

Urban waste for biomethane grid injection and transport in urban areas

Project No: IEE/10/251



Good practice examples for the management and logistics of organic urban waste



WP 2 – Task 2.1 / D 2.1

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UrbanBiogas website: www.urbanbiogas.eu

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Preface

This report was elaborated in the framework of the UrbanBiogas project (Urban waste for biomethane grid injection and transport in urban areas). The objective of this report is to show in short factsheets 11 examples of the management and logistics of organic urban waste in different European countries. This should provide input to the UrbanBiogas target cities City of Zagreb (Croatia), Municipality of Abrantes (Portugal), City of Graz (Austria), City of Rzeszów (Poland), and North Vidzeme Region including the City of Valmiera (Latvia), for which the UrbanBiogas consortium is currently developing Waste-to-Biomethane (WtB) concepts. In the WtB concept, anaerobic digestion (AD) from organic waste, adjacent upgrading to biomethane quality and grid injection in the natural gas distribution network or direct use in transport is promoted. The current situation, including legal financial and administrative framework conditions, in the target cities is very different. It ranges from no separate waste collection at all to quite sophisticated systems, from nearly no experience in biogas production and upgrading to some experience with several installations on the national level. Therefore, also the present report describes good practice examples for the management and logistics of organic urban waste in order to present a large range of different concepts in different countries. Complementary to this document, the UrbanBiogas consortium furthermore elaborated a report on “Good practice projects for biogas production from waste, upgrading and utilization”, which is available at the UrbanBiogas website.

Glossary

Biowaste	Biowaste is defined as the organic fraction of waste arising from households, commerce and the food manufacturing industry. This biowaste is usually characterized by very good digestibility.
Green waste	The organic fraction of the waste stream arising mainly from “green” waste from landscape maintenance and gardening waste. This is usually characterized by higher lignin contents and thus, often used for composting instead of fermentation.
Anaerobic digestion	AD is a natural process in which microorganisms break down organic matter, in the absence of oxygen, into biogas and digestate.
Biogas	A combustible gas derived from decomposing biological waste under anaerobic conditions. Biogas from organic waste normally consists of 50 – 75 Vol. % methane.
Biomethane	Raw biogas which is produced through anaerobic digestion normally consists of 50-75 Vol. % methane, 25-55 % carbon dioxide, 0-10 % water vapor and small amounts of nitrogen, hydrogen, oxygen, ammoniac and sulphur hydrogen. Upgraded or purified biogas is called “biomethane”. Biomethane has a methane content of >95 Vol. %.
Digestate	The digested effluent from the AD process. Digestate still contains all nutrients from the input substrates. Thus, it is an excellent organic fertilizer.
Composting	The controlled process whereby compostable organic wastes are microbiologically transformed under aerobic conditions for a period usually not less than six weeks.

WURZER UMWELT GMBH



GENERAL INFORMATION ABOUT THE PROJECT

Location: Am Kompostwerk 1, 85462 Eitting (near Munich), Germany

Operating area: several counties surrounding Munich (e.g. Erding, Freising and Dachau)

Serving area size: approx. 2,500 km²

Population: over 500,000 inhabitants

Households: approx. 125,000

Website: www.wurzer-umwelt.de



TECHNICAL DATA

Separate collection: Wurzer Umwelt is only collecting biowaste and green waste.

Quantity of MSW: Biowaste: 28,000 t/y; **Green waste:** 100,000 m³/y

Composition of MSW: Biowaste: 100 % use in biogas plant; **Green waste:** Composting

Recycling rate: 100 % of the biowaste is used in the biogas plant and 100 % of the green waste for composting.

No. of bins: Bins for organic household waste (called "brown bins") are owned by the municipality and provided for the households. Wurzer only collects the content of the bins.

No. of vehicles: approx. 300

Collection rate: approx. 539 t per week

WASTE MANAGEMENT – LEGAL OBLIGATIONS

- All European Member States have to fulfil the Landfill Directive 1999/31/EC and the Waste Framework Directive 2008/98/EC to considerably reduce land filling of the biodegradable part of MSW.
- Germany implemented on this basis the so-called Waste Disposal Ordinance to fulfil the European directives.
- Additionally Wurzer has to fulfil the Waste Management Constitution (AbfWS - Abfallwirtschaftssatzung) of the administrative district of Erding.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** Collects organic municipal waste from households by using brown bins.
- **Utilization of biowaste:** Collected waste is milled and cleaned from bulky inorganic material before it is used in two horizontal fermenters to produce biogas under thermophile conditions (52 – 56°C). Small inorganic material (e.g. smaller particles of plastic, glass, etc.) is removed after the fermentation and before further composting of the digestate.
- **Quantity of biowaste:** 28,000 t/y
- **Energy utilization:** The biogas is used in three Combined Heat and Power (CHP) plants (each 307 KW_{el}).
- **Energy production:** The produced electricity is fed into the grid and the heat is consumed on the company ground of Wurzer Umwelt during winter time. However there is a lack of heat use in summer.
- **Composting:** After the process of the biogas plant, the digestate is mixed with structural material, further composted, and sold as a fertilizer. Besides, annually 100,000 m³ biomass from public landscape maintenance (e.g. wood which is not suitable for biogas production) is used for composting. During the aerobic composting process (lasts 2 – 3 months) biodegradable waste is sorted in piles by its quality and size. After this process the compost is sold with different qualities.

