Vlaamse Compostorganisatie vzw

ECOLOGICAL AND ECONOMICAL BENEFITS OF COMPOST - ABSTRACT

Biowaste can be treated in composting and digestion plants. The kind of biowaste (type, composition, …) determines the treatment option to be chosen. More wet wastes would preferably go to digestion, green waste with high content of lignine is better in a composting plant.
The synergy between energy- and material recovery is important for biological treatment. Therefore Flanders investigates different scenarios of anaerobic digestion and biomass for energy in combination with composting. The aim still is to produce a compost of good quality with high content of stable organic matter or a good quality of treated digestate.
LCA studies have important shortcomings. It is important to use them with care and interpret with caution. Mostly LCA studies are not able to take the value of (stable organic matter in) compost into account. Nevertheless the cycle only closes when the products are applied in a useful and sustainable way. Benefits such as soil health and fertility, reduced pesticide consumption, substitution of mineral fertilisers, improved workability and water retention capacity, reduced irrigation needs, etc. are essential criteria for the production of compost.

It is difficult to find a balance between energy- and material recovery.
Compost is an important soil improver, with specific qualities. Especially the high amount of stable organic matter, in combination with the low availability of nutrients makes compost unique. Compost can substitute a lot of raw materials that are scarce. To focus only on energy is a threat for fertility of soil, which also will have an impact on e.g. production of food, energy crops, …
To guarantee this quality of compost it will be important to have a variety of input materials, also the more ligneous wastes. These types of biowaste are also wanted for biomass incineration.
Through treated digestates plant nutrients will be recovered. Treated digestates are used as a substitution of mineral fertilisers. Phosphorus is e.g. a very limited resource, only available for the next 50 to 70 years. Anaerobic digestion is a combination of energy- and material recovery. In Flanders the economic performance of anaerobic digestion is depending on a successful waste water treatment. From the economical point of view, anaerobic digestion should lead to the application of both the electricity and the heat. In Flanders it is not easy to find a market for the heat, in the neighbourhood of the production facility.
In some cases, depending on the anaerobic process, digestion residues can be composted. Sometimes green waste has to be added to improve the composting process. This compost is a soil improver, rather than a fertiliser.

Different scenarios are possible to achieve synergies between biowaste recycling and energy recovery:

