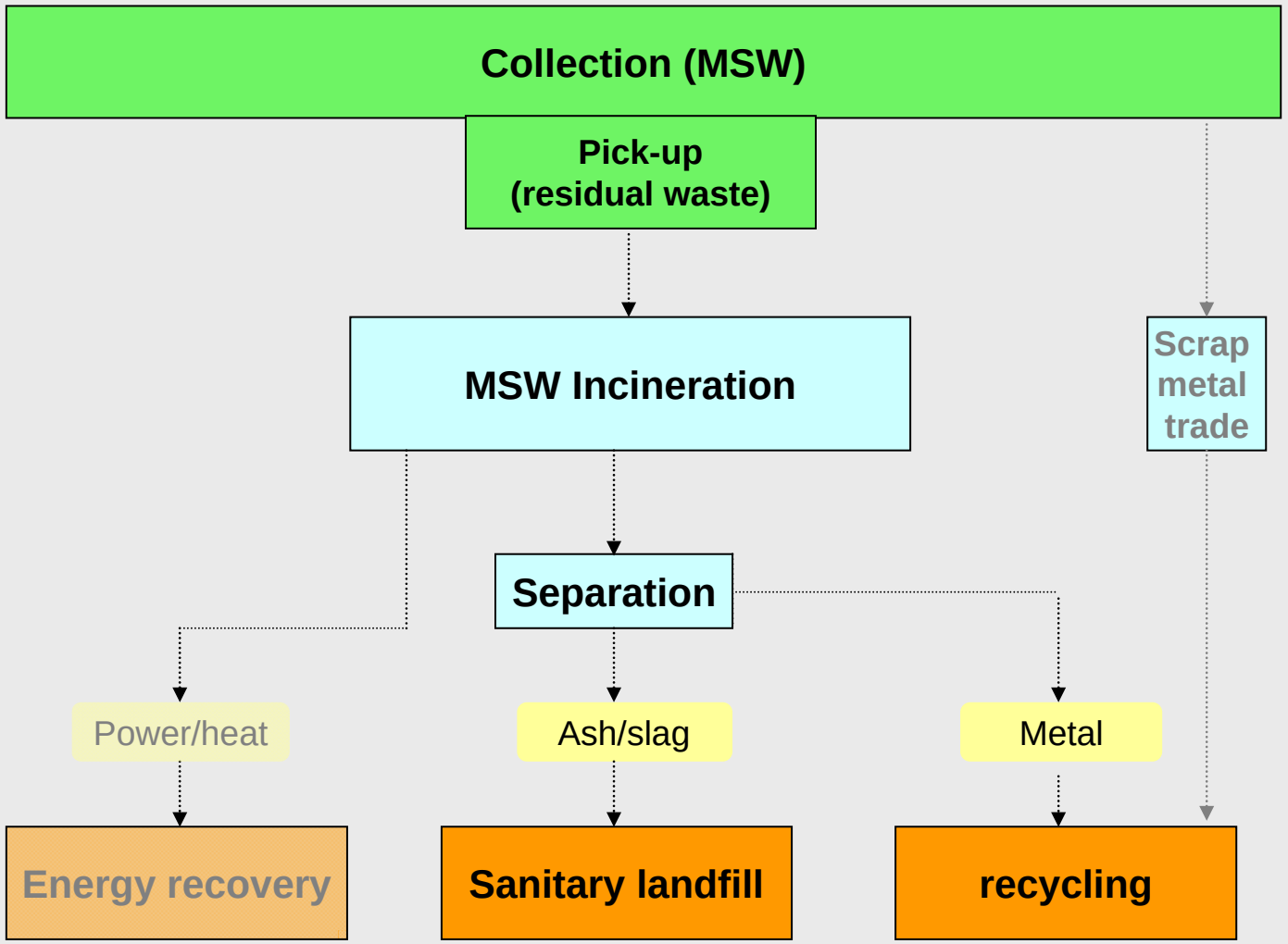
5.4. Scenario 1: Recycling



5.5. Scenario 2: Biological treatment



5.6. Scenario 3: Incineration



6. Process of decision making

- Methods for decision making process
- Objectives and strategy
- Development of evaluation criteria
- Process of decision making based on evaluation criteria
- Decision

