Universität Rostock

Traditio et Innovatio

Biodrying for Mechanical Biological Treatment of mixed municipal solid waste and potential for RDF production.

Ayman Elnaas

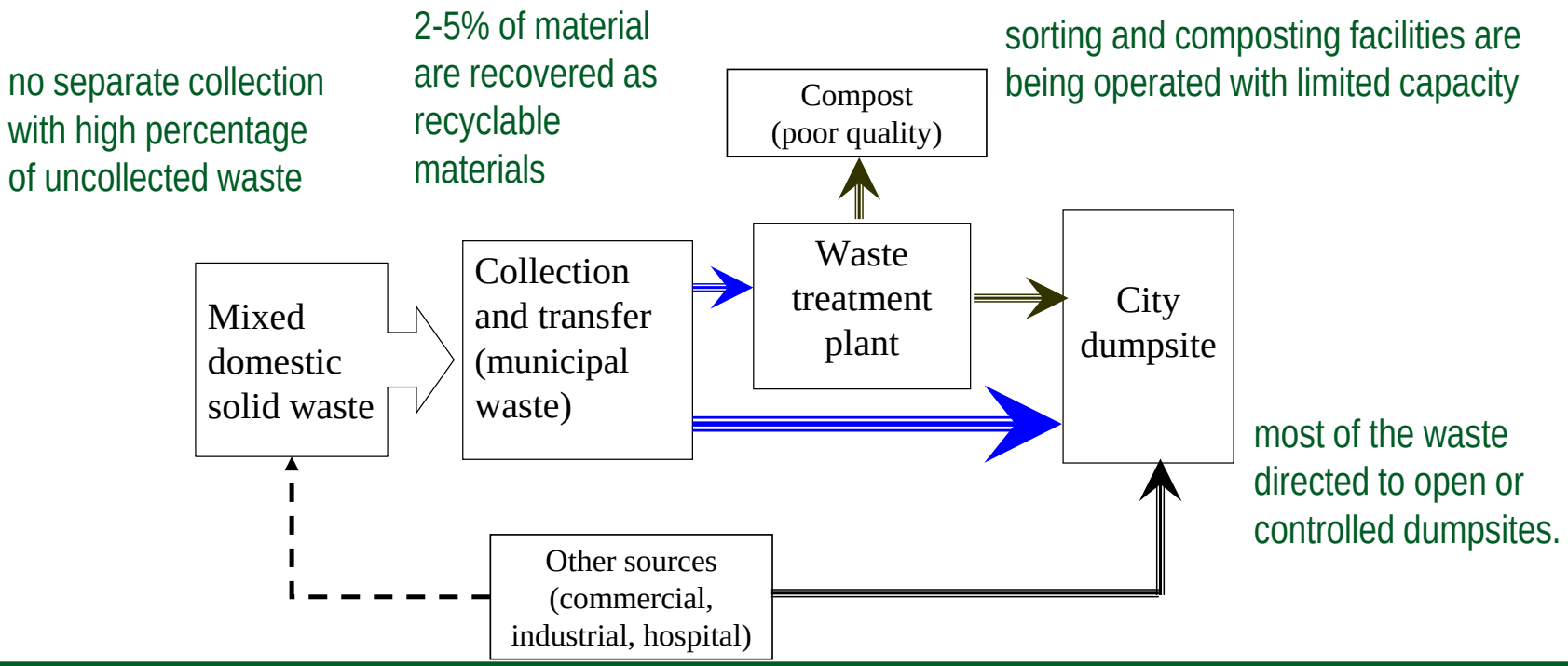
Department Waste Management and Material Flow

University of Rostock

- **KfW Development Bank.**
- **Tunisian National Agency for Waste Management (ANGed). University of Innsbruck**
- **Lahmeyer GKW Consult GmbH**
- **STE, Tunis**
- **University of Tunis.**

Overview

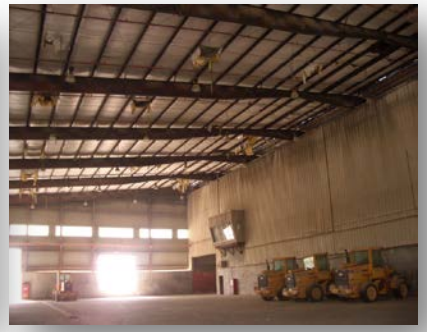
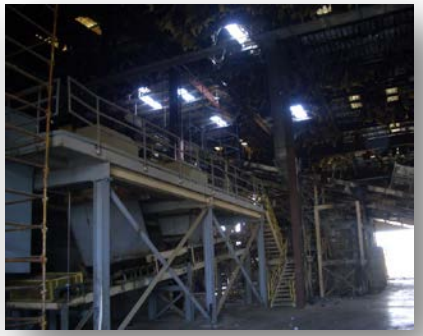
- Collection and sorting, composting, incineration of medical wastes and sanitary landfills starting to be implemented
- Recycling, reuse and resource recovery still at the initial stages.



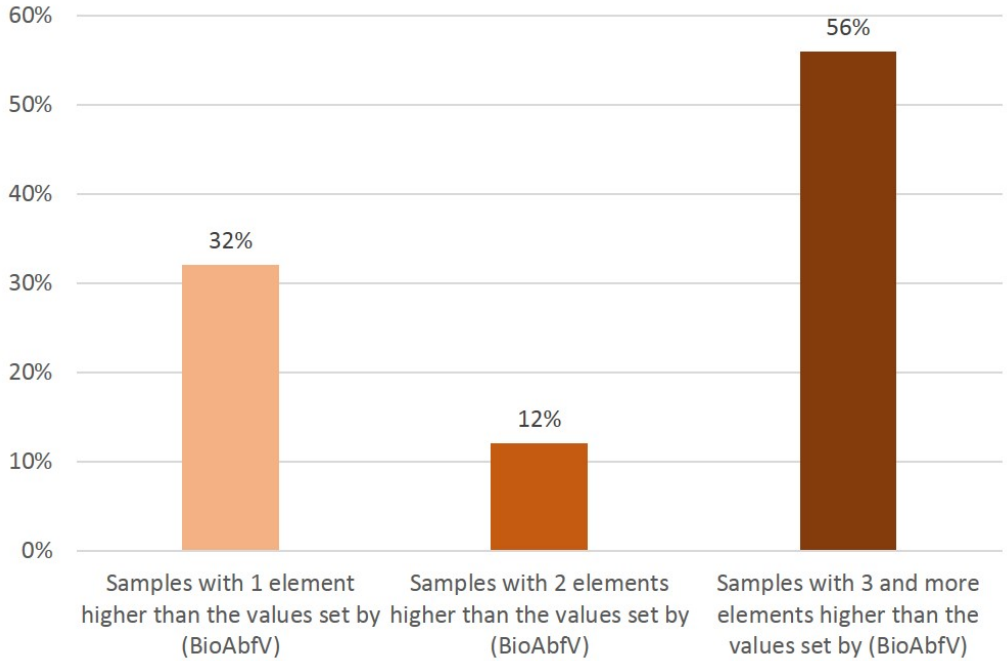
Current situation

failure of treatment plants was due to:

