

Appendix 4 Documentation of the MSW Expenditure Functions

1	Introduction	3
2	Projection of MSW Generation	4
2.1	MSW Sources and Fractions Covered by FEASIBLE	4
2.2	Projection of MSW Generation by Households	7
2.3	Projection of MSW Generation by Commerce, Industry and C&D	9
3	Expenditure Functions for MSW Collection	11
3.1	Coverage of MSW Collection	11
3.2	MSW Collection Methods	12
3.2.1	Expenditure Functions	13
3.3	MSW Collection Systems	21
3.4	Corrections to Expenditure Functions	24
3.4.1	Share of Re-Investment Expenditure	25
3.5	Expenditure Function for Additional Transport	26
4	Expenditure Functions for MSW Treatment/Recovery	27
4.1	Treatment/Recovery Facilities	27
4.1.1	Waste Flow Considerations	28
4.2	Expenditure Functions for Treatment/Recovery	28
4.2.1	Waste Flow and Investment/O&M Expenditure	28
4.2.2	Method of Establishing the Expenditure Functions	29
4.2.3	MRF Mixed Waste	30
4.2.4	MRF Recyclables	33
4.2.5	MRF WEE	34
4.2.6	Composting Plants	35
4.2.7	Bio gasification Plant	37
4.2.8	Landfills	39
4.2.9	Incineration Plants	44
4.2.10	Treatment Facility for Hazardous Household Waste	48
4.2.11	C&D Recycling Facility	49
4.3	Transport of Residues to Landfills	50
4.3.1	Expenditure Function	51
5	Calculation of the Efficiency and Revenue of Recycling/Recovery	52
5.1	By-Products	52

5.1.1 Revenue from Sale of By-Products 52

- Attachment 1 Efficiencies of Collection Methods
- Attachment 2 Detailed Overview of MSW Collection Expenditure Functions
- Attachment 3 Compatibility between Collection Methods and R&D Facilities
- Attachment 4 Details on MSW Treatment/ Recovery Expenditure Functions

1 Introduction

The expenditure functions for the municipal solid waste management sector are calculated in several stages which correspond to a generalised waste flow as illustrated in Figure 1 below.

Figure 1 Generalised waste flow



The key parameters related to the expenditure functions for each step in the waste flow are described in the following chapters.

Chapter 2 describes the assumptions and modelling parameters regarding projection of MSW generation.

Chapter 3 describes the assumptions and modelling parameters regarding expenditure functions for MSW collection.

Chapter 4 describes the assumptions and modelling parameters regarding expenditure functions for MSW treatment and recovery.

Chapter 5 describes the assumptions and modelling parameters regarding the calculation of recycling and recovery efficiencies and revenue.

2 Projection of MSW Generation

2.1 MSW Sources and Fractions Covered by FEASIBLE

The MSW sources and fractions covered by FEASIBLE are presented in Table 1 below. The MSW generation and composition (per source and fraction) in the base year are entered by the user. FEASIBLE then generates a projection of the waste generation per source and fraction in the planning period.

Table 1 Sources and fractions handled by FEASIBLE

Source	Fractions
Households, urban area, multi-storey houses Households, urban area, single-family houses Households, rural area	Paper Cardboard Cardboard, bulky Plastic Glass Metal Metal, bulky Food Garden Non-combustible, residual Combustible, residual Combustible, residual, bulky Hazardous WEEE
Commerce and services	Paper Cardboard Plastic Glass Metal Food Garden Non-combustible, residual, bulky Combustible, residual WEEE
Industry	Paper Cardboard Plastic Glass Metal Food Non-combustible, residual Combustible, residual

Source	Fractions
Construction and demolition	Plastic Metal Concrete, tile, rubble Non-combustible, residual Combustible, residual
Wastewater treatment plants ¹	Sludge

Standard composition In some cases, data on MWS composition may not exist. FEASIBLE offers three standard options which represent the typical composition of MSW in the following types of countries:

- CIS countries
- CEE countries
- EU countries

The standard compositions are shown in Table 2 below.

Table 2 Standard composition of MSW in FEASIBLE (EU, CEE and CIS countries)

Source	Fractions	EU	CEE	CIS
Households, urban area, multi-storey houses	Paper	23.3%	7.1%	8.5%
	Cardboard	5.3%	4.5%	6.4%
	Cardboard, bulky	0.4%	0.4%	0.4%
	Plastic	5.6%	5.4%	6.4%
	Glass	4.3%	7.2%	8.5%
	Metal	1.8%	2.7%	3.4%
	Metal, bulky	2.1%	0.9%	0.9%
	Food	28.7%	44.6%	46.7%
	Garden	3.1%	2.2%	2.1%
	Non-combustible, residual	1.6%	1.8%	4.2%
	Non-combustible, residual bulky	10.2%	2.2%	2.1%
	Combustible, residual	3.7%	16.0%	6.4%
	Combustible, residual, bulky	8.4%	4.4%	3.4%
	Hazardous	0.3%	0.2%	0.2%
	WEEE	1.2%	0.4%	0.4%
Total		100.0%	100.0%	100.0%

¹ Sludge is imported from the wastewater module of FEASIBLE for disposal at a landfill.

Source	Fractions	EU	CEE	CIS
Households, urban area, single-family houses	Paper	15.0%	9.0%	10.6%
	Cardboard	3.6%	5.6%	7.1%
	Cardboard, bulky	0.5%	0.4%	0.5%
	Plastic	3.7%	6.8%	7.1%
	Glass	2.7%	9.0%	10.6%
	Metal	1.3%	3.4%	3.8%
	Metal, bulky	2.7%	0.9%	0.9%
	Food	18.0%	26.0%	28.3%
	Garden	19.2%	8.6%	9.4%
	Non-combustible, residual	2.6%	2.3%	4.7%
	Non-combustible, residual bulky	13.0%	3.2%	3.5%
	Combustible, residual	5.9%	20.2%	9.4%
	Combustible, residual, bulky	10.8%	4.3%	3.8%
	Hazardous	0.2%	0.1%	0.1%
	WEEE	0.8%	0.2%	0.2%
	Total	100.0%	100.0%	100.0%
Households, rural area	Paper	24.5%	13.0%	14.2%
	Cardboard	5.9%	10.8%	11.8%
	Cardboard, bulky	1.0%	0.0%	0.0%
	Plastic	5.9%	10.8%	11.8%
	Glass	4.2%	13.0%	14.2%
	Metal	2.0%	2.2%	2.4%
	Metal, bulky	3.3%	0.0%	0.0%
	Food	26.1%	25.8%	28.3%
	Garden	0.0%	0.0%	0.0%
	Non-combustible, residual	4.2%	2.2%	2.4%
	Non-combustible, residual bulky	3.3%	0.0%	0.0%
	Combustible, residual	8.2%	21.6%	14.2%
	Combustible, residual, bulky	9.8%	0.0%	0.0%
	Hazardous	0.3%	0.2%	0.2%
	WEEE	1.3%	0.4%	0.5%
	Total	100.0%	100.0%	100.0%
Commerce and services	Paper	38.0%	30.0%	25.0%
	Cardboard	10.0%	14.0%	15.0%
	Plastic	10.0%	15.0%	20.0%
	Glass	2.0%	2.0%	1.0%
	Metal	3.0%	2.0%	1.0%
	Food	15.0%	16.0%	17.0%
	Garden	5.0%	5.0%	5.0%
	Non-combustible, residual	5.0%	5.0%	5.0%
	Combustible, residual	10.0%	10.0%	10.0%
	WEEE	2.0%	1.0%	1.0%
	Total	100.0%	100.0%	100.0%

Source	Fractions	EU	CEE	CIS
Industry	Paper	20.0%	25.0%	33.0%
	Cardboard	25.0%	25.0%	24.0%
	Plastic	4.0%	6.0%	7.0%
	Glass	1.0%	3.0%	5.0%
	Metal	25.0%	15.0%	4.0%
	Food	6.0%	4.0%	1.0%
	Non-combustible, residual	8.0%	10.0%	12.0%
	Combustible, residual	11.0%	12.0%	14.0%
	Total	100.0%	100.0%	100.0%
Construction and demolition	Plastic	0.2%	0.0%	0.0%
	Metal	3.0%	3.0%	3.0%
	Concrete, tile, rubble	80.0%	60.0%	60.0%
	Non-combustible, residual	15.0%	35.0%	35.0%
	Combustible, residual	1.8%	2.0%	2.0%
		Total	100.0%	100.0%

Source: Consultant's estimate

2.2 Projection of MSW Generation by Households

In FEASIBLE, the projection of household MSW generation is linked to a forecast concerning the private consumption of goods. This is found to be a more appropriate measure for growth in waste generation rather than using growth in GDP or domestic demand.

Formally, the use of GDP can be expressed by following equation:

$$GDP - export + import = C + G + S$$

where C is private consumption, G public consumption and S is savings.

Savings do not create waste, and public consumption is input to the public production generating waste, but this waste is calculated under commercial² and industrial waste, section 2.3.

The private consumption of services is not very waste generating. Private consumption is divided as follows:

$$C = c_g + c_s$$

g and s being consumption of goods and services, respectively.

The relationship is, hence, assumed to be:

$$\% \text{ change in household MSW generation} = \% \text{ change in } C_g$$

² This implicitly means that public services are calculated as part of commerce

As consumption patterns often differ between urban and rural areas, the projection is also differentiated. The two projection functions, hence, are:

$$\% \text{ change in urban household MSW generation} = \% \text{ change in } C_{g(\text{urban})}$$

$$\% \text{ change in rural household MSW generation} = \% \text{ change in } C_{g(\text{rural})}$$

MSW generation patterns for the two types of urban households are assumed to be identical. The MSW generation is projected in aggregation for the two groups. Afterwards, the MSW volumes are divided on single-family and multi-storey houses based on the expected development in population distribution among the two housing types.

All fractions are projected in this way, except the fractions of food waste and garden waste, which are projected as described below.

Projection of generation of food waste

Even though the amount of food waste is likely to grow with the level of consumption, there is a limit to its growing potential compared to the consumption of other types of goods. FEASIBLE projects the generation of food waste by comparing the situation in the region/municipality modelled with the situation in the EU in 2002. The model contains a fixed point of reference (EU, 2002) describing the relation between GDP(or GRP)/capita and food waste generation. This fixed point is different for each household type as illustrated in Table 3 below:

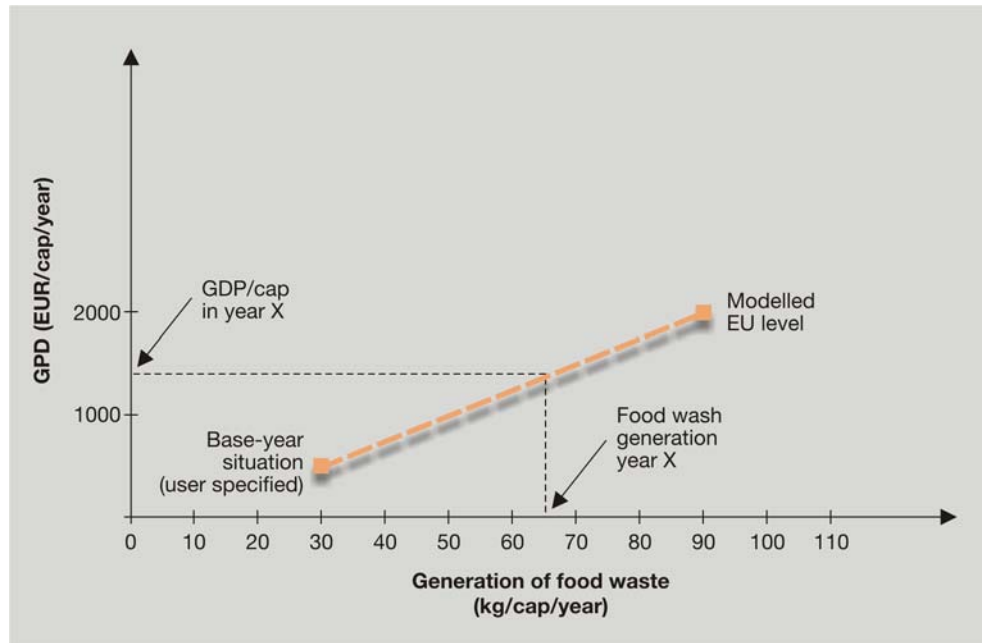
Table 3 *EU food waste generation and GDP/cap, 2002*

Household type	Food waste generation (kg/cap/year)	GDP (EUR/cap/year)
USF	91	12,000
UMS	93	9,000
Rural	80	6,000

Note: The user may change this fixed reference point (see how in user manual)
Source: Consultant's estimate

The model assumes a linear development of the relation between GDP/capita and food waste generation. The food waste generation in a given year is thus determined by the GDP/capita in that year. This is illustrated in Figure 2 which shows the projection for USF.

Figure 2 Projection of food waste, USF



Projection of generation of garden waste

The generation of garden waste has very little to do with income level. It is simply assumed that the volume of garden waste grows proportionally with the population growth so that garden waste per capita remains constant.

2.3 Projection of MSW Generation by Commerce, Industry and C&D

It is normally expected that the amount of commercial and industrial waste increases proportionally with the production level. At sector level, this may be true. However, as production and thereby income level increase, the production shifts towards other sectors.

The projection of MSW in FEASIBLE distinguishes between the four most aggregated sectors, namely:

- Commerce (including public services),
- Industry,
- C&D, and
- Agriculture (incl. fishery and raw product extraction). MSW from this sector is assumed to be zero.

FEASIBLE takes into account shifts in MSW generation patterns due to shifts among the four aggregated sectors, but within each sector, the composition of the waste is assumed to be constant.

The generation of MSW is assumed to grow proportionally with the production in the sector. I.e. the projection is based on a projection of development in rela-

tive distribution of GDP among the four sectors. This could also be expressed as follows:

% change in commerce MSW generation = % change in GDP (commerce)

% change in industry MSW generation = % change in GDP (industry)

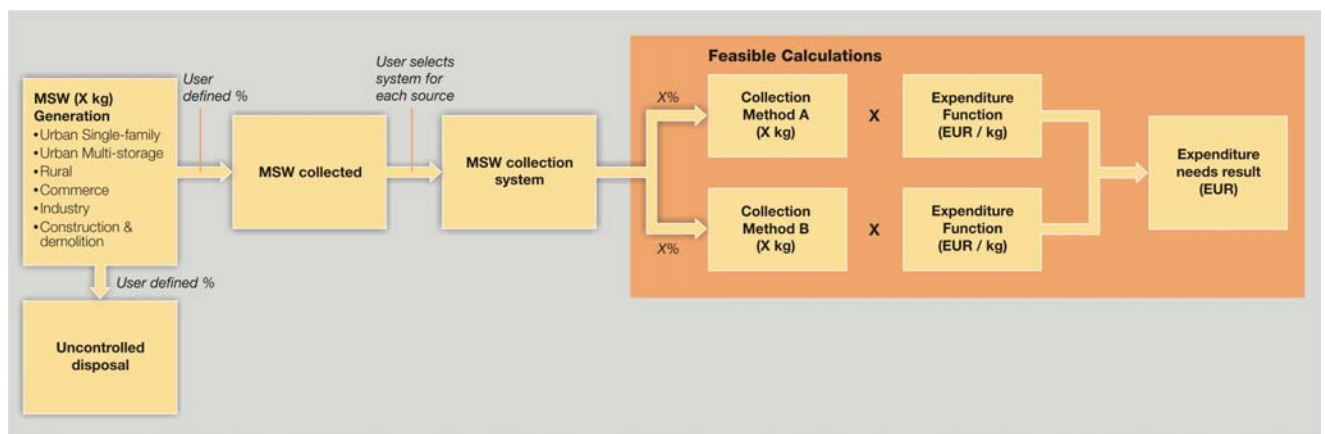
% change in C&D MSW generation = % change in GDP (C&D)

For instance, it is assumed that when industrial production increases by 1%, it means that all economic sectors and sub-sectors under industry also increase by 1%.

3 Expenditure Functions for MSW Collection

FEASIBLE works with a number of standard collection systems which are composed of various combinations of standard collection methods. There is an expenditure function for each collection method. The flow diagram below illustrates how expenditure functions for MSW collection are applied in FEASIBLE.

Figure 3 Waste flow and application of expenditure functions for MSW collection



3.1 Coverage of MSW Collection

The first element in the flow diagram in Figure 3 is the share of waste that is not collected (or in other words, the coverage of the MSW collection services). This share is specified by the user for each source of MSW, and this is, hence, one of the service level parameters that the user can change in the model.

When the user specifies a rate for MSW not collected, this is spread evenly on all fractions for the specific MSW source.

The MSW collection rate is calculated as the residual of the rate for MSW not collected.

In some collection systems, FEASIBLE assumes that a certain share of garden and food waste is composted locally (see Attachment 1). This waste is calculated as collected.

In some collection systems, FEASIBLE assumes that bulky waste is not collected (see Attachment 1). The user should take this into account when specifying the rate of MSW not collected (see how to in the user manual).

3.2 MSW Collection Methods

FEASIBLE operates with the following collection methods:

For households:

- Kerbside, ordinary collection (door-to-door collection of mixed waste)
- Kerbside, dual collection (door-to-door collection of food waste and residual mixed waste, separately)
- Drop-off, recycling station (an outlying enclosed area to which the waste generator is required to take recyclable and hazardous waste and place it into separate containers)
- Drop-off, take back (used products are taken back to the producer, either directly or through the dealer's network)
- Drop-off, decentralised bring banks (a container in the near vicinity to which the generator is required to take a recyclable waste fractions)

Only for single-family households:

- Kerbside, recyclables collection (door-to-door collection of recyclable waste fractions)

For commerce, industry and C&D:

- Container ordinary collection (collection of mixed waste)
- Container recyclables collection (separate collection of recyclable fractions)

For wastewater treatment plants:

- Sludge transport

These methods represent steps in efficiency in enabling "extraction" of recyclable materials, with ordinary collection as the least efficient method. For example, a collection method requiring householders to bring their recyclable material to e.g. a recycling station will be less efficient in diverting recyclable material from the waste stream than a method with door-to-door recyclables collection.

3.2.1 Expenditure Functions

The costs of collecting commercial waste, industrial waste, C&D waste and sludge are considered to be private costs and are, therefore, not included in FEASIBLE. Likewise, the costs of the collection method involving take-back are considered to be private. Hence, expenditure functions have been developed for all methods applicable to the three types of households³ included in FEASIBLE, except take-back.

Approach

Two approaches have been applied - a general approach and a specific approach for recycling stations.

The costs of waste collection are determined by a number of factors, including the size of the area of covered, the number of households within the area, the waste generated by the households, etc. In order to develop expenditure functions, which express the costs as depending on the amount of waste generated, a typical area covered by a collection vehicle was taken as the starting point. Based on a number of assumptions concerning each waste collection method in the typical area, the cost per tonne of waste was established.

In order to calculate the costs for individual fractions or groups of fractions, it was necessary to work with assumptions concerning the waste generation and composition per type of household. For this purpose, a waste quantity and composition analysis from a waste characterisation survey made by COWI in Lithuania 1997 was used. The results of this survey are shown in Table 4 below.

Table 4 Assumptions on waste generation and composition

Fraction	Multi-storey		Single-family	
	kg/person/year	%	kg/person/year	%
Paper	16	8	41.6	10.9
Cardboard	10	5	26	6.8
Plastic	12	6	31.2	8.2
Glass	16	8	41.6	10.9
Metal	6	3	15.6	4.1
Food waste	100	50	120	31.6
Other combustibles	36	18	93.6	24.6
Other non-combustibles	4	2	10.4	2.7
Total	200	100	380	100

Source: Waste characterisation survey in Lithuania, COWI, 1997

The average size of household used as basis on calculating the costs were:

³ Multi-storey housing in urban areas; single-family housing in urban areas and housing in rural areas.

- multi-storey and single-family household (urban): 3 persons/household
- single family (rural): 3.5 persons/household

No survey of waste generation and composition from rural households was available. For modelling purposes, a rural household was estimated to generate an amount of waste similar to that of a multi-storey household. The assumptions concerning collection methods for each type of household are listed in Table 5 to Table 7 below.

Table 5 Assumptions on amount of MSW collected by one collection vehicle - urban multi-storey households

Collection method	MSW (kg/pers/year) (a)	Household size (pers) (b)	Waste gener- ated (Kg/HH/week) (c=a*b/52)	HH/collection vehicle/week (d)	Amount of waste collected (tonne/year) (e=c*d/1000*52)
Ordinary collection	200	3	11.54	2,929	1,757
Dual collection					
- food	103	3	5.94	5,816	1,797
- residual	97	3	5.60	4,526	1,317
Bring banks					
- glass	5	3	0.28	38,400	553
- paper	5	3	0.28	38,400	553
- metal	2	3	0.10	38,400	207
- plastic	4	3	0.21	32,000	346

Source: Consultant's estimate

Table 6 Assumptions on amount of MSW collected by one collection vehicle - urban single-family households:

Collection method	MSW (kg/pers/year) (a)	Household size (pers) (b)	Waste gener- ated (Kg/HH/week) (c=a*b/52)	HH/collection vehicle/week (d)	Amount of waste collected (tonne/year) (e=c*d/1000*52)
Ordinary collection	380	3	21.92	1,600	1,824
Dual collection					
- food	128	3	7.38	1,600	614
- residual	251	3	14.48	1,600	1,205
Bring banks					
- glass	19	3	1.08	28,800	1,616
- paper	13	3	0.72	28,800	1,080
- metal	5	3	0.27	28,800	406
- plastic	9	3	0.54	24,000	677
Kerbside recyclables	85	3	4.92	1,600	409

collection					
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Source: Consultant's estimate

Table 7 Assumptions on amount of MSW collected by one collection vehicle - rural households

Collection method	MSW (kg/pers/year)	Household size (pers)	Waste generated (Kg/HH/week)	HH/collection vehicle/week	Amount of waste collected (tonne/year)
	(a)	(b)	(c=a*b/52)	(d)	(e=c*d/1000*52)
Ordinary collection	200	3.5	13.5	1,000	700

Source: Consultant's estimate

The assumptions on MSW amounts collected by one collection vehicle were then compared to assumptions concerning the expenditure associated with collection by one vehicle. This was used to generate an estimated expenditure per tonne of collected MSW. This is documented for each collection method below.

Expenditure for ordinary collection

Urban multi-storey households

The expenditure for MSW ordinary collection in an urban area with multi-storey houses covered by one vehicle is estimated at EUR 148,419 per year (see Table 8).

The estimated amount of MSW collected is estimated at 1,757 tonne/year (see Table 5).

This results in the following collection expenditure function:

84 EUR/tonne of MSW

Table 8 Expenditure for ordinary collection, UMS households

Expenditure type	Expenditure (EUR/year)
Vehicle (rear-end loader), capacity: 8 tonnes	28,932
Containers	19,171
Licence	902
Insurance	3,365
Labour	76,716
Diesel	10,236
Oil	1,024
Maintenance	6,729
Other/miscellaneous	1,346
Total	148,419

Note: Detailed assumptions in Attachment 2.
 Source: Consultant's estimate

Urban single-family households

The expenditure for MSW ordinary collection in an urban area with single-family houses covered by one vehicle is estimated at EUR 175,208 per year (see Table 9).

The estimated amount of MSW collected is estimated in Table 6.

This results in the following collection expenditure function:

96 EUR/tonne of MSW

Table 9 Expenditure for ordinary collection, USF households

Expenditure type	Expenditure (EUR/year)
Vehicle (rear-end loader), capacity: 8 tonnes	28,932
Containers	15,337
Licence	673
Insurance	3,365
Labour	115,074
Diesel	3,412
Oil	341
Maintenance	6,729
Other/miscellaneous	1,346
Total	175,208

Note: Detailed assumptions in Attachment 2.

Source: Consultant's estimate

Rural households

The expenditure for MSW ordinary collection in a rural area covered by one vehicle is estimated at EUR 138,141 per year (see Table 10).

The estimated amount of MSW collected is estimated in **Error! Reference source not found.**

This results in the following collection expenditure function:

197 EUR/tonne of MSW

Table 10 Expenditure for ordinary collection, rural households

Expenditure type	Expenditure (EUR/year)
Vehicle (rear-end loader), capacity: 8 tonnes	28,932
Containers	6,390
Licence	902
Insurance	3,365
Labour	76,716

Diesel	12,510
Oil	1,251
Maintenance	6,729
Other/miscellaneous	1,346
Total	138,141

Note: Detailed assumptions in Attachment 2.
 Source: Consultant's estimate

Urban multi-storey households

Dual collection

The expenditure for MSW dual collection in an urban area with multi-storey houses covered by one vehicle is estimated in Table 11.

The estimated amount of MSW collected is estimated in Table 5.

This results in the following collection expenditure functions:

Mixed dry fraction: 54 EUR/tonne
Food: 74 EUR/tonne

Table 11 Expenditure for dual collection, UMS households

Expenditure type	Expenditure (EUR/year)	
	Mixed dry fraction	Food
Vehicle (rear-end loader), capacity: 8 tonnes	28,932	28,932
Containers	19,171	10,736
Licence	902	902
Insurance	3,365	3,365
Labour	76,716	76,716
Diesel	4,170	4,170
Oil	417	417
Maintenance	6,729	6,729
Other/miscellaneous	1,346	1,346
Total	141,747	133,312

Note: Detailed assumptions in Attachment 2.
 Source: Consultant's estimate

Urban single-family households

The expenditure for MSW dual collection in an urban area with single-family houses covered by one vehicle is estimated in Table 12.

The estimated amount of MSW collected is estimated in Table 6.

This results in the following collection expenditure functions:

Mixed dry fraction: 19 EUR/tonne
Food: 72 EUR/tonne

Table 12 Expenditure for dual collection, USF households

Expenditure type	Expenditure (EUR/year)	
	Mixed dry fraction	Food
Vehicle (rear-end loader), capacity: 8 tonnes	28,932	28,932
Containers	20,449	10,224
Licence	673	673
Insurance	3,365	3,365
Labour	115,074	115,074
Diesel	10,236	10,236
Oil	1,024	1,024
Maintenance	6,729	6,729
Other/miscellaneous	1,346	1,346
Subtracted due to 50% vehicle utilisation	- 93,913	- 88,801
Total	93,913	88,801

Note: Detailed assumptions in Attachment 2.

Source: Consultant's estimate

Bring banks

Urban multi-storey households

The expenditure for MSW bring banks collection in an urban area with multi-storey houses covered by one vehicle is presented in Table 13.

The estimated amount of MSW collected is estimated in Table 5.

This results in the following collection expenditure functions:

Paper: 92 EUR/tonne

Glass: 60 EUR/tonne

Plastic: 152 EUR/tonne

Metal: 122 EUR/tonne

Table 13 Expenditure for bring banks, UMS households

Expenditure type	Expenditure (EUR/year)			
	Paper	Glass	Plastic	Metal
Vehicle (rear-end loader), capacity: 8 tonnes	28,932	33,754	28,932	28,932
Containers	15,337	7,668	19,171	15,337
Licence	673	1,346	673	673
Insurance	3,365	3,365	3,365	3,365
Labour	38,358	38,358	38,358	38,358
Diesel	4,549	4,549	4,549	4,549
Oil	455	455	455	455
Maintenance	8,075	8,075	8,075	8,075
Other/miscellaneous	2,050	1,346	1,346	1,346
Total	101,793	98,916	104,923	101,089

Note: Detailed assumptions in Attachment 2.

