



WP 6 – TASK 6.7 – FEASIBILITY STUDY ON DIFFERENTIATED GATE FEES

29.02.2016

Date of publication : 02/03/2016

Author(s) : Robert Gruwez, Pro Natura

IEE project : IEE/12/046/SI2.645700 – GR3



Co-funded by the Intelligent Energy Europe
Programme of the European Union

Project website: <http://www.grassgreenresource.eu/>

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1 INTRODUCTION

In the framework of the GR3-project, different study cases were performed, in which the profitability of grass digestion for e.g. municipalities was calculated. Due to a low willingness of existing, wet digesters to use grass residues in their feedstock, also own investments were taken into account. However, in many cases, the investments are too high and the profits too low to develop a feasible business (see WP5).

The goal of this study is to calculate whether a differentiated gate fee system would increase the feasibility of grass digestion under own management. Therefore, we focused on scenario 2 in the case of the municipality of Beersel (Flanders). In that scenario, 2000 tons of grass is digested in a dry, small scale digester (see WP5 and Annex). The differentiated gate fees are applied on the VGF-waste. For the municipalities, the disposal costs for VGF-waste are relatively high. However, VGF-waste can contain up to 60% grass residues from lawns, which can be digested. Hence, by asking a higher gate fee for VGF-waste to the inhabitants of Beersel and by giving them the opportunity to deliver their pure lawn grass at the recycling park for free, the amount of VGF that has to be disposed of can be significantly decreased. This can be seen as an extra revenue for the business case.

2 SCENARIO 2 IN THE STUDY CASE OF BEERSEL

The municipality of Beersel yearly processes about 2000 ton of biomass (Table 1). Most of this is VGF-waste that is collected door to door. In the recycling park, about 590 ton of green waste is available and the municipality produces about 100 ton of grass waste from verges.

By far the largest cost for the town is the collection and treatment of VGF-waste.

Table1: amount of bio waste within the municipality of Beersel and the costs to process the waste.

Waste	Weight	Action	Price	Total cost
<i>Verge cuttings</i>	112855 kg	mowing	64 euro per hour	€ 19.360,00
		processing	54,54 euro per ton	€ 7.447,69
<i>Green waste</i>	593120 kg	disposal	32,42 euro per ride	€ 3.138,26
		processing	52,89 euro per ton	€ 37.957,84
<i>VGF</i>	1288690 kg	disposal	18,6 euro per ton	€ 29.003,26
		processing	73,43 euro per ton	€ 114.500,49

In scenario 2 of the case study, the grass waste from verge cuttings was altered up to 2000 tons (see Annex). This could be achieved by using grass from e.g. separated disposal of green waste and VGF-waste or by using grass from neighbouring municipalities. The grass would be digested in a small scale, dry digester. In this scenario, two ways of processing the digestate were studied: disposal at a green composter and disposal at agricultural land (see Annex).

In Table 2, the total investment costs, the exploitation costs and the benefits are shown. In case of disposal of the digestate at a green composter, no feasible business case is possible. Disposal at agricultural land would lead to a pay back period of 13 year, which is still to long. However, differentiated gate fees for VGF-waste were not taken in to account.

Table 2: results scenario 2 from the Beersel case study

	Disposal at green composter	Disposal at agricultural land
Investment	981.330 €	1 106 330 €
Exploitation costs	326.143 €	222 704€
Benefits	305.622 €/y (year 1-10)	305 622 €/y (year 1-10)
Pay back period	-	>13 year

3 DIFFERENTIATED GATE FEE FOR VGF-WASTE

At this moment, the municipality asks 1 euro for one bag for VGF (100l). In this study we will increase the price to 2 and 3 euro in the supposition that more people will decide to dispose their grass separately (a low (30% and high (80%) response will be taken into account. Finally, the amount of grass in the VGF-waste is of importance. Niemegeers (2005). reported that 30 to 60% of the VGF is grass, hence, we will use 30%, 45% and 60% in this study. In total, 12 cases will be calculated.

3.1 TOTAL WEIGHT AND VOLUME OF GRASS AND OTHER VGF-WASTE

The average specific weight of VGF-waste is 775 kg/m (Verhulst 2014). We assumed that compacted grass would have the same specific weight. Table 3 shows the total volumes of grass and other VGF-waste in case of an amount of 30%, 45% and 60% of grass. In addition, the total weight for both fractions is also shown.