- the mismanagement of the plants
- the selection of inappropriate technology for the local conditions
    - *high operating costs*
    - *frequent mechanical breakdowns*
- lack of understanding of the composting process
- untrained personnel for the operational procedures
    - *poor maintenance*


Current situation



- heavy metals
- organic pollutants
- physical risks

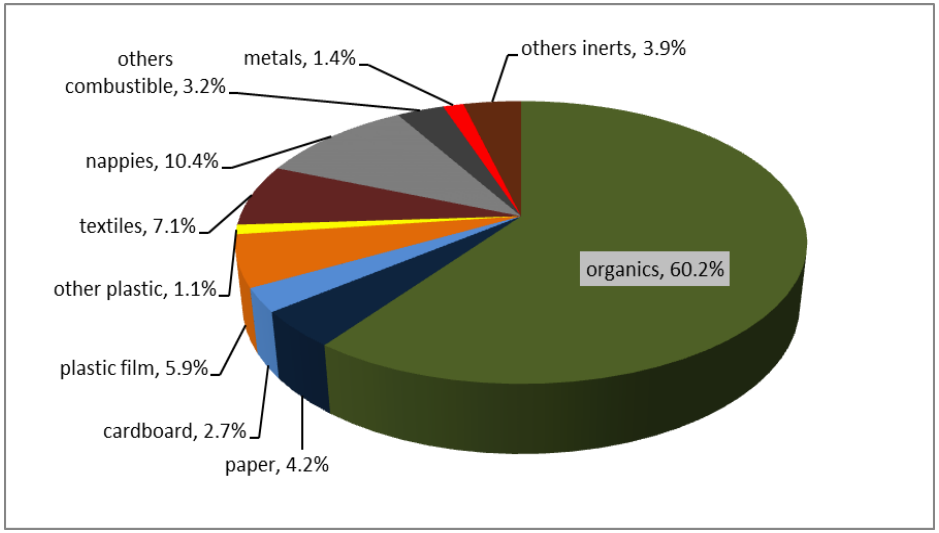
  (sharp objects, glass and the aesthetical problem of plastic)

The aim of this Study

- Assess the performance of Biological drying process of solid waste, by aerated windrow composting/stabilization, was investigated
- Investigate the potential for RDF produced by using the biological drying/stabilization process
- The economic feasibility and financial risk of the project proposal is evaluated by carrying out a capacity analysis.

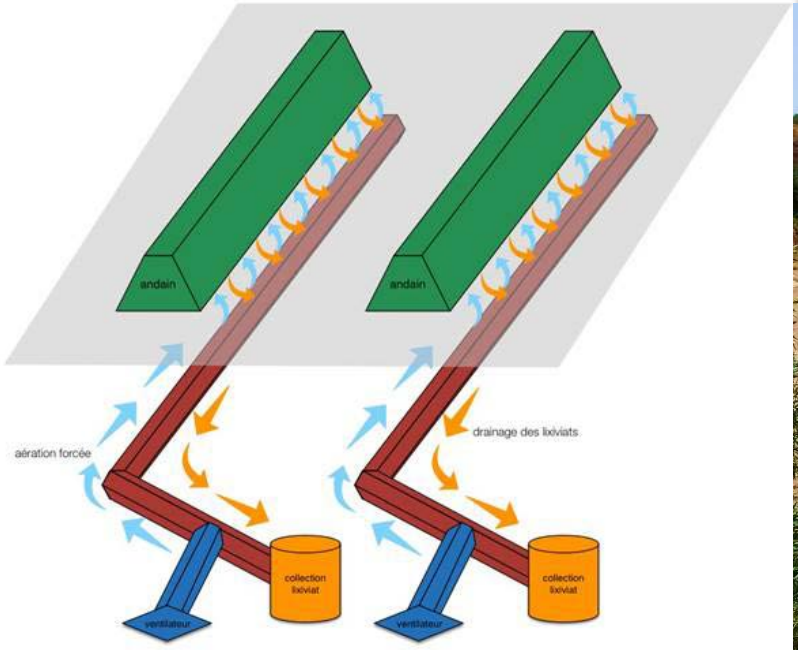
Materials and methods

Input material



Trials	Quantity of waste (t)	Number of windrows	Beginning of trail	End of trail
1	110	2	25/06/2014	15/07/2014
2	96	1	04/08/2014	28/08/2014
3	98	1	03/09/2014	23/09/2014
4	145	2	27/10/2014	19/11/2014
5	60	1	02/12/2014	17/12/2014