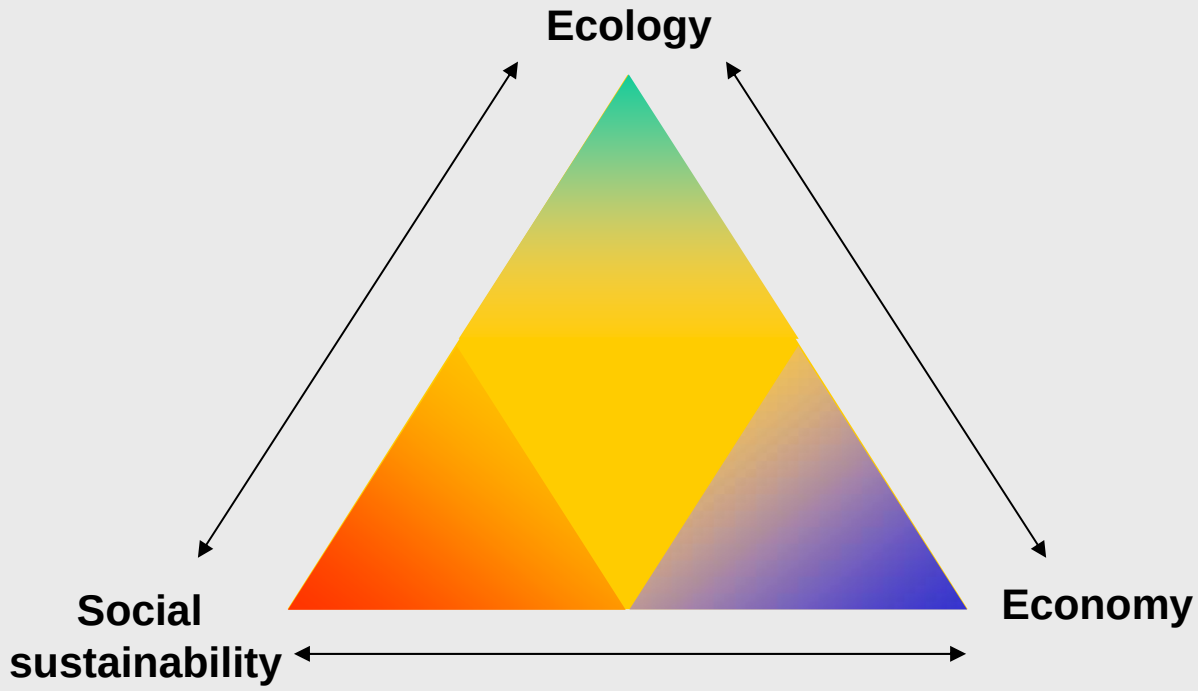
6.1. Methods for decision making process

- Consideration
- Vote
- Discussion
- Decision criteria
- Etc.

6.2. Objectives and strategy

Overall objectives:

- Protection of human resources, nature and environment
- Waste disposal security
- Financial sustainability and cost efficiency
- Resource efficiency
- Social sustainability



Specific targets

Ecology
- Waste prevention (deposit systems, innovative production, …)
- Implementation of environmental standards (disposal, incineration, mechanical-biological treatment, …)
- Reduction targets of deposition (prohibition of deposition for recyclables & organic material, tax on deposition, …)
- Determination of recycling targets (take-back obligation by producer, tax on resources, …)
- Reduction of carbon emission

Economy
- Selection of most cost effective technology
- Competition by selection of waste management operators
- Fee system by means of financial incentives

Social sustainability
- Acceptance of waste management system
- Participation of relevant stakeholders (recycling enterprises, waste pickers, …)
- Creation of jobs

6.3. Development of evaluation criteria

- Waste disposal security
- Protection of human resources, nature and environment
- Environmental impact
- Financial sustainability
- Social sustainability

- Compliance with legislation
- Technical feasibility
- Local job creation potential
- Flexibility

6.4. Process of decision making based on evaluation criteria

Decision making for a specific waste treatment in Khanty-Mansiysk

- Planning and political directions
- Technical feasibility
- Procedure to approve the waste management facility in the current legislation
- Procedure to approve the location of waste management facility
- Financing feasibility
- Market for secondary raw materials from waste

6.4. Process of decision making based on evaluation criteria

Assessment of scenarios – Step 1:

- The core assessment criteria are summarised and rated by a 5 - point scale (++, +, 0, -, - -).
- The assessment is relative to the baseline scenario (sanitary landfill, without recycling activities or deposition reducing measures):

  (++) - a very significant improvement for the respective scenario to the baseline

  (+) - a significant improvement for the respective scenario to the baseline

  (0) - no change with respect to the status-quo

  (-) - a distinct disadvantage for the respective scenario

  (--) - a very distinct disadvantage for the respective scenario.