Source: Consultant's estimate

Urban single-family households

The expenditure for MSW bring banks collection in an urban area with single-family houses covered by one vehicle is estimated in Table 14).

The estimated amount of MSW collected is estimated in Table 6.

This results in the following collection expenditure functions:

Paper: 94 EUR/tonne

Glass: 32 EUR/tonne

Plastic: 155 EUR/tonne

Metal: 124 EUR/tonne

Table 14 Expenditure for bring banks, USF households

Expenditure type	Expenditure (EUR/year)			
	Paper	Glass	Plastic	Metal
Vehicle (rear-end loader), capacity: 8 tonnes	28,932	33,754	28,932	28,932
Containers	15,337	12,269	19,171	15,337
Licence	673	1,346	673	673
Insurance	3,365	3,365	3,365	3,365
Labour	38,358	38,358	38,358	38,358
Diesel	4,549	4,549	4,549	4,549
Oil	455	455	455	455
Maintenance	8,075	8,075	8,075	8,075
Other/miscellaneous	2,050	1,346	1,346	1,346
Total	101,793	103,517	104,923	101,089

Note: Detailed assumptions in Attachment 2.

Source: Consultant's estimate

Kerbside recyclables collection

Urban single-family households

The expenditure for MSW kerbside collection of recyclables in an urban area with single-family houses covered by one vehicle is estimated in Table 15.

The estimated amount of MSW collected is estimated in Table 6.

This results in the following collection expenditure function:

112 EUR/tonne of recyclables

Table 15 Expenditure for recyclables collection, USF households

Expenditure type	Expenditure (EUR/year)
Vehicle (rear-end loader), capacity: 8 tonnes	28,932
Containers	15,337
Licence	565
Insurance	3,365
Labour	115,074
Diesel	10,236
Oil	1,024
Maintenance	6,729
Other/miscellaneous	1,346
Total	182,607

Note: Detailed assumptions in Attachment 2.

Source: Consultant's estimate

Recycling stations

Recycling stations are established as collection points for both recyclable materials and certain waste fractions from households, ensuring collection of bulky waste, garden waste and hazardous household waste. Normally, a municipality/local authority will construct one recycling station for the citizens living in the municipality. In large municipalities with more than 100,000 inhabitants, one recycling station will be established per 100,000 inhabitants.

The cost of constructing and operating a recycling station vary depending on the number of citizens served by the station (and by the quantity of waste received from the citizens.) Estimates on investments and operational expenditure have been made for three different sizes of recycling stations - 20,000, 50,000 and 100,000 inhabitants. The operation and maintenance expenditure as well as depreciation and interest of the investment for these stations are estimated to:

20,000 inhabitants:	67 EUR/tonne
50,000 - :	29 EUR/tonne
100,000 - :	19 EUR/tonne

At the level of a typical waste management planning area, a mixture recycling station of different sizes will be constructed. Anticipating a mixture of 10% large stations, 40% medium-size stations and 50% small stations, the average cost of applying the recycling station collection method is estimated at 47 EUR/tonne of delivered waste/recyclable materials.

3.3 MSW Collection Systems

In FEASIBLE, a number of collection systems are pre-defined, with certain combinations of collection methods. By working with collection systems, the combinations of sources, fractions, and collection methods are limited and thereby, the possible "paths" through which the waste flow is reduced.

In each collection system, the waste collection efficiency of each collection method has been determined in relation to each fraction in a pre-set combination with other collection methods. The collection efficiencies are described in Attachment 1. The collection systems available in FEASIBLE represent standard types of collection systems and have been elaborated based on COWI's experience in CIS/CEE/EU countries and with a view to representing both existing conditions and the possible developments considering national and EU directives and requirements.

FEASIBLE operates with 7 collection systems for urban single-family households, 5 for urban multi-storey households, 2 for rural households, commerce, industries, and C&D, respectively, and one collection system for sludge from wastewater treatment plants. These collection systems combine the above mentioned collection methods as illustrated in Table 16 below.

For households, the collection system has either kerbside ordinary collection or kerbside dual collection as the basic collection method. Commerce, industry and C&D have container ordinary collection as the basic method.

These basic methods are then combined with other methods, placing the collection systems in a hierarchy according to the sophistication of the system, where the potential for advanced treatment/energy recovery and recycling increases according to the number of the system. For example, a recycling station is less efficient when combined with kerbside recyclables collection, but together, the two methods have a higher collection efficiency than when each is applied individually.

Table 16 Collection systems

Collection system	Waste collection method	Kerbside ordinary collection	Kerbside dual collection	Kerbside recyclables collection	Drop-off - bring banks	Drop-off - recycling station	Drop-off - take back	Container ordinary collection	Container recyclables collection	Sludge transport
USF households										
CUS1		X								
CUS2		X				X				
CUS3		X			X	X	X			
CUS4		X		X		X	X			
CUS5			X			X	X			
CUS6			X		X	X	X			
CUS7			X	X		X	X			
UMS households										
CUM1		X								
CUM2		X				X				
CUM3		X			X	X	X			
CUM4			X			X	X			
CUM5			X		X	X	X			
Rural households										
CRH1		X								
CRH2		X				X				
Commerce										
CC1								X		
CC2								X	X	
Industry										
CI1								X		
CI2								X	X	
C&D										
CC&D1								X		
CC&D2								X	X	
WWTP										
WWTP1										X

3.4 Corrections to Expenditure Functions

In collection systems with collection of recyclables, there is a reduced share of mixed waste or dry mixed waste to be collected through ordinary collection or dual collection, respectively. The collection efficiencies of these collection methods (the share of waste collected) are then below 100%⁴. The collection cost per tonne of collected waste for urban single family households, therefore, increases corresponding to the reduction in the share of mixed waste to be collected. There is no increase in collection costs for urban multi-storey households, since the decrease in the quantity of mixed waste results in a greater number of households sharing each container/collection vehicle. Thereby, the same amount of waste is collected and the collection expenditure per tonne of mixed waste is maintained at the same level.

The increase in the cost of collection from single-family households (urban and rural) reflects a lower amount of waste in each container and is equal to keeping the expenditure per household constant. The increase is in the range of 8 -30% depending on the actual collection system. For multi-storey housing, more households are included in the area covered by one vehicle, hence, the expenditure per household is lower, and the cost per tonne is the same as in the basic system.

For **ordinary collection**, the corrected assumptions and resulting expenditure functions are shown in Table 17.

Table 17 Assumptions on ordinary collection in advanced collection systems

Collection system	MSW (kg/pers/year)	Household size (pers)	Waste generated (Kg/HH/week)	HH/collection vehicle/week	Amount of waste collected (tonne/year)
	(a)	(b)	(c=a*b/52)	(d)	(e=c*d/1000*52)
CUS2	361	3	20.83	1600	1,733
CUS3	324	3	18.69	1600	1,555
CUS4	292	3	16.85	1600	1,402
CUM2	193	3	11.13	3035	1,757
CUM3	183	3	10.56	3201	1,757
CRH2	193	3.5	12.99	1000	676

Source: Consultant's estimate

The resulting corrected expenditure functions for ordinary collection in the systems CUS2, CUS3 and CUS4 are:

CUS2: 101 EUR/tonne MSW

CUS3: 113 EUR/tonne MSW

CUS4: 125 EUR/tonne MSW

CRH2: 204 EUR/tonne MSW

⁴ See Attachment 1

For **dual collection**, the corrected assumptions and resulting expenditure functions for collection of the residual dry mixed fraction are shown in Table 18.

Table 18 Assumptions on dual collection in advanced collection systems

Collection system	MSW (kg/pers/year)	Household size (pers)	Waste gener- ated (Kg/HH/week)	HH/collection vehicle/week	Amount of waste collected (tonne/year)
	(a)	(b)	(c=a*b/52)	(d)	(e=c*d/1000*52)
CUS5	233	3	13.44	1,600	1,118
CUS6	196	3	11.31	1,600	941
CUS7	163	3	9.40	1,600	782
CUM5	90	3	5.2	4,874	1,318
CUM6	76	3	4.4	5,760	1,318

Source: Consultant's estimate

The resulting corrected expenditure functions for dual collection in the systems CUS5, CUS6 and CUS7 are:

CUS5: 42 EUR/tonne

CUS6: 50 EUR/tonne

CUS7: 60 EUR/tonne

3.4.1 Share of Re-Investment Expenditure

As can be seen in the tables in section 3.2.1, the expenditure related to vehicles and containers is assumed to occur as running replacement and has, hence, been annualised to determine the expenditure function for each collection method. It is estimated that this expenditure constitutes a share of approximately 30% in each collection system⁵. This expenditure may be determined as a re-investment expenditure.

When transferring expenditure data from the MSW module to the supply of finance component, FEASIBLE divides the collection expenditure into two components:

- O&M
- Re-investment

Re-investment expenditure accounts for approx. 30% of the total collection expenditure and includes equipment expenditure related to the following categories of expenditure:

- Vehicles
- Containers

⁵ This will vary depending on the waste composition which is user defined, but tests indicate that 30% is a fair estimate

Operation expenditure accounts for approx 70% of the total collection expenditure and includes expenditure related to the following categories of expenditure

- Licences
- Insurance
- Labour
- Diesel
- Oil
- Maintenance
- Other/miscellaneous

3.5 Expenditure Function for Additional Transport

The expenditure functions for collection contain assumptions on certain transport distances from the collection area to a disposal or recovery/treatment facility. These transport distances are shown in Table 19. In cases where the collection transport distance exceeds these standards, an input is required specifying the extra transport distance in km.

Table 19 Assumptions concerning transport distances in expenditure functions for MSW collection

Collection method	Assumed transport distance in collection expenditure function
Ordinary collection	10 km
Dual collection	15 km
Bring banks	10 km
Kerbside collection of recyclables	10 km

Expenditure functions have been established for three intervals of transport distances: 10-30 km, 30-60 km and >60 km.

For the first interval, the estimated transport expenditure is based on estimates concerning the costs of additional transport with an ordinary 6-tonne collection truck, with one driver.

The transport expenditure functions for the second and third intervals are based on cost estimates for transfer stations with capacities varying between 50,000 and 250,000 tonnes/year and two transport distances of 25 and 50 km. The cost estimates for these different transfer stations have been used to estimate an approximate expenditure per tonne/km for the two specified intervals.

The expenditure functions included in the model are presented below.

10-30 km: 0.34 EUR/tonne/km
 30-60 km: 0.27 EUR/tonne/km
 >60 km: 0.2 EUR/tonne/km

4 Expenditure Functions for MSW Treatment/Recovery

This chapter describes the assumptions and expenditure functions associated with the next stage in the waste flow: the treatment and recovery of the collected MSW.

Section 4.1 gives a brief description of the MSW facilities included in FEASIBLE.

Section 4.2 describes the expenditure functions associated with the facilities

Section 4.3 describes the modelling assumptions regarding residues from the facilities and the expenditure function for the transport of these to landfill.

4.1 Treatment/Recovery Facilities

FEASIBLE includes different recovery/disposal methods for municipal solid waste which are believed to match both existing conditions and predicted future developments, taking into consideration the selected collection systems and relevant targets/directives.

Table 20 Recovery/disposal facilities included in FEASIBLE

No.	Recovery/Disposal Facility	Sub-type
1	MRF - Mixed waste	a. Dry mixed waste b. Wet mixed waste
2	MRF - Recyclables	a. Mixed recyclables b. Source separated recyclables
3	MRF - WEEE	Only one type
4	Composting plant	a. Windrow (garden waste) b. In-vessel composting (food waste)
5	Bio gasification plant	Only one type
6	Landfill	a. EU b. Controlled landfill c. Dump

No.	Recovery/Disposal Facility	Sub-type
7	Incineration plant	a. New - heat/electricity b. New - heat c. Old
8	HHW treatment facility	Only one type
9	C&D recycling facility	Only one type

4.1.1 Waste Flow Considerations

The specification of recovery/treatment facilities is linked to the type of collection systems. I.e., a recovery facility for organic waste (composting or biogasification plant) should be specified if the collection system specified includes the kerbside dual collection method. Similarly, kerbside collection of recyclables from households will require a MRF for mixed recyclables.

FEASIBLE generally only allows compatible combinations of collection systems and treatment and recovery facilities. A compatibility matrix describing the various options for waste flow routing from the collection methods to the recovery/disposal methods for each waste fraction is displayed in Attachment 3.

Some of the recyclables collected are assumed to be sold without further treatment and, therefore, exit the waste flow before the recovery and disposal step. This is reflected in the table in Attachment 3 as "sold". Experience shows that recyclable materials from commerce, industry and C&D are "cleaner" (not containing impurities). These separated materials can often be delivered directly to a recycling dealer (sold).

The recyclables from households, on the other hand, will typically pass through a materials recovery facility before they are ready for sale. They are then referred to as a by-product of the given facility (see chapter 5 on revenue from the sale of by-products).

4.2 Expenditure Functions for Treatment/Recovery

A number of expenditure functions have been developed for recovery/disposal facilities including an investment expenditure function and an operation and maintenance (O&M) expenditure function.

4.2.1 Waste Flow and Investment/O&M Expenditure

O&M expenditure is calculated from the actual amount of waste sent to each facility. This reflects the capacity utilised at individual facilities. This is based on input by the user, who is required to distribute the waste collected to the appropriate type of facility.

O&M expenditure

Investment expenditure Investment expenditure is calculated from the design capacity specified for new facilities. This is based on input by the modeller, who is required to specify the size (capacity) and number of individual facilities of a given type. FEASIBLE generates a table showing the capacity required for each type of facility, which helps the user to specify the individual facilities. Realistic maximum and minimum capacities are defined in FEASIBLE for each type of facility.

Re-investment expenditure Re-investment expenditure is calculated as a percentage of the estimated investment expenditure. For all facilities except landfills, FEASIBLE operates with an annual re-investment expenditure of 2% of the investment expenditure. The investment expenditure functions for landfills are constructed on the basis of phased development and, therefore, include both investment and re-investment expenditure (see section 4.2.8).

4.2.2 Method of Establishing the Expenditure Functions

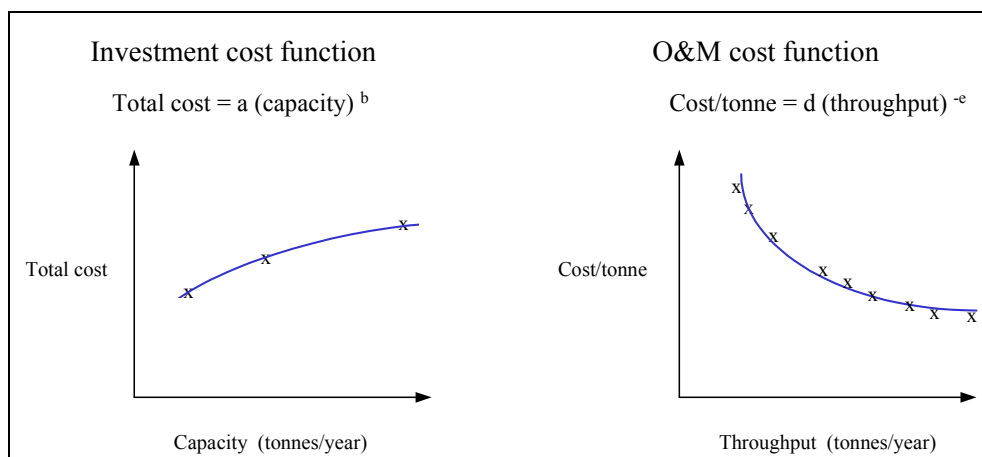
With the exception of hazardous waste treatment facility and WEEE treatment facilities, the expenditure function for a given type of facility is estimated by choosing three to four representative facilities of different sizes and then estimating the investment and O&M expenditure of each of these facilities. This results in a number of points that are connected to a best fitting curve to establish a generic (continuous) expenditure function. This is illustrated in Figure 4.

In order to calculate investment expenditure, a number of baseline expenditure elements are itemised, such as land, fencing, surface preparation, buildings and various types of equipment. The sum of the baseline expenditure elements gives a total investment cost, which is used to estimate the investment expenditure function of a given facility (see Figure 4, left).

To estimate the O&M expenditure functions, fixed and variable O&M expenditure are estimated for three different throughputs for each facility capacity (see Figure 4, right). The amount of waste treated at each facility (throughput) is varied from the design capacity to about 60% of the design capacity. Fixed O&M expenditure is independent of the waste treated at the facility and includes salaries and the costs of maintaining civil works and equipment. Variable O&M expenditure change quickly in response to a change in throughput.

Details on the assumptions made are provided in Attachment 4.

Figure 4 Generic investment and O&M expenditure functions for waste management facilities



MRF1a (dry mixed waste)

4.2.3 MRF Mixed Waste

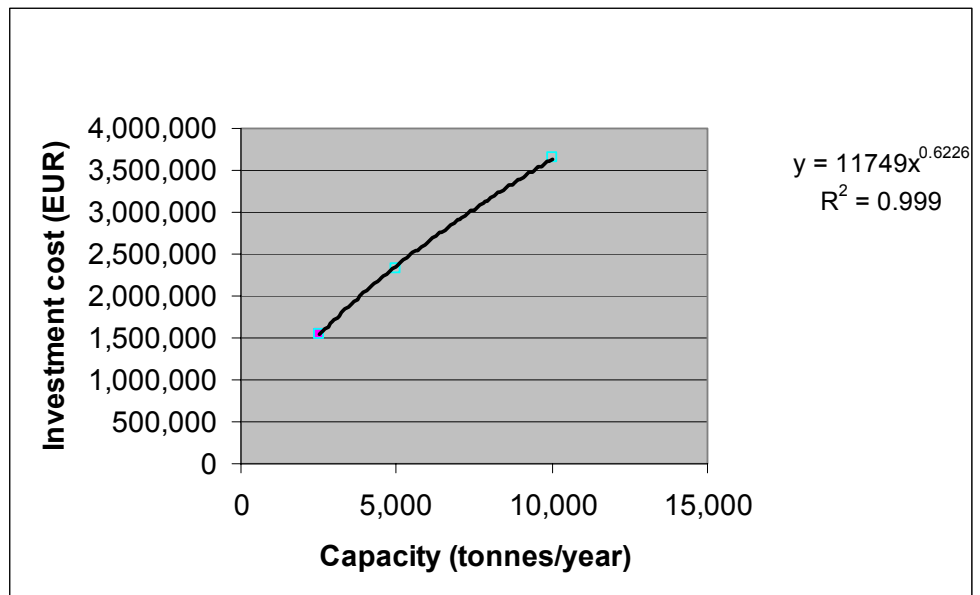
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 21 Expenditure, MRF1a

Capacity t/year	Investment EUR	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/t/year
2,500	1,545,087	96,275	164,460	104
5,000	2,324,226	141,965	223,795	73
10,000	3,662,719	201,561	291,844	49

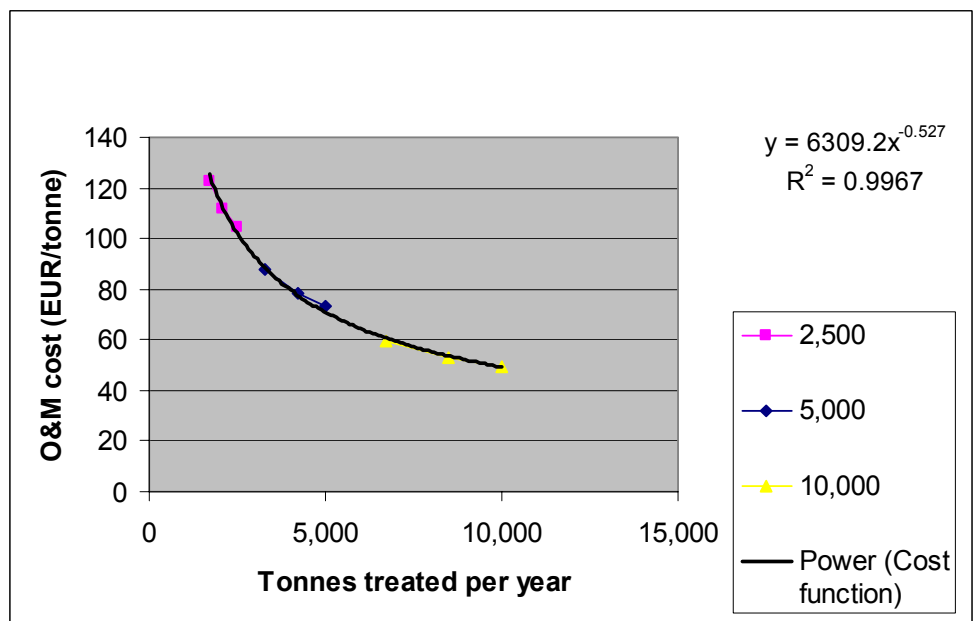
Source: Consultant's estimate

Figure 5 Investment expenditure function MRF1a



Source: Consultant's estimate

Figure 6 O&M expenditure function for MRF1a



Source: Consultant's estimate

MRF1b (wet mixed waste)

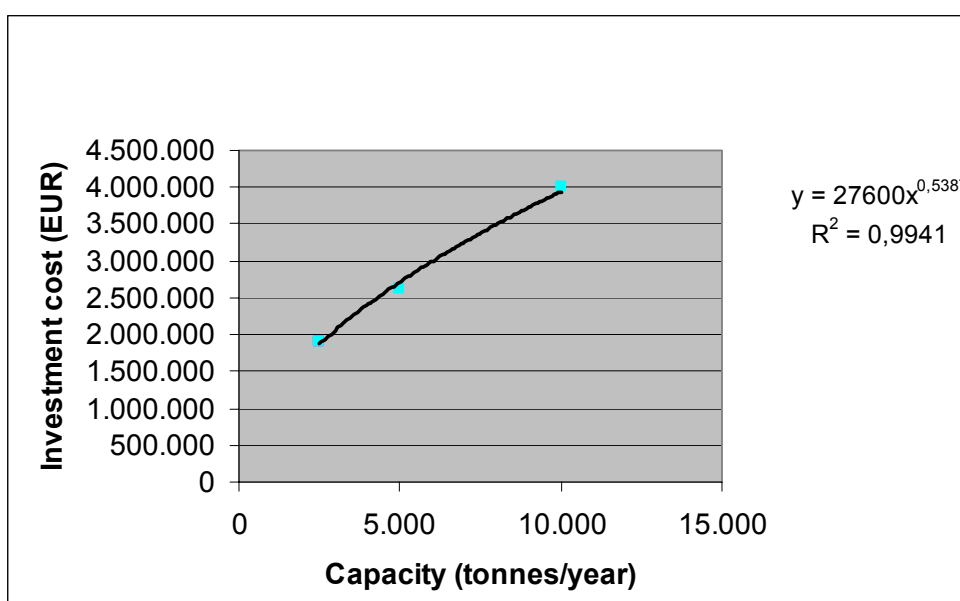
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 22 Expenditure, MRF1b

Capacity t/year	Investment EUR	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/t/year
2.500	1.899.596	113.029	382.444	198
5.000	2.625.841	153.884	609.626	153
10.000	4.008.748	240.081	1.225.410	147

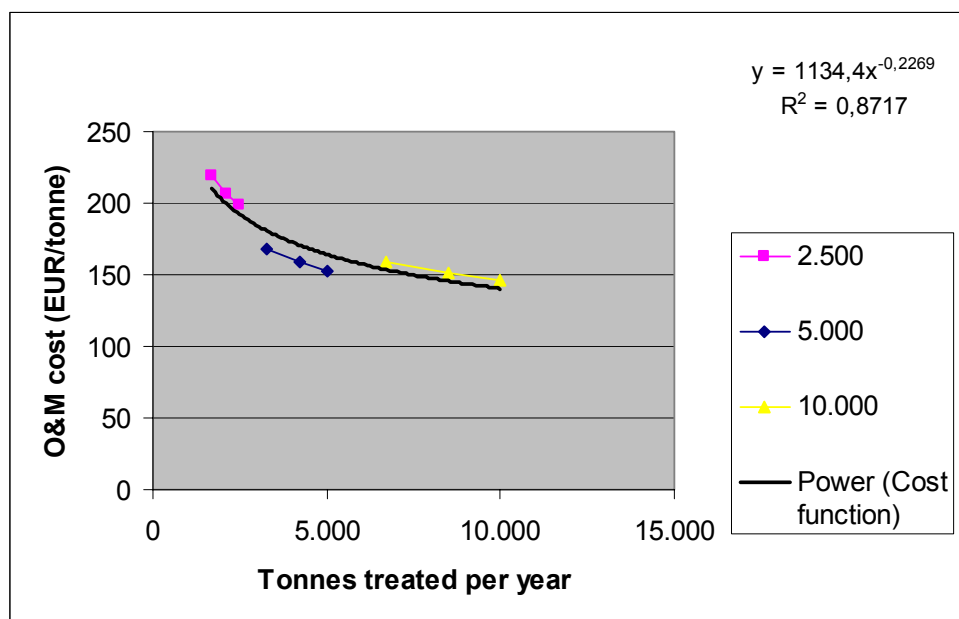
Source: Consultant's estimate

Figure 7 Investment Expenditure Function, MRF1b



Source: Consultant's estimate

Figure 8 O&M Expenditure Function, MRF1b



Source: Consultant's estimate

4.2.4 MRF Recyclables

MRF2a (mixed recyclables)

The expenditure function for MRF2a (mixed recyclables) is identical to that for MRF1a (mixed waste), as the facilities are very similar.