Materials and methods



Universität Rostock Traditio et Innovatio

Materials and methods

Receiving 100 tonnes of waste

Turning waste

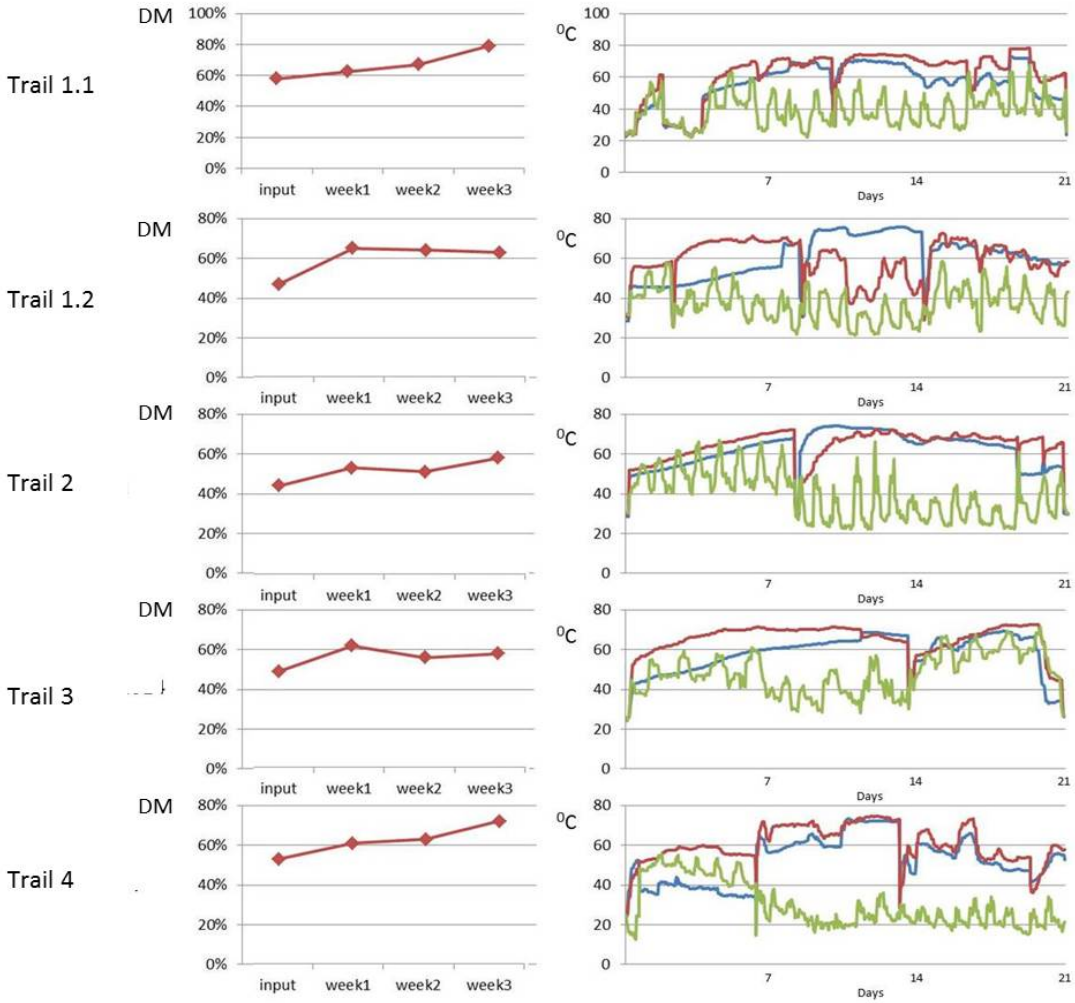
Build the windrow

Laying the membrane

Setting up the Wireless Temperature Sensor

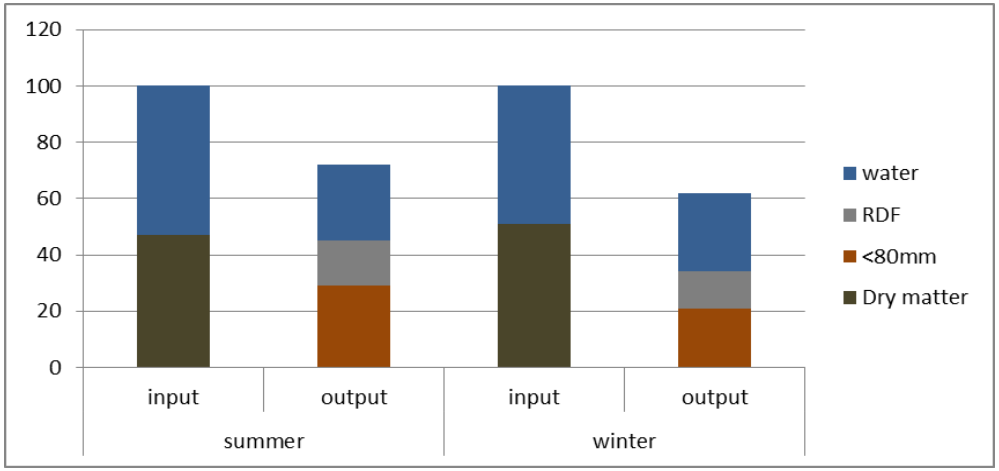
Overall view

Experimental monitoring

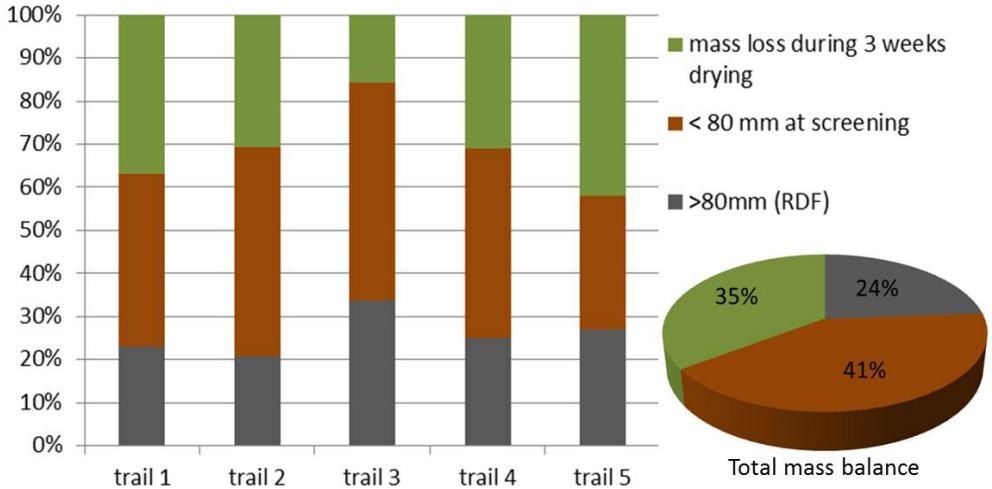


Results

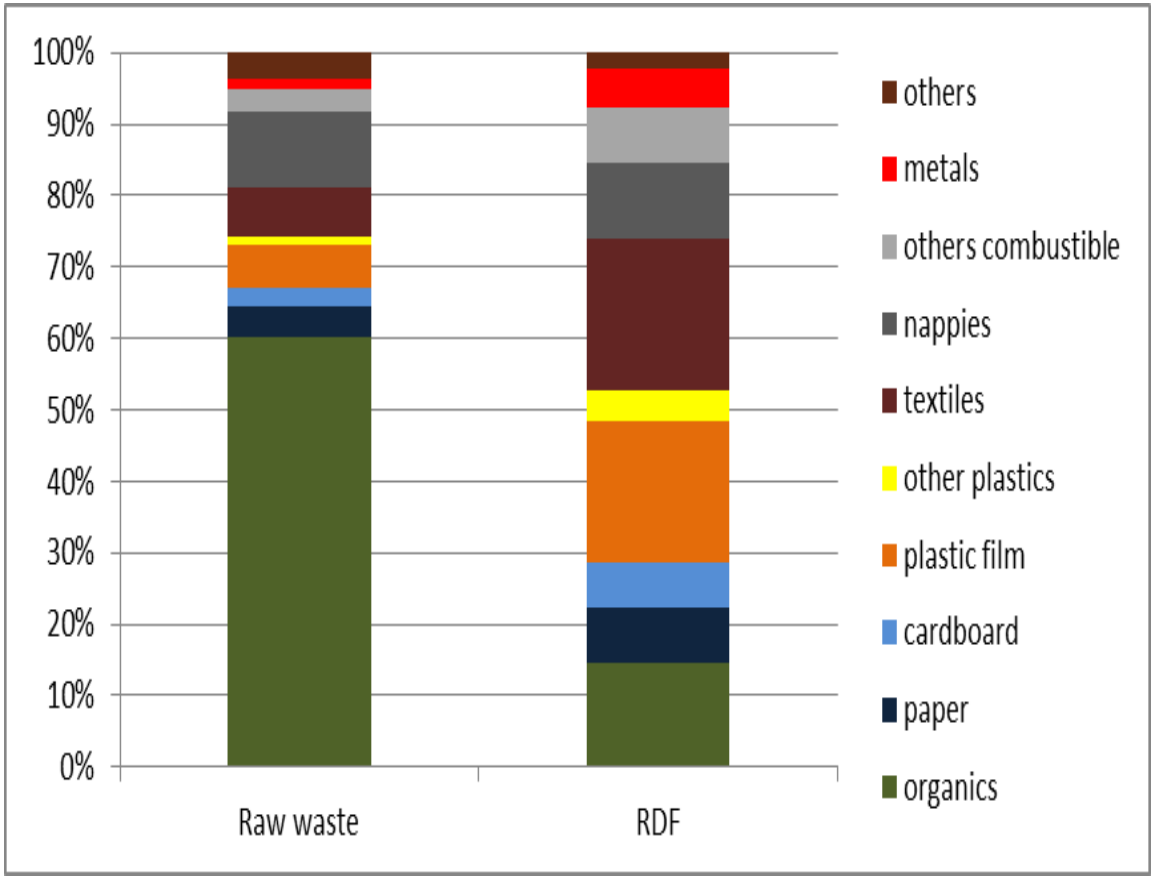
mass balance



Screening at 80mm