6.4. Process of decision making based on evaluation criteria

Ranking of criteria Criteria	Scenario 0 Baseline	Scenario 1 Recycling	Scenario 2 Incineration
Costs & financing	++	0	-
Environmental impact	--	+	0
Carbon emission reduction	--	++	0
Resource efficiency	--	++	-
Reduction of deposition	--	+	++
Disposal of hazardous residues from waste treatment	0	0	-
Accordance with regional waste management concept	0	++	-
Flexibility (change of waste amounts, legal requirements, changing demands of recycling industry)	-	++	--
Waste disposal security (includes the risks of a functioning recycling industry)	+	+	++
Social impact (health, public acceptance, impact on local employment)	0	+	-

6.4. Process of decision making based on evaluation criteria

Assessment of scenarios – Step 2:

- In order to come to a final decision, the importance of each criteria has to be weighted.
- Therefore an opinion poll was carried out by representatives of the responsible administration in Khanty-Mansiysk.
- The result of the opinion poll was transferred to a weighting-matrix.
- Independently from this result, a second weighting-matrix was proposed by the German consultants.

6.4. Process of decision making based on evaluation criteria

Criteria / Weighting matrix	Weighting factor representatives KM	Weighting factor German Consultants
Costs & financing	33%	30%
Environmental impact	24%	10%
Carbon emission reduction		5%
Resource efficiency		2,5%
Reduction of deposition	19%	10%
Disposal of hazardous residues from waste treatment		2,5%
Accordance with regional waste management concept	14%	20%
Flexibility (change of waste amounts, legal requirements, changing demands of recycling industry)	5%	5%
Waste disposal security (includes the risks of a functioning recycling industry)		5%
Social impact (health, public acceptance, impact on local employment)	10%	10%

6.4. Process of decision making based on evaluation criteria

Results of assessment

Criteria	Scenario 0 Baseline	Scenario 1 Recycling	Scenario 2 Incineration
Result of assessment representatives KM	¼ (-)	(+)	¼ (-)
Result of assessment German Consultants	(0)	(+)	½ (-)

- Both waste treatment options incineration & MBT are **technical feasible.**
- The recycling scenario **is performing better** than incineration.
- Incineration **is more expensive,** but has the **highest deposition reduction.**
- Incineration **is less accepted** by population and administrative approval for demand of emission standards **is higher.**
- MBT **is less expensive** and **more environmentally friendly,** but pre-condition is an **effective recycling industry.**

6.5. Decision

Administration of the town Khanty-Mansiysk, actively took part in the process of data collection, the development of scenarios and the pre-selection of scenarios. We received all relevant information in form of a decision aid (document "Integrated Waste Management Concept - Comparison of pre-selected scenarios" / "Интегрированная концепция обращения с отходами - Сравнение предварительно отобранных сценариев"). After weighing the advantages and disadvantages of the "Mechanical-biological treatment with recycling of secondary raw materials" or the "incineration" of municipal waste, we decided that we want to build on the

Scenario 2: Mechanical-biological treatment with recycling of secondary raw materials

and want to develop this scenario further into a sustainable waste management concept for the town Khanty-Mansiysk within the project aforementioned.