MRF2b (sorted recyclables)

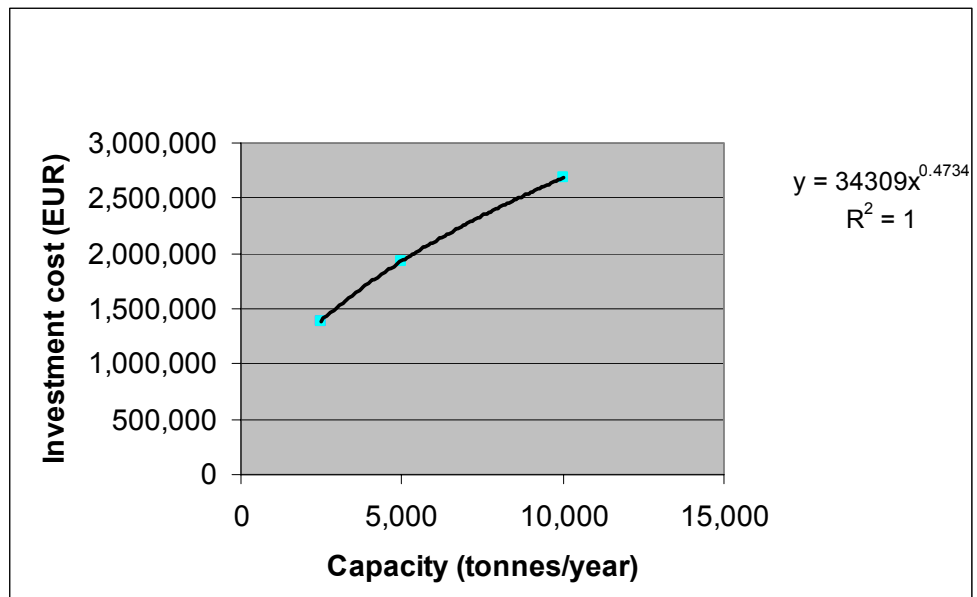
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 23 Expenditure, MRF2b

Capacity t/year	Investment EUR	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/t/year
2,500	1,391,655	88,522	198,108	115
5,000	1,936,070	120,065	291,090	82
10,000	2,682,369	165,803	426,433	59

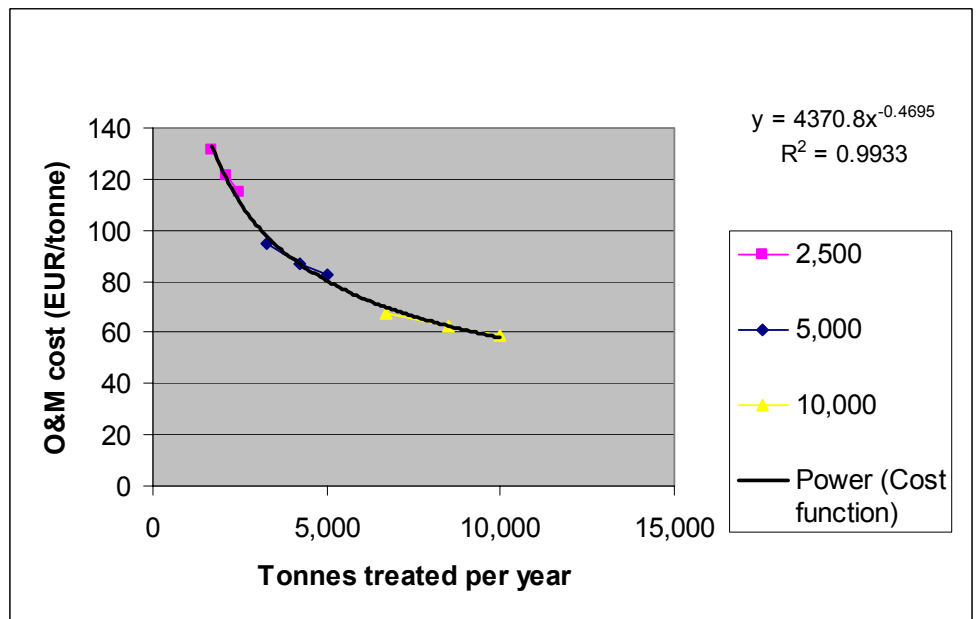
Source: Consultant's estimate

Figure 9 Expenditure function MRF2b



Source: Consultant's estimate

Figure 10 O&M expenditure function for MRF2b



Source: Consultant's estimate

4.2.5 MRF WEE

The expenditure function for MRFs for WEEE consists of a fixed treatment expenditure per tonne, since it is not likely that the cost of establishing and operating a WEEE recovery facility will be shouldered by local authorities.

The treatment expenditure of EUR 454 per tonne included in FEASIBLE is based on cost data from a company treating WEEE from 10 Danish municipalities.

4.2.6 Composting Plants

Windrow

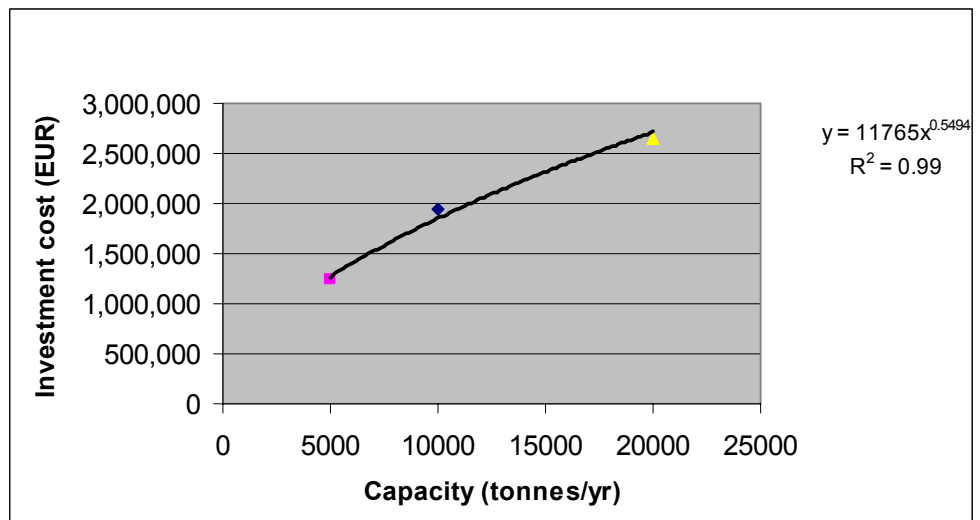
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 24 Expenditure, windrow composting

Capacity t/year	Investment EUR	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/t/year
5,000	1,239,384	177,044	20,205	39
10,000	1,937,820	204,579	27,166	23
20,000	2,654,441	298,122	40,135	17

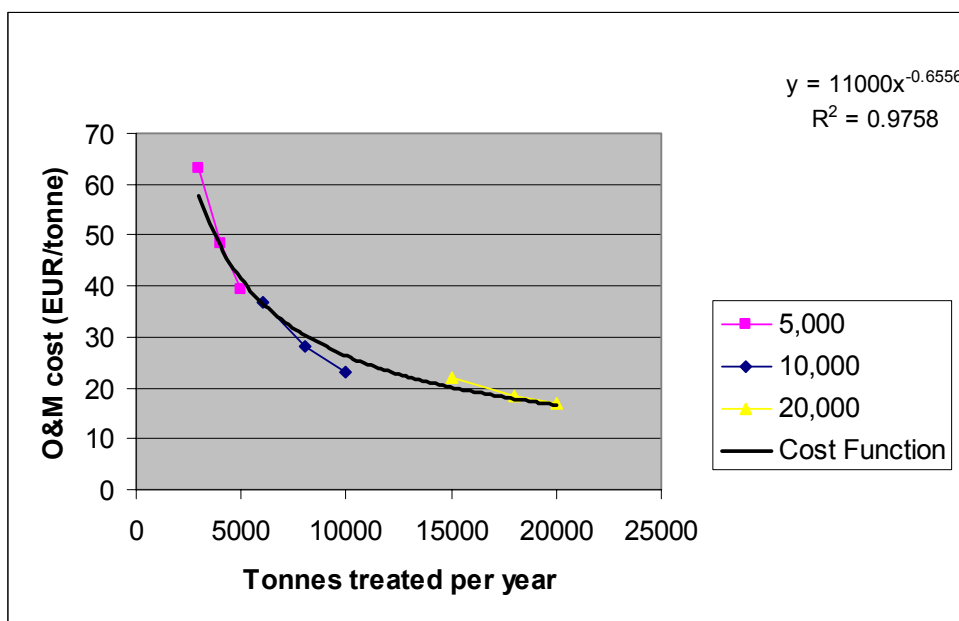
Source: Consultant's estimate

Figure 11 Investment expenditure function, windrow composting



Source: Consultant's estimate

Figure 12 O&M expenditure function for windrow composting



Source: Consultant's estimate

In-vessel

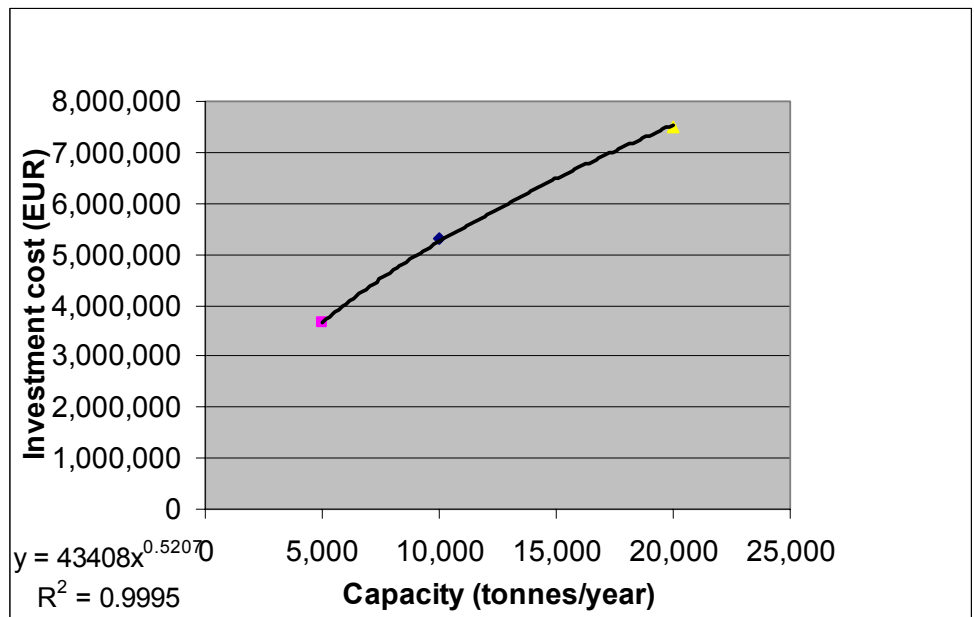
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 25 Expenditure, in-vessel composting

Capacity t/year	Investment EUR	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/t/year
5,000	3,645,222	189,639	46,595	47
10,000	5,300,673	240,417	88,425	33
20,000	7,502,826	344,224	169,421	26

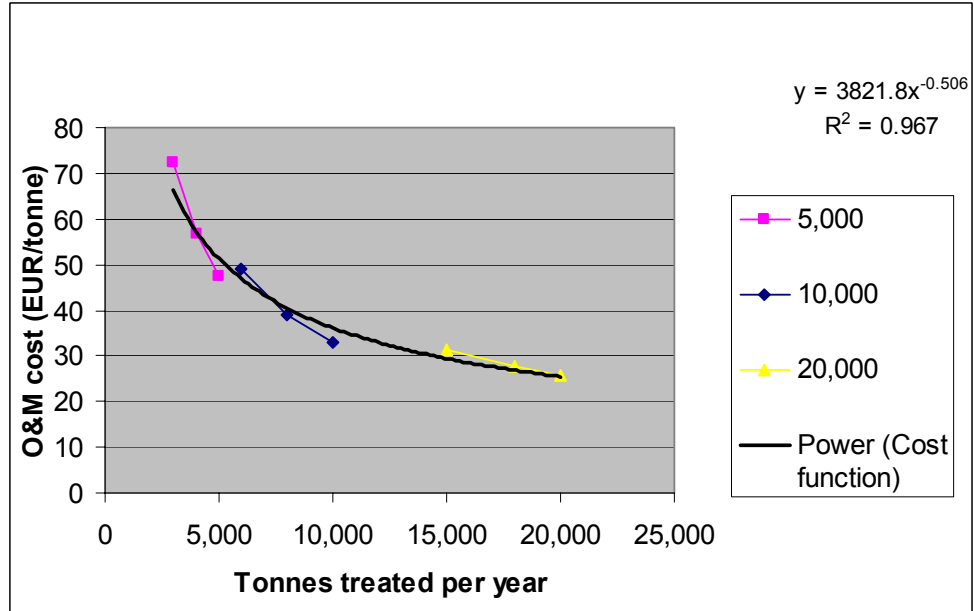
Source: Consultant's estimate

Figure 13 Investment expenditure function, in-vessel composting



Source: Consultant's estimate

Figure 14 O&M expenditure function for in-vessel composting



Source: Consultant's estimate

4.2.7 Bio gasification Plant

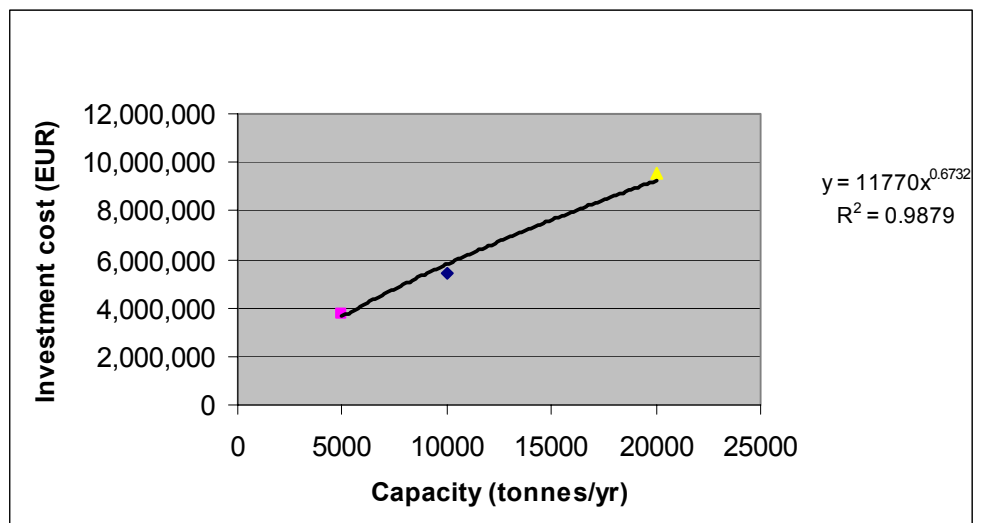
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 26 Expenditure, bio gasification plant

Capacity t/year	Investment EUR	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/t/year
5,000	3,747,376	266,836	21,198	58
10,000	5,463,392	372,058	42,396	41
20,000	9,528,129	613,676	84,791	35

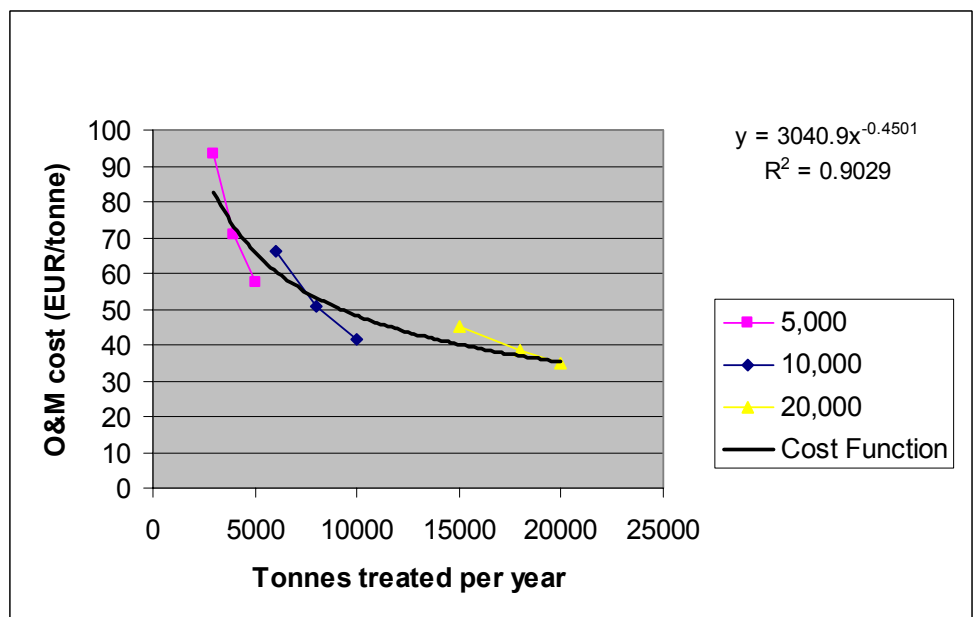
Source: Consultant's estimate

Figure 15 Investment expenditure function, bio gasification plant



Source: Consultant's estimate

Figure 16 O&M expenditure function for a bio gasification plant



Source: Consultant's estimate

4.2.8 Landfills

Expenditure functions for landfills are slightly more complicated than those for the other types of facilities.

Investment expenditure

Investment expenditure for landfills can not be assumed to occur on one occasion, in the year preceding the start of operations, as for other facilities. The investment expenditure for landfills of different design capacities is estimated for the opening of 5 cells of equal size, each open for approximately 4 years, and landfill closure costs, which are incurred once the landfill is full.

The percentage distribution of the total investment cost is the same regardless of design capacity. The total investment cost is, therefore, distributed over time, as new cells are opened and the facility is closed. This implies that re-investment expenditure is included in the calculated investment expenditure.

Table 27 Distribution of investment costs for landfills

Landfill	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Closure
A	21%	13%	25%	13%	23%	6%
B	29%	11%	23%	11%	20%	5%

Source: Consultant's estimate

O&M expenditure

O&M expenditure functions for landfills of different sizes are calculated based on the O&M expenditure function for cell 3. O&M costs for landfills vary over time, depending on which cell is being filled. Expenditure for cell 3 is used a representative average of the expenditure for cells 1 to 5.

Landfill A

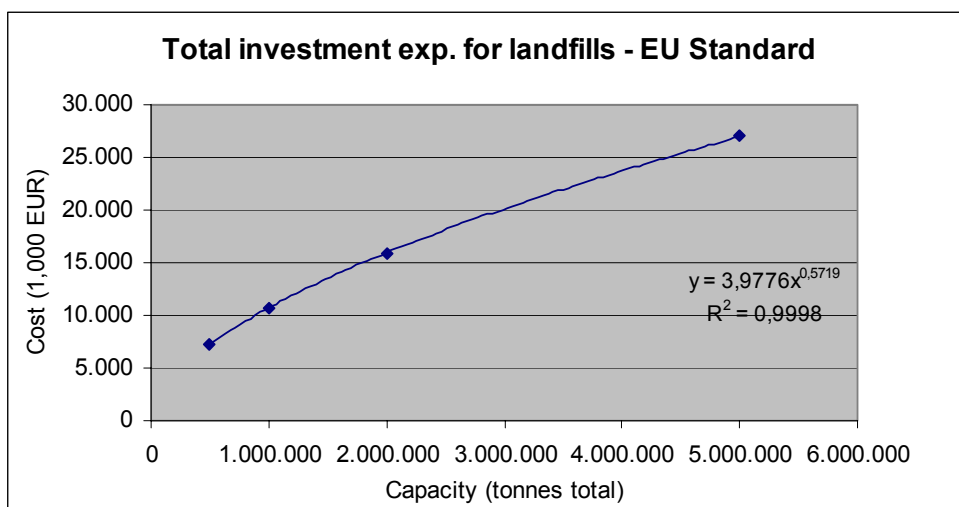
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 28 Investment expenditure, landfill A

t/year	Capacity		Cell 1 EUR '000	Cell 2 EUR '000	Cell 3 EUR '000	Cell 4 EUR '000	Cell 5 EUR '000	Closure EUR '000	Total cost EUR '000
	t/cell	t total							
25,000	100,000	500,000	1,655	820	1,879	820	1,647	423	7,243
50,000	200,000	1,000,000	2,308	1,301	2,726	1,301	2,494	626	10,756
100,000	400,000	2,000,000	3,284	2,065	3,911	2,065	3,522	949	15,796
250,000	1,000,000	5,000,000	5,153	3,804	6,462	3,804	6,153	1,729	27,104
Mean distribution of total costs			21%	13%	25%	13%	23%	6%	100%

Source: Consultant's estimate

Figure 17 Investment expenditure function, landfill A



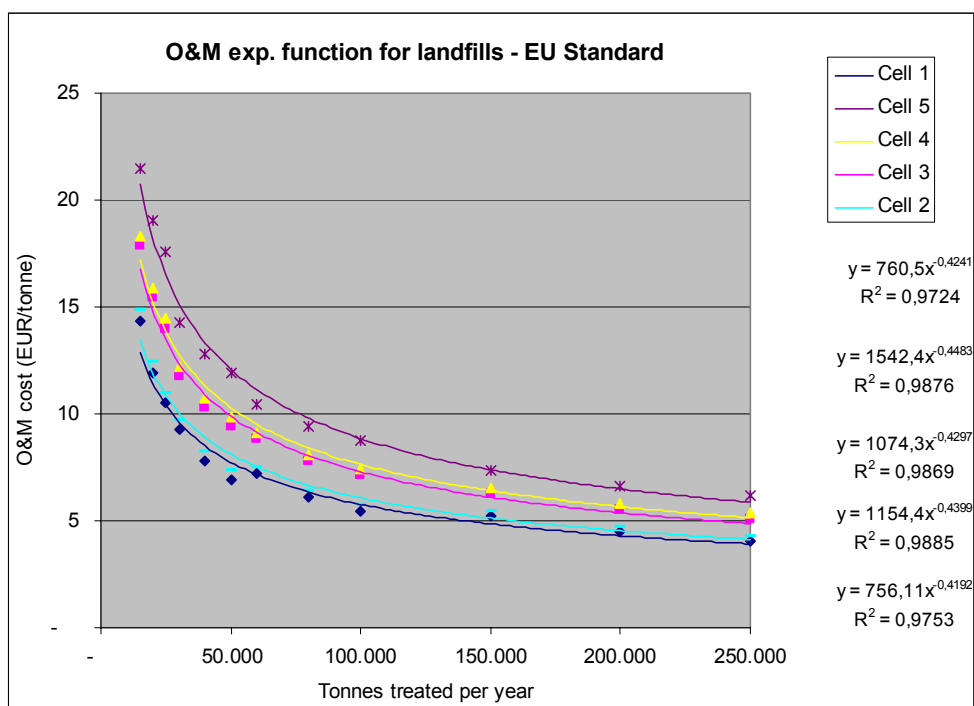
Source: Consultant's estimate

Table 29 O&M expenditure, landfill A

Capacity tpa	Tonnes treated (tpa)	Fixed cost EUR/yr	Variable cost (EUR/yr)					O&M cost (EUR/yr)				
			Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5
25.000	15.000	145.363	70.028	77.617	122.184	129.521	176.787	14	15	18	18	21
	20.000	145.363	93.371	103.489	162.912	172.694	235.716	12	12	15	16	19
	25.000	145.363	116.713	129.361	203.640	215.868	294.645	10	11	14	14	18
50.000	30.000	176.508	102.188	114.235	177.194	188.841	250.793	9	10	12	12	14
	40.000	176.508	136.251	152.313	236.259	251.788	334.391	8	8	10	11	13
	50.000	176.508	170.313	190.391	295.324	314.735	417.988	7	7	9	10	12
100.000	60.000	260.103	170.969	190.091	270.611	289.099	367.980	7	8	9	9	10
	80.000	260.103	227.958	253.455	360.815	385.466	490.640	6	6	8	8	9
	100.000	260.103	284.948	316.819	451.019	481.832	613.300	5	6	7	7	9
250.000	150.000	441.529	342.428	377.652	498.215	545.180	666.439	5	5	6	7	7
	200.000	441.529	456.571	503.537	664.286	726.907	888.585	4	5	6	6	7
	250.000	441.529	570.714	629.421	830.358	908.634	1.110.731	4	4	5	5	6

Source: Consultant's estimate

Figure 18 O&M Expenditure function for landfill A



Source: Consultant's estimate

Landfill B

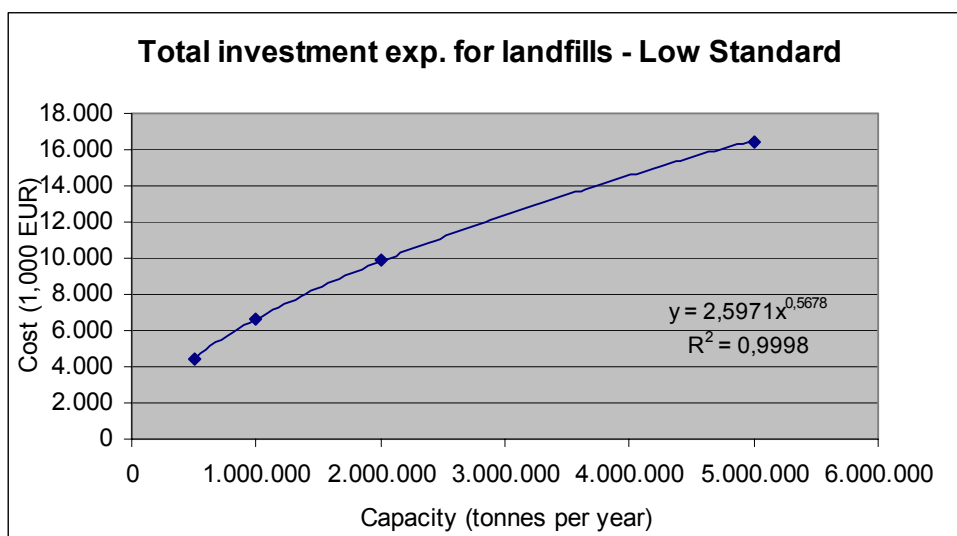
The calculation of O&M and investment expenditure functions are described in the tables and graphs below. Details on assumptions behind the unit costs are provided in Attachment 4.