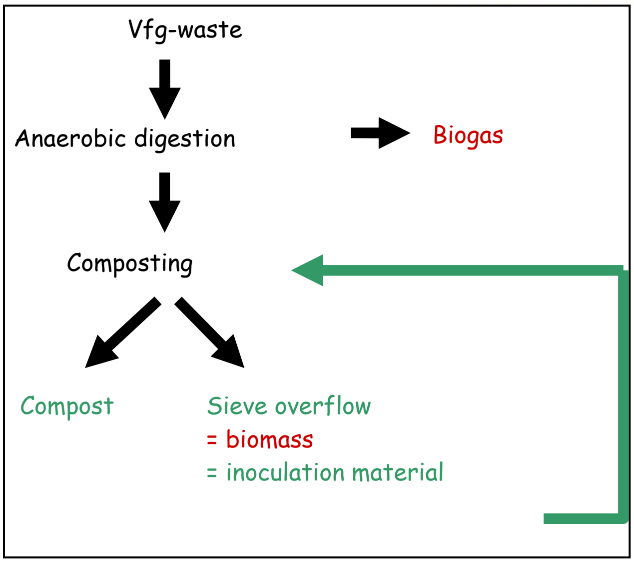

Figure 1. ***Scenario for Vfg-waste***

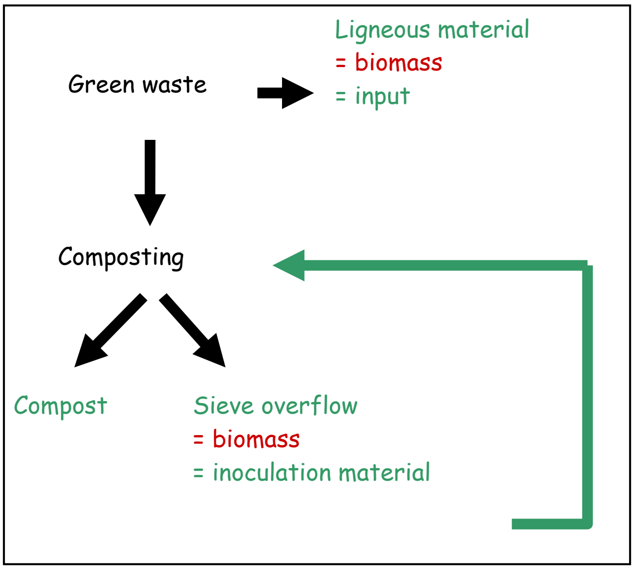

Figure 2. ***Scenario for green waste***

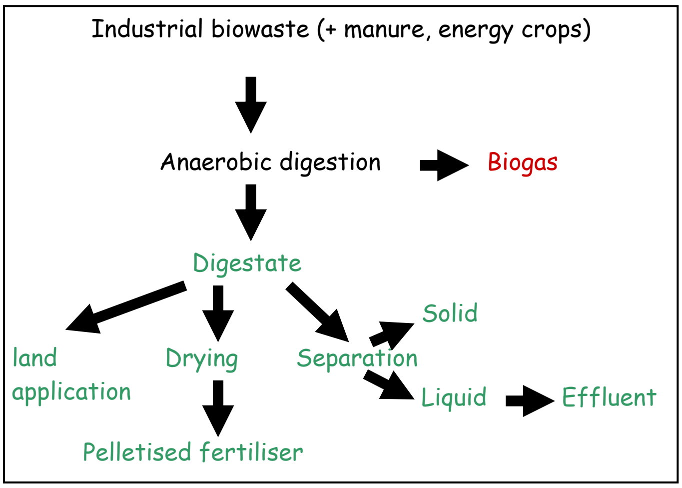

Figure 3. ***Scenario for industrial biowaste***

The compost is an important element in the first and the second scenario (see Figure 1 and Figure 2). Vlaco has calculated the benefits of compost, both ecological and economical, for these scenarios.

Through the years Vlaco has done a lot of research on sales potential. Because of the competition with manure, Vlaco always has searched for sales areas, other than farming. In Flanders compost is sold mainly in landscaping and public and private gardening (41 %), soil mixing (22 %), wholesale (13 %), potting soil (11 %) and agriculture (only 6 %) (see Figure 4). The added value of high quality compost applications (potting soil) or in the green is higher than in agriculture. In potting soil, landscaping and gardening, compost is a substitute for peat. The environmental impact, expressed as CO_2 equivalents, will be much higher than in agriculture.

