EUBIONET 2

Factsheet 9 – the Netherlands

Renewable energy from waste

Waste incinerator that provides district heating in Vienna.

Availability of biomass in waste

In the Netherlands waste is processed either by landfills, waste incinerators, compost installations or sludge processing installations. In 1990 most waste was still being landfilled in the Netherlands. Landfilling, however, gives problems with methane emissions (a powerfull greenhouse gas), contamination of soil and availability of land. That's why it was decided that landfilling should be stopped in favour of incineration. In the last decennium of the 20th century a number of Waste Incineration Plants (WIP's) has been build and the separate collection of biowaste has been started. Due to this the landfilling has been reduced to about 20% in 2004. In 2004 the total of waste processed was 12.1 Mton.

Waste types and ways of processing in 2004 in the Netherlands

Waste type\ Amounts in ktonnes	**Landfilled**	**Incinerated**	**Composted/ fermented**	**Total**
Household waste	59	3,182	1,448	4,689
Commercial and industrial waste	801	1,231		2,032
Waste residue household and industrial waste*	181	769		950
Waste of the municipal cleansing department	95			95
Shredder waste	160			160
Construction and demolition waste	280			280
Remaining waste (incl. hazardous)	500	180		680
Green waste			1,864	1,864
Cleansing sludge	13	800		813
Polluted soil (hazardous and non-hazardous)	500			500
Total	**2,589**	**6,162**	**3,312**	**12,063**

*waste residue after sorting and separation of household waste en non-process related industrial waste

With respect to the greenhouse gas emissions of waste processing this policy has been very successful. The greenhouse gas emissions of the processed waste were reduced from 12 Mtonne CO_2-eq in 1990 to 0.9 Mtonne in 2004.

In most other countries a major part of the household waste is still being landfilled, causing an enormous emission of methane. Separate collection of biowaste and incineration can reduce the emission of greenhouse gases of countries where most waste is still being landfilled with 2–5% of their total greenhouse gas emission.

Parts of these waste streams contain biological components and can be used to produce renewable energy. The total net heating value of biological components in the Dutch waste streams equaled 62.7 PJ in 2004.

Over half of the total net heating value is made up by the paper and cardboard fractions in the household waste, commercial sector & industry waste and the remaining waste streams together with the wood fractions in the green waste.

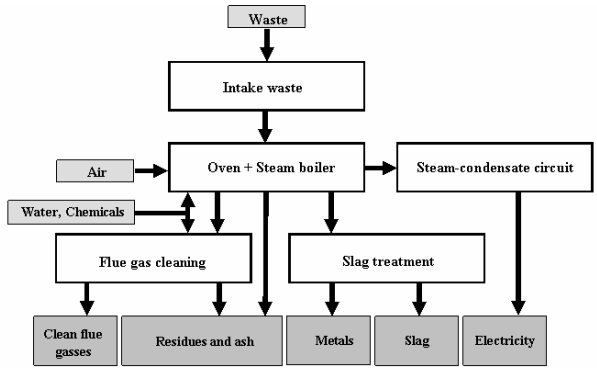
In practice not all available biomass is used for energy production, but large amounts are for example also composted. In the Biomass action plan of the ministry of economic affairs (2005) it is estimated that the maximum contribution of bioenergy can be 83 to 97 PJ in 2010. The biggest contribution will be made by waste incineration plants (WIPs) and the use of biomass in coal-fired power plants (appr. 54 PJ). The remaining 29 to 43 PJ will come largely from small-scale plants.