Первый заместитель
Главы Администрации
города Ханты-Мансийска

В.В.Журавлев

Директор Департамента
городского хозяйства
Администрации города

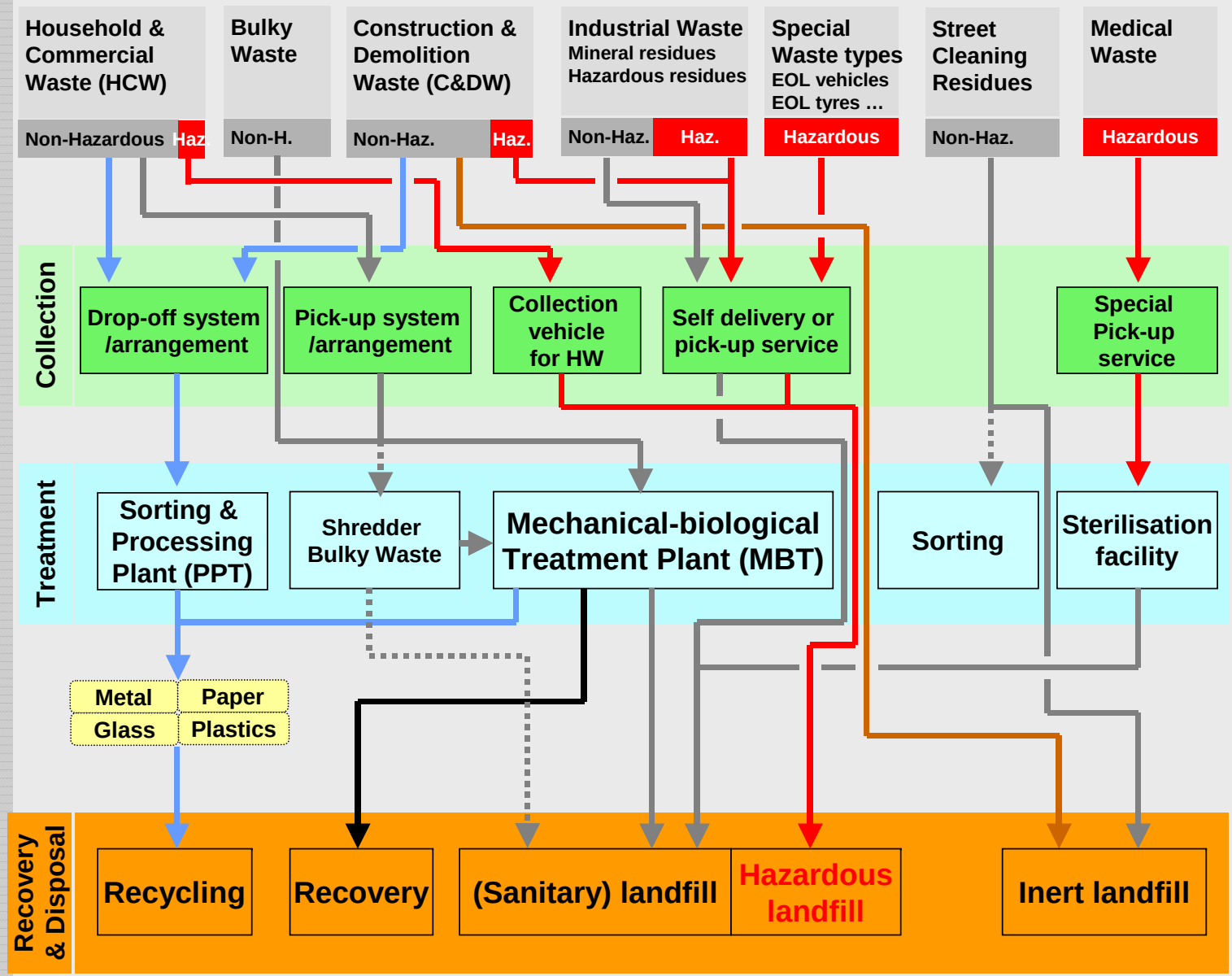
С.А.Эрнст

7. Development of a sustainable waste management concept

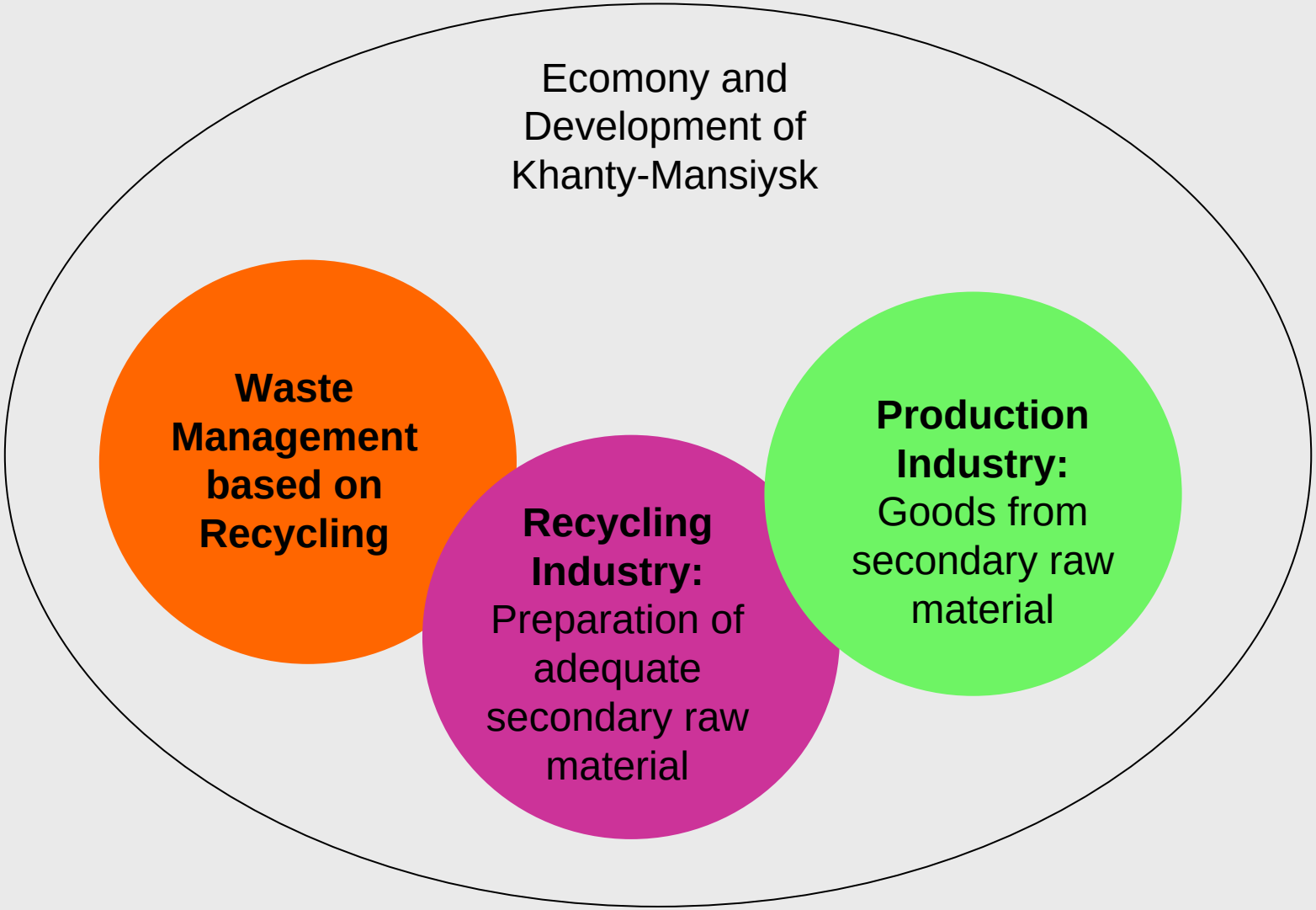
1. Recycling Concept
2. Pre-conditions for recycling
3. Technical description of Sorting and MBT
4. Technical description of a landfill
5. Proposals for implementation

7.1. Recycling Concept - Illustration

7. Development of a sustainable waste management concept



7.2. Pre-conditions for recycling



7.3. Technical description of Sorting and MBT

Mechanical biological treatment comprises a combination of mechanical and biological processes that further treat mixed residual waste before disposal.

The aim of this process combination is to minimise the environmental impacts of end disposal and to gain some further value from the waste through the recovery of recyclables and, in some cases, energy. The possible process configurations are numerous although consisting always of mechanical processes and a core biological treatment.

With rising environmental standards and higher recycling requirements, integrated systems have been developed that combine the two technology stages as an integrated entity and include emissions and odour control facets within a closed cycle.

They can offer a reasonably flexible approach to the management of different waste materials due to their high tolerance of variation in waste composition and can even function without any additional collection infrastructure, means they are also suited to the unsegregated household waste stream.