Table 3: amount of grass and remaining VGF-waste (volume and weight) in the VGF-waste depending on the different percentages of grass

Percentage grass	30	45	60
Grass (m ³)	498,8	748,3	997,7
Remaining VGF (m ³)	1.164,0	914,6	665,1
Grass (kg)	386.607	579.910,5	773.214
Remaining VGF (kg)	902.083	708.779,5	515.476

Arbitrary, we assume that the bags are filled up to 70%. Hence, for a total of 1.288.690 kg (or m³) VGF-waste, the benefits from the bags is 23.755 euro/year.

3.2 THE DIFFERENT CASES: RESULTS AND DISCUSSION

In the following, we calculate for an amount of 30%, 45% and 60% grass in the VGF-waste different scenario's: 2 vs 3 euro/VGF-bag and a response of 30% vs 80% (see table 4, 5 and 6 respectively)

To calculate the benefits from the VGF-bags in each scenario, we used following formula

$$B = ((1-r)*Vt + r*Vvgf)/0.07*p$$

With B being the benefits, r the response rate, Vt tot total volume of the VGF-waste, Vvgf the volume of the VGF-waste without the grass and p the price of one vgf-bag.

Next, the total weight of the remaining VGF-waste that still has to be processed is calculated with the following formula

$$G = Gvgf*r + Gtot*(1-r)$$

With G the weight of the remaining VGF-waste that still needs to be processed, Gvgf the total weight of the VGF-waste without the grass, Gtot the total initial weight of the VGF and r the response rate.

Finally, we calculated the extra benefits of the selling of VGF-bags compared to the current system and the avoided processing costs due to a decreased amount of VGF-waste.

Table 4: benefits and avoided costs for four different scenario staking in to account an amount of 30% of grass in the VGF-waste

Cost one VGF-bag (euro)	2	2	3	3
Response (%)	30	80	30	80
Benefits VGF-bags (euro)	43.233,5	36.107,1	64.850,2	54.160,6
Weight remaining VGF-waste (kg)	1.172.707,9	979.404,4	1.172.707,9	979.404,4
Costs for disposal of VGF-waste (euro)	107.924,3	90.134,6	107.924,3	90.134,6
Extra benefits from VGF-bags (euro)	19.478,8	12.352,4	41.095,6	30.406,0
Avoided costs VGF disposal (euro)	10.673,8	28.463,6	10.673,8	28.463,6
Total benefits (euro)	30.152,6	40.816,0	51.769,4	58.869,5

Table 5: benefits and avoided costs for four different scenario staking in to account an amount of 45% of grass in the VGF-waste

Cost one VGF-bag (euro)	2	2	3	3
Response (%)	30	80	30	80
Benefits VGF-bags (euro)	41.095,6	30.406,0	61.643,3	45.608,9
Weight remaining VGF-waste (kg)	1.114.716,9	824.761,6	1.114.716,9	824.761,6
Costs for disposal of VGF-waste (euro)	102.587,4	75.902,8	102.587,4	75.902,8
Extra benefits from VGF-bags (euro)	17.340,9	6.651,3	37.888,7	21.854,3
Avoided costs VGF disposal (euro)	16.010,7	42.695,3	16.010,7	42.695,3
Total benefits (euro)	33.351,6	49.346,6	53.899,4	64.549,6

Table 6: benefits and avoided costs for four different scenario staking in to account an amount of 60% of grass in the VGF-waste

Cost one VGF-bag (euro)	2	2	3	3
Response (%)	30	80	30	80
Benefits VGF-bags (euro)	38.957,6	24.704,8	58.436,4	37.057,3
Weight remaining VGF-waste (kg)	1.056.725,8	670.118,8	1.056.725,8	670.118,8
Costs for disposal of VGF-waste (euro)	97.250,5	61.671,0	97.250,5	61.671,0
Extra benefits from VGF-bags (euro)	15.203,0	950,2	34.681,8	13.302,6
Avoided costs VGF disposal (euro)	21.347,7	56.927,1	21.347,7	56.927,1
Total benefits (euro)	36.550,6	57.877,3	56.029,5	70.229,7

The results show that extra yearly benefits can be achieved up to 70.000 euro. Even in the worst cast: low amount of grass in VGF-waste, low response rate and low price for the bags, a benefit of 30.000 euro is possible.