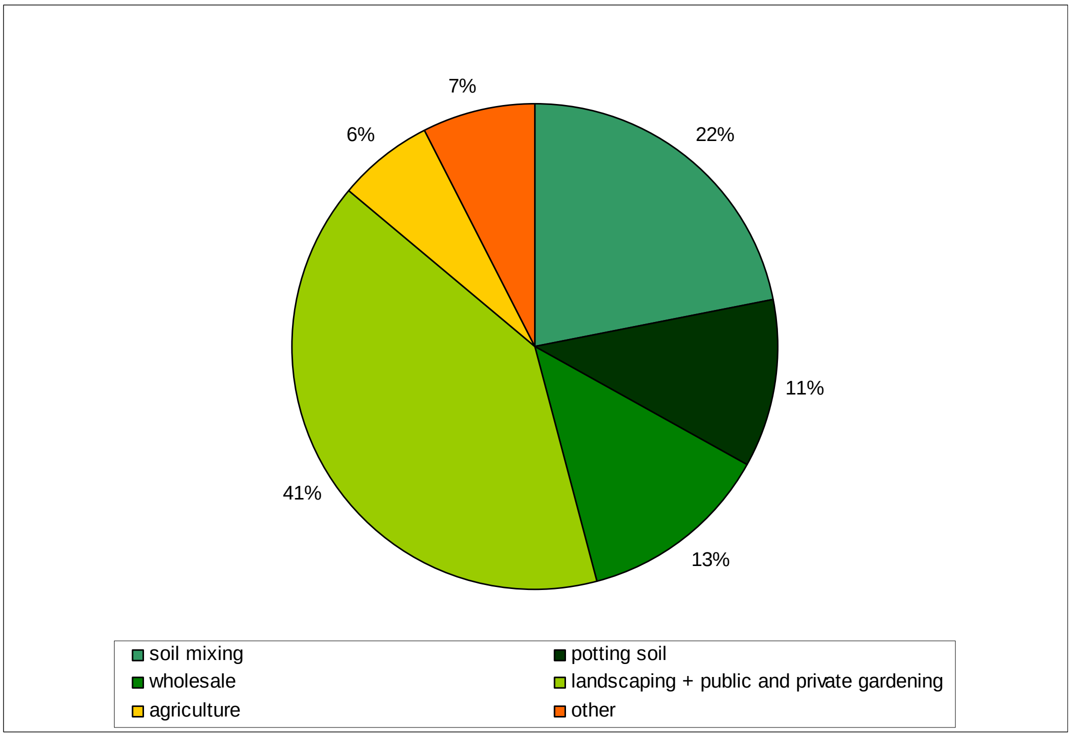

Figure 4. Sales areas of compost in Flanders (2007).

Lots of European soils are degrading. The European Soil Strategy urges more attention to the need for organic matter in soil: 45% of soils in Europe show a lack of organic matter. This is also a problem in Flanders: almost 50% of the soils are below the target for organic matter (see Figure 5). It’s a difficult task to raise the organic matter content of the soil. A range of measures is necessary: green manures, crop residues, organic fertilizers are all essential. It’s of significant importance that in the future a sufficient amount of compost is produced. Vlaco vzw calculated that annually 540 000 tonnes of vfg-compost or 810 000 tonnes of green compost can be used in agriculture in Flanders.

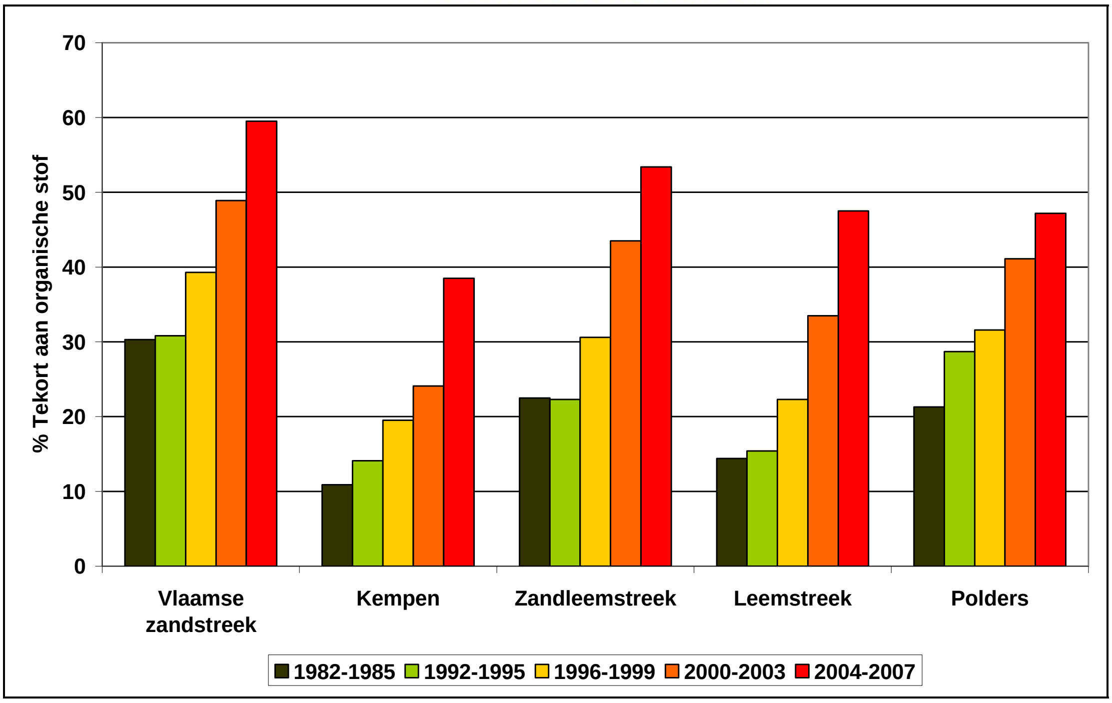

Figure 5. ***Percentage of agricultural soils below the target for organic matter for different soil types in Flanders.***