Table 30 Investment expenditure, landfill B

t/year	Capacity		Cell 1 EUR '000	Cell 2 EUR '000	Cell 3 EUR '000	Cell 4 EUR '000	Cell 5 EUR '000	Closure EUR '000	Total cost EUR '000
	tonnes/cell	tonnes total							
25,000	100,000	500,000	1,447	439	1,050	439	818	250	4,444
50,000	200,000	1,000,000	1,978	697	1,581	697	1,349	352	6,654
100,000	400,000	2,000,000	2,762	1,107	2,333	1,107	2,101	513	9,922
250,000	1,000,000	5,000,000	4,190	2,038	3,768	2,038	3,458	926	16,419
Mean distribution of total costs			29%	11%	23%	11%	20%	5%	100%

Source: Consultant's estimate

Figure 19 Expenditure function, landfill B



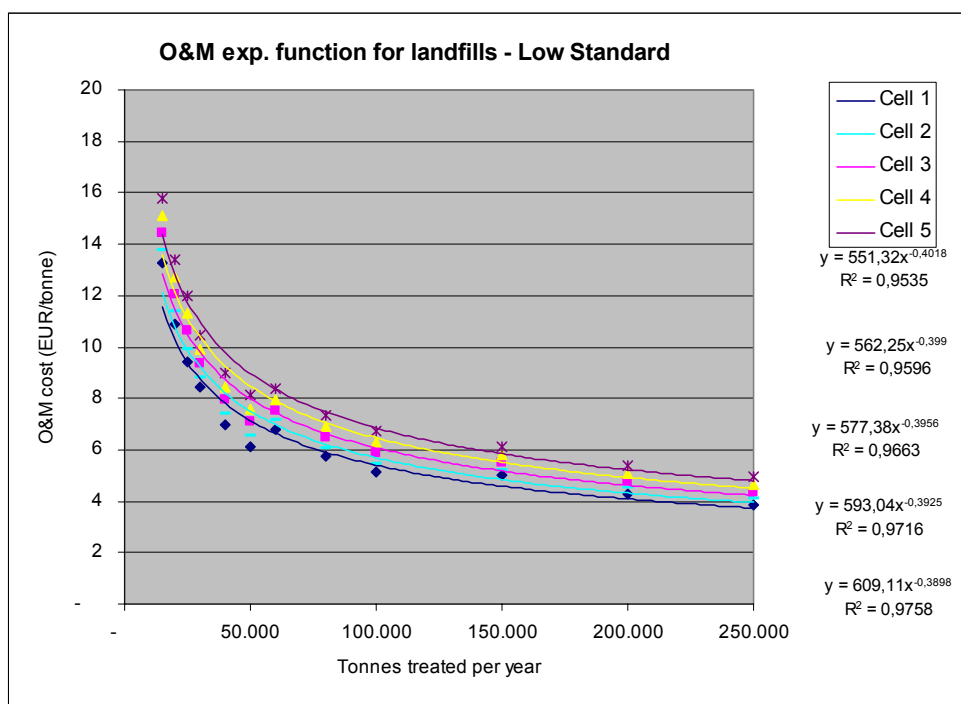
Source: Consultant's estimate

Table 31 O&M expenditure, landfill B

Capacity tpa	Tonnes treated (tpa)	Fixed cost EUR/yr	Variable cost (EUR/yr)					O&M cost (EUR/yr)				
			Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5
25.000	15.000	142.977	55.681	63.270	73.388	83.507	93.625	13	14	14	15	16
	20.000	142.977	74.242	84.360	97.851	111.342	124.833	11	11	12	13	13
	25.000	142.977	92.802	105.450	122.314	139.178	156.042	9	10	11	11	12
50.000	30.000	172.720	80.210	92.256	108.318	124.380	140.442	8	9	9	10	10
	40.000	172.720	106.946	123.008	144.424	165.840	187.256	7	7	8	8	9
	50.000	172.720	133.683	153.760	180.530	207.300	234.070	6	7	7	8	8
100.000	60.000	254.091	154.414	173.537	199.033	224.530	250.027	7	7	8	8	8
	80.000	254.091	205.885	231.382	265.378	299.373	333.369	6	6	6	7	7
	100.000	254.091	257.357	289.228	331.722	374.217	416.711	5	5	6	6	7
250.000	150.000	430.454	320.095	353.124	397.163	441.202	485.241	5	5	6	6	6
	200.000	430.454	426.794	470.833	529.551	588.270	646.989	4	5	5	5	5
	250.000	430.454	533.492	588.541	661.939	735.337	808.736	4	4	4	5	5

Source: Consultant's estimate

Figure 20 O&M Expenditure function for landfill B



Source: Consultant's estimate

Landfill C

For landfill, type C, FEASIBLE contains no expenditure function for investment as the standard of this landfill is like a dump and, therefore, it requires no (or very limited) investment costs. The calculation of O&M expenditure functions is described in the table and graph below. Details on the assumptions behind the unit costs are provided in Attachment 4.

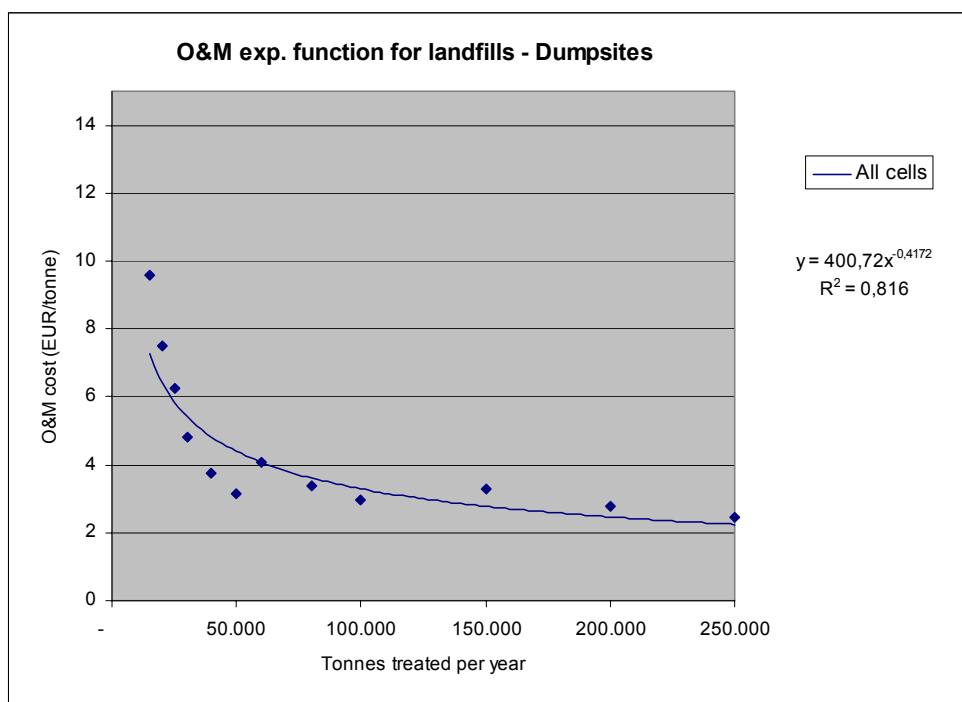
Table 32 O&M expenditure, landfill C

Capacity t/year	Tonnes treated t/year	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/year
25,000	15.000	124.815	18.864	10
	20.000	124.815	25.151	7
	25.000	124.815	31.439	6
50,000	30.000	125.208	18.864	5
	40.000	125.208	25.151	4
	50.000	125.208	31.439	3
100,000	60.000	169.888	75.454	4
	80.000	169.888	100.606	3
	100.000	169.888	125.757	3

Capacity t/year	Tonnes treated t/year	Fixed cost EUR/year	Variable cost EUR/year	O&M cost EUR/year
250,000	150.000	303.400	188.636	3
	200.000	303.400	251.514	3
	250.000	303.400	314.393	2

Source: Consultant's estimate

Figure 21 O&M expenditure function for landfill C



Source: Consultant's estimate

4.2.9 Incineration Plants

Incineration plant A

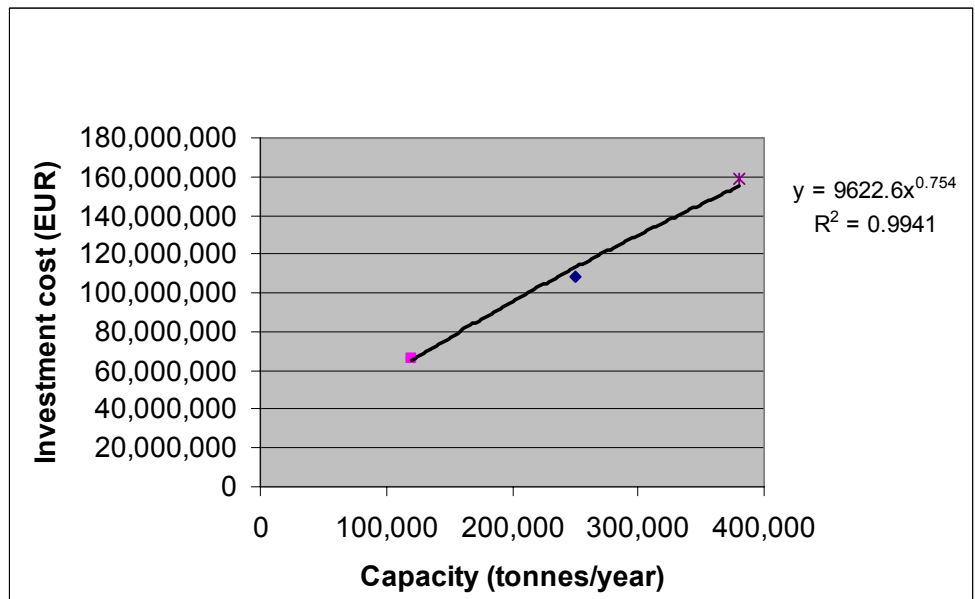
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 33 Expenditure, incineration plant A

Capacity t/year	Investment EUR	Fixed O&M EUR/year	Variable O&M EUR/year	Total O&M EUR/t/year
120,000	65,948,856	1,770,188	1,487,147	27
250,000	108,815,612	2,625,841	2,688,930	21
380,000	158,950,202	3,413,190	3,990,646	19

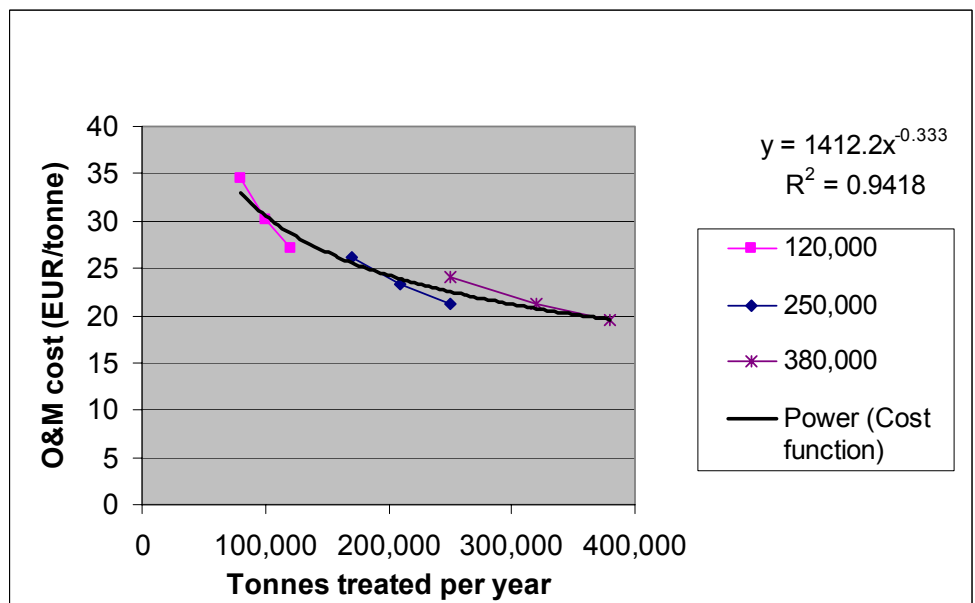
Source: Consultant's estimate

Figure 22 Investment expenditure function, incineration plant A



Source: Consultant's estimate

Figure 23 O&M expenditure function for incineration plant A



Source: Consultant's estimate

Incineration plant B

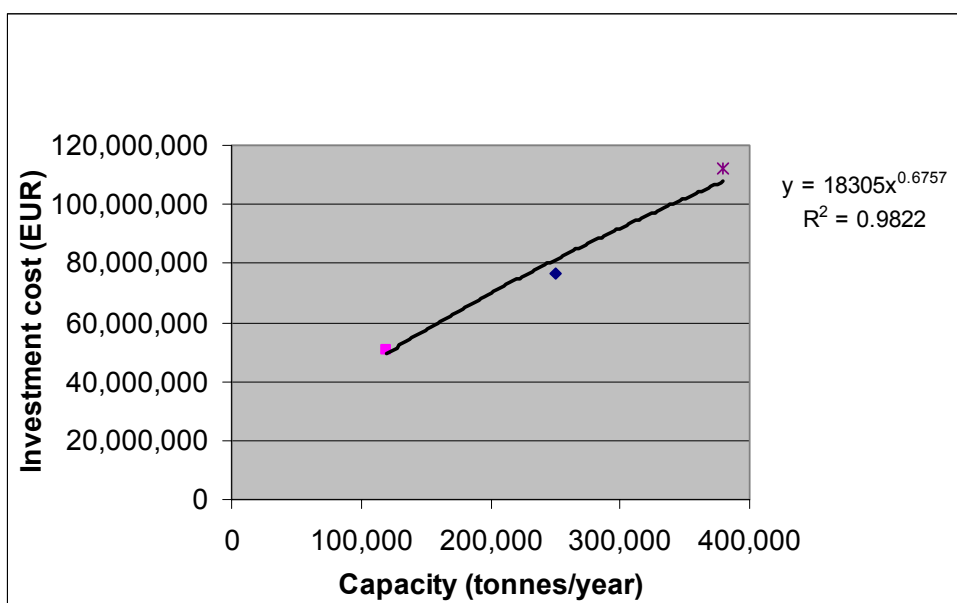
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 34 Expenditure, incineration plant B

Capacity t/year	Investment EUR	Fixed O&M EUR/year	Variable O&M EUR/year	Total O&M EUR/t/year
120,000	50,605,653	1,487,349	1,238,627	23
250,000	76,514,132	2,150,202	2,185,027	17
380,000	112,113,055	2,737,685	3,252,557	16

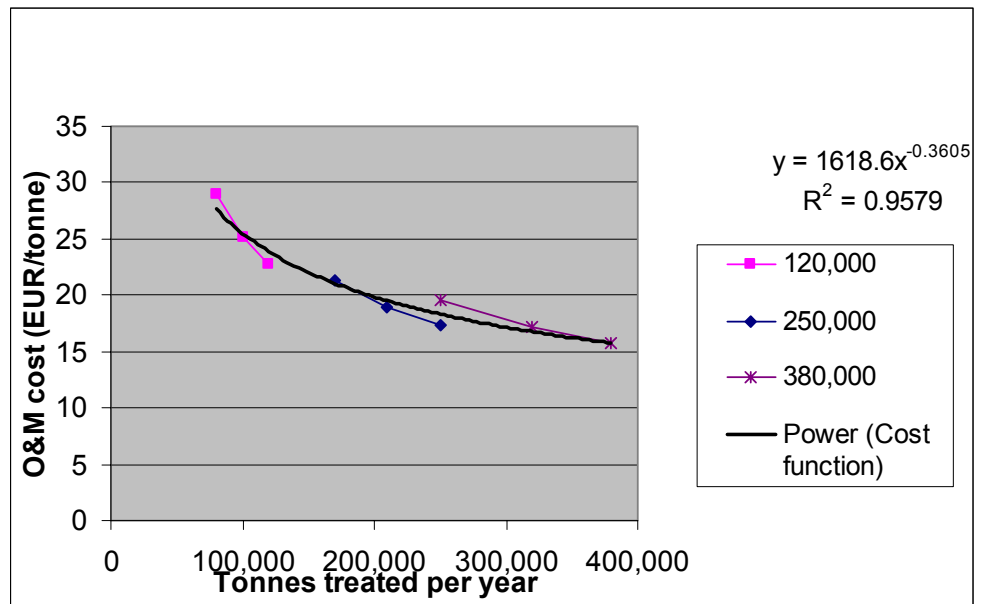
Source: Consultant's estimate

Figure 24 Investment expenditure function, incineration plant B



Source: Consultant's estimate

Figure 25 O&M Expenditure function for incineration plant B



Source: Consultant's estimate

Incineration plant C

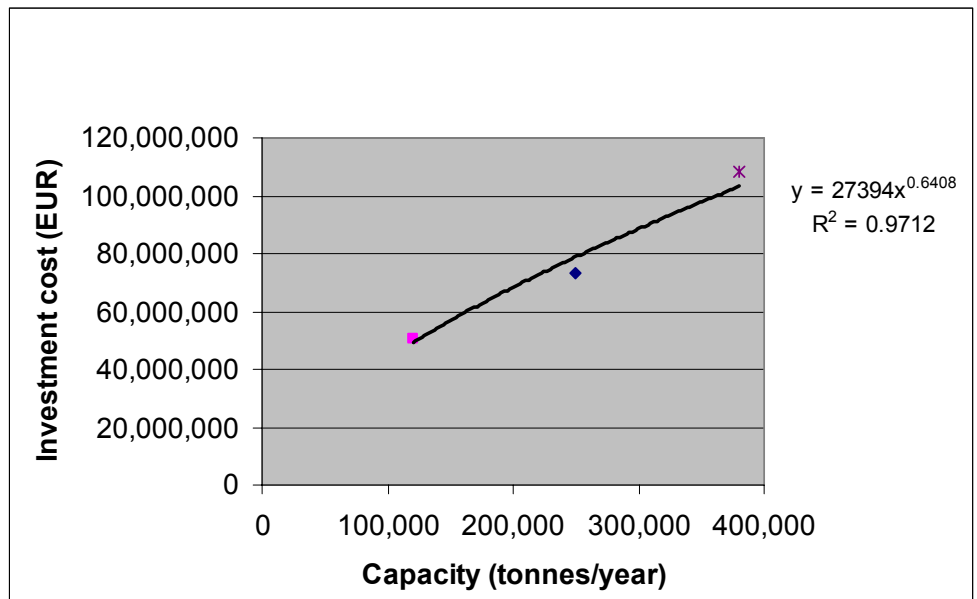
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 35 Investment expenditure, incineration plant C

Capacity t/year	Investment EUR	Fixed O&M EUR/year	Variable O&M EUR/year	Total O&M EUR/t/year
120,000	50,605,653	1,568,102	1,285,061	24
250,000	73,283,984	1,991,252	2,222,577	17
380,000	108,075,370	2,572,073	5,005,518	20

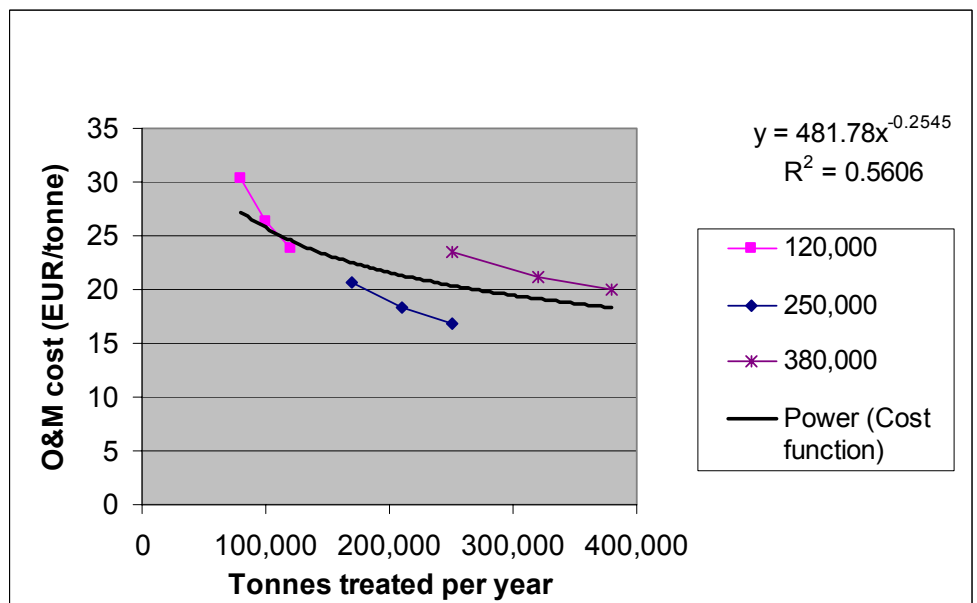
Source: Consultant's estimate

Figure 26 Expenditure function, incineration plant C



Source: Consultant's estimate

Figure 27 O&M expenditure function for incineration plant C



Source: Consultant's estimate

4.2.10 Treatment Facility for Hazardous Household Waste

The expenditure function for facilities that treat hazardous household waste consists of a fixed treatment cost since it is not likely that the cost of establishing and operating a WEEE recovery facility will be shouldered by local authorities.

The treatment cost of EUR 890 per tonne included in FEASIBLE is based on data from a hazardous waste composition analysis in Kaunas in Lithuania, and the treatment cost of different types of hazardous waste at Kommunekemi in Denmark. The treatment cost has been calculated as a weighted average of the treatment cost of different waste types, taking into consideration the distribution on different hazardous waste types.

4.2.11 C&D Recycling Facility

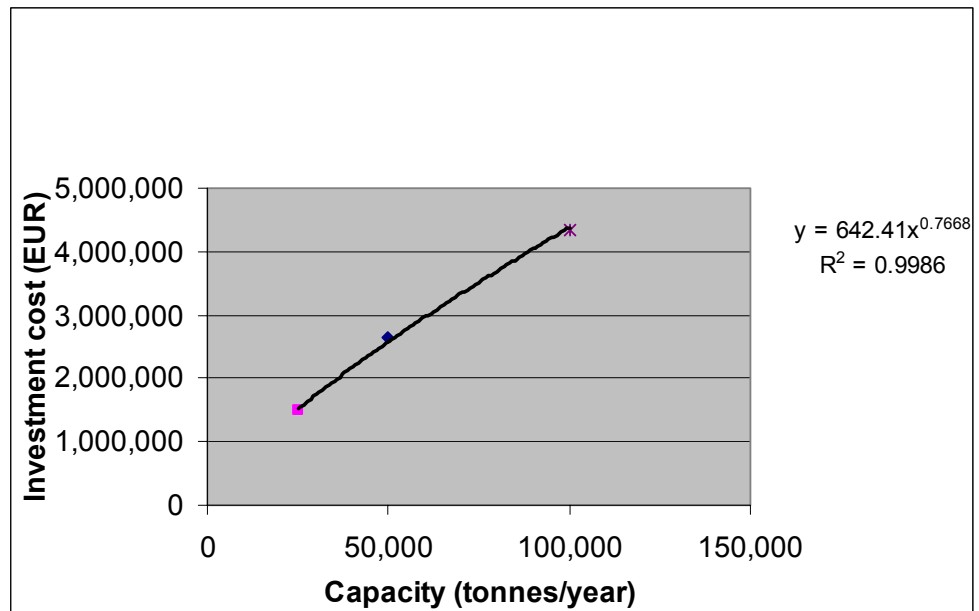
The calculation of O&M and investment expenditure functions is described in the tables and graphs below. Details on the assumptions behind the unit costs are provided in Attachment 4.

Table 36 Expenditure, C&D recycling facility

Capacity t/year	Investment EUR	Fixed O&M EUR/year	Variable O&M EUR/year	Total O&M EUR/t/year
25,000	1,496,366	191,396	31,171	9
50,000	2,634,993	251,767	41,830	6
100,000	4,331,898	422,830	74,132	5

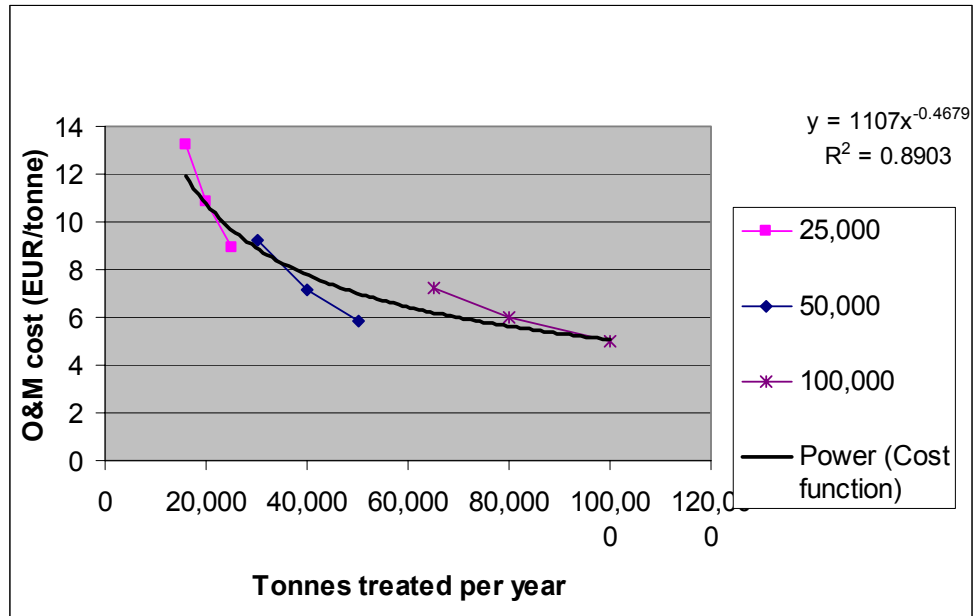
Source: Consultant's estimate

Figure 28 Investment expenditure function, C&D recycling facility



Source: Consultant's estimate

Figure 29 O&M expenditure function for a C&D recycling facility



Source: Consultant's estimate

4.3 Transport of Residues to Landfills

All waste management facilities, except landfills, generate a solid residue that has to be disposed of at a landfill. FEASIBLE calculates the amount of residue to be landfilled (see Table 37), and the user specifies the distance from the facility to the landfill.

Table 37 Residues generated at recovery/disposal facilities (in % of waste entering the facility)

Residue	Recovery and disposal facility	MRF - mixed waste	MRF - mixed recyclables	MRF - sep. recyclables	MRF - WEEE	Windrow composting plant	In vessel composting plant	Bio gasification plant	Incineration plant	HHW treatment facility	C&D recycling facility
Paper		25%	15%	5%							
Cardboard		15%	10%	2%							
Cardboard, bulky			10%	2%							
Plastic		40%	30%	10%							
Glass		10%	10%	2%							
Metal		10%	5%	1%							
Metal, bulky			5%	1%							
Concrete, tile, rubble											10%
Unspecified fraction						8%	5%	5%	15%		

Source: Consultant's estimate

4.3.1 Expenditure Function

The Danish transport cost for residues is estimated at 0.13 EUR/tonne/km. This estimate is based on data from the Danish Road Haulage Association concerning the cost of transport by a truck with a capacity of 20 tonnes.

5 Calculation of the Efficiency and Revenue of Recycling/Recovery

5.1 By-Products

Most waste management facilities produce by-products that may be associated with costs or revenues. The assumptions in FEASIBLE regarding the by-products produced by each type of facility are illustrated in Table 38 below.

5.1.1 Revenue from Sale of By-Products

The revenue is calculated by FEASIBLE based on the output table and prices of by-products entered by the user.

Revenue = output * price

Table 38 *By-products generated at recovery/disposal facilities (as a function of the amount of waste entering the facility)*

By-product	Recovery and disposal facility													
	MRF - mixed waste (wet)	MRF - mixed waste (dry)	MRF - mixed recyclables	MRF - sep. recyclables	MRF - WEEE	Windrow composting plant	In vessel composting plant	Bio gasification plant	Landfill EU standard	Incineration plant, type A	Incineration plant, type B	Incineration plant, type C	HHW treatment facility	C&D recycling facility
Paper	50%	75%	85%	95%										
Cardboard	60%	85%	90%	98%										
Cardboard, bulky			90%	98%										
Plastic	50%	60%	70%	90%										
Glass	85%	90%	90%	98%										
Metal	85%	90%	95%	99%										
WEEE					50%									
Concrete, tile, rubble														90%
Compost						40%	35%	35%						
Biogas (in m ³ /t)								150						
Liquid fertiliser								25%						
Recovered heat (in GJ/t)										6	6			
Recovered electricity (in kWh/t)									60	560				
Ash										10%	10%	10%		

Source: Consultant's estimate

Attachment 1 Efficiencies of Collection Methods

The tables below illustrate the assumptions made regarding collection efficiencies of the different collection method (per source and fraction) when implemented in certain combinations.

Method of Establishing Assumptions

Household Waste

For bulky waste delivered to a recycling station, a collection efficiency of 100% is assumed. This is based on the assumption that households are compelled to dispose of their bulky waste as it is not collected through ordinary or dual collection. The only alternative to delivering to the recycling station would be illegal disposal. However, it is assumed that the households prefer the recycling station.