Bio-components in different waste types and their net heating values

Waste type	Bio-components in waste	Moisture content in bio-component	Net heating value (MJ/kg)	Percentage of bio-component in waste type	Contribution to heating value of all bio- fractions (MJ/kg)	Amounts of waste in 2004 (ktonnes)	Total heating value of bio-contents in 2004 (TJ)
Household waste	OPK	30%	11,03	25,9%	4,68	3900	18241
	Wood	15%	15,19	3,2%			
	GFT	57%	2,91	34,9%			
	RCF	15%	16,46	1,9%			
Household waste (bulky)	OPK	20%	12,95	5,8%	7,25	790	5725
	Wood	15%	15,19	28,6%			
	GFT	30%	6,27	15,0%			
	RCF	15%	16,46	7,3%			
Remaining after separation	OPK	20%	12,95	30,5%	7,27	950	6910
	Wood	15%	15,19	5,8%			
	GFT	30%	6,27	22,8%			
	RCF	15%	16,46	6,1%			
Commercial sector and industrial waste	OPK	20%	12,95	25,6%	5,31	2127	11294
	Wood	15%	15,19	4,3%			
	GFT	55%	3,16	42,5%			
	RCF	15%	16,46	0,0%			
Construction and demolition waste	OPK	20%	12,95	0,0%	10,85	280	3038
	Wood	15%	15,19	50,1%			
	GFT	55%	3,16	0,0%			
	RCF	15%	16,46	19,7%			
Remaining waste (incl. hazardous)	OPK	20%	12,95	56,4%	9,79	680	6659
	Wood	15%	15,19	12,7%			
	GFT	55%	3,16	5,0%			
	RCF	15%	16,46	2,4%			
Green waste					5,82	1864	10856
	Wood	40%	10,00	50,0%			
	Grass	80%	1,65	50,0%			
				Total heating value of bio-waste			**62722**

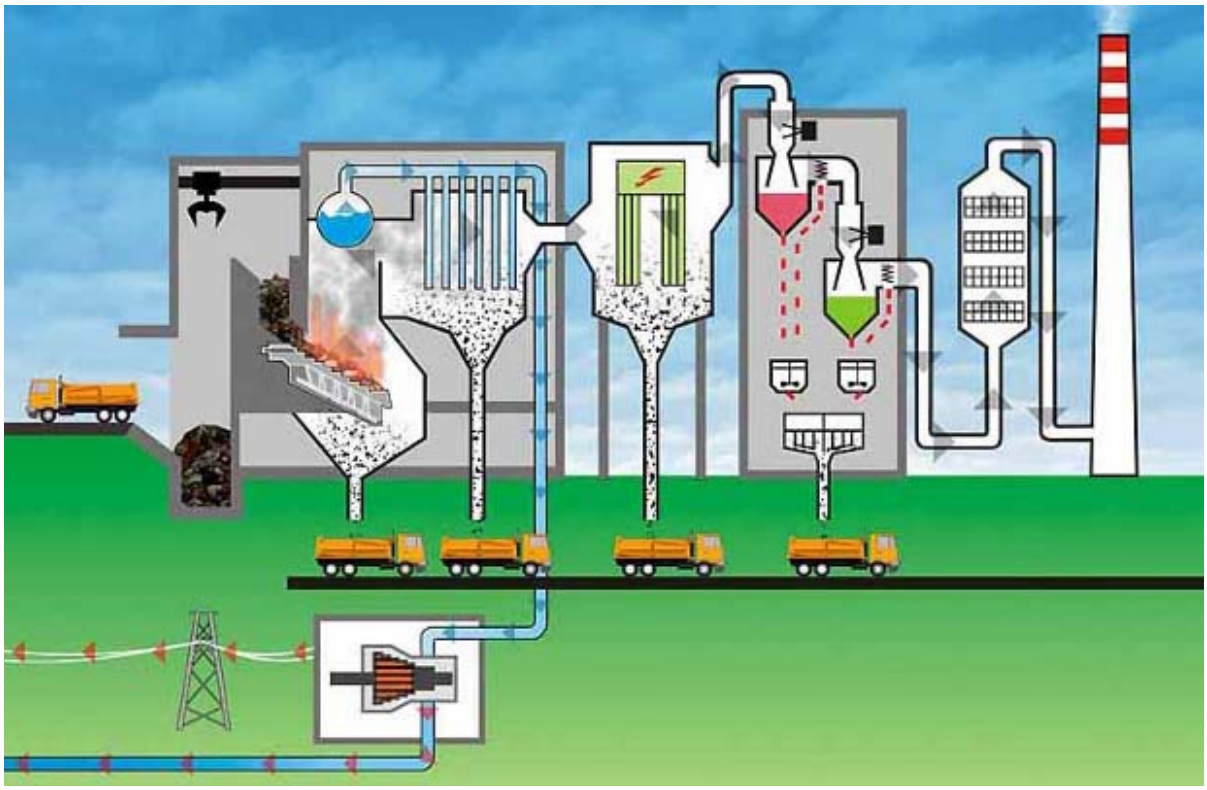
OPK= Paper/ Cardboard
GFT= Vegetable, fruit and garden fraction (biowaste)
RCF= Remaining combustible fractions (Like leather, textile etc.: 50% of this is from biological origin)