For the different applications of compost, several benefits can be mentioned:

Potting soil:

a. substitution of peat as a substrate
b. nutrients
c. suppression of diseases

Landscaping + public and private gardening:

a. substitution of peat as a soil improver
b. nutrients
c. suppression of diseases

Agriculture:

a. nutrients (substitution of mineral fertilisers)
b. suppression of diseases (use of less pesticides)
c. carbon storage in soil
d. water retention capacity
e. improved production
f. less soil erosion

Others (e.g. export, soil decontamination, covering landfills, …): difficult to quantify

In the document “Ecological and economical benefits of vfg- and green compost” ([1]) the ecological and economical benefits for the different scenarios and different applications are calculated for the Flemish situation. Because of the different market structure much more compost is used as a substitution for peat, which results in higher CO_2 reduction and better economical values.
In Table 1 the CO_2-balance for composting of vfg- and green waste is calculated and anaerobic digestion, composting and incineration are compared. Per tonne of green waste that is composted, in stead of incinerated, 624 kg CO_2 is saved. Per tonne of vfg-waste that is composted, in stead of

[1] Ecologische en economische voordelen van gft- en groencompost, Vlaco vzw, 2009

incinerated, 517 kg CO_2 is saved. Taking into account the amounts that are composted in 2007, Flanders saved 290.000 tonnes of CO_2 by separate collection and composting of green waste and 190.000 tonnes of CO_2 by separate collection and composting of vfg-waste.
We also calculated the energy balance. Table 2 gives the results. The energy that is used during compost production can be delivered by using a limited amount of ligneous material for energy recuperation. Anaerobic digestion followed by composting seems to be a clear and good way to combine energy and material recovery.
Composting has, besides the reduction of CO_2 emissions also other advantages that can not be expressed as CO_2 equivalents. These are also quantified in Table 3.
Table 3 gives an overview of the ecological impact of compost on the water retention capacity of the soil and on erosion. By composting the vfg- and green waste in Flanders, 80.000 to 110.000 m³ of water are saved. Besides that, using compost avoids the erosion of 2.700 to 3.400 tonnes of soil from the fields. This also contributes to soil fertility.
In Table 4 the economical value of compost use is shown. The economical replacement value comes to 55 euro/tonne green compost and 65 euro/tonne vfg-compost.

More information:
Vlaco vzw
Kan. De Deckerstraat 37
2800 Mechelen
Belgium
www.vlaco.be
info@vlaco.be
tel 0032 15 451 370

Table 1. ***CO_2-balance for vfg- and green waste that is composted in comparison with incineration.***

		Green waste composting			Vfg-waste composting			Vfg-waste digestion with post composting		
		without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	5% sieve overflow for biomass	10% sieve overflow for biomass	without biomass	5% sieve overflow for biomass	10% sieve overflow for biomass
Emissions compost production versus incineration	g CO2/tonne waste	-309000	-309000	-309000	-273595	-273595	-273595	-294740	-294740	-294740
Emissions spreading compost	g CO2/tonne waste	1521	1292	1521	1140	1140	1140	1140	1140	1140
Avoided emission peat (incl mining and transport)	g CO2/tonne waste	-287879	-244697	-287879	-215909	-215909	-215909	-215909	-215909	-215909
Avoided emission spreading peat	g CO2/tonne waste	-1315	-1118	-1315	-986	-986	-986	-986	-986	-986
Avoided emission production mineral fertiliser	g CO2/tonne waste	-2939	-2498	-2939	-3604	-3604	-3604	-2251	-2251	-2251
Avoided emission spreading mineral fertiliser	g CO2/tonne waste	-80	-68	-80	-105	-105	-105	-74	-74	-74
C-sequestration	g CO2/tonne waste	-24200	-24200	-24200	-24200	-24200	-24200	-24200	-24200	-24200
Total effect	g CO2/tonne waste	-623.892	-580.289	-623.892	-517.259	-517.259	-517.259	-537.020	-537.020	-537.020
		tonne greenwaste			tonne vfg-waste					
Separate collection for 2007		465.000			368.000					
TOTAL tonne CO2 savings for 2007		**290.110**	**269.834**	**290.110**	**190.351**	**190.351**	**190.351**	**197.624**	**197.624**	**197.624**