For non-bulky waste, the waste collection efficiencies specified in FEASIBLE are based on COWI's experience in Northern Europe which indicates typical levels of "extraction" of recyclable materials/waste fractions. The typical levels of extraction indicated indicate the percentage of the share of each fraction which is potentially recyclable.

Recycling stations:	up to 25% ⁶ for recyclable materials and 75-80% for certain waste fractions
Bring banks:	up to 50-60% for recyclable materials
Kerbside collection of recyclables:	up to 70-80% for recyclable materials and 90-100% for certain waste fractions

The collection efficiencies in FEASIBLE have been deduced as illustrated in the tables below.

⁶ In fact, a high efficiency per household is assumed, however, it is expected that only a minor share of the households will actually use the recycling station for delivery of recyclable materials. This is reflected in **Error! Reference source not found.**

Table 39 *Collection efficiencies, recycling station*

Fraction	Share of total fraction potentially recyclable	Collection efficiency of potentially recyclable material	Share of households using the station	Collection efficiency (in % of total fraction)*
Paper	64%	80%	20%	10%
Cardboard	83%	80%	20%	15%
Plastic	64%	80%	20%	10%
Glass	95%	80%	20%	15%
Metal	69%	80%	20%	10%

* rounded to nearest 5
 Source: Consultant's estimate

Table 40 *Collection efficiencies, bring banks*

Fraction	Share of total fraction potentially recyclable	Collection efficiency of potentially recyclable material	Collection efficiency (in % of total fraction)*
Paper	64%	50%	30%
Cardboard	83%	-	-
Plastic	64%	50%	30%
Glass	95%	50%	45%
Metal	69%	50%	35%

* rounded to nearest 5
 Source: Consultant's estimate

Table 41 *Collection efficiencies, kerbside collection of recyclables*

Fraction	Share of total fraction potentially recyclable	Collection efficiency of potentially recyclable material	Collection efficiency (in % of total fraction)*
Paper	64%	75%	45%
Cardboard	83%	75%	60%
Plastic	64%	75%	45%
Glass	95%	75%	70%
Metal	69%	75%	50%

* rounded to nearest 5
 Source: Consultant's estimate

Commerce, Industry, and C&D

The collection efficiency for recyclable materials from commerce, industry and C&D activities is based on rough estimates made on the basis of waste flow analyses made at national scale in Northern Europe (primarily Denmark).

The collection efficiencies represent the consultant's best estimates based on experience with these collection systems in northern European countries (including the CEE).

Waste Flow Routing of Fractions Generated by Urban Households

Notes concerning collection systems for urban households:

Note: No collection is specified for household waste from urban households and is calculated as follows:
1) where no recycling station exists, no bulky waste is collected.
The remaining "no collection" is domestic and garden waste.
The same % of each (domestic and garden waste) fraction is assumed not to be collected.
The sum of the non-collected bulky, domestic and garden waste is the household waste that is not collected
2) where bulky waste is collected at a recycling station, the same % of all household waste fractions is assumed not to be collected
80% of food is collected separately and 20% is collected together with mixed waste
Local composting in urban areas includes home composting of garden waste at SF houses only

Table 42 Waste flow routing of fractions generated by households living in single family houses in urban areas (1 of 2)

	No collection	No collection - Bulky waste	Local composting	Kerbside - Ordinary collection	Kerbside - Dual collection	Kerbside - Recyclables collection	Drop-off - Bring banks	Drop-off - Recycling Centre	Drop-off - Take back
CUH1									
Paper	0	0	0	100	0	0	0	0	0
Cardboard	0	0	0	100	0	0	0	0	0
Cardboard, bulky	0	100	0	0	0	0	0	0	0
Plastic	0	0	0	100	0	0	0	0	0
Glass	0	0	0	100	0	0	0	0	0
Metal	0	0	0	100	0	0	0	0	0
Metal, bulky	0	100	0	0	0	0	0	0	0
Food waste	0	0	0	100	0	0	0	0	0
Garden waste	0	0	100	0	0	0	0	0	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	100	0	0	0	0	0	0	0
Hazardous waste	0	0	0	100	0	0	0	0	0
WEEE	0	70	0	30	0	0	0	0	0
Other non-combust, bulky	0	100	0	0	0	0	0	0	0
CUH2									
Paper	0	0	0	90	0	0	0	10	0
Cardboard	0	0	0	85	0	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	90	0	0	0	10	0
Glass	0	0	0	85	0	0	0	15	0
Metal	0	0	0	90	0	0	0	10	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	100	0	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	80	0	0	0	20	0
WEEE	0	0	0	30	0	0	0	70	0
Other non-combust, bulky	0	0	0	0	0	0	0	100	0
CUH3									
Paper	0	0	0	65	0	0	30	5	0
Cardboard	0	0	0	85	0	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	65	0	0	30	5	0
Glass	0	0	0	50	0	0	45	5	0
Metal	0	0	0	65	0	0	30	5	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	100	0	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	40	0	0	0	30	30
WEEE	0	0	0	30	0	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0
CUH4									
Paper	0	0	0	53	0	45	0	2	0
Cardboard	0	0	0	38	0	60	0	2	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	53	0	45	0	2	0
Glass	0	0	0	28	0	70	0	2	0
Metal	0	0	0	48	0	50	0	2	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	100	0	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	40	0	0	0	30	30
WEEE	0	0	0	30	0	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0

Table 43 Waste flow routing of fractions generated by households living in single family houses in urban areas (2 of 2)

	No collection	No collection - Bulky waste	Local composting	Kerbside - Ordinary collection	Kerbside - Dual collection	Kerbside - Recyclables collection	Drop-off - Bring banks	Drop-off - Recycling Centre	Drop-off - Take back
CUH5									
Paper	0	0	0	0	90	0	0	10	0
Cardboard	0	0	0	0	85	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	0	90	0	0	10	0
Glass	0	0	0	0	85	0	0	15	0
Metal	0	0	0	0	90	0	0	10	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	0	100	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	0	100	0	0	0	0
Other combustibles	0	0	0	0	100	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	0	40	0	0	30	30
WEEE	0	0	0	0	30	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0
CUH6									
Paper	0	0	0	0	65	0	30	5	0
Cardboard	0	0	0	0	85	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	0	65	0	30	5	0
Glass	0	0	0	0	50	0	45	5	0
Metal	0	0	0	0	65	0	30	5	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	0	100	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	0	100	0	0	0	0
Other combustibles	0	0	0	0	100	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	0	40	0	0	30	30
WEEE	0	0	0	0	30	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0
CUH7									
Paper	0	0	0	0	53	45	0	2	0
Cardboard	0	0	0	0	38	60	0	2	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	0	53	45	0	2	0
Glass	0	0	0	0	28	70	0	2	0
Metal	0	0	0	0	48	50	0	2	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	0	100	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	0	100	0	0	0	0
Other combustibles	0	0	0	0	100	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	0	40	0	0	30	30
WEEE	0	0	0	0	30	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0

Source: Consultant's estimate

Table 44 Waste flow routing of fractions generated by households living in multi storey houses in urban areas (1 of 2)

	No collection	No collection - Bulky waste	Local composting	Kerbside - Ordinary collection	Kerbside - Dual collection	Kerbside - Recyclables collection	Drop-off - Bring banks	Drop-off - Recycling Centre	Drop-off - Take back
CUH1									
Paper	0	0	0	100	0	0	0	0	0
Cardboard	0	0	0	100	0	0	0	0	0
Cardboard, bulky	0	100	0	0	0	0	0	0	0
Plastic	0	0	0	100	0	0	0	0	0
Glass	0	0	0	100	0	0	0	0	0
Metal	0	0	0	100	0	0	0	0	0
Metal, bulky	0	100	0	0	0	0	0	0	0
Food waste	0	0	0	100	0	0	0	0	0
Garden waste	0	0	100	0	0	0	0	0	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	100	0	0	0	0	0	0	0
Hazardous waste	0	0	0	100	0	0	0	0	0
WEEE	0	70	0	30	0	0	0	0	0
Other non-combust, bulky	0	100	0	0	0	0	0	0	0
CUH2									
Paper	0	0	0	90	0	0	0	10	0
Cardboard	0	0	0	85	0	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	90	0	0	0	10	0
Glass	0	0	0	85	0	0	0	15	0
Metal	0	0	0	90	0	0	0	10	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	100	0	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	80	0	0	0	20	0
WEEE	0	0	0	30	0	0	0	70	0
Other non-combust, bulky	0	0	0	0	0	0	0	100	0
CUH3									
Paper	0	0	0	65	0	0	30	5	0
Cardboard	0	0	0	85	0	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	65	0	0	30	5	0
Glass	0	0	0	50	0	0	45	5	0
Metal	0	0	0	65	0	0	30	5	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	100	0	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	40	0	0	0	30	30
WEEE	0	0	0	30	0	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0

Source: Consultant's estimate

Table 45 Waste flow routing of fractions generated by households living in multi storey houses in urban areas (2 of 2)

	No collection	No collection - Bulky waste	Local composting	Kerbside - Ordinary collection	Kerbside - Dual collection	Kerbside - Recyclables collection	Drop-off - Bring banks	Drop-off - Recycling Centre	Drop-off - Take back
CUH5									
Paper	0	0	0	0	90	0	0	10	0
Cardboard	0	0	0	0	85	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	0	90	0	0	10	0
Glass	0	0	0	0	85	0	0	15	0
Metal	0	0	0	0	90	0	0	10	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	0	100	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	0	100	0	0	0	0
Other combustibles	0	0	0	0	100	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	0	40	0	0	30	30
WEEE	0	0	0	0	30	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0
CUH6									
Paper	0	0	0	0	65	0	30	5	0
Cardboard	0	0	0	0	85	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	0	65	0	30	5	0
Glass	0	0	0	0	50	0	45	5	0
Metal	0	0	0	0	65	0	30	5	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	0	0	100	0	0	0	0
Garden waste	0	0	50	0	0	0	0	50	0
Other non-combustibles	0	0	0	0	100	0	0	0	0
Other combustibles	0	0	0	0	100	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	0	40	0	0	30	30
WEEE	0	0	0	0	30	0	0	30	40
Other non-combust, bulky	0	0	0	0	0	0	0	100	0

Source: Consultant's estimate

Waste Flow Routing of Fractions Generated by Rural Households

Notes concerning collection systems for rural households:

Note: No collection is specified for household waste from rural households and is calculated as follows:

1) where no recycling station exists, no bulky waste is collected.

The remaining "no collection" is domestic and garden waste.

The same % of each (domestic and garden waste) fraction is assumed not to be collected.

The sum of the non-collected bulky, domestic and garden waste is the household waste that is not collected

2) where bulky waste is collected at a recycling station, the same % of all household waste fractions is assumed not to be collected

"No collection" in rural areas does not include garden waste.

Garden waste that is not collected in rural areas is composted locally.

Local composting includes home composting and community composting

Table 46 Waste flow routing of fractions generated by households living in rural areas

	No collection	No collection - Bulky waste	Local composting	Kerbside - Ordinary collection	Kerbside - Dual collection	Kerbside - Recyclables collection	Drop-off - Bring banks	Drop-off - Recycling Centre	Drop-off - Take back
CRH1									
Paper	0	0	0	100	0	0	0	0	0
Cardboard	0	0	0	100	0	0	0	0	0
Cardboard, bulky	0	100	0	0	0	0	0	0	0
Plastic	0	0	0	100	0	0	0	0	0
Glass	0	0	0	100	0	0	0	0	0
Metal	0	0	0	100	0	0	0	0	0
Metal, bulky	0	100	0	0	0	0	0	0	0
Food waste	0	0	90	10	0	0	0	0	0
Garden waste	0	0	100	0	0	0	0	0	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	100	0	0	0	0	0	0	0
Hazardous waste	0	0	0	100	0	0	0	0	0
WEEE	0	0	0	100	0	0	0	0	0
Other non-combust, bulky	0	100	0	0	0	0	0	0	0
CRH2									
Paper	0	0	0	90	0	0	0	10	0
Cardboard	0	0	0	85	0	0	0	15	0
Cardboard, bulky	0	0	0	0	0	0	0	100	0
Plastic	0	0	0	90	0	0	0	10	0
Glass	0	0	0	85	0	0	0	15	0
Metal	0	0	0	90	0	0	0	10	0
Metal, bulky	0	0	0	0	0	0	0	100	0
Food waste	0	0	50	50	0	0	0	0	0
Garden waste	0	0	100	0	0	0	0	0	0
Other non-combustibles	0	0	0	100	0	0	0	0	0
Other combustibles	0	0	0	100	0	0	0	0	0
Other combustibles, bulky	0	0	0	0	0	0	0	100	0
Hazardous waste	0	0	0	80	0	0	0	20	0
WEEE	0	0	0	30	0	0	0	70	0
Other non-combust, bulky	0	0	0	0	0	0	0	100	0

Source: Consultant's estimate

Table 47 *Waste flow routing of fractions generated by commerce*

	No collection	Local composting	Container ordinary collection	Container recyclables collection
CC1				
Paper	0%	0%	100%	0%
Cardboard	0%	0%	100%	0%
Plastic	0%	0%	100%	0%
Glass	0%	0%	100%	0%
Metal	0%	0%	100%	0%
Food waste	0%	0%	100%	0%
Garden waste	0%	100%	0%	0%
Other non-combustibles	0%	0%	100%	0%
Other combustibles	0%	0%	100%	0%
WEEE	0%	0%	100%	0%
CC2				
Paper	0%	0%	40%	60%
Cardboard	0%	0%	40%	60%
Plastic	0%	0%	70%	30%
Glass	0%	0%	40%	60%
Metal	0%	0%	20%	80%
Food waste	0%	0%	100%	0%
Garden waste	0%	70%	0%	30%
Other non-combustibles	0%	0%	100%	0%
Other combustibles	0%	0%	100%	0%
WEEE	0%	0%	30%	70%

Source: Consultant's estimate

Table 48 *Waste flow routing of fractions generated by industry*

	No collection	Local composting	Container ordinary collection	Container recyclables collection
C11				
Paper	0%	0%	100%	0%
Cardboard	0%	0%	100%	0%
Plastic	0%	0%	100%	0%
Glass	0%	0%	100%	0%
Metal	0%	0%	100%	0%
Food waste	0%	0%	100%	0%
Other non-combustibles	0%	0%	100%	0%
Other combustibles	0%	0%	100%	0%
C12				
Paper	0%	0%	40%	60%
Cardboard	0%	0%	40%	60%
Plastic	0%	0%	40%	60%
Glass	0%	0%	40%	60%
Metal	0%	0%	80%	20%
Food waste	0%	0%	80%	20%
Other non-combustibles	0%	0%	100%	0%
Other combustibles	0%	0%	30%	70%

Source: Consultant's estimate

Table 49 Waste flow routing of fractions generated by construction (C&D)

	No collection	Local composting	Container ordinary collection	Container recyclables collection
CC&D1				
Plastic	0%	0%	100%	0%
Metal	0%	0%	100%	0%
Other non-combustibles	0%	0%	100%	0%
Other combustibles	0%	0%	100%	0%
Concrete/tile/rubber	0%	0%	100%	0%
CC&D2				
Plastic	0%	0%	50%	50%
Metal	0%	0%	10%	90%
Other non-combustibles	0%	0%	100%	0%
Other combustibles	0%	0%	30%	70%
Concrete/tile/rubber	0%	0%	10%	90%

Source: Consultant's estimate

Attachment 2 Detailed Overview of MSW Collection Expenditure Functions

Baseline cost elements for Ordinary Collection - Urban

Basic Assumptions: Kerbside - Ordinary collection - SF	
Collection Vehicle	Rear End Loader
Fractions collected	Mixed waste
Fraction density	145 kg/m ³
Collection frequency	Weekly
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre (3 km/litre)
Collection receptacle (container)	0,14 m ³ , plastic bins
Container capacity used	90%
No. Containers	1.600
Container replacement period	5 years, 6 %
Households per vehicle	1.600
Performed work per week	1.600 households
Collection distance	45 km/day (260 days)
Total waste collected	27 tonnes/week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	40 EUR

Assumptions SF:

Weekly collection
 One container with volume of 140 litres.
 1 households/container, assuming that 83% of the container capacity is used.
 1.600 households per collection vehicle
16,8 kg/household/week equals 116 litre/household/week, assuming 100% of potential quantity is collected
 Unit quantity kg/pers 292 Household size 3
 Average distance between househ 281
 Collection procedure lasts about 6 minutes/4 containers corresponding 40 containers/hour
 8 working hours per day 5 days per week
1600 containers collected per week
 Collected waste unloaded 10 km outside town boundaries. Time used on transport and unloading is estimated to 30 min.

		Distribution of O&M Costs											
O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	15.337	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	115.074	38.358	3	Person				100%					
Diesel	3.412	0,87	3.900	Litre			100%						
Oil	341		10	%			100%						
Maintenance	6.729	6.729	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	175.208						2%	68%			28%		2%

Total O&M costs/tonne	125 EUR/ton
Costs per household per week	2,11 EUR/household

Baseline cost elements for Ordinary Collection - Urban

Basic Assumptions: Kerbside - Ordinary collection - SF	
Collection Vehicle	Rear End Loader
Fractions collected	Mixed waste
Fraction density	145 kg/m ³
Collection frequency	Weekly
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre (3 km/litre)
Collection receptacle (container)	0,14 m ³ , plastic bins
Container capacity used	90%
No. Containers	1.600
Container replacement period	5 years, 6 %
Households per vehicle	1.600
Performed work per week	1.600 households
Collection distance	45 km/day (260 days)
Total waste collected	27 tonnes/week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	40 EUR

Assumptions SF:

Weekly collection
 One container with volume of 140 litres.
 1 households/container, assuming that 83% of the container capacity is used.
 1.600 households per collection vehicle
16,8 kg/household/week equals 116 litre/household/week, assuming 100% of potential quantity is collected
 Unit quantity kg/pers 292 Household size 3
 Average distance between househ 281
 Collection procedure lasts about 6 minutes/4 containers corresponding 40 containers/hour
 8 working hours per day 5 days per week
1600 containers collected per week
 Collected waste unloaded 10 km outside town boundaries. Time used on transport and unloading is estimated to 30 min.

		Distribution of O&M Costs											
O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	15.337	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	115.074	38.358	3	Person				100%					
Diesel	3.412	0,87	3.900	Litre			100%						
Oil	341		10	%			100%						
Maintenance	6.729	6.729	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	175.208						2%	68%			28%		2%

Total O&M costs/tonne	125 EUR/ton
Costs per household per week	2,11 EUR/household

Baseline cost elements for Ordinary Collection - Rural

Basic Assumptions: Kerbside - Ordinary collection - V SF rural	
Collection Vehicle	Rear End Loader
Fractions collected	Mixed waste
Fraction density	160 kg/m ³
Collection frequency	Weekly
Vehicle capacity	50 m ³ , 8 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,87 EUR/litre (3 km/litre)
Collection receptacle (container)	0,09 m ³ ,
Container capacity used	80%
No. Containers	1.000
Container replacement period	5 years, 6 %
Households per vehicle	1.000
Performed work per week	1.000 households
Collection distance	55 km/day (260 days)
Total waste collected	13 tonnes/week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	27 EUR

Assumptions Rural:

Weekly collection
 One container with volume of 90 litres.
 1 household/container, assuming that 93% of the container capacity is used.
 1.000 households per collection vehicle
13,5 kg/household/week equals 84 litre/household/week, assuming 100% of potential quantity is collected
 Unit quantity kg/pers 200 Household size 3,5
 Average distance between households/collection points is 50 - 100 m in village area and 10 km between neighbouring villages. Time
 Average collection procedure (incl. transport) lasts about 2½ minutes/cc 25 containers/hour
 8 working hours per day 5 days per week
1000 containers collected per week
 Collected waste unloaded 10 km outside town boundaries. Time used on transport and unloading is estimated to 30 min.

O&M costs		Distribution of O&M Costs												
EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other		
Vehicles	28.932	0,18	1	EUR/year										100%
Containers	6.390	0,24	1	EUR/year										100%
Licence	902	902	1	Licence										100%
Insurance	3.365	3.365	1	Insurance										100%
Labour	76.716	38.358	2	Person				100%						
Diesel	12.510	0,87	14.300	Litre				100%						
Oil	1.251		10	% of diesel				100%						
Maintenance	6.729	6.729	1	Lump sum				40%		60%				
Other/miscellaneous	1.346	1.346	1	Lump sum				50%		50%				
Total O&M costs	138.141							10%	58%			29%		3%

Total O&M costs/tonne	197 EUR/ton
Costs per household per week	2,66 EUR/household

Baseline cost elements for Dual Collection.

Basic Assumptions: Kerbside - Dual collection - MS urban	
Collection Vehicle	Rear End Loader
Fractions collected	Food waste
Fraction density	300 kg/m ³
Collection frequency	Weekly
Vehicle capacity	10 m ³ , 8 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,87 EUR/litre (3 km/litre)
Collection receptacle (container)	0,8 m ³ ,
Container capacity used	60%
No. Containers	240
Container replacement period	5 years, 6 %
Households per vehicle	5.816
Performed work per week	5.816 households
Collection distance	55 km/day (260 days)
Total waste collected	35 tonnes/week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	188 EUR

Assumptions MS:

Weekly collection
 One container with volume of 800 litres.
 24 households/container, assuming that 60% of the container capacity is used.
 5.816 households per collection vehicle
5,9 kg/household/week equals 20 litre/household/week, assuming 100% of potential quantity is collected
 Unit quantity kg/pers 103 Household size 3
 Average distance between households/collection points is 400 - 500 m
 Collection procedure lasts about 10 minutes/container corresponding to 6 containers/hour
 8 working hours per day 5 days per week
240 containers collected per week
 Collected materials unloaded 15 km outside town boundaries. Time used on transport and unloading is estimated to 45 min.

		Distribution of O&M Costs											
O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	10.736	0,24	1	EUR/year							100%		
Licence	902	902	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	76.716	38.358	2	Person				100%					
Diesel	4.170	0,87	4.767	Litre			100%						
Oil	417		10	% of diesel			100%						
Maintenance	6.729	6.729	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	133.312						3%	60%			33%		3%
Total O&M costs/tonne		74 EUR/tonne											
Costs per household per week		0,44											

Baseline cost elements for Dual Collection

Basic Assumptions: Kerbside - Dual collection - MS urban	
Collection Vehicle	Rear End Loader
Fractions collected	Residual waste
Fraction density	120 kg/m ³
Collection frequency	Weekly
Vehicle capacity	12 m ³ , 8 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre (3 km/litre)
Collection receptacle (container)	1,1 m ³
Container capacity used	80%
No. Containers	240
Container replacement period	5 years, 6 %
Households per vehicle	4.526
Performed work per week	4.526 households
Collection distance	55 km/day (260 days)
Total waste collected	25 tonnes/week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	336 EUR

Assumptions MS:

Weekly collection
 One container with volume of 1100 litres.
 19 households/container, assuming that 80% of the container capacity is used.
 4.526 households per collection vehicle
5,6 kg/household/week equals 47 litre/household/week, assuming 100% of potential quantity is collected

Average distance between households/collection points is 400 - 500 m
 Collection procedure lasts about 10 minutes/container corresponding to 6 containers/hour
 8 working hours per day 5 days per week
240 containers collected per week
 Collected materials unloaded 15 km outside town boundaries. Time used on transport and unloading is estimated to 45 min.

		Distribution of O&M Costs											
O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	19.171	0,24	1	EUR/year							100%		
Licence	902	902	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	76.716	38.358	2	Person				100%					
Diesel	4.170	0,87	4.767	Litre			100%						
Oil	417		10	% of diesel			100%						
Maintenance	6.729	6.729	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	141.747						3%	56%			37%		3%

Total O&M costs/tonne	54 EUR/tonne
Costs per household per week	0,60

Baseline cost elements for Dual Collection

Basic Assumptions: Kerbside - Dual collection - SF urban	
Collection Vehicle	Rear End Loader
Fractions collected	Food waste
Fraction density	300 kg/m ³
Collection frequency	Every fortnight
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,87 EUR/litre (3 km/litre)
Collection receptacle (container)	0,09 m ³ , plastic bins
Container capacity used	70%
No. Containers	1.600
Container replacement period	5 years, 6 %
Households per vehicle	1.600
Performed work per week	1.600 households
Collection distance	45 km/day (260 days)
Total waste collected	24 tonnes/fortnight
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	27 EUR

Assumptions SF:**Fortnightly collection**

One container with volume of 90 litres.
 1 households/container, assuming that 109% of the container capacity is used.
 1.600 households per collection vehicle
14,8 kg/household/fortnight equals 49 litre/household/week, assuming 100% of potential quantity is collected
 Unit quantity kg/pers 128 Household size 3
 Average distance between households/collection points is 50 - 100 m
 Collection procedure lasts about 6 minutes/4 containers corresponding to 40 containers/hour
 8 working hours per day 5 days per week
1600 containers collected per fortnight
 Collected materials unloaded 15 km outside town boundaries. Time used on transport and unloading is estimated to 45 min.

		Distribution of O&M Costs											
O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	10.224	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	115.074	38.358	3	Person				100%					
Diesel	10.236	0,87	11.700	Litre			100%						
Oil	1.024		10	% of diesel			100%						
Maintenance	6.729	6.729	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	88.801						13%	133%			49%		5%

Total O&M costs/tonne	72 EUR/tonne
Costs per household per fortnight	0,53

Baseline cost elements for Dual Collection

Basic Assumptions: Kerbside - Dual collection - SF urban	
Collection Vehicle	Rear End Loader
Fractions collected	Residual waste
Fraction density	120 kg/m ³
Collection frequency	Every fortnight
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre (3 km/litre)
Collection receptacle (container)	0,24 m ³
Container capacity used	80%
No. Containers	1.600
Container replacement period	5 years, 6 %
Households per vehicle	1.600
Performed work per fortnight	1.600 households
Collection distance	45 km/day (260 days)
Total waste collected	46 tonnes/fortnight
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	54 EUR

Assumptions SF:

Fortnightly collection
 One container with volume of 240 litres.
 1 households/container, assuming that 201% of the container capacity is used.
 1.600 households per collection vehicle
29,0 kg/household/fortnight equals 242 litre/household/ week, assuming 100% of potential quantity is collected
 Unit quantity kg/pers 251 Household size 3
 Average distance between households/collection points is 50 - 100 m
 Collection procedure lasts about 7 minutes/5 containers corresponding to 40 containers/hour
 8 working hours per day 5 days per week
1.600 containers collected per fortnight
 Collected materials unloaded 10 km outside town boundaries. Time used on transport and unloading is estimated to 30 min.

		Distribution of O&M Costs											
O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	20.449	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	115.074	38.358	3	Person				100%					
Diesel	10.236	0,87	11.700	Litre			100%						
Oil	1.024		10	% of diesel			100%						
Maintenance	6.729	6.729	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	93.913						12%	126%			58%		4%

Total O&M costs/tonne	19 EUR/tonne
Costs per household per fortnight	0,56

Baseline cost elements for Bring Banks (Recyclable materials).
(without transfer facility).