When looking in detail, we see that the extra benefits from selling VGF-bags decreases when the response rate increases and when the amount of grass in the VFG-waste increases. However, this is each time largely compensated by the avoided costs for processing the VGF-waste.

Due to the different assumptions, it should be clear that the calculated benefits are rather indicative than absolute. For example, more research has to be done on which price is needed (and acceptable) to have a certain response rate. However, these results clearly indicate that differentiated gate fees have the possibility to gain extra benefits from grass digestion.

4 FEASIBILITY OF SCENARIO 2 FROM CASE BEERSEL

In this chapter, we look at the effect on the feasibility of the business case in Beersel, where a small scale, dry digester is installed and managed by the municipality, using the lowest and the highest extra benefit (30.152,6 euro and 70.229,7 euro respectively) due to a differentiated gate fee. We used both the results from disposal of digestate at a green composter and at agricultural land (Table 7 and 8 respectively). For all cases, we calculate how much the investment costs need to decrease to have a payback time of maximum 10 years.

Table 7: results scenario 2 from the Beersel case study with extra benefits due to differentiated gate fees, in case the digestate is disposed at a green composter.

Extra benefits	low	high
Investment	981.330 €	981.330 €
Exploitation costs	326.143 €/y	326.143 €/y
Benefits (incl. extra)	± 335 775 €/y (year 1-10)	± 375.852 €/y (year 1-10)
Pay back period	>101year	>19year

Table 8: results scenario 2 from the Beersel case study with extra benefits due to differentiated gate fees, in case the digestate is disposed at agricultural land.

Extra benefits	low	high
Investment	1.106.330 €	1.106.330 €
Exploitation costs	222.704 €/y	222.704 €/y
Benefits (incl. extra)	± 335.775 €/y (year 1-10)	± 375.852 €/y (year 1-10)
Pay back period	>9year	>7year

When disposing the digestate at a green composter, it is still not feasible for the municipality to digest their grass with a small scale dry digester (pay back period of 101 year and of 19 year for the lowest and highest benefits respectively). This means that even if 60% of the VGF-waste exists of grass, the price of a VGF-bag is increased up to 3 euro and 80% of the people decides to dispose their grass separately, the case is still not feasibly. Investment costs should lower with about 90% and 50% in case of low and high extra benefits respectively.

If the digestate is disposed at agricultural land, a feasible business case can be developed, even at the lowest extra benefits from differentiated gate fees (about 30.000 euro).

5 CONCLUSION

Differentiated gate fees can be a helpful tool to increase the feasibility of digesting grass in an own small scale, dry digester for a municipality. Especially if the digestate can be disposed at agricultural land, the business cases have a positive return, even at the lowest extra benefit of 30.000 euro/year.

It has to be stated that some arbitrary assumptions were used concerning the response rate of people, when altering the price of the VGF-bags. However, the trends remain clear.

6 LITERATURE

Niemegeers J (2005) Literatuur- en praktijkonderzoek naar een preferentieel inzamel- en verwerkingssysteem voor groenten-, fruit- en tuinafval. BBL

Verhulst T (2014) Overzichtstabel soortelijk gewicht afvalstromen – bijlage 4. www.lne.be

7 ANNEX

In this annex, the different scenario's for the case of Beersel are described (Table 9) and the results of the calculations are shown (Table 10). For more details, we refer to the case studies in WP5..

Table 9: description of the three scenario's.