7.3. Technical description of Sorting and MBT

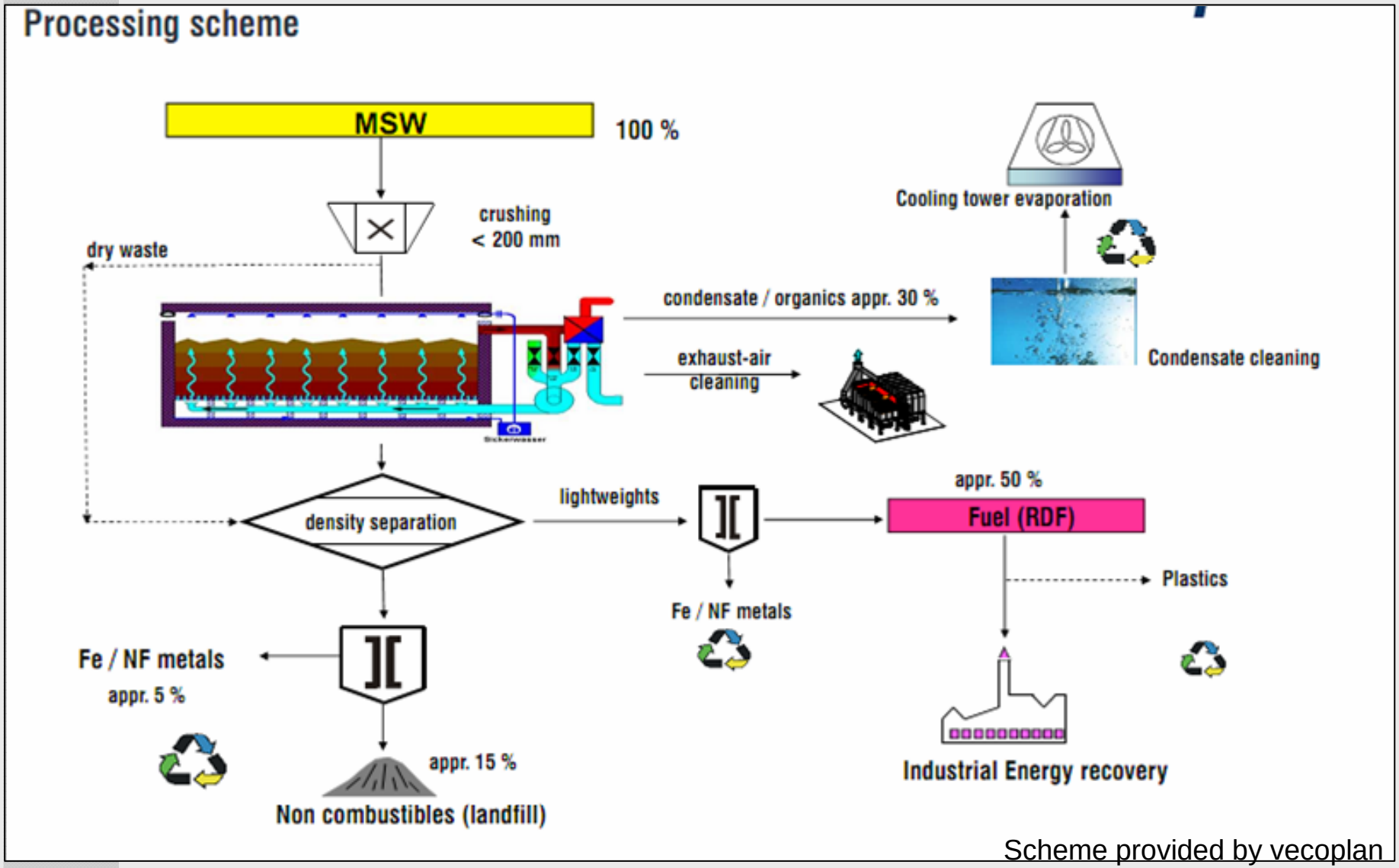
Mechanical biological waste treatment shall achieve:

- a stabilisation and reduction of the risk potential together with a significant weight and volume loss thru biological decomposition which could count towards the diversion of biodegradable waste from landfill, and in
  conjunction therewith

- the processing of the waste in order to generate separate material streams
  and improve suitability for subsequent treatment processes and

- the recovery of recyclable materials.