Incineration technology



Electricity production in a WIP.

In a WIP first the bulky materials are cut in smaller pieces and all waste is mixed in the bunker in order to get a good mixture of materials with a different heating value. With a large crane the waste is put on a grid and is burned at around 1000ºC. The produced heat is used to produce steam and with generators electricity is produced. The flue gas passes several purification steps before it is emitted by means of a stack. The slag is stripped from metals.



Scheme of WIP with electricity generation and flue gas cleaning equipment.

Costs

The costs of the collection of mixed municipal solid waste differs per municipality and lies between €20 and €50 per tonne. The costs of the separate collection of household biowaste lies between €15 and €40 per tonne.

The gate fee for processing the waste in WIP's, excluding ca. €12/tonne transfer and shipping costs, was on average €110/tonne in 2006. This is about 85% of the income of WIP's, while another 15% comes from the sales of electricity making the total price of waste processing ca. €130/tonne. From the total cost ca. €30/tonne (24%) can be attributed to the production of electricity.

Organization

Collection

In the Netherlands the collection of household waste is the responsibility of municipalities. Municipalities can organize the collection with their own personnel or can contract a private collection firm.

Collection of municipal solid waste with containers.

Collection truck.

Incineration

Some incineration plants are privately owned and some are owned by municipalities. The incineration capacity differs per plant.

Data WIP's in the Netherlands

information from: Werkgroep afvalregistratie Afvalverwerking in Nederland, Gegevens 2004; Vereniging Afvalbedrijven & SenterNovem; September 2005

WIP	incinerated in 2004 in ktonne	capacity in 2006	production of electricity 2004 nett GWh_e/yr	electricity from biomass nett GWh_e/yr	production of heat 2004 GWh/yr	plans for extension ktonne
GAVI Wijster	483	440	356	134		500
Twence	307	300	181	72		220
ARN	270	270	191	71	181	
AVR Duiven	336	360	159	53	143	30
AVR Duiven (TCI)	72					
HVC Alkmaar	521	660	311	191		
AEB Amsterdam	879	860	592	256	39	500
HVCafvalcentrale Dordrecht	207	240	65	19		225
AVR Chemie	58	0				
AVR (Roteb)	388	380	183	56		100
AVR Rijnmond	1125	1150	497	194	568	200
ZAVIN	7	8			26	
SITA ReEnergy	54	67			23	180
AZN **	656	650	473		*	325
sum	**5.363**		**3008**		**979**	**2280**

** AZN delivers 5300 TJ heat to the neighbouring power plant, who produces 473 GWh electricity
WWPP = waste water purification plant

Contracting

All incineration plants have contracted municipalities for the incineration of the household waste. These contracts are for a period of 5, 10 or more years.

Besides the household waste they incinerate commercial waste. Contracts for incineration of this waste are mostly for shorter periods.

Fuel quality and energy production by WIP's

The presence of chlorine in most waste streams and the mostly high moisture content of the waste mean that the quality of the fuel and the electrical efficiency are quite low. The existing 11 WIP's in the Netherlands currently make a substantial contribution to renewable energy, because 50% of the total energy produced is regarded as renewable. The electrical efficiency of the waste incineration is about 22% plus 7% thermal.

Incineration lines with electrical efficiencies up to 30% are being build. Higher efficiencies are difficult to reach due to the chlorine content (PVC) of the mixed waste.