Basic Assumptions: Drop off - Bring banks - MS	
Collection Vehicle	Rear End Loader
Fractions collected	Paper
Fraction density	110 kg/m ³
Collection frequency	bi-weekly
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,87 EUR/litre
Container	2,2 m ³
Container capacity	80%
No. Containers	96
Container replacement period	5 years, 6 %
Households per Bring Bank	400
Performed work per week	38.400 households
Collection distance	20 km/day
Total waste collected	11 tonnes/week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	673 EUR

Assumptions MS:

Collection every 2 week
 Two containers with volume of 2200 litres. (2 x 1100 litres)
 400 households/container, assuming that 92% of the container capacity is used.
 38.400 households per collection vehicle
0,3 kg/household/week equals 2,5 litres/household/week 30% of potential quantity has been assumed to be
 Unit quantity kg/pers 4,8 Household size 3
 Average distance between bring banks/collection points is 400 m
 Collection procedure lasts about 25minutes/containers corresponding to 2,4 containers/hour
 8 working hours per day 5 days per week
96 containers collected per week
 Collected materials unloaded within town boundaries (10 km)

Cardboard is not included. Collecting cardboard in such a system would require using special compacting equipment otherwise it may be necessary to empty the cardboard containers every day.

O&M costs	EUR/year	Unit cost	Nos.	Unit	Distribution of O&M Costs								
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	15.337	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	% of diesel			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	2.050	2.050	1	Lump sum				50%			50%		
Total O&M costs	101.793						5%	42%			49%		4%

Total O&M costs/tonne	92 EUR/tonne
Costs per household per 2 weeks	0,03 EUR

Baseline cost elements for Bring Banks (Recyclable materials).
(without transfer facility).

Basic Assumptions: Drop off - Bring banks - MS	
Collection Vehicle	Multilift truck with container
Fractions collected	Glass
Fraction density	300 kg/m ³
Collection frequency	Every third week
Vehicle capacity	12 m ³ , 8 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre
Container	1,5 m ³
Container capacity	75%
No. Containers	96
Container replacement period	5 years, 6 %
Households per Bring Bank	400
Performed work per 2 weeks	38.400 households
Collection distance	20 km/day
Total waste collected	11 tonnes/week
Investment costs	
Vehicle purchase price	188.425 EUR
Cost per container	336 EUR

Assumptions MS:

Collection every 3 week
 One container with volume of 1500 litres. (Cube)
 400 households/container, assuming that 74% of the container capacity is used.
 38.400 households per collection vehicle
0,3 kg/household/week equals 0,9 litres/household/week 30% of potential quantity has been assumed to be
 Unit quantity kg/pers 4,8 Household size 3
 Average distance between bring banks/collection points is 400 m
 Collection procedure lasts about 25 minutes/container corresponding to 2,4 containers/hour
 8 working hours per day 5 days per week
96 containers collected/emptyings per week
 Collected materials unloaded within town boundaries (10 km)

O&M costs	EUR/year	Unit cost	Nos.	Unit	Distribution of O&M Costs								
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	33.754	0,18	1	EUR/year							100%		
Containers	7.668	0,24	1	EUR/year							100%		
Licence	1.346	1.346	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	% of diesel			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	98.916						5%	43%			47%		5%

Total O&M costs/tonne	60 EUR/tonne
Costs per household per three weeks	0,0

Baseline cost elements for Bring Banks (Recyclable materials).
(without transfer facility).

Basic Assumptions: Drop off - Bring banks - MS	
Collection Vehicle	Rear End Loader
Fractions collected	Plastic
Fraction density	50 kg/m ³
Collection frequency	Bi- weekly
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre
Container	3,3 m ³
Container capacity	75%
No. Containers	80
Container replacement period	5 years, 6 %
Households per Bring Bank	400
Performed work per week	32.000 households
Collection distance	20 km/day
Total waste collected	7 tonnes/ week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	1.009 EUR

Assumptions MS:

Collection every 2 week
 Three containers with volume of 3300 litres. (3 x 1100 litres)
 400 households/container, assuming that 101% of the container capacity is used.
 32.000 households per collection vehicle
0,2 kg/household/week equals 4,15 litres/household/week 30% of potential quantity has been assumed to t
 Unit quantity kg/pers 3,6 Household size 3
 Average distance between households/collection points is 400 m
 Collection procedure lasts about 30 minutes/container corresponding to 2 containers/hour
 8 working hours per day 5 days per week
80 containers collected per week
 Collected materials unloaded within town boundaries.(10 km)

O&M costs	EUR/year	Unit cost	Nos.	Unit	Distribution of O&M Costs								
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	19.171	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Incurrence									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	% of diesel			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	104.923						5%	40%			51%		4%

Total O&M costs/tonne	152 EUR/tonne
Costs per household per 2 weeks	0,0

Baseline cost elements for Bring Banks (Recyclable materials).

Basic Assumptions: Drop off - Bring banks - MS	
Collection Vehicle	Rear End Loader
Fractions collected	Metal
Fraction density	100 kg/m ³
Collection frequency	Every second week
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,87 DKK/litre
Container	2,2 m ³
Container capacity	75%
No. Containers	96
Container replacement period	5 years, 6 %
Households per Bring Bank	400
Performed work per fortnight	38.400 households
Collection distance	20 km/day
Total waste collected	4 tonnes/ week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	673 EUR

Assumptions MS:

Collection every 4 week
 One container with volume of 2200 litres. (2 x 1100 litres)
 400 households/container, assuming that 76% of the container capacity is used.
 38.400 households per collection vehicle
0,1 kg/household/week equals 1,04 litres/household/week 30% of potential quantity has been assumed to be
 Unit quantity kg/pers 1,8 Household size 3
 Average distance between households/collection points is 400 m
 Collection procedure lasts about 25 minutes/containers corresponding to 2,4 containers/hour
 8 working hours per day 5 days per week
96 containers collected/emptyings per week
 Collected materials unloaded within town boundaries.(10 km)

		Distribution of O&M Costs											
O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	15.337	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	% of diesel			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	101.089						5%	42%			49%		4%

Total O&M costs/tonne	122 EUR/tonne
Costs per household per four weeks	0,0

**Baseline cost elements for Bring Banks (Recyclable materials).
(without transfer facility).**

Basic Assumptions: Drop off - Bring banks - SF	
Collection Vehicle	Rear End Loader
Fractions collected	Paper
Fraction density	110 kg/m3
Collection frequency	weekly
Vehicle capacity	10 m³, 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre
Container	2,2 m3
Container capacity	75%
No. Containers	96
Container replacement period	5 years, 6 %
Households per Bring Bank	300
Performed work per week	28.800 households
Collection distance	20 km/day
Total waste collected	21 tonnes/week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	673 EUR

Assumptions SF:

Collection every 1 week
 One container with volume of 2200 litres. 2 x 1100 litres)
 300 households/container, assuming that 89% of the container capacity is used.
 28.800 households per collection vehicle
0,7 kg/household/week equals 7 litres/household/week 30% of potential quantity has been assumed to t
 Unit quantity kg/pers 12,5 Household size 3
 Average distance between bring banks/collection points is 800 m
 Collection procedure lasts about 25 minutes/containers corresponding to 2,4 containers/hour
 8 working hours per day 5 days per week
96 containers collected/emptyings per week
 Collected materials unloaded within town boundaries.(10 km)

Cardboard is not included. Collecting cardboard in such a system would require using special compacting equipment otherwise it may be necessary to empty the cardboard containers every day.

O&M costs	DKK/year	Unit cost	Nos.	Unit	Distribution of O&M Costs								
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	15.337	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	%			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	2.050	2.050	1	Lump sum				50%			50%		
Total O&M costs	101.793						5%	42%			49%		4%

Total O&M costs/tonne	94 DKK/tonne
Costs per household per week	0,1

Baseline cost elements for Bring Banks (Recyclable materials).
(without transfer facility).

Basic Assumptions: Drop off - Bring banks - SF and R	
Collection Vehicle	Multilift truck with container
Fractions collected	Glass
Fraction density	300 kg/m ³
Collection frequency	Every week
Vehicle capacity	12 m ³ , 8 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre
Container	2,5 m ³
Container capacity	75%
No. Containers	96
Conatiner replacement period	5 years, 6 %
Households per Bring Bank	300
Performed work per week	28.800 households
Collection distance	20 km/day
Total waste collected	31 tonnes/week
Investment costs	
Vehicle purchase price	188.425 EUR
Cost per container	538 EUR
O&M costs	EUR/year
Vehicles	33.754
Containers	12.269
Licence	1.346
Insurance	3.365
Labour	38.358
Diesel	4.549
Oil	455
Maintenance	8.075
Other/miscellaneous	1.346
Total O&M costs	103.517
Total O&M costs/tonne	32 EUR/tonne
Costs per household per 2 weeks	0,0

Assumptions SF:

Collection every 2 week
 One container with volume of 2500 litres. (Cube)
 300 households/container, assuming that 86% of the container capacity is used.
 28.800 households per collection vehicle
1,1 kg/household/week equals 3,6 litres/household/week 45% of potential quantity has been assumed to be
 Unit quantity kg/pers 18,7 Household size 3
 Average distance between bring banks/collection points is 800 m
 Collection procedure lasts about 25 minutes/container corresponding to 2,4 containers/hour
 8 working hours per day 5 days per week
96 containers collected/emptyings per week
 Collected materials unloaded within town boundaries.(10 km)

Distribution of O&M Costs

O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	33.754	0,18	1	EUR/year							100%		
Containers	12.269	0,24	1	EUR/year							100%		
Licence	1.346	1.346	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	%			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	103.517						5%	41%			50%		5%

Baseline cost elements for Bring Banks (Recyclable materials).
(without transfer facility).

Basic Assumptions: Drop off - Bring banks - SF	
Collection Vehicle	Rear End Loader
Fractions collected	Plastic
Fraction density	50 kg/m ³
Collection frequency	weekly
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre
Container	3,3 m ³
Container capacity	75%
No. Containers	80
Container replacement period	5 years, 6 %
Households per Bring Bank	300
Performed work per three weeks	24.000 households
Collection distance	20 km/day
Total waste collected	13 tonnes/ week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	1.009 EUR
O&M costs	EUR/year
Vehicles	28.932
Containers	19.171
Licence	673
Insurance	3.365
Labour	38.358
Diesel	4.549
Oil	455
Maintenance	8.075
Other/miscellaneous	1.346
Total O&M costs	104.923
Total O&M costs/tonne	155 EUR/tonne
Costs per household per week	0,1

Assumptions SF:

Collection every 1 week
 One container with volume of 3300 litres.
 300 households/container, assuming that 99% of the container capacity is used.
 24.000 households per collection vehicle
0,5 kg/household/week equals 10,8 litres/household/week 30% of potential quantity has been assumed to be
 Unit quantity kg/pers 9,4 Household size 3
 Average distance between bring banks/collection points is 800 m
 Collection procedure lasts about 30 minutes/containers corresponding to 2 containers/hour
 8 working hours per day 5 days per week
80 containers collected/emptyings per week
 Collected materials unloaded within town boundaries.(10 km)

Distribution of O&M Costs

O&M costs	EUR/year	Unit cost	Nos.	Unit	Distribution of O&M Costs								
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	19.171	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	% of diesel			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	104.923						5%	40%			51%		4%

Baseline cost elements for Bring Banks (Recyclable materials).
(without transfer facility).

Basic Assumptions: Drop off - Bring banks - SF and R	
Collection Vehicle	Rear End Loader
Fractions collected	Metal
Fraction density	100 kg/m ³
Collection frequency	Every week
Vehicle capacity	10 m ³ , 6 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre
Container	2,2 m ³
Container capacity	75%
No. Containers	96
Container replacement period	5 years, 6 %
Households per Bring Bank	300
Performed work per week	28.800 households
Collection distance	20 km/day
Total waste collected	8 tonnes/ week
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per container	673 EUR
O&M costs	EUR/year
Vehicles	28.932
Containers	15.337
Licence	673
Insurance	3.365
Labour	38.358
Diesel	4.549
Oil	455
Maintenance	8.075
Other/miscellaneous	1.346
Total O&M costs	101.089
Total O&M costs/tonne	124 EUR/tonne
Costs per household per 2 weeks	0,0

Assumptions SF:

Collection every 2 week
 One container with volume of 2200 litres. (2 x 1100 litres)
 300 households/container, assuming that 74% of the container capacity is used.
 28.800 households per collection vehicle
0,3 kg/household/week equals 2,7 litres/household/week 30% of potential quantity has been assumed to be
 Unit quantity kg/pers 4,7 Household size 3
 Average distance between bring banks/collection points is 800 m
 Collection procedure lasts about 25 minutes/containers corresponding to 2,4 containers/hour
 8 working hours per day 5 days per week
96 containers collected/emptings per week
 Collected materials unloaded within town boundaries.(10 km)

Distribution of O&M Costs

O&M costs	EUR/year	Unit cost	Nos.	Unit	Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	15.337	0,24	1	EUR/year							100%		
Licence	673	673	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	38.358	38.358	1	Person				100%					
Diesel	4.549	0,87	5.200	Litre			100%						
Oil	455		10	%			100%						
Maintenance	8.075	8.075	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	101.089						5%	42%			49%		4%

Baseline cost elements for Kerbside - Recyclables Collection (for SF only)
(without transfer facility).

Basic Assumptions: Kerbside - Recyclables Collection - SF	
Collection Vehicle	Rear End Loader
Fractions collected	Dry recyclables
Fraction density	160 kg/m ³
Collection frequency	Every month
Vehicle capacity	8 m ³ , 5 tons
Vehicle capacity used	100%
Vehicle replacement period	7 years, 6 %
Diesel price	0,874831763 EUR/litre (3 km/litre)
Collection receptacle	0,14 plastic bins
Container capacity used	60%
No. Containers	1.600
Container replacement period	5 years, 6 %
Households per vehicle	1.600
Performed work per week	1.600 households
Collection distance	45 km/day (260 days)
Total waste collected	8 tonnes/month
Investment costs	
Vehicle purchase price	161.507 EUR
Cost per plastic bag	40 EUR

Assumptions:

Collection every 4 week
 One container with volume of 140 litres.
 1 households/container, assuming that 88% of the container capacity is used.
 1.600 households per collection vehicle
4,9 kg/household/week equals 31 litre/household/week, assuming 40% of potential quantity is collected
 Unit quantity kg/pers 85,2 Household size 3
 Average distance between households/collection points is 50 - 100 m
 Collection procedure lasts about 6 minutes/4 containers corresponding to 40 containers/hour
 8 working hours per day 5 days per week
1600 containers collected per week
 Collected materials unloaded inside town boundaries. Time used on transport and unloading is estimated to 20 min.

O&M costs	EUR/year	Unit cost	Nos.	Unit	Distribution of O&M Costs								
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Vehicles	28.932	0,18	1	EUR/year							100%		
Containers	15.337	0,24	1	EUR/year							100%		
Licence	565	565	1	Licence									100%
Insurance	3.365	3.365	1	Insurance									100%
Labour	115.074	38.358	3	Person				100%					
Diesel	10.236	0,87	11.700	Litre			100%						
Oil	1.024		10	% of diesel			100%						
Maintenance	6.729	6.729	1	Lump sum				40%			60%		
Other/miscellaneous	1.346	1.346	1	Lump sum				50%			50%		
Total O&M costs	182.607						6%	65%			27%		2%

Total O&M costs/tonne	112 EUR/tonne
Costs per household per week	2,2

Attachment 3 Compatibility between Collection Methods and R&D Facilities

Waste source/ Fraction	Waste collection method								
	Kerbside ordinary collection	Kerbside dual collection	Kerbside recyclables collection	Drop-off - bring banks	Drop-off - recycling station	Drop-off - take back	Container ordinary coll.	Container recyclables collection	Sludge transport
Paper	LF/IP	LF/IP/MRF1	MRF2A	MRF2B	MRF2B				
Cardboard	LF/IP	LF/IP/MRF1	MRF2A		MRF2B				
Cardboard,					MRF2B				
Plastic	LF/IP	LF/IP/MRF1	MRF2A	MRF2B	MRF2B				
Glass	LF/IP	LF/IP/MRF1	MRF2A	MRF2B	MRF2B				
Metal	LF/IP	LF/IP/MRF1	MRF2A	MRF2B	MRF2B				
Metal, bulky					Sold				
Food	LF/IP	CP/BP							
Garden					CP/LF/IP				
Other combus-	LF/IP	LF/IP/MRF1							
Other combus-					LF/IP				
Other non-	LF	LF/MRF1			LF				
WEEE	LF/IP	LF/IP/MRF1			MRF3/LF/IP	MRF3/LF/IP			
Hazardous	LF/IP	LF/IP/MRF1			HWF/LF/IP	HWF/LF/IP			
Paper							LF/IP	Sold	
Cardboard							LF/IP	Sold	
Plastic							LF/IP	Sold	
Glass							LF/IP	Sold	
Metal							LF/IP	Sold	
Food							LF/IP		
Garden							LF/IP	CP/LF/IP	
Other combus-							LF/IP		
Other non-							LF/IP		
WEEE							LF/IP	MRF3	
Paper							LF/IP	Sold	
Cardboard							LF/IP	Sold	
Plastic							LF/IP	Sold	
Glass							LF/IP	Sold	
Metal							LF/IP	Sold	
Food							LF/IP	BP/LF/IP	
Other combus-							LF/IP	LF/IP	
Other non-							LF/IP		
Plastic							LF	Sold	
Metal							LF	Sold	
Concrete, tile,							LF	CDF/LF	
Other combus-							LF	LF/IP	
Other non-							LF		
Sludge									LF

Attachment 4 Details on MSW Treatment/ Recovery Expenditure Functions

Baseline cost elements for MRF for mixed household waste
Capacity: 10,000 tons recyclables per year

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hours	Equipment	Materials	Other	
Investments														
Land acquisition	6.000	m ²	20,19	121.131	100%									
Civil works and Equipment														
• Surface preparation	6.000	m ²	3,36	20.188				50%		50%				
• Excavations	3.000	m ³	6,73	20.188				50%		50%				
• Paved area	2.500	m ²	53,84	134.590				15%		15%		70%		
• Unpaved area	500	m ²	13,46	6.729				30%		30%		40%		
• Supply systems	500	m	134,59	67.295				20%		20%		60%		
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%		70%		
• Fencing	350	m	33,65	11.777				15%		10%		75%		
Sorting building (incl. Service facility)	1.500	m ²	672,95	1.009.421				30%				70%		
Storage building	2.500	m ²	336,47	841.184				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				10%			80%	10%		
Presorting machinery	1	nos.	201.884,25	201.884				10%			80%	10%		
Sorting conveyor	2	nos.	100.942,13	201.884				20%			80%			
Conveyor ventilation	2	nos.	33.647,38	67.295				30%			70%			
Baling system	1	nos.	201.884,25	201.884				20%			80%			
Fork lift and frontloader	2	nos.	40.376,85	80.754							100%			
Haulage vehicle	3	nos.	80.753,70	242.261							100%			
Containers, conveyor	10	nos.	2.018,84	20.188							100%			
Containers residual	10	nos.	5.383,58	53.836							100%			
Misc. (incl. design etc.)	20	%	3.194.818,30	638.964				10%	20%		40%	30%		
Total investments				4.008.748	3%			20%	3%	1%	31%	42%		
					Distribution of Costs Operation and Maintenance									
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Fixed O&M costs														
Maintenance, station	6	% of investm.	2.614.401,08	156.864				40%		60%				
Maintenance, conveyor/baler	6	% of investm.	323.014,80	19.381				40%		60%				
Maintenance, transport equipment	5	% of investm.	476.446,84	23.822				40%		60%				
Miscellaneous	20	%	200.067,29	40.013				20%	20%	30%	30%			
Total Fixed costs				240.081				37%	3%	55%	5%			
Variable O&M costs														
Salaries, station	30	person	33.647,38	1.009.421				100%						
Personal protection equipment	1	Lump sum	13.458,95	13.459							100%			
Power	800.000	kWh	0,16	127.052		100%								
Fuel	40.000	litre	0,87	34.993			100%							
Water and waste water	2.500	m ³	2,69	6.729										100%
Miscellaneous	20	%	168.775,24	33.755				20%	20%	30%	30%	30%		
Total Variable costs				1.225.410		10%	3%	83%	1%	1%	2%			1%
Other (not used)														
Sale of recyclables, revenue	Depends on composition of the incoming waste													
Transport/disposal of residue, cost	Depends on composition of the incoming waste													

Baseline cost elements for MRF for mixed household waste
Capacity: 5,000 tons recyclables per year

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	4.000	m ²	20,19	80.754	100%									
Civil works and Equipment														
• Surface preparation	4.000	m ²	3,36	13.459				50%		50%				
• Excavations	2.000	m ³	6,73	13.459				50%		50%				
• Paved area	1.000	m ²	53,84	53.836				15%		15%		70%		
• Unpaved area	500	m ²	13,46	6.729				30%		30%		40%		
• Supply systems	400	m	134,59	53.836				20%		20%		60%		
• Lighting, incl. cables	5	nos.	1.345,90	6.729				15%		15%		70%		
• Fencing	300	m	33,65	10.094				15%		10%		75%		
Sorting building (incl. Service facility)	1.000	m ²	672,95	672.948				30%				70%		
Storage building	1.500	m ²	336,47	504.711				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				10%			80%	10%		
Presorting machinery	1	nos.	161.507,40	161.507				10%			80%	10%		
Sorting conveyor	1	nos.	100.942,13	100.942				20%			80%			
Conveyor ventilation	1	nos.	33.647,38	33.647				30%			70%			
Baling system	1	nos.	134.589,50	134.590				20%			80%			
Fork lift and frontloader	2	nos.	40.376,85	80.754							100%			
Haulage vehicle	2	nos.	80.753,70	161.507							100%			
Containers, conveyor	10	nos.	2.018,84	20.188							100%			
Containers residual	7	nos.	5.383,58	37.685							100%			
Misc. (incl. design etc.)	20	%	2.089.502,02	417.900				10%	20%		40%	30%		
Total investments				2.625.841	3%			19%	3%	1%	33%	40%		
Fixed O&M costs														
Maintenance, station	6	% of investm.	1.675.639,30	100.538				40%		60%				
Maintenance, conveyor/baler	6	% of investm.	161.507,40	9.690				40%		60%				
Maintenance, transport equipment	5	% of investm.	360.161,51	18.008				40%		60%				
Miscellaneous	20	%	128.236,88	25.647				20%	20%	30%	30%			
Total Fixed costs				153.884				37%	3%	55%	5%			
Variable O&M costs														
Salaries, station	16	person	33.647,38	538.358				100%						
Personal protection equipment	1	Lump sum	6.729,48	6.729							100%			
Power	300.000	kWh	0,16	47.645		100%								
Fuel	2.400	litre	0,87	2.100			100%							
Water and waste water	1.500	m ³	2,69	4.038									100%	
Miscellaneous	20	%	53.781,97	10.756				20%	20%	30%	30%			
Total Variable costs				609.626	8%	0%		89%	0%	1%	2%			1%

Baseline cost elements for MRF for mixed household waste
Capacity: 2,500 tons recyclables per year

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hours	Equipment	Materials	Other	
Investments														
Land acquisition	2.800	m ²	20,19	56.528	100%									
Civil works and Equipment														
• Surface preparation	2.800	m ²	3,36	9.421				50%		50%				
• Excavations	1.300	m ³	6,73	8.748				50%		50%				
• Paved area	800	m ²	53,84	43.069				15%		15%		70%		
• Unpaved area	400	m ²	13,46	5.384				30%		30%		40%		
• Supply systems	250	m	134,59	33.647				20%		20%		60%		
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%		70%		
• Fencing	200	m	33,65	6.729				15%		10%		75%		
Sorting building (incl. Service facility)	600	m ²	672,95	403.769				30%				70%		
Storage building	1.000	m ²	336,47	336.474				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				10%			80%	10%		
Presorting machinery	1	nos.	121.130,55	121.131				10%			80%	10%		
Sorting conveyor	1	nos.	80.753,70	80.754				20%			80%			
Conveyor ventilation	1	nos.	33.647,38	33.647				30%			70%			
Baling system	1	nos.	100.942,13	100.942				20%			80%			
Fork lift and frontloader	2	nos.	40.376,85	80.754							100%			
Haulage vehicle	2	nos.	80.753,70	161.507							100%			
Containers, conveyor	10	nos.	2.018,84	20.188							100%			
Containers residual	5	nos.	5.383,58	26.918							100%			
Misc. (incl. design etc.)	20	%	1.513.458,95	302.692				10%	20%		40%	30%		
Total investments				1.899.596	3%			18%	3%	1%	38%	36%		
					Distribution of Costs Operation and Maintenance									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
	6	% of investm.	1.097.442,80	65.847				40%		60%				
Maintenance, conveyor/baler	8	% of investm.	137.281,29	10.983				40%		60%				
Maintenance, transport equipment	5	% of investm.	347.240,92	17.362				40%		60%				
Miscellaneous	20	%	94.191,12	18.838				20%	20%	30%	30%			
Total Fixed costs				113.029				37%	3%	55%	5%			
Variable O&M costs														
Salaries, station	10	person	33.647,38	336.474				100%						
Personal protection equipment	1	Lump sum	3.364,74	3.365							100%			
Power	200.000	kWh	0,16	31.763		100%								
Fuel	1.200	litre	0,87	1.050			100%							
Water and waste water	1.000	m ³	2,69	2.692									100%	
Miscellaneous	20	%	35.504,71	7.101				20%	20%	30%	30%	30%		
Total Variable costs				382.444		8%	0%	88%	0%	1%	1%		1%	

Baseline cost elements for MRF for source separated recyclables
Capacity: 10,000 tons per year

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hours	Equipment	Materials	Other	
Investments														
Land acquisition	5.000	m ²	20,19	100.942	100%									
Civil works and Equipment														
• Surface preparation	5.000	m ²	3,36	16.824				50%		50%				
• Excavations	3.000	m ³	6,73	20.188				50%		50%				
• Paved area	1.500	m ²	53,84	80.754				15%		15%		70%		
• Unpaved area	500	m ²	13,46	6.729				30%		30%		40%		
• Supply systems	500	m	134,59	67.295				20%		20%		60%		
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%		70%		
• Fencing	300	m	33,65	10.094				15%		10%		75%		
Sorting building (incl. Service facility)	1.000	m ²	672,95	672.948				30%				70%		
Storage building	2.000	m ²	336,47	672.948				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				10%			80%	10%		
Sorting conveyor	1	nos.	100.942,13	100.942				20%			80%			
Conveyor ventilation	1	nos.	33.647,38	33.647				30%			70%			
Baling system	1	nos.	201.884,25	201.884				20%			80%			
Fork lift and frontloader	2	nos.	40.376,85	80.754							100%			
Haulage vehicle	1	nos.	80.753,70	80.754							100%			
Containers, conveyor	10	nos.	2.018,84	20.188							100%			
Containers recidual	4	nos.	5.383,58	21.534							100%			
Misc. (incl. design etc.)	20	%	2.133.243,61	426.649				10%	20%		40%	30%		
Total investments				2.682.369	4%			21%	3%	2%	26%	44%		
					Distribution of Costs Operation and Maintenance									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Maintenance, station	6	% of investm.	1.938.088,83	116.285				40%		60%				
Maintenance, conveyor/baler	6	% of investm.	161.507,40	9.690				40%		60%				
Maintenance, transport equipment	5	% of investm.	243.876,18	12.194				40%		60%				
Miscellaneous	20	%	138.169,58	27.634				20%	20%	30%	30%			
Total Fixed costs				165.803				37%	3%	55%	5%			
Variable O&M costs														
Salaries, station	10	person	33.647,38	336.474				100%						
Power	400.000	kWh	0,16	63.526		100%								
Fuel	10.000	litre	0,87	8.748			100%							
Water and waste water	1.000	m ³	2,69	2.692									100%	
Miscellaneous	20	%	74.966,35	14.993				20%	20%	30%	30%	30%		
Total Variable costs				426.433		15%	2%	80%	1%	1%	1%		1%	