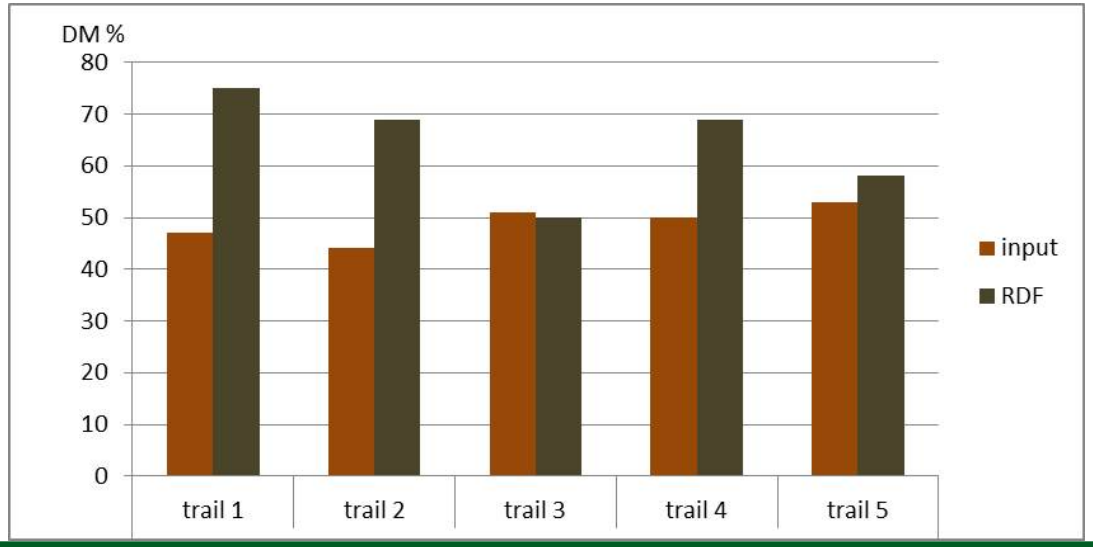
RDF characterization



Results

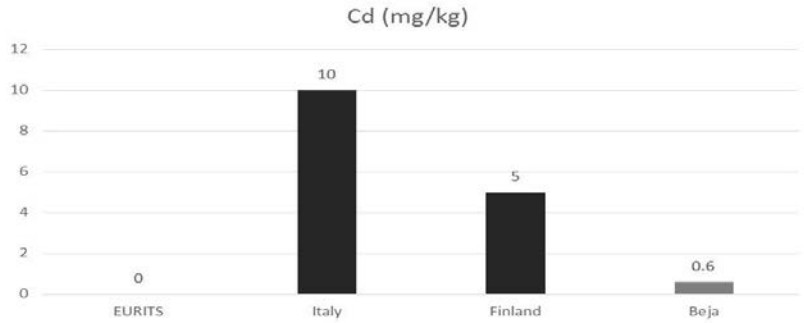
Parameter	summer trial			winter trial	Average
	1	2	3	4	
DM_{Input} (%)	47	44	54	47	48
LHV_{Input} (MJ/Kg)	16.04	16.79	17.94	15.56	16.24
$DM_{output/RDF}$ (%)	75	69	50	67	66
$LHV_{output/RDF}$ (MJ/Kg)	18.87	20.61	19.96	18.87	19.58
$Ash_{output/RDF}$ (%)	31.9	17.6	20.3	23.8	24

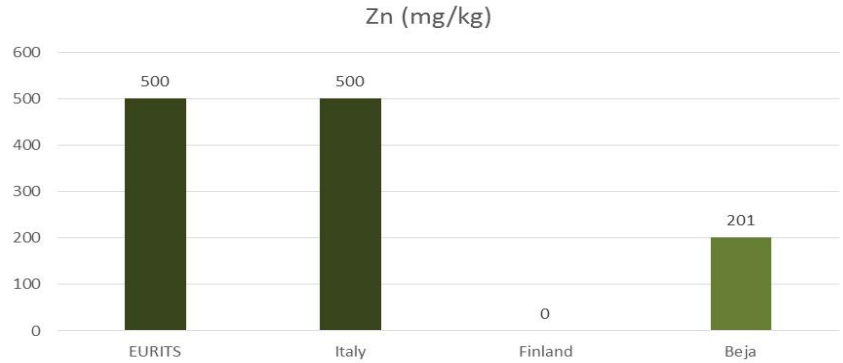
The dry matter of the input and the produced RDF