In 2004 the total combined electricity and heat production (exploited) was 4.0 TWh (14.6 PJ), which means that 2.0 TWh thereof was produced from biological feedstock. Besides, the WIP's produced 1464 ktonnes of slags, 47 ktonnes of fly ash, 126 ktonnes of ferro metals and 12 ktonnes of non-ferro metals.

Energy production of incineration installations (AVI's) anno 2004

	Incinerated in 2004 (ktonnes)	Electricity production in 2004 net GWh/y	Electricity production in 2004 gross GWh/y	Heat production in2004 GWh/y
Total	5.363	2.513	3.064	979

Recommendation of suitability

Waste incineration with high energy production and elaborate flue gas cleaning equipment is a good method and relative cheap method to diminish the greenhouse gas emissions from landfilling of putrescible waste.
In the Netherlands almost all household waste is being incinerated in WIP's. The existing incineration plants are being enlarged with extra lines or have plans for it.

The newest lines have higher efficiencies, up to 30% electric efficiency. These higher efficiencies mean that also more electricity will be produced from the waste of biogenic origin.

The incineration technology is proven in lots of existing plants. There is less experience with newest high efficiency lines.

Energy production from separated waste streams

Co-firing in coal fired power plant

Waste from households and offices contains large amounts of plastic and paper. Several WIP's have the opportunity to isolate a so-called paper-plastic fraction (PPF) from Refuse Derived Fuel (RDF) using wind sifters. PPF can be used to produce Subcoal, which can be co-fired in coal fired power plants, cement kilns or lime kilns. At the moment Subcoal is produced on small scale by a paper mill in Roermond for use in lime kilns. This process has been tested a pilot study. For the production of Subcoal, the PPF fraction is ground, stripped from contaminations and dried. Subsequently, it is crushed into small grains. In powder coal fired power plants these grains are pulverized to powder and co-fired with the powder coal. This process is patented by DSM.

In this way Subcoal burns-out completely and produces a limited amount of ash thereby meeting the requirements of coal fired power plants. The net heating value of Subcoal is ca. 21 MJ/kg against 26 MJ/kg for coal. When compared to incineration in an AVI, the Subcoal route gives a higher energy production and is more environmentally friendly as was concluded from an environmental study by CE. On average about 50% of the Subcoal is from biological origin which enables the coal fired power plants to increase their renewable energy production from locally produced feedstocks. At the same time the capacity of WIP's is increased.

In 1999 the costs for transportation and sorting were estimated at €74–87 and €13 respectively giving a total cost of €87–100 roughly equalling the gate fee for incineration of unsorted household waste in the Netherlands at time.

Coal fired power plants also co-fire biomass streams such as wood chips, dried chicken manure and sewage sludge, which are produced locally. Besides cacao beans olive pulp and wood pellets are imported for co-firing.

Biological drying

Biological drying is a process to decrease the amount of waste to be processed in WIP's by about 40%. In this process water evaporates and organic compounds are decomposed leaving fraction such as paper and plastics. While the total weight of the waste decreases, the calorific value per kg increases. The remaining fraction can be used for co-firing in for example cement kilns. This principle is tested in an installation in Maasbracht.

Biogas production

Part of organic waste such as vegetable, fruit and garden (GFT) waste is fermented to produce biogas (methane) and enriched compost. One of these installations is situated in Lelystad where biowaste is processed via the so-called Biocel process. In the process net energy production is achieved by converting the biogas to heat and power with a heat-electric power production unit. In this plant 35 ktonnes of GFT were processed, producing 2.1 GWh electricity and 11.6 TJ heat per year (3.15 mln m^3 biogas).

In a similar process in 2004, 98 million m^3 of landfill gas was converted to 163 GWh electricity and 150 TJ heat. A big advantage of the landfill gas collection is that the methane in this gas is not contributing directly to greenhouse gas emissions, while methane is a 21 times stronger green house gas than carbon dioxide.

Also manure (pig and chicken) is used in yeast processes for electricity production. An example is an installation in Beltrum where about 36 ktonnes of manure via biogas and a heat-electric power production unit were converted to 3.5 GWh per year.

Produced by SenterNovem, August 2007.

Intelligent Energy Europe