Table 2. Energy balance

		Green waste composting			Vfg-waste composting			Vfg-waste digestion with post composting		
		without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass
Use of energy and fossil fuel for composting / digestion versus incineration[2]	kWh/tonne waste	204,49	117,82	117,82	222,20	193,31	164,42	48,82	19,93	-8,96
Use of energy and fossil fuel spreading compost	kWh/tonne waste	5,83	4,96	5,83	4,38	4,38	4,38	4,38	4,38	4,38
Avoid use of energy and fossil fuel spreading peat	kWh/tonne waste	-5,04	-4,29	-5,04	-3,78	-3,78	-3,78	-3,78	-3,78	-3,78
Avoid use of energy and fossil fuel transporting peat	kWh/tonne waste	-116,76	-116,76	-116,76	-116,76	-116,76	-116,76	-87,57	-87,57	-87,57
Avoid use of energy and fossil fuel spreading mineral fertilisers	kWh/tonne waste	-0,31	-0,26	-0,31	-0,40	-0,40	-0,40	-0,28	-0,28	-0,28
Balance use of energy and fossil fuel	kWh/tonne waste	88,21	1,47	1,55	105,63	76,74	47,86	-38,44	-67,33	-96,22

	tonne green waste	tonne vfg-waste
Separate collection for 2007	465.000	368.000

TOTAL GWh savings for 2007	**-41**	**-1**	**-1**	**-49**	**-36**	**-22**	**18**	**31**	**45**

[2] Only electricity is used (no heat).

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Table 3. ***Ecological impact of compost on water retention capacity of the soil and on erosion***

		Green waste composting			Vfg-waste composting			Vfg-waste digestion with post composting		
		without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass
Water retention capacity min	l water/tonne waste	111,11	94,44	111,11	83,33	83,33	83,33	83,33	83,33	83,33
Water retention capacity max	l water/tonne waste	148,15	125,93	148,15	111,11	111,11	111,11	111,11	111,11	111,11
Erosion min	kg soil/tonne waste	3,80	3,23	3,80	2,85	2,85	2,85	2,85	2,85	2,85
Erosion min	kg soil/tonne waste	4,56	3,88	4,56	3,42	3,42	3,42	3,42	3,42	3,42

	tonne green waste	tonne vfg-waste
Separate collection for 2007	465.000	368.000

		Green waste composting			Vfg-waste composting			Vfg-waste digestion with post composting		
		without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass
Water retention capacity min	m^3 water	51.667	43.917	51.667	30.667	30.667	30.667	30.667	30.667	30.667
Water retention capacity max	m^3 water	68.889	58.556	68.889	40.889	40.889	40.889	40.889	40.889	40.889
Erosion min	ton soil	1.767	1.502	1.767	1.049	1.049	1.049	1.049	1.049	1.049
Erosion min	ton soil	2.120	1.802	2.120	1.259	1.259	1.259	1.259	1.259	1.259

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Table 4. ***Economical benefits of compost use***

	Green waste composting			Vfg-waste composting			Vfg-waste digestion with post composting		
	without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass	without biomass	15% green waste for biomass	15% sieve overflow for biomass
Peat substitution	16,65	14,23	16,65	12,61	12,61	12,61	12,61	12,61	12,61
Substitution mineral fertiliser	6,88	5,98	6,88	9,04	9,04	9,04	6,52	6,52	6,52
Disease suppression	1,10	0,94	1,10	0,83	0,83	0,83	0,83	0,83	0,83
C-sequestration	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10
Water retention capacity	2,59	2,20	2,59	1,94	1,94	1,94	1,94	1,94	1,94
Erosion	0,08	0,07	0,08	0,06	0,06	0,06	0,06	0,06	0,06
Total economical benefit	**27,41**	**23,52**	**27,41**	**24,58**	**24,58**	**24,58**	**22,06**	**22,06**	**22,06**