Baseline cost elements for MRF for source separated recyclables
Capacity: 5,000 tons per year

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hours	Equipment	Materials	Other	
Investments														
Land acquisition	3.500	m ²	20,19	70.659	100%									
Civil works and Equipment														
• Surface preparation	3.500	m ²	3,36	11.777				50%		50%				
• Excavations	2.000	m ³	6,73	13.459				50%		50%				
• Paved area	1.000	m ²	53,84	53.836				15%		15%		70%		
• Unpaved area	500	m ²	13,46	6.729				30%		30%		40%		
• Supply systems	400	m	134,59	53.836				20%		20%		60%		
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%		70%		
• Fencing	250	m	33,65	8.412				15%		10%		75%		
Sorting building (incl. Service facility)	800	m ²	672,95	538.358				30%				70%		
Storage building	1.000	m ²	336,47	336.474				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				10%			80%	10%		
Sorting conveyor	1	nos.	100.942,13	100.942				20%			80%			
Conveyor ventilation	1	nos.	33.647,38	33.647				30%			70%			
Baling system	1	nos.	134.589,50	134.590				20%			80%			
Fork lift and frontloader	2	nos.	40.376,85	80.754							100%			
Haulage vehicle	1	nos.	80.753,70	80.754							100%			
Containers, conveyor	10	nos.	2.018,84	20.188							100%			
Containers recidual	3	nos.	5.383,58	16.151							100%			
Misc. (incl. design etc.)	20	%	1.541.049,80	308.210				10%	20%		40%	30%		
Total investments				1.936.070	4%			20%	3%	2%	30%	41%		
					Distribution of Costs Operation and Maintenance									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Maintenance, station	6	% of investm.	1.308.209,96	78.493				40%		60%				
Maintenance, conveyor/baler	6	% of investm.	161.507,40	9.690				40%		60%				
Maintenance, transport equipment	5	% of investm.	237.415,88	11.871				40%		60%				
Miscellaneous	20	%	100.053,84	20.011				20%	20%	30%	30%			
Total Fixed costs				120.065				37%	3%	55%	5%			
Variable O&M costs														
Salaries, station	7	person	33.647,38	235.532				100%						
Power	250.000	kWh	0,16	39.704		100%								
Fuel	6.000	litre	0,87	5.249			100%							
Water and waste water	500	m ³	2,69	1.346									100%	
Miscellaneous	20	%	46.298,79	9.260				20%	20%	30%	30%			
Total Variable costs				291.090		14%	2%	82%	1%	1%	1%		0%	

Baseline cost elements for MRF for source separated recyclables**Capacity: 2,500 tons per year**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hours	Equipment	Materials	Other	
Investments														
Land acquisition	2.500	m ²	20,19	50.471	100%									
Civil works and Equipment														
• Surface preparation	2.500	m ²	3,36	8.412				50%		50%				
• Excavations	1.300	m ³	6,73	8.748				50%		50%				
• Paved area	800	m ²	53,84	43.069				15%		15%		70%		
• Unpaved area	400	m ²	13,46	5.384				30%		30%		40%		
• Supply systems	250	m	134,59	33.647				20%		20%		60%		
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%		70%		
• Fencing	200	m	33,65	6.729				15%		10%		75%		
Sorting building (incl. Service facility)	500	m ²	672,95	336.474				30%				70%		
Storage building	600	m ²	336,47	201.884				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				10%			80%	10%		
Sorting conveyor	1	nos.	80.753,70	80.754				20%			80%			
Conveyor ventilation	1	nos.	33.647,38	33.647				30%			70%			
Baling system	1	nos.	100.942,13	100.942				20%			80%			
Fork lift and frontloader	2	nos.	40.376,85	80.754							100%			
Haulage vehicle	1	nos.	80.753,70	80.754							100%			
Containers, conveyor	10	nos.	2.018,84	20.188							100%			
Containers recidual	2	nos.	5.383,58	10.767							100%			
Misc. (incl. design etc.)	20	%	1.108.681,02	221.736				10%	20%		40%	30%		
Total investments				1.391.655	4%			19%	3%	2%	36%	37%		
					Distribution of Costs Operation and Maintenance									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
	6	6	% of investm.	853.970,39	51.238			40%		60%				
Maintenance, conveyor/baler		8	% of investm.	137.281,29	10.983			40%		60%				
Maintenance, transport equipment		5	% of investm.	230.955,59	11.548			40%		60%				
Miscellaneous		20	%	73.768,51	14.754			20%	20%	30%	30%			
Total Fixed costs				88.522				37%	3%	55%	5%			
Variable O&M costs														
Salaries, station		5	person	33.647,38	168.237			100%						
Power		150.000	kWh	0,16	23.822		100%							
Fuel		300	litre	0,87	262			100%						
Water and waste water		300	m ³	2,69	808								100%	
Miscellaneous		20	%	24.892,33	4.978			20%	20%	30%	30%	30%		
Total Variable costs				198.108		12%	0%	85%	1%	1%	1%	30%	0%	

Baseline cost elements for a windrow composting plant for garden waste.**Capacity: Input 20,000 tons per year. Output (compost) 8,000 tons per year**

	Nos.	Unit	Unit price	Total	Distribution of Investment Costs								
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Investments			EUR	EUR									
Land acquisition	60.000	m ²	0,67	40.377	100%								
Civil works and Equipment													
Surface preparation	60.000	m ²	3,36	201.884				50%		50%			
Excavations	1.000	m ³	6,73	6.729				50%		50%			
Composting surface	45.000	m ²	16,82	757.066				15%		15%		70%	
Supply systems	4.000	m	134,59	538.358				30%		30%		40%	
Lightning incl. cables	20	nos.	1.345,90	26.918				20%		20%		60%	
Fencing	1.000	m	33,65	33.647				15%		15%		70%	
Garage/ service building	200	m ²	269,18	53.836				30%				70%	
Office	50	m ²	807,54	40.377				40%				60%	
Weigh bridge	1	nos.	60.565,28	60.565				10%			80%	10%	
Conveyor belt	2	nos.	6.729,48	13.459				10%			90%		
Branch crusher	1	nos.	154.777,93	154.778							100%		
Screen	1	nos.	111.036,34	111.036							100%		
Wheel loader	2	nos.	134.589,50	269.179							100%		
Misc. (incl. design etc.)	15	%	2.308.209,96	346.231				10%	20%		40%	30%	
Total investments				2.654.441	2%			17%	3%	15%	28%	36%	
					Distribution of O&M Costs								
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Buildings	Other
Salaries	5	person	38.358,01	191.790				100%					
Maintenance, civil works	2	% of investm.	1.907.637,95	38.153				40%		60%			
Maintenance, equipment	8	% of investm.	630.720,05	50.458				40%		60%			
Misc.	20	%	88.610,36	17.722				20%	20%	30%		30%	
Total Fixed costs				298.122				77%	1%	20%		2%	
Variable O&M costs													
Power	50.000	kWh	0,16	7.941		100%							
Water and wastewater	2.000	m ³	2,69	5.384									100%
Fuel	23.000	litre	0,87	20.121			100%						
Miscellaneous	20	%	33.445,49	6.689				20%	20%	30%		30%	
Total Variable costs				40.135		20%	50%	3%	3%	5%		5%	13%

Baseline cost elements for a Biogasification plant for food waste
Capacity: Input 20,000 tons per year

	Nos.	Unit	Unit price	Total	Distribution of Investment Costs								
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Investments													
Land acquisition	12.000	m ²	20,19	242.261	100%								
Civil works and Equipment													
Surface preparation	12.000	m ²	3,36	40.377				50%		50%			
Excavations	4.000	m ³	6,73	26.918				50%		50%			
Paved area	7.000	m ²	53,84	376.851				15%		15%		70%	
Supply systems	500	m	134,59	67.295				30%		30%		40%	
Lightning incl. cables	8	nos.	2.018,84	16.151				20%		20%		60%	
Fencing	500	m	33,65	16.824				15%		15%		70%	
Buildings	2000	m ²	807,54	1.615.074				15%		10%		75%	
Weigh bridge	1	nos.	60.565,28	60.565				40%				60%	
Treatment equipment	1	nos.	5.383.580,08	5.383.580				15%			75%	10%	
Wheel loader	1	nos.	134.589,50	134.590							100%		
Misc. (incl. design etc.)	20	%	7.738.223,42	1.547.645				10%	20%		40%	30%	
Total investments				9.528.129	2,5%			14,1%	3,2%	2,9%	50,3%	26,9%	
					Distribution of O&M Costs								
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materialss	Other
Salaries	6	person	38.358,01	230.148				100%					
Maintenance, civil works	2	% of investm.	2.591.386,27	51.828				40%		60%			
Maintenance, equipment	4	% of investm.	6.694.481,83	267.779				40%		60%			
Misc.	20	%	319.607,00	63.921				20%	20%	30%		30%	
Total Fixed costs				613.676				60%	2%	34%		3%	
Variable O&M costs													
Power	400.000	kWh	0,16	63.526		100%							
Water and wastewater	2.000	m3	2,69	5.384									100%
Fuel	2.000	litre	0,87	1.750			100%						
Miscellaneous	20	%	70.659,49	14.132				20%	20%	30%		30%	
Total Variable costs				84.791		75%	2%	3%	3%	5%		5%	6%

Baseline cost elements for a Biogasification plant for food waste
Capacity: Input 10,000 tons per year

	Nos.	Unit	Unit price	Total	Distribution of Investment Costs								
Investments					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Land acquisition	7.000	m ²	20,19	141.319	100%								
Civil works and Equipment													
Surface preparation	7.000	m ²	3,36	23.553				50%		50%			
Excavations	2.000	m ³	6,73	13.459				50%		50%			
Paved area	4.000	m ²	53,84	215.343				15%		15%		70%	
Supply systems	250	m	134,59	33.647				30%		30%		40%	
Lightning incl. cables	6	nos.	2.018,84	12.113				20%		20%		60%	
Fencing	350	m	33,65	11.777				15%		15%		70%	
Buildings	1200	m ²	807,54	969.044				15%		10%		75%	
Weigh bridge	1	nos.	60.565,28	60.565				40%				60%	
Treatment equipment	1	nos.	2.960.969,04	2.960.969				10%			80%	10%	
Wheel loader	1	nos.	134.589,50	134.590							100%		
Misc. (incl. design etc.)	20	%	4.435.060,57	887.012				10%	20%		40%	30%	
Total investments				5.463.392	2,6%			11,3%	3,2%	3,0%	52,3%	27,5%	
					Distribution of O&M Costs								
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Salaries	4	person	38.358,01	153.432				100%					
Maintenance, civil works	2	% of investm.	1.534.724,09	30.694				40%		60%			
Maintenance, equipment	4	% of investm.	3.787.348,59	151.494				40%		60%			
Misc.	20	%	182.188,43	36.438				20%	20%	30%		30%	
Total Fixed costs				372.058				63%	2%	32%		3%	
Variable O&M costs													
Power	200.000	kWh	0,16	31.763		100%							
Water and wastewater	1.000	m ³	2,69	2.692									100%
Fuel	1.000	litre	0,87	875			100%						
Miscellaneous	20	%	35.329,74	7.066				20%	20%	30%		30%	
Total Variable costs				42.396		75%	2%	3%	3%	5%		5%	6%

Baseline cost elements for a Biogasification plant for food waste
Capacity: Input 5,000 tons per year

	Nos.	Unit	Unit price	Total	Distribution of Investment Costs								
Investments					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Land acquisition	4.000	m ²	20,19	80.754	100%								
Civil works and Equipment													
Surface preparation	4.000	m ²	3,36	13.459				50%		50%			
Excavations	1.000	m ³	6,73	6.729				50%		50%			
Paved area	2.500	m ²	53,84	134.590				15%		15%		70%	
Supply systems	150	m	134,59	20.188				30%		30%		40%	
Lightning incl. cables	6	nos.	2.018,84	12.113				20%		20%		60%	
Fencing	250	m	33,65	8.412				15%		15%		70%	
Buildings	800	m ²	807,54	646.030				15%		10%		75%	
Weigh bridge	1	nos.	60.565,28	60.565				40%				60%	
Treatment equipment	1	nos.	2.018.842,53	2.018.843				10%			80%	10%	
Wheel loader	1	nos.	134.589,50	134.590							100%		
Misc. (incl. design etc.)	20	%	3.055.518,17	611.104				10%	20%		40%	30%	
Total investments				3.747.376	2,2%			11,3%	3,3%	2,8%	53,2%	27,3%	
					Distribution of O&M Costs								
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Salaries	3	person	38.358,01	115.074				100%					
Maintenance, civil works	2	% of investm.	1.009.825,03	20.197				40%		60%			
Maintenance, equipment	4	% of investm.	2.656.796,77	106.272				40%		60%			
Misc.	20	%	126.468,37	25.294				20%	20%	30%		30%	
Total Fixed costs				266.836				64%	2%	31%		3%	
Variable O&M costs													
Power	100.000	kWh	0,16	15.882		100%							
Water and wastewater	500	m ³	2,69	1.346									100%
Fuel	500	litre	0,87	437			100%						
Miscellaneous	20	%	17.664,87	3.533				20%	20%	30%		30%	
Total Variable costs				21.198		75%	2%	3%	3%	5%		5%	6%

Baseline cost elements for an in-vessel composting plant for food waste.**Capacity: Input 20,000 tons per year. Output (compost) 7,000 tons per year**

	Nos.	Unit	Unit price	Total	Distribution og Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments			EUR	EUR										
Land acquisition	15.000	m ²	6,73	100.942	100%									
Civil works and Equipment														
Surface preparation	15.000	m ²	3,36	50.471				50%		50%				
Excavations	1.000	m ³	6,73	6.729				50%		50%				
Paved area	10.000	m ²	53,84	538.358				15%		15%		70%		
Supply systems	500	m	134,59	67.295				30%		30%		40%		
Lightning incl. cables	8	nos.	1.345,90	10.767				20%		20%		60%		
Fencing	500	m	33,65	16.824				15%		15%		70%		
Garage/ service building	200	m ²	269,18	53.836				15%		10%		75%		
Office	50	m ²	807,54	40.377				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				40%				60%		
Reactor building	1800	nos.	942,13	1.695.828				10%			80%	10%		
Treatment equipment	1	nos.	2.018.842,53	2.018.843				15%			85%			
Electrical-, automatic and SRS	1	nos.	1.345.895,02	1.345.895							100%			
Screen	1	nos.	111.036,34	111.036							100%			
Wheel loader	1	nos.	134.589,50	134.590							100%			
Misc. (incl. design etc.)	20	%	6.252.355,32	1.250.471				10%	20%		40%	30%		
Total investments				7.502.826	1%			10%	3%	2%	69%	14%		
					Distribution og Costs Operation and Maintenance									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries	3	person	38.358,01	115.074				100%						
Maintenance, civil works	2	% of investm.	3.049.259,76	60.985				40%		60%				
Maintenance, equipment	3	% of investm.	4.332.436,07	129.973				40%		60%				
Misc.	20	%	190.958,28	38.192				20%	20%	30%		30%		
Total Fixed costs				344.224				58%	2%	37%		3%		
Variable O&M costs														
Power	800.000	kWh	0,16	127.052		100%								
Water and wastewater	2.000	m ³	2,69	5.384									100%	
Fuel	10.000	litre	0,87	8.748			100%							
Miscellaneous	20	%	141.184,39	28.237				20%	20%	30%		30%		
Total Variable costs				169.421		75%	5%	3%	3%	5%		5%	3%	

Baseline cost elements for an in-vessel composting plant for food waste.**Capacity: Input 10,000 tons per year. Output (compost) 3,500 tons per year**

	Nos.	Unit	Unit price	Total	Distribution og Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments			EUR	EUR										
Land acquisition	10.000	m ²	6,73	67.295	100%									
Civil works and Equipment														
Surface preparation	10.000	m ²	3,36	33.647				50%		50%				
Excavations	700	m ³	6,73	4.711				50%		50%				
Paved area	5.000	m ²	53,84	269.179				15%		15%		70%		
Supply systems	500	m	134,59	67.295				30%		30%		40%		
Lightning incl. cables	6	nos.	1.345,90	8.075				20%		20%		60%		
Fencing	400	m	33,65	13.459				15%		15%		70%		
Garage/ service building	200	m ²	269,18	53.836				15%		10%		75%		
Office	50	m ²	807,54	40.377				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				40%				60%		
Reactor building	1200	nos.	942,13	1.130.552				10%			80%	10%		
Treatment equipment	1	nos.	1.345.895,02	1.345.895				15%			85%			
Electrical-, automatic and SRS	1	nos.	1.076.716,02	1.076.716							100%			
Screen	1	nos.	111.036,34	111.036							100%			
Wheel loader	1	nos.	134.589,50	134.590							100%			
Misc. (incl. design etc.)	20	%	4.417.227,46	883.445				10%	20%		40%	30%		
Total investments				5.300.673	1%			10%	3%	2%	70%	13%		
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries	2	person	38.358,01	76.716				100%						
Maintenance, civil works	2	% of investm.	2.018.034,99	40.361				40%		60%				
Maintenance, equipment	3	% of investm.	3.201.884,25	96.057				40%		60%				
Misc.	20	%	136.417,23	27.283				20%	20%	30%		30%		
Total Fixed costs				240.417				57%	2%	37%		3%		
Variable O&M costs														
Power	400.000	kWh	0,16	63.526		100%								
Water and wastewater	1.500	m ³	2,69	4.038										100%
Fuel	7.000	litre	0,87	6.124			100%							
Miscellaneous	20	%	73.687,75	14.738				20%	20%	30%		30%		
Total Variable costs				88.425		72%	7%	3%	3%	5%		5%		5%

Baseline cost elements for an in-vessel composting plant for food waste.**Capacity: Input 5,000 tons per year. Output (compost) 1,700 tons per year**

	Nos.	Unit	Unit price	Total	Distribution og Costs Investment									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments					DKK									
Land acquisition	7.000	m ²	6,73	47.106	100%									
Civil works and Equipment														
Surface preparation	7.000	m ²	3,36	23.553				50%		50%				
Excavations	500	m ³	6,73	3.365				50%		50%				
Paved area	5.000	m ²	53,84	269.179				15%		15%		70%		
Supply systems	200	m	134,59	26.918				30%		30%		40%		
Lightning incl. cables	6	nos.	1.345,90	8.075				20%		20%		60%		
Fencing	340	m	33,65	11.440				15%		15%		70%		
Garage/ service building	100	m ²	269,18	26.918				15%		10%		75%		
Office	50	m ²	807,54	40.377				30%				70%		
Weigh bridge	1	nos.	60.565,28	60.565				40%				60%		
Reactor building	700	nos.	942,13	659.489				10%			80%	10%		
Treatment equipment	1	nos.	942.126,51	942.127				15%			85%			
Electrical-, automatic and SRS	1	nos.	672.947,51	672.948							100%			
Screen	1	nos.	111.036,34	111.036							100%			
Wheel loader	1	nos.	134.589,50	134.590							100%			
Misc. (incl. design etc.)	20	%	3.037.685,06	607.537				10%	20%		40%	30%		
Total investments				3.645.222	1%			10,3%	3%	1,9%	68,3%	15,0%		
					Distribution og Costs Operation and Maintenance									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries	2	person	38.358,01	76.716				100%						
Maintenance, civil works	2	% of investm.	1.355.854,64	27.117				40%		60%				
Maintenance, equipment	3	% of investm.	2.232.839,84	66.985				40%		60%				
Misc.	20	%	94.102,29	18.820				20%	20%	30%		30%		
Total Fixed costs				189.639				62%	2%	33%		3%		
Variable O&M costs														
Power	200.000	kWh	0,16	31.763		100%								
Water and wastewater	1.000	m ³	2,69	2.692									100%	
Fuel	5.000	litre	0,87	4.374			100%							
Miscellaneous	20	%	38.829,07	7.766				20%	20%	30%		30%		
Total Variable costs				46.595		68%	9%	3%	3%	5%		5%	6%	

Baseline cost elements for MRF for dry mixed waste/mixed recyclables**Capacity: 10,000 tons per year**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	5.000	m ²	20,19	100.942	100%									
Civil works and Equipment														
• Surface preparation	5.000	m ²	3,36	16.824				50%		50%				
• Excavations	3.000	m ³	6,73	20.188				50%		50%				
• Paved area	1.500	m ²	53,84	80.754				15%		15%			70%	
• Unpaved area	500	m ²	13,46	6.729				30%		30%			40%	
• Supply systems	500	m	134,59	67.295				20%		20%			60%	
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%			70%	
• Fencing	300	m	33,65	10.094				15%		10%			75%	
Sorting building (incl. Service facility)	2.000	m ²	672,95	1.345.895				30%					70%	
Storage building	1.000	m ²	336,47	336.474				30%					70%	
Weigh bridge	1	nos.	60.565,28	60.565				10%				80%	10%	
Conveyor	10	nos.	8.075,37	80.754				20%				80%		
Ventilation system	1	nos.	134.589,50	134.590				30%				70%		
Sorting machinery	4	nos.	100.942,13	403.769				20%				80%		
Baling system	1	nos.	201.884,25	201.884				20%				80%		
Fork lift and frontloader	2	nos.	40.376,85	80.754								100%		
Haulage vehicle	1	nos.	80.753,70	80.754								100%		
Containers, conveyor	8	nos.	2.018,84	16.151								100%		
Containers recidual	4	nos.	5.383,58	21.534								100%		
Misc. (incl. design etc.)	20	%	2.950.201,88	590.040				10%	20%			40%	30%	
Total investments				3.662.719	2,8%			21,7%	3,2%	1,3%		30,8%	40,2%	
Fixed O&M costs														
Maintenance, station	6	% of investm.	2.341.857,34	140.511				40%				60%		
Maintenance, conveyor/baler	6	% of investm.	258.411,84	15.505				40%				60%		
Maintenance, transport equipment	5	% of investm.	239.030,96	11.952				40%				60%		
Miscellaneous	20	%	167.967,70	33.594				20%	20%			30%	30%	
Total Fixed costs				201.561				37%	3%			55%	5%	
Variable O&M costs														
Salaries, station	6	person	33.647,38	201.884				100%						
Power	400.000	kWh	0,16	63.526			100%							
Fuel	10.000	litre	0,87	8.748				100%						
Water and waste water	1.000	m ³	2,69	2.692										100%
Miscellaneous	20	%	74.966,35	14.993				20%	20%			30%	30%	
Total Variable costs				291.844				22%	3%			2%	2%	1%

Baseline cost elements for MRF for dry mixed waste/mixed recyclables**Capacity: 5,000 tons per year**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	3.500	m ²	20,19	70.659	100%									
Civil works and Equipment														
• Surface preparation	3.500	m ²	3,36	11.777				50%		50%				
• Excavations	2.000	m ³	6,73	13.459				50%		50%				
• Paved area	1.000	m ²	53,84	53.836				15%		15%			70%	
• Unpaved area	500	m ²	13,46	6.729				30%		30%			40%	
• Supply systems	400	m	134,59	53.836				20%		20%			60%	
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%			70%	
• Fencing	250	m	33,65	8.412				15%		10%			75%	
Sorting building (incl. Service facility)	1.200	m ²	672,95	807.537				30%					70%	
Storage building	600	m ²	336,47	201.884				30%					70%	
Weigh bridge	1	nos.	60.565,28	60.565				10%				80%	10%	
Sorting conveyor	1	nos.	201.884,25	201.884				20%				80%		
Conveyor ventilation	1	nos.	33.647,38	33.647				30%				70%		
Baling system	1	nos.	201.884,25	201.884				20%				80%		
Fork lift and frontloader	2	nos.	40.376,85	80.754								100%		
Haulage vehicle	1	nos.	80.753,70	80.754								100%		
Containers, conveyor	18	nos.	2.018,84	36.339								100%		
Containers recidual	4	nos.	5.383,58	21.534								100%		
Misc. (incl. design etc.)	20	%	1.860.026,92	372.005				10%	20%			40%	30%	
Total investments				2.324.226	3,0%			20,3%	3,2%	1,5%		32,8%	39,1%	
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Maintenance, station	6	% of investm.	1.469.717,36	88.183				40%				60%		
Maintenance, conveyor/baler	6	% of investm.	282.637,95	16.958				40%				60%		
Maintenance, transport equipment	5	% of investm.	263.257,07	13.163				40%				60%		
Miscellaneous	20	%	118.304,17	23.661				20%	20%	30%		30%		
Total Fixed costs				141.965				37%	3%	55%		5%		
Variable O&M costs														
Salaries, station	5	person	33.647,38	168.237				100%						
Power	250.000	kWh	0,16	39.704		100%								
Fuel	6.000	litre	0,87	5.249			100%							
Water and waste water	500	m ³	2,69	1.346									100%	
Miscellaneous	20	%	46.298,79	9.260				20%	20%	30%		30%		
Total Variable costs				223.795		18%	2%	76%	1%	1%		1%	1%	

Baseline cost elements for MRF for dry mixed waste/mixed recyclables
Capacity: 2.500 tons per year