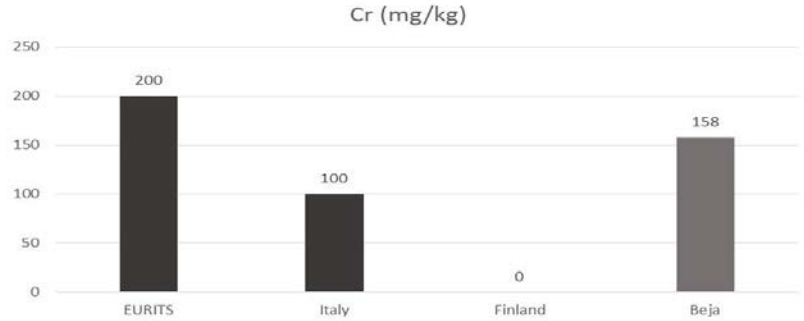


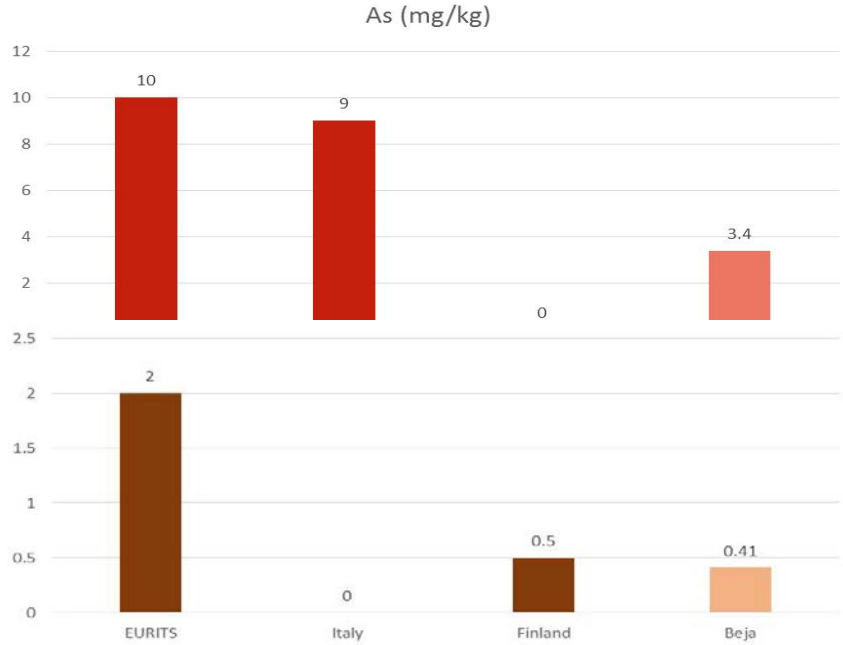
Universität Rostock Traditio et Innovatio

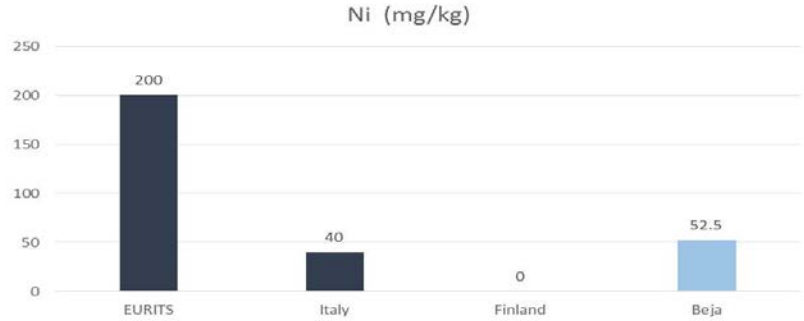
Heavy metals







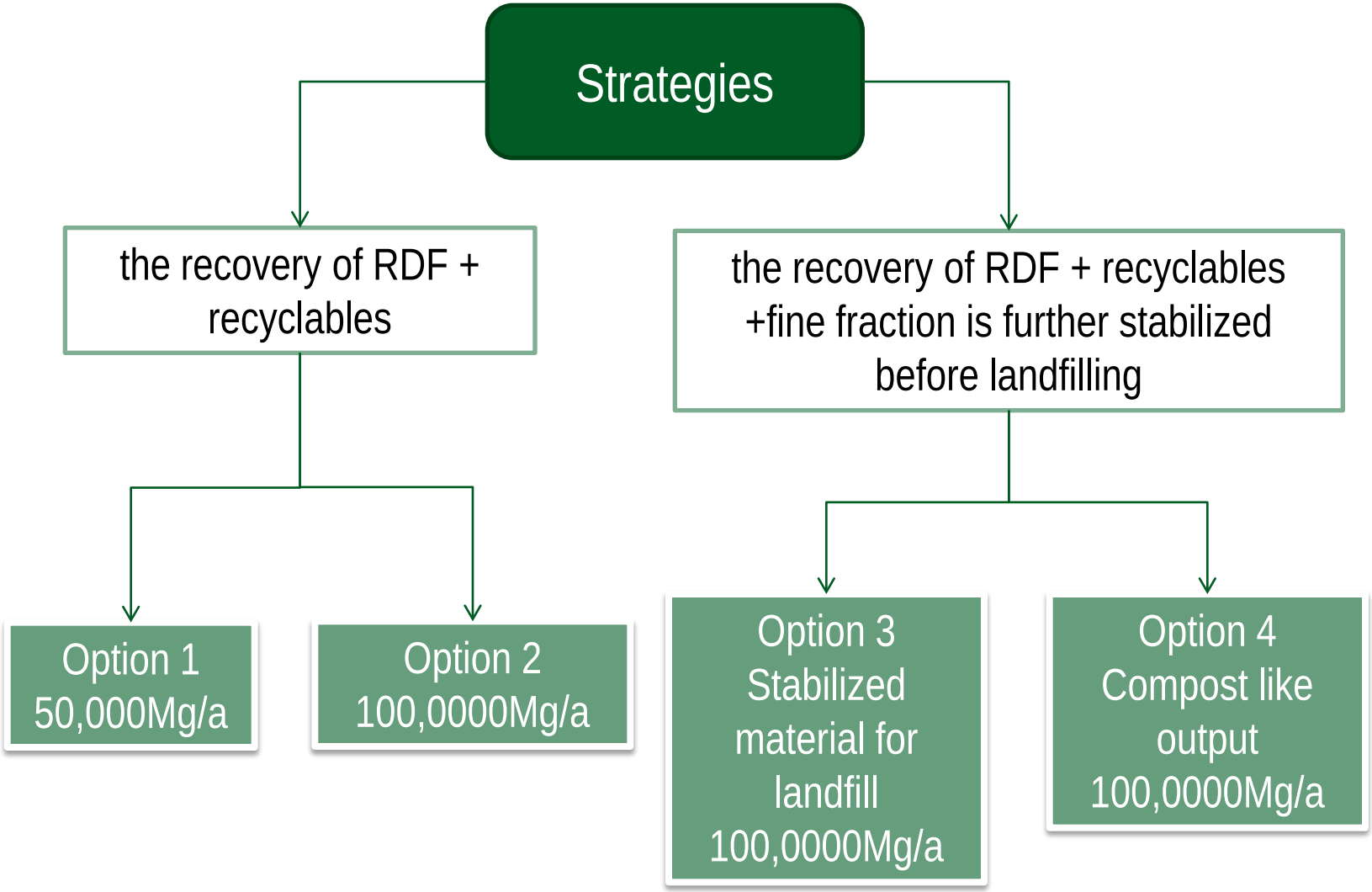




Hg (mg/kg)