7.3. Technical description of Sorting and MBT



Scheme provided by vecoplan

7.4. Technical description of a landfill

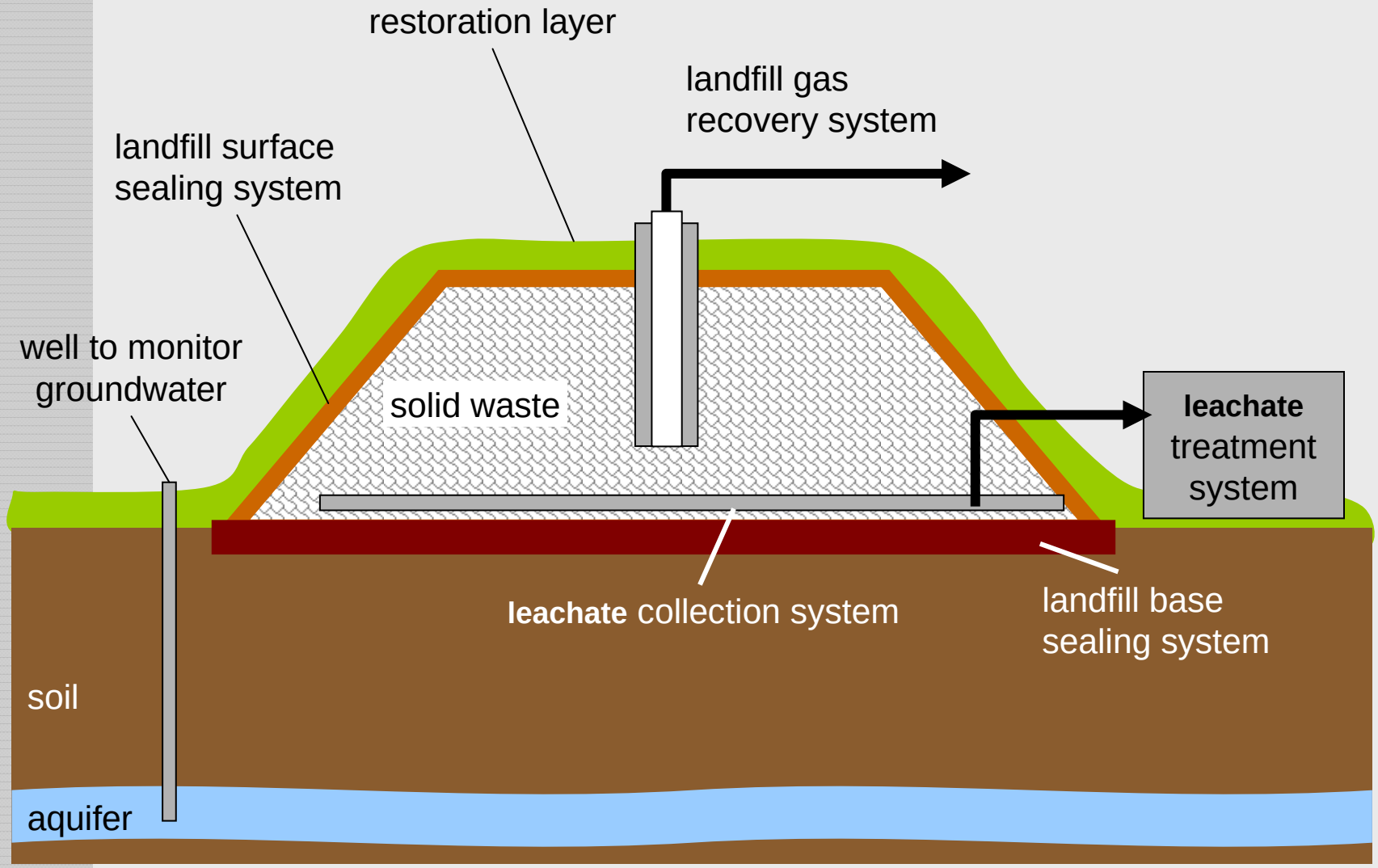
A sanitary landfill is an engineered area for a final but environmentally friendly disposal of non-hazardous solid waste. The optimal size of the area and facilities depends on waste amount disposed on of the landfill and local circumstances.