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	2.500	m ²	20,19	50.471	100%									
Civil works and Equipment														
• Surface preparation	2.500	m ²	3,36	8.412				50%		50%				
• Excavations	1.300	m ³	6,73	8.748				50%		50%				
• Paved area	800	m ²	53,84	43.069				15%		15%			70%	
• Unpaved area	400	m ²	13,46	5.384				30%		30%			40%	
• Supply systems	250	m	134,59	33.647				20%		20%			60%	
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%			70%	
• Fencing	200	m	33,65	6.729				15%		10%			75%	
Sorting building (incl. Service facility)	800	m ²	672,95	538.358				30%					70%	
Storage building	300	m ²	336,47	100.942				30%					70%	
Weigh bridge	1	nos.	60.565,28	60.565				10%				80%	10%	
Sorting conveyor	1	nos.	107.671,60	107.672				20%				80%		
Conveyor ventilation	1	nos.	33.647,38	33.647				30%				70%		
Baling system	1	nos.	100.942,13	100.942				20%				80%		
Fork lift and frontloader	2	nos.	40.376,85	80.754								100%		
Haulage vehicle	1	nos.	80.753,70	80.754								100%		
Containers, conveyor	10	nos.	2.018,84	20.188								100%		
Containers recidual	2	nos.	5.383,58	10.767								100%		
Misc. (incl. design etc.)	20	%	1.236.541,05	247.308				10%	20%			40%	30%	
Total investments				1.545.087	3,3%			19,4%	3,2%	1,6%		34,3%	38,2%	
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Maintenance, station	6	% of investm.	975.100,94	58.506				40%		60%				
Maintenance, conveyor/baler	6	% of investm.	169.582,77	10.175				40%		60%				
Maintenance, transport equipment	5	% of investm.	230.955,59	11.548				40%		60%				
Miscellaneous	20	%	80.228,80	16.046				20%	20%	30%		30%		
Total Fixed costs				96.275				37%	3%	55%		5%		
Variable O&M costs														
Salaries, station	4	person	33.647,38	134.590				100%						
Power	150.000	kWh	0,16	23.822		100%								
Fuel	300	litre	0,87	262			100%							
Water and waste water	300	m ³	2,69	808									100%	
Miscellaneous	20	%	24.892,33	4.978				20%	20%	30%		30%		
Total Variable costs				164.460		14%	0%	82%	1%	1%		1%	0%	

Baseline cost elements for MRF for dry mixed waste/mixed recyclables
Capacity: 2.500 tons per year

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	2.500	m ²	20,19	50.471	100%									
Civil works and Equipment														
• Surface preparation	2.500	m ²	3,36	8.412				50%		50%				
• Excavations	1.300	m ³	6,73	8.748				50%		50%				
• Paved area	800	m ²	53,84	43.069				15%		15%			70%	
• Unpaved area	400	m ²	13,46	5.384				30%		30%			40%	
• Supply systems	250	m	134,59	33.647				20%		20%			60%	
• Lightning, incl. cables	5	nos.	1.345,90	6.729				15%		15%			70%	
• Fencing	200	m	33,65	6.729				15%		10%			75%	
Sorting building (incl. Service facility)	800	m ²	672,95	538.358				30%					70%	
Storage building	300	m ²	336,47	100.942				30%					70%	
Weigh bridge	1	nos.	60.565,28	60.565				10%				80%	10%	
Sorting conveyor	1	nos.	107.671,60	107.672				20%				80%		
Conveyor ventilation	1	nos.	33.647,38	33.647				30%				70%		
Baling system	1	nos.	100.942,13	100.942				20%				80%		
Fork lift and frontloader	2	nos.	40.376,85	80.754								100%		
Haulage vehicle	1	nos.	80.753,70	80.754								100%		
Containers, conveyor	10	nos.	2.018,84	20.188								100%		
Containers recidual	2	nos.	5.383,58	10.767								100%		
Misc. (incl. design etc.)	20	%	1.236.541,05	247.308				10%	20%			40%	30%	
Total investments				1.545.087	3,3%			19,4%	3,2%	1,6%		34,3%	38,2%	
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Maintenance, station	6	% of investm.	975.100,94	58.506				40%		60%				
Maintenance, conveyor/baler	6	% of investm.	169.582,77	10.175				40%		60%				
Maintenance, transport equipment	5	% of investm.	230.955,59	11.548				40%		60%				
Miscellaneous	20	%	80.228,80	16.046				20%	20%	30%		30%		
Total Fixed costs				96.275				37%	3%	55%		5%		
Variable O&M costs														
Salaries, station	4	person	33.647,38	134.590				100%						
Power	150.000	kWh	0,16	23.822		100%								
Fuel	300	litre	0,87	262			100%							
Water and waste water	300	m ³	2,69	808									100%	
Miscellaneous	20	%	24.892,33	4.978				20%	20%	30%		30%		
Total Variable costs				164.460		14%	0%	82%	1%	1%		1%	0%	

Baseline cost elements for C & D recycling plant for concrete/tile rubble.**Capacity: Input 100,000 tons per year. Output (construction materials) 90.000 tons per year, residues 10.000 tons per year**

	Nos.	Unit	Unit price	Total	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	10.000	m ²	6,73	67.295	100%									
Civil works and Equipment														
Earth preparation	10.000	m ²	3,36	33.647				50%		50%				
Surface preparation	10.000	m ²	107,67	1.076.716				15%		15%			70%	
Supply systems	200	m	134,59	26.918				30%		30%			40%	
Lightning incl. cables	8	nos.	1.345,90	10.767				20%		20%			60%	
Fencing	400	m	33,65	13.459				15%		15%			70%	
Garage/ service building	100	m ²	269,18	26.918				15%		10%			75%	
Office	50	m ²	807,54	40.377				30%					70%	
Weigh bridge	1	nos.	60.565,28	60.565				40%					60%	
Crushing equipment incl. conveyors	1	nos.	2.018.842,53	2.018.843				15%				85%		
Screen	1	nos.	111.036,34	111.036								100%		
Wheel loader	1	nos.	134.589,50	134.590								100%		
Misc. (incl. design etc.)	20	%	3.553.835,80	710.767				10%	20%			40%	30%	
Total investments				4.331.898	2%			14%	3%	4%		52%	25%	
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries	5	person	38.358,01	191.790				100%						
Maintenance, civil works	2	% of investm.	1.474.562,58	29.491				40%		60%				
Maintenance, equipment	6	% of investm.	2.717.362,05	163.042				40%		60%				
Misc.	20	%	192.532,97	38.507				20%	20%	30%		30%		
Total Fixed costs				422.830				65%	2%	30%		3%		
Variable O&M costs														
Power	50.000	kWh	0,16	7.941		100%								
Water and wastewater	500	m ³	2,69	1.346										100%
Fuel	60.000	litre	0,87	52.490			100%							
Miscellaneous	20	%	61.776,58	12.355				20%	20%	30%		30%		
Total Variable costs				74.132		11%	71%	3%	3%	5%		5%	2%	

Baseline cost elements for C & D recycling plant for concrete/tile rubble.

Capacity: Input 50,000 tons per year. Output (construction materials) 45.000 tons per year, residues 5.000 tons per year

	Nos.	Unit	Unit price	Total	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	6.000	m ²	6,73	40.377	100%									
Civil works and Equipment														
Earth preparation	6.000	m ²	3,36	20.188				50%		50%				
Surface preparation	6.000	m ²	107,67	646.030				15%		15%			70%	
Supply systems	200	m	134,59	26.918				30%		30%			40%	
Lightning incl. cables	6	nos.	1.345,90	8.075				20%		20%			60%	
Fencing	320	m	33,65	10.767				15%		15%			70%	
Garage/ service building	100	m ²	269,18	26.918				15%		10%			75%	
Office	50	m ²	807,54	40.377				30%					70%	
Weigh bridge	1	nos.	60.565,28	60.565				40%					60%	
Crushing equipment incl. conveyors	1	nos.	1.076.716,02	1.076.716				15%				85%		
Screen	1	nos.	111.036,34	111.036								100%		
Wheel loader	1	nos.	134.589,50	134.590								100%		
Misc. (incl. design etc.)	20	%	2.162.180,35	432.436				10%	20%			40%	30%	
Total investments				2.634.993	2%			14%	3%	5%		51%	26%	
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries	3	person	38.358,01	115.074				100%						
Maintenance, civil works	2	% of investm.	935.127,86	18.703				40%		60%				
Maintenance, equipment	6	% of investm.	1.586.810,23	95.209				40%		60%				
Misc.	20	%	113.911,17	22.782				20%	20%	30%		30%		
Total Fixed costs				251.767				66%	2%	30%		3%		
Variable O&M costs														
Power	50.000	kWh	0,16	7.941		100%								
Water and wastewater	250	m ³	2,69	673									100%	
Fuel	30.000	litre	0,87	26.245			100%							
Miscellaneous	20	%	34.858,68	6.972				20%	20%	30%		30%		
Total Variable costs				41.830		19%	63%	3%	3%	5%		5%	2%	

Baseline cost elements for C & D recycling plant for concrete/tile rubble.**Capacity: Input 25,000 tons per year. Output (construction materials) 22.500 tons per year, residues 2.500 tons per year**

	Nos.	Unit	Unit price	Total	Distribution of Investment Costs								
Investments	EUR				Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Land acquisition	3.000	m ²	6,73	20.188	100%								
Civil works and Equipment													
Earth preparation	3.000	m ²	3,36	10.094				50%		50%			
Surface preparation	3.000	m ²	107,67	323.015				15%		15%		70%	
Supply systems	100	m	134,59	13.459				30%		30%		40%	
Lightning incl. cables	6	nos.	1.345,90	8.075				20%		20%		60%	
Fencing	220	m	33,65	7.402				15%		15%		70%	
Garage/ service building	100	m ²	269,18	26.918				15%		10%		75%	
Office	50	m ²	807,54	40.377				30%				70%	
Weigh bridge	1	nos.	60.565,28	60.565				40%				60%	
Crushing equipment incl. conveyors	1	nos.	538.358,01	538.358				15%			85%		
Screen	1	nos.	67.294,75	67.295							100%		
Wheel loader	1	nos.	134.589,50	134.590							100%		
Misc. (incl. design etc.)	20	%	1.230.148,05	246.030				10%	20%		40%	30%	
Total investments				1.496.366	1%			14%	3%	4%	51%	27%	
Distribution of O&M Costs													
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Salaries	3	person	38.358,01	115.074				100%					
Maintenance, civil works	2	% of investm.	515.208,61	10.304				40%		60%			
Maintenance, equipment	6	% of investm.	888.290,71	53.297				40%		60%			
Misc.	20	%	63.601,62	12.720				20%	20%	30%		30%	
Total Fixed costs				191.396				75%	1%	22%		2%	
Variable O&M costs													
Power	50.000	kWh	0,16	7.941		100%							
Water and wastewater	200	m ³	2,69	538									100%
Fuel	20.000	litre	0,87	17.497			100%						
Miscellaneous	20	%	25.975,77	5.195				20%	20%	30%		30%	
Total Variable costs				31.171		25%	56%	3%	3%	5%		5%	2%

Baseline cost elements for an Incineration Plant.Incineration with **heat and electricity recovery**. Capacity **380,000 tons per year**Set up: **3x16 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	50.000	m ²	13,46	672.948	100%									
Civil works														
Buildings, soil preparation, pavement etc.	1	nos.	26.917.900,40	26.917.900				40%					60%	
Equipment														
Furnace and boiler	3	nos.	17.496.635,26	52.489.906				40%				60%		
Fluegas treatment	3	nos.	8.748.317,63	26.244.953				30%				70%		
Turbine and generator	3	nos.	8.748.317,63	26.244.953				30%				70%		
Misc. (incl. design etc.)	20	%	131.897.711,98	26.379.542				10%	20%			40%	30%	
Total investments				158.950.202	0%			32%	3%			50%	15%	
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries, operation	27	person	40.376,85	1.090.175				100%						
Salaries, administration	5	person	47.106,33	235.532				100%						
Maintenance, building	1	% of investm.	32.301.480,48	323.015				40%		60%				
Maintenance, equipment	1,3	% of investm.	125.975.773,89	1.574.697				40%		60%				
Miscellaneous	10	%	1.897.711,98	189.771				20%	20%	30%		30%		
Total Fixed costs				3.413.190				62%	1%	35%		2%		
Variable O&M costs														
Water	0,25	m ³ /ton waste	0,67	63.930										100%
Anxillary materials for operation	1	-	1.615.074,02	1.615.074						100%				
Waste water	0,10	m ³ /ton waste	1,35	51.144										100%
Maintenance, building	1	% of investm.	32.301.480,48	323.015				40%		60%				
Maintenance, equipment	1,3	% of investm.	125.975.773,89	1.574.697				40%		60%				
Miscellaneous	10	%	3.627.860,03	362.786				20%	20%	30%		30%		
Total Variable costs				3.990.646				21%	2%	72%		3%		3%

Baseline cost elements for an Incineration PlantIncineration with **heat and electricity recovery**. Capacity 250,000 tons per yearSet up: **2x16 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	45.000	m ²	13,46	605.653	100%									
Civil works														
Buildings, soil preparation, pavement etc.	1	nos.	20.188.425,30	20.188.425				40%					60%	
Equipment														
Furnace and boiler	2	nos.	17.496.635,26	34.993.271				40%			60%			
Fluegas treatment	2	nos.	8.748.317,63	17.496.635				30%			70%			
Turbine and generator	2	nos.	8.748.317,63	17.496.635				30%			70%			
Misc. (incl. design etc.)	20	%	90.174.966,35	18.034.993				10%	20%		40%	30%		
Total investments				108.815.612	1%			32%	3%		48%	16%		
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries, operation	24	person	40.376,85	969.044				100%						
Salaries, administration	5	person	47.106,33	235.532				100%						
Maintenance, building	1	% of investm.	24.226.110,36	242.261				40%		60%				
Maintenance, equipment	1,3	% of investm.	83.983.849,26	1.049.798				40%		60%				
Miscellaneous	10	%	1.292.059,22	129.206				20%	20%	30%		30%		
Total Fixed costs				2.625.841				67%	1%	31%		1%		
Variable O&M costs														
Water	0,25	m ³ /ton waste	0,67	42.059									100%	
Ancillary materials for operation	1	-	1.076.716,02	1.076.716						100%				
Wastewater	0,10	m ³ /ton waste	1,35	33.647									100%	
Maintenance, building	1	% of investm.	24.226.110,36	242.261				40%		60%				
Maintenance, equipment	1,3	% of investm.	83.983.849,26	1.049.798				40%		60%				
Miscellaneous	10	%	2.444.481,83	244.448				20%	20%	30%		30%		
Total Variable costs				2.688.930				21%	2%	72%		3%	3%	

Baseline cost elements for an Incineration PlantIncineration with **heat and electricity recovery**. Capacity 120,000 tons per yearSet up: **2x8 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investment														
Land acquisition	40.000	m ²	13,46	538.358	100%									
Civil works														
Buildings, soil preparation, pavement etc.	1	nos.	13.458.950,20	13.458.950				40%					60%	
Equipment														
Furnace and boiler	2	nos.	10.094.212,65	20.188.425				40%				60%		
Fluegas treatment	2	nos.	5.383.580,08	10.767.160				30%				70%		
Turbine and generator	1	nos.	10.094.212,65	10.094.213				30%				70%		
Misc. (incl. design etc.)	20	%	54.508.748,32	10.901.750				10%	20%			40%	30%	
Total investments				65.948.856	1%			32%	3%			47%	17%	
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries, operation	18	person	40.376,85	726.783				100%						
Salaries, administration	4	person	47.106,33	188.425				100%						
Maintenance, building	1	% of investm.	16.150.740,24	161.507				40%		60%				
Maintenance, equipment	1,3	% of investm.	49.259.757,74	615.747				40%		60%				
Miscellaneous	10	%	777.254,37	77.725				20%	20%	30%		30%		
Total Fixed costs				1.770.188				70%	1%	28%		1%		
Variable O&M costs														
Water	0,25	m ³ /ton waste	0,67	20.188									100%	
Ancillary materials for operation	1	Nos.	538.358,01	538.358						100%				
Wastewater	0,10	m ³ /ton waste	1,35	16.151									100%	
Maintenance, building	1	% of investm.	16.150.740,24	161.507				40%		60%				
Maintenance, equipment	1,3	% of investm.	49.259.757,74	615.747				40%		60%				
Miscellaneous	10	%	1.351.951,55	135.195				20%	20%	30%		30%		
Total Variable costs				1.487.147				23%	2%	70%		3%	2%	

Baseline cost elements for an Incineration Plant

Incineration with **heat recovery**. Capacity 380,000 tons per year

Set up: **3x16 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs								
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Investments													
Land acquisition	50.000	m²	13,46	672.948	100%								
Civil works													
Buildings, soil preparation, pavement etc.	1	nos.	24.226.110,36	24.226.110				40%				60%	
Equipment													
Furnace and boiler	3	nos.	14.131.897,71	42.395.693				40%			60%		
Fluegas treatment	3	nos.	8.748.317,63	26.244.953				30%			70%		
Misc. (incl. design etc.)	20	%	92.866.756,39	18.573.351				10%	20%		40%	30%	
Total investments				112.113.055	1%			32%	3%		46%	18%	
					Distribution of O&M Costs								
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Salaries, operation	26	person	40.376,85	1.049.798				100%					
Salaries, administration	5	person	47.106,33	235.532				100%					
Maintenance, building	1	% of investm.	29.071.332,44	290.713				40%		60%			
Maintenance, equipment	1,3	% of investm.	82.368.775,24	1.029.610				40%		60%			
Miscellaneous	10	%	1.320.323,01	132.032				20%	20%	30%		30%	
Total Fixed costs				2.737.685				67%	1%	30%		1%	
Variable O&M costs													
Water	0,25	m³/ton waste	0,67	63.930									100%
Anxillary materials for operation	1	-	1.615.074,02	1.615.074						100%			
Waste water	0,10	m³/ton waste	1,35	51.144									100%
Maintenance, building	1	% of investm.	29.071.332,44	290.713				40%		60%			
Maintenance, equipment	1,3	% of investm.	82.368.775,24	1.029.610				40%		60%			
Miscellaneous	10	%	2.020.861,37	202.086				20%	20%	30%		30%	
Total Variable costs				3.252.557				17%	1%	76%		2%	4%

Baseline cost elements for an Incineration Plant

Combustion with **heat recovery**. Capacity 250,000 tons per year

Set up: **2x16 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs								
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Investments													
Land acquisition	45.000	m²	13,46	605.653	100%								
Civil works													
Buildings, soil preparation, pavement etc.	1	nos.	17.496.635,26	17.496.635				40%				60%	
Equipment													
Furnace and boiler	2	nos.	14.131.897,71	28.263.795				40%			60%		
Fluegas treatment	2	nos.	8.748.317,63	17.496.635				30%			70%		
Misc. (incl. design etc.)	20	%	63.257.065,95	12.651.413				10%	20%		40%	30%	
Total investments				76.514.132	0,8%			32%	3%		45%	19%	
					Distribution of O&M Costs								
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Salaries, operation	23	person	40.376,85	928.668				100%					
Salaries, administration	5	person	47.106,33	235.532				100%					
Maintenance, building	1	% of investm.	20.995.962,31	209.960				40%		60%			
Maintenance, equipment	1,3	% of investm.	54.912.516,82	686.406				40%		60%			
Miscellaneous	10	%	896.366,08	89.637				20%	20%	30%		30%	
Total Fixed costs				2.150.202				72%	1%	26%		1%	
Variable O&M costs													
Water	0,25	m³/ton waste	0,67	42.059									100%
Anxcillary materials for operation	1	-	1.076.716,02	1.076.716						100%			
Waste water	0,10	m³/ton waste	1,35	33.647									100%
Maintenance, building	1	% of investm.	20.995.962,31	209.960				40%		60%			
Maintenance, equipment	1,3	% of investm.	54.912.516,82	686.406				40%		60%			
Miscellaneous	10	%	1.362.382,23	136.238				20%	20%	30%		30%	
Total Variable costs				2.185.027				18%	1%	76%		2%	3%

Baseline cost elements for an Incineration Plant

Combustion with **heat recovery**. Capacity 120,000 tons per year

Set up: **2x8 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs								
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other
Investments													
Land acquisition	40.000	m²	13,46	538.358	100%								
Civil works													
Buildings, soil preparation, pavement etc.	1	nos.	10.767.160,16	10.767.160				40%				60%	
Equipment													
Furnace and boiler	2	nos.	10.094.212,65	20.188.425				40%			60%		
Fluegas treatment	2	nos.	5.383.580,08	10.767.160				30%			70%		
Misc. (incl. design etc.)	20	%	41.722.745,63	8.344.549				10%	20%		40%	30%	
Total investments				50.605.653	1,1%			33%	3%		45%	18%	
					Distribution of O&M Costs								
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other
Salaries, operation	16	person	40.376,85	646.030				100%					
Salaries, administration	4	person	47.106,33	188.425				100%					
Maintenance, building	1	% of investm.	12.920.592,19	129.206				40%		60%			
Maintenance, equipment	1,3	% of investm.	37.146.702,56	464.334				40%		60%			
Miscellaneous	10	%	593.539,70	59.354				20%	20%	30%		30%	
Total Fixed costs				1.487.349				73%	1%	25%		1%	
Variable O&M costs													
Water	0,25	m³/ton waste	0,67	20.188									100%
Anxcillary materials for operation	1	Nos.	538.358,01	538.358						100%			
Waste water	0,10	m³/ton waste	1,35	16.151									100%
Maintenance, building	1	% of investm.	12.920.592,19	129.206				40%		60%			
Maintenance, equipment	1,3	% of investm.	37.146.702,56	464.334				40%		60%			
Miscellaneous	10	%	703.903,10	70.390				20%	20%	30%		30%	
Total Variable costs				1.238.627				20%	1%	74%		2%	3%

Baseline cost elements for an Incineration Plant.

Incineration **without** energy recovery. Capacity 380,000 tons per year

Set up: **3x16 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	50.000	m ²	13,46	672.948	100%									
Civil works														
Buildings, soil preparation, pavement etc.	1	nos.	18.842.530,28	18.842.530				40%					60%	
Equipment														
Furnace	3	nos.	12.113.055,18	36.339.166				40%			60%			
Fluegas treatment	3	nos.	8.748.317,63	26.244.953				30%			70%			
Cooling system	3	nos.	2.691.790,04	8.075.370				30%			70%			
Misc. (incl. design etc.)	20	%	89.502.018,84	17.900.404				10%	20%		40%	30%		
Total investments				108.075.370	0,6%			31,6%	3,3%		49,0%	15,4%		
					Distribution of O&M Costs									
					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Fixed O&M costs														
Salaries, operation	24	person	40.376,85	969.044				100%						
Salaries, administration	4	person	47.106,33	188.425				100%						
Maintenance, building	1	% of investm.	22.611.036,34	226.110				40%		60%				
Maintenance, equipment	1,3	% of investm.	84.791.386,27	1.059.892				40%		60%				
Miscellaneous	10	%	1.286.002,69	128.600				20%	20%	30%		30%		
Total Fixed costs				2.572.073				66%	1%	31%		1%		
Variable O&M costs														
Water	0,25	m ³ /ton waste	0,67	63.930									100%	
Ancillary materials for operation	1	-	1.615.074,02	1.615.074						100%				
Waste water	0,10	m ³ /ton waste	1,35	51.144									100%	
Electricity	120,00	kWh/ton	0,03	1.534.320				100%						
Maintenance, building	1	% of investm.	22.611.036,34	226.110									100%	
Maintenance, equipment	1,3	% of investm.	84.791.386,27	1.059.892									100%	
Miscellaneous	10	%	4.550.471,06	455.047				20%	20%	30%		30%		
Total Variable costs				5.005.518		31%		2%	2%	35%		3%	28%	

Baseline cost elements for an Incineration Plant.

Incineration **without** energy recovery. Capacity 250,000 tons per year

Set up: **2x16 tons per hour**

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	45.000	m ²	13,46	605.653	100%									
Civil works														
Buildings, soil preparation, pavement etc.	1	nos.	13.458.950,20	13.458.950				40%					60%	
Equipment														
Furnace	2	nos.	12.113.055,18	24.226.110				40%			60%			
Fluegas treatment	2	nos.	8.748.317,63	17.496.635				30%			70%			
Cooling system	2	nos.	2.691.790,04	5.383.580				30%			70%			
Misc. (incl. design etc.)	20	%	60.565.275,91	12.113.055				10%	20%		40%	30%		
Total investments				73.283.984	0,8%			31,6%	3,3%		48,3%	16,0%		
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries, operation	21	person	40.376,85	847.914				100%						
Salaries, administration	4	person	47.106,33	188.425				100%						
Maintenance, building	1	% of investm.	16.150.740,24	161.507				40%		60%				
Maintenance, equipment	1,3	% of investm.	56.527.590,85	706.595				40%		60%				
Miscellaneous	10	%	868.102,29	86.810				20%	20%	30%		30%		
Total Fixed costs				1.991.252				70%	1%	27%		1%		
Variable O&M costs														
Water	0,25	m ³ /ton waste	0,67	42.059									100%	
Ancillary materials for operation	1	-	1.076.716,02	1.076.716						100%				
Waste water	0,10	m ³ /ton waste	1,35	33.647									100%	
Electricity						100%								
Maintenance, building	1	% of investm.	16.150.740,24	161.507									100%	
Maintenance, equipment	1,3	% of investm.	56.527.590,85	706.595									100%	
Miscellaneous	10	%	2.020.524,90	202.052				20%	20%	30%		30%		
Total Variable costs				2.222.577		0%		2%	2%	51%		3%	42%	

Baseline cost elements for an Incineration Plant.

Incineration *without* energy recovery. Capacity 120,000 tons per year

Set up: 2x8 tons per hour

	Nos.	Unit	Unit price (EUR)	Total (EUR)	Distribution of Investment Costs									
					Land	Power	Fuel	Labour	Professionals	Machine hour	Equipment	Materials	Other	
Investments														
Land acquisition	40.000	m ²	13,46	538.358	100%									
Civil works														
Buildings, soil preparation, pavement etc.	1	nos.	10.767.160,16	10.767.160				40%					60%	
Equipment														
Furnace	2	nos.	10.094.212,65	20.188.425				40%			60%			
Fluegas treatment	2	nos.	3.364.737,55	6.729.475				30%			70%			
Cooling system	2	nos.	2.018.842,53	4.037.685				30%			70%			
Misc. (incl. design etc.)	20	%	41.722.745,63	8.344.549				10%	20%		40%	30%		
Total investments				50.605.653	1,1%			32,5%	3,3%		45,4%	17,7%		
					Distribution of O&M Costs									
Fixed O&M costs					Land	Power	Fuel	Labour	Professionals	Consumables	Equipment	Materials	Other	
Salaries, operation	18	person	40.376,85	726.783				100%						
Salaries, administration	4	person	47.106,33	188.425				100%						
Maintenance, building	1	% of investm.	12.920.592,19	129.206				40%		60%				
Maintenance, equipment	1,3	% of investm.	37.146.702,56	464.334				40%		60%				
Miscellaneous	10	%	593.539,70	59.354				20%	20%	30%		30%		
Total Fixed costs				1.568.102				74%	1%	24%		1%		
Variable O&M costs														
Water	0,25	m ³ /ton waste	0,67	20.188									100%	
Ancillary materials for operation	1	Nos.	538.358,01	538.358						100%				
Waste water	0,10	m ³ /ton waste	1,35	16.151									100%	
Electricity						100%								
Maintenance, building	1	% of investm.	12.920.592,19	129.206									100%	
Maintenance, equipment	1,3	% of investm.	37.146.702,56	464.334									100%	
Miscellaneous	10	%	1.168.236,88	116.824				20%	20%	30%		30%		
Total Variable costs				1.285.061		0%		2%	2%	45%		3%	49%	