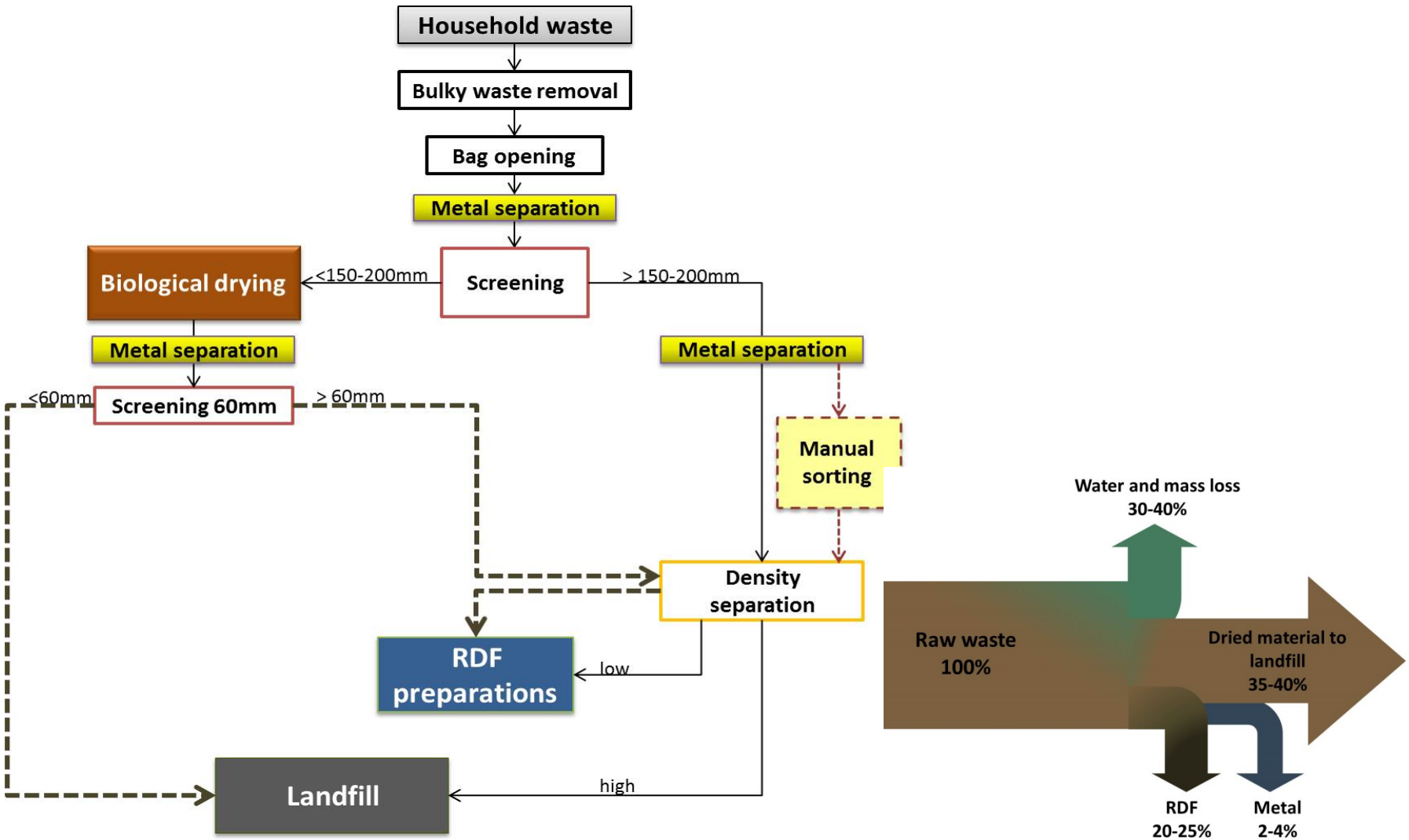
Universität Rostock Traditio et Innovatio

Proposed RDF Facilities for the Arab region



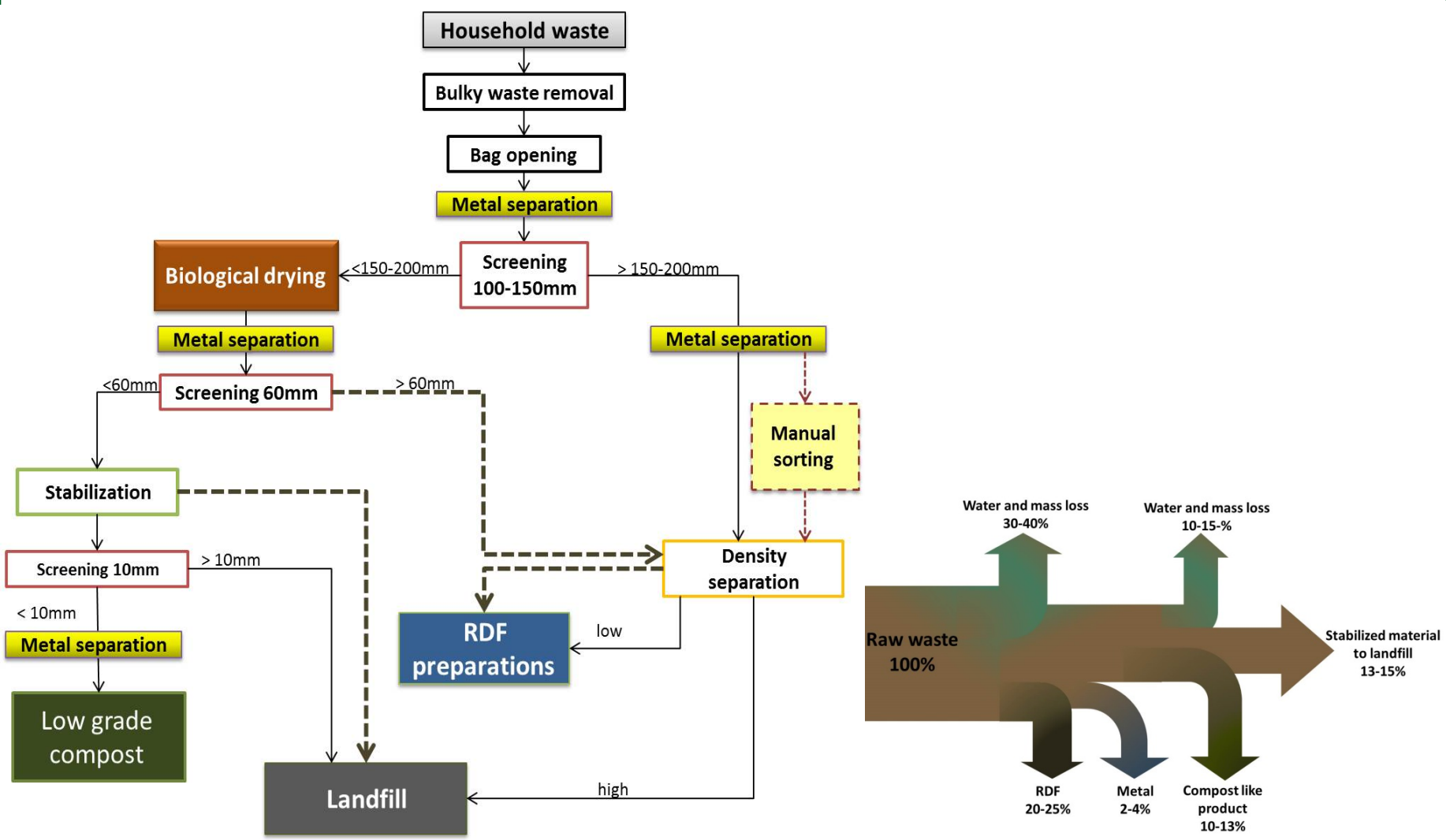
Universität Rostock Traditio et Innovatio

Strategy 1, biological drying, RDF production and recyclable material recovery.