For avoiding risks of public health, waste disposal safety and ecological problems such as contamination of surface or groundwater resources or uncontrolled emissions of gases, the landfill is to be equipped with a full leachate collection and treatment, landfill gas collection and utilisation as well as appropriate landfill surface and base sealing system. Furthermore, the waste is to be spread in layers and covered with inert material at the end of each operating day.

An operation of a sanitary landfill has an economic advantage in comparison to more expensive treatment options. For amortization of the investment for the construction and closure of the landfill, an operation time between 15-20 years is imperative.

The unpredictable behaviour of the deposit requires a long permanent control at least 20-30 years after closure of the landfill and aftercare about 80-100 years after closure of the landfill.

7.4. Technical description of a landfill



Construction according to [EIA 2007]

7.5. Implementation of waste treatment

- Planning, design and construction of the Mechanical-Biological Treatment plant has to be commissioned to an experienced company.
- Preparation of the tendering procedure
  The information produced by the Russian-German SWMC-project, such as the Status-Quo report, description of the Solid Waste Management Concept, additional information on waste properties, market conditions for recyclables and RDF, project budget etc. is available for the tendering process
- Search for location of the MBT
  Information on distances, infrastructure etc. can be taken from the detailed Status-Quo report. Adjustment with other affected resorts (environmental impact assessment, construction permits etc.) Public acceptance of waste treatment plants needs to be communicated.

8. Resources for development of a sustainable waste management concept

1. General resources
2. Resources within the project

8.1. General resources

- Political will
- Budget
- Schedule
- Human resources

8.2. Resources within the project

- **Political will:**
  - Urban duma and urban administration proposed the idea of the project.
- **Budget:**
  - 80% by the German Federal Environment Ministry and the German Federal Environment Agency:
    - For Russian local municipalities/ waste disposal companies: Payments for travel and material costs
    - For Ugra State University: Payments for translation and organisation of meetings in Khanty-Mansiysk, travel costs, over head costs
    - For TU Berlin/ ARGUS e.V.: Payments for organisation of the project, advisory and supporting the implementation of waste analysis, travel costs, over head costs
  - 20% by all partners
- **Schedule/ Time period for implementing:**
  - 1.5 years

8.2. Resources within the project

Time period: 17 months																
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Catalyst, needs, ideea			**Strategic planning Status-quo report**								**Develop-ment of scenarios Feasibility study**		**Des-cision**	**Development of sustainable waste management concept**		
			Collec-ting data	Waste analysis	Collecting data		Market anal-ysis			Waste ana-lysis						

8.2. Resources within the project

Human resources:

- Employee and entire equipment for implementing the waste analysis – from M DEP
- Employee of High Technology park and students from the Ugra State University to implement the market analysis
- Employee of different department of the town to carry out the data analysis
- Employee of Regional department of Ecology – for further information
- German expert team of two institution: Technische Universität Berlin (Technical University of Berlin) and ARGUS e.V.

9. Conclusions

- General conclusions
- Conclusions for the project in Khanty-Mansiysk

9.1. General conclusions

- It can be expected that without any waste management the municipal waste will be increased rapidly in the next years internationally; i.e. In Russians towns.
- One of the global challenges is to deal with waste in an environmental manner and had to be taken into account seriously.
- A detailed concept of resources needed such as human resources, time and budget is essential to develop a sustainable waste management concept.

9.2. Conclusions of the project in Khanty-Mansiysk

- Without any waste management measures the amount of Municipal Solid Waste will increase up to 55 thousand tons per year in 2024.
- By implementing the recycling/MBT option the waste amount to be deposited can be reduced up to 13,200 Mg/a.
- Additionally recyclables and secondary fuels can be produced.
- The separate collection can be implemented in 2012, the MBT plant can be completed in 2016.
- Additional jobs can be created by operating the waste treatment facilities and recycling activities.

Thank you very much for your attention!

80% of this project has been funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety with means of the Advisory Assistance Programme for Environmental Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia. It has been technically supervised by the Federal Environment Agency Federal Environment Agency of the Federal Republic of Germany (Umweltbundesamt, UBA). The content of this publication lies within the responsibility of the authors.

20% of this project has been funded by the Technische Universität Berlin, ARGUS e.V., Ugra State University of Khanty-Mansiysk, the town Khanty-Mansiysk and the waste disposal company Municipal Road - Operational Enterprise (M DEP).