	<i>Unit</i>	<i>Scenario 1</i>	<i>Scenario 2</i>	<i>Scenario 3</i>
Feed stock				
Verge cuttings	Ton/year	113	500	1000
Separated grass from lawn mowing	Ton/year	297	1500	3000
VGF-waste	Ton/year	1289	0	0
Energy crops (maize)	Ton/year	0	2000	4000
Total	Ton/year	1698	4000	8000
Digester				
Type		Dry Eribox	Dry Eribox	Dry Eribox
Volume	m ³	210	480	960
Dimensions	m ³	7 x 30	16x 30	32x 30
Digestate processing				
Separation		No	No	No
Thickening		No	No	No
Drying		Yes	Yes	Yes
Hygienization		Only for disposal at agricultural land	Only for disposal at agricultural land	Only for disposal at agricultural land
Digestate disposal (after drying)				
Digestate – no hygienization	Ton / year	1455	2830	5440
Digestate – hygienization	Ton / year	1530	3007	5793
Energy production				
Biogas	Nm ³ /year	170000 ¹	560 000 ¹	1120000 ¹
Utilization technology		CHP	CHP	CHP
Net electricity	MWh(e)/year	± 244	±635	± 1 300
Net heath ²	MWh(th)/year	± 380	±1 191	± 2 160
Assumed margin of safety		5%	5%	5%

¹ Assumption : Biogas yield of grass 100 Nm³/ton – this is only possible if the feed stock is sufficiently fresh.

² Of this net heath, an significant amount will have to be used for hygienization fot he digestate if it's disposed on agricultural land. For disposal at a green composter, this is not necessary (hygienization will be performed in the composting installation)

Table 10: results for the three scenario's.

	<i>Unit</i>	<i>Scenario 1</i>	<i>Scenario 2</i>	<i>Scenario 3</i>
Investments				
Digester	euro	268100	612 800	1 225 600
CHP	euro	100000	150 000	300 000
Hygienization (disposal at land)	euro	100000	125 000	150000
Civils (also for insiling)	euro	30000	45 000	60 000
Equipment	euro	5000 ³	7 500	10 000
EIA	euro	15000	20 000	20 000
Thickeners and air cleaning	euro	15000	25 000	30 000
Licensing and Administration	euro	20000	20000	20000
Connection to the grid	euro	15000	15000	15000
Unanticipated costs	euro	43310	86 030	164 560
Total (disposal at composter)	euro	511410	981 330	1 845 160
Total (disposal at land)	euro	611410	1 106 330	1 995 160
Amortization	euro	10 jaar	10 jaar	10 jaar
Exploitation costs				
Maintenance (non CHP)	euro/year	12 000	23 700	43 068
Maintenance CHP	euro/year	9600	11 840	23 680
Digestate disposal (composting)	euro/year	107 292	208 684	401 146
Digestate disposal (land) ⁴	euro/year	53 550	105 245	202 755
Purchase energy crops	euro/year	0	50 000	100 000
Assurance	euro/year	4720	4720	7080
Process follow up	euro/year	2000	2000	2000
Administration	euro/year	10000	10000	10000
Personnel	euro/year	15 000	15 000	15 000
Total (disposal at composter)	euro/year	160 895	326 143	602 164
Total (disposal at land)	euro/year	107 153	222 704	403 773
Benefits				
Avoided costs disposal green waste	euro/year	15685	79 335	158 670
Avoided costs verge cuttings	euro/year	6155	27 270	54 540
Avoided costs disposal VGF	euro/year	94629	0	0
Avoided costs electricity	euro/year	2683	2683	2683
Avoided costs natural gas	euro/year	13834	13834	13834
Injection green power	euro/year	14550	47 500	100 000
Green power certificates	euro/year	31100	86 500	174 000
CHP certificates	euro/year	17600	48 500	98 000

³ In the estimated investment costs, no pretreatment of the waste streams is taken into account. If VGF-waste and grass from verge cuttings would be digested, it is nevertheless recommended to provide a cleaning step to remove contamination (plastics, metals,...)

⁴ assumption : disposal costs of 35€/ton – cfr. disposal cost of “manure from animals”.

Total	euro/year	196 236	305 622	601 727
Balance (first 10 year)⁵(=benefits– (amortization + operational costs))				
Average/year (disposal at composter)	euro/year	-15 800	-118 654	-184 952
Pay back period (disposal at composter)	year	> 10 year	> 10 year	> 10 year
Average/year (disposal at land)	euro/year	+ 27 942	- 27 715	- 1 562
Pay back period (disposal at land)	year	6.9 year	> 10 year	10 year

⁵ This financial analysis does not take into account interest rates for loans etc.