Universität Rostock Traditio et Innovatio

Strategy 2, biological drying, RDF and stabilized material production and recyclable material recovery.



Economic Feasibility Analysis

The cost of each plant includes:

- Total capital investment.
- Operation and maintenance cost.

Revenues:

- Sale of produced RDF.
- Recycled materials.
- Gate fee.

Assumptions

- Plant work for 4000hr/yr.
- 2 shifts daily each shift is 8 hours.

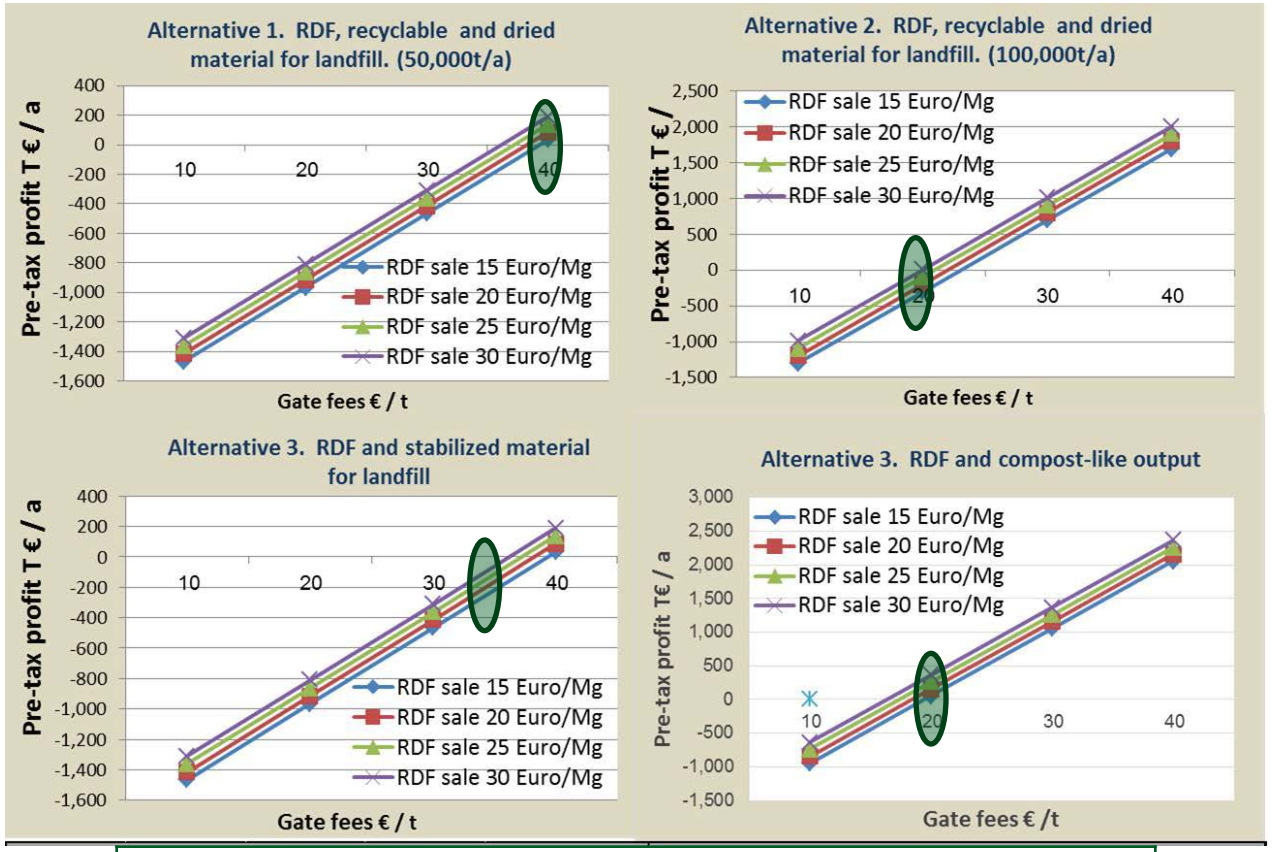
Universität Rostock Traditio et Innovatio

Capital costa and assumptions

Option	Capacity	Quantity (Mg/a)	capital investment (Million Euro)
1	RDF production and recyclables recovery.	50000	8
2	RDF production and recyclables recovery.	100000	12
3	RDF, recyclables recovery and stabilized material for landfilling.	100000	14
4	RDF, recyclables recovery, compost-like output (CLO) and inert material for landfilling.	100000	14

Annual cost:		
Net equity percentage	30	%
Useful economic life	15	years
Interest (inflation adjusted)	5	%p.a.
Insurance, Revisions	2	%p.a.
Expenses:		
Removal costs for residues and transportation	10	€ / Mg
Maintenance costs	100	€ / h
Electricity consumption costs	80	€/ MWh
Personnel costs (1 man): 12000 €/a		
Number of necessary persons: 40		
Effective	480000	€/a

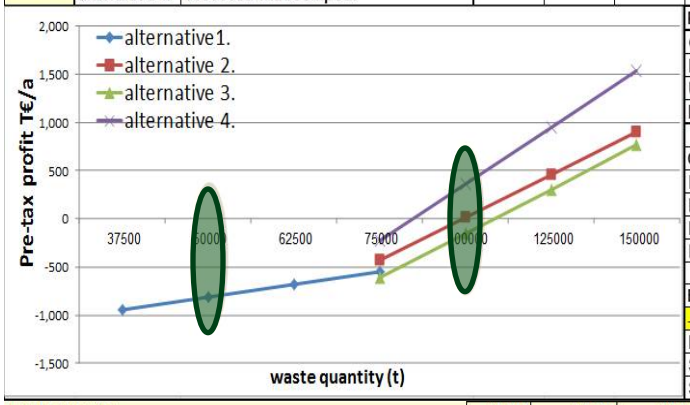
Gate fees and RDF selling price



Revenue		
Gate fee	10,20,30,40	€ / Mg
Sale of RDF	15,20,25,30	€ / Mg
Sale of recyclables	50	€ / Mg
Sale of compost like output	10	€ / Mg

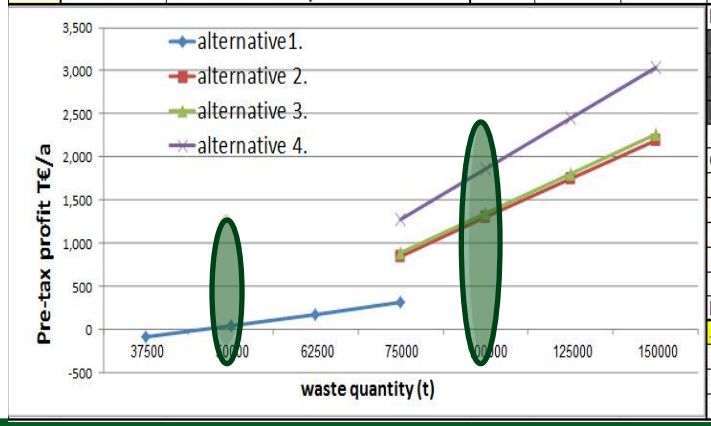
Revenue from the suggested options

waste quantity		37,500	50,000	62,500	75,000	100,000	125,000	150,000	t
Pre-tax profit T€/a	alternative1. 50000t/a drying and RDF production	-943	-810	-678	-546				T€ / a
	alternative 2. 100000t/a drying and RDF production				-436	9	454	898	T€ / a
	alternative 3. 100000t/a with stabilization				-610	-152	306	763	T€ / a
	alternative 4. 100000t/a with compost				-224	363	949	1,536	T€ / a



Parameter :		
Capital investment	8,12,14	MioEUR
Net equity	30	%
Useful economic life	15	years
Interest (inflation adjusted)	5	% p.a.
Costs:		
Effective personnel costs	480,000	EUR/a
Maintenance	100	EUR / Op hour
Removal of residues	10	EUR / Mg
Electricity consumption	80	EUR / MWh
Earnings:		
- Waste acception fee	20	EUR / Mg
RDF sale	30	EUR / Mg
Sale of recyclable material	50	EUR / Mg
Sale of compost	10	EUR / Mg

waste quantity		37,500	50,000	62,500	75,000	100,000	125,000	150,000	t
Pre-tax profit T€/a	alternative1. 50000t/a drying and RDF production	-83	49	181	314				T€ / a
	alternative 2. 100000t/a drying and RDF production				854	1,298	1,743	2,187	T€ / a
	alternative 3. 100000t/a with stabilization				894	1,352	1,810	2,268	T€ / a
	alternative 4. 100000t/a with compost				1,280	1,867	2,454	3,040	T€ / a



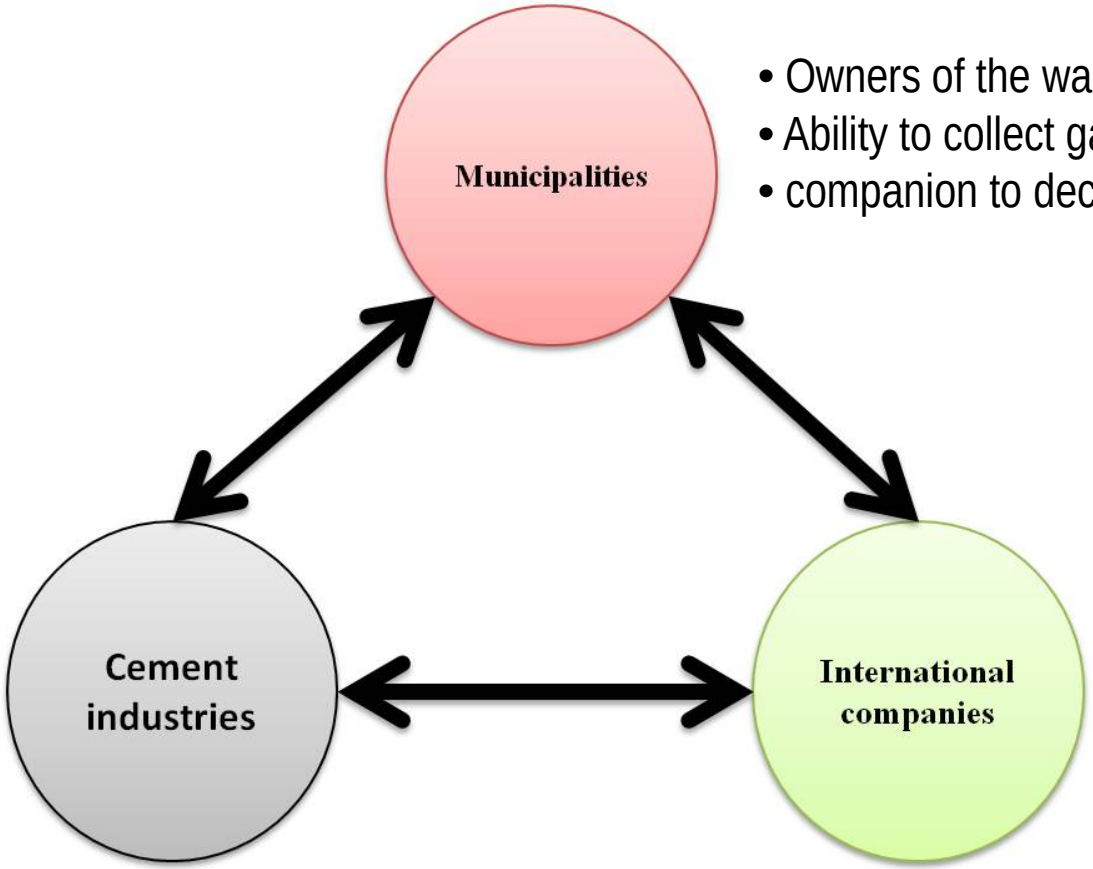
Parameter :		
Capital investment	14	MioEUR
Net equity	30	%
Useful economic life	15	years
Interest (inflation adjusted)	5	% p.a.
Costs:		
Effective personnel costs	480,000	EUR/a
Maintenance	100	EUR / Op hour
Removal of residues	10	EUR / Mg
Electricity consumption	80	EUR / MWh
Earnings:		
- Waste acception fee	20	EUR / Mg
RDF sale	30	EUR / Mg
Sale of recyclable material	50	EUR / Mg
Sale of compost	10	EUR / Mg

Conclusions

- RDF production considered a good alternative for the region
  - the reduction of the moisture content
  - increase in the calorific value
  - decrease leachate production
- The biodrying process dried the waste within 3 weeks.
  - efficient screening of the waste
  - Easley separate the recyclables and high calorific components from the organic fines fraction.
- High capital investment is needed to set up a RDF plant.
- return on investment is not guaranteed to treat the designed waste quantity for all cases.
- The selection of the appropriate solution for MSW must be based on many factors, such as the availability of land for disposal
  - market for recyclable material
  - the need for energy production

Universität Rostock Traditio et Innovatio

Cooperation between municipalities cement industries and international waste companies



- Owners of the waste
- Ability to collect gate fees
- companion to decision-makers

- Owners of the facilities to utilize RDF.
- Investment capability
- Willing to reduce the energy cost

- Owners of the Know-how.
- Experienced in this field.
- Investment capability

Universität Rostock Traditio et Innovat

Separation at source „Wet“ and „Dry“ is the trend in the world

Wet

2 ways for the treatment

Loss through biological treatment (ca. 25 %)

Compost Ca. 50 %)

Landfill (25 %)

Drying and preperation of RDF for cement industry

Loss through biological treatment (ca. 25 %)

RDF (Ca. 50 %)

Landfill (25 %)

Dry

Separation of recycling material and preperation of RDF for cement industry

Recycling material for sell (ca. 25 %)

RDF (Ca. 50 %)

Landfill (25 %)

Universität Rostock Traditio et Innovatio

Thank you for your attention