ECONOMICAL INFORMATION

- **MSW collection charge (per household):** 135 – 1,900 €/y (depending on the size of the needed bin)
- **Biowaste collection charge:** Use of a brown bin is already included in the MSW collection charge.
- **Gate-fee (€/t):** n/a
- **Biowaste treatment technology investment costs:** 8.7 M €
- **Biowaste treatment facility operation:** n/a
- **Annual sales of compost:** n/a
- **Price of compost:** 11 – 19 €/m³
- **Investment expected payback period:** n/a

SUMMARY of PROJECT IMPLEMENTATION

Wurzer Umwelt GmbH was founded in 1984. As one of the first companies in the region, Wurzer Umwelt GmbH was certified in 1999 as waste treatment company. Wurzer Umwelt GmbH is certified by several institutions for quality compost and substrate. The waste treatment site of Wurzer Umwelt GmbH in Eitting, Germany, has an area of 200,000 m².

All energy needs of the company are self-supplied with 100 % renewable energies. Wurzer Umwelt GmbH is since 2011 proud owner of a photovoltaic installation on the roof of their machine halls. Thus, 3,000 t CO₂ can be saved annually.



GANSER ENTSORGUNG



GENERAL INFORMATION ABOUT THE PROJECT

Location: Taufkirchner Str. 1, 85649 Kirchstockach (near Munich), Germany

Operating area: Rural district of Munich and parts of Munich

Serving area size: approx. 2,000 km² (for biowaste collection)

Population: approx. 400,000

Households: approx. 100,000

Website: www.ganser-entsorgung.de



TECHNICAL DATA

- **Separate collection:** Ganser is only collecting biowaste and green waste.
- **Quantity of MSW: Biowaste:** 30,500 t/y ; **Green waste** (e.g. from garden maintenance): 15,000 t/y
- **Compositing of MSW: Biowaste:** 100 % fermentation; **Green waste:** 100 % composting
- **Recycling rate:** Only fermentation and composting
- **No. of bins:** Bins for organic household waste (called "brown bins") are owned by the municipality and provided for the households. Ganser only receives the content of the bins which are collected by municipality owned trucks.
- **No. of vehicles:** None by Ganser → Task of the municipality
- **Collection rate: Biowaste:** 590 t per week

WASTE MANAGEMENT – LEGAL OBLIGATIONS

- All European Member States have to fulfil the Landfill Directive 1999/31/EC and the Waste Framework Directive 2008/98/EC to considerably reduce land filling of the biodegradable part of MSW.
- Germany implemented on this basis the so-called Waste Disposal Ordinance to fulfil the European directives.
- Additionally Ganser has to fulfil the Waste management Constitution (AbfWS - Abfallwirtschaftssatzung) of the administrative district of Munich.

BIOWASTE MANAGEMENT

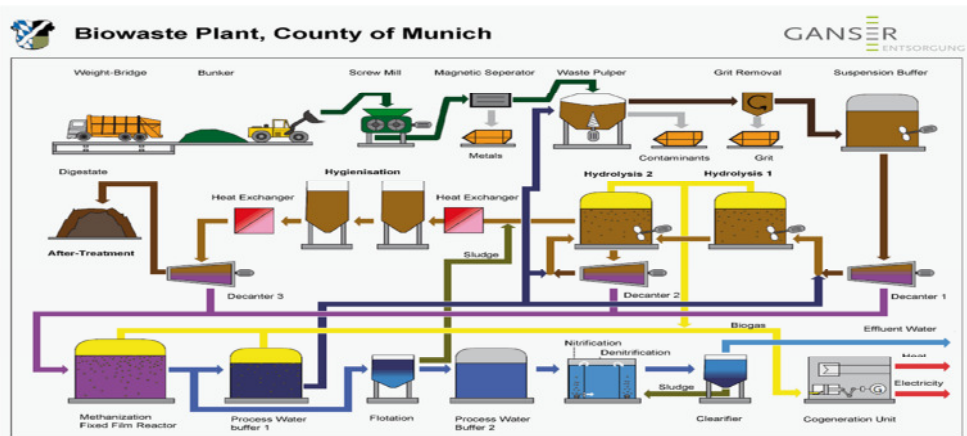
- **Description of biowaste collection:** The biological waste is delivered by the municipality to Ganser Entsorgung or can be delivered directly to Ganser Entsorgung by a fee.
- **Utilization of biowaste:** Delivered waste is registered with a vehicle scale and brought into a flat bunker within the delivery hall. After that a front loader is used to feed it into a screw mill where it is chopped roughly and then is mixed with water to get a pumpable slurry. Before this slurry gets into the methane reactor it is separated into a liquid and solid phase. The liquid phase with an already high amount of dissolved organic material is pumped directly into the methane reactor. The solid phase is mixed with process water and 2 or 4 days later the arising liquid is also feed in the methane reactor. The methanogenesis takes place under mesophilic conditions (37°C). Ganser Entsorgung produces more than 2.3 M m³ of biogas per year. The whole technology of this process is provided by BTA International (www.bta-international.de).
- **Energy production:** The produced biogas is used in two CHP plants with altogether 620 KW electrical power, 2.3 M Nm³ of biogas and 5 M KWh electricity is produced per year.
- **Energy utilization:** This electricity is fed into the grid. The resulting heat is used for heating the methane reactor and additionally for woodchip drying.
- **Composting:** After the fermentation in the biogas plant the resulting solid hydrolysis residue, contaminant free and low in salt, is further stabilized in the plant's existing composting facility together with the garden waste. The compost is certified and frequently controlled on its quality.

ECONOMICAL INFORMATION

- **MSW collection charge (per person):** on average 90 €/y
- **Biowaste collection charge :** 98 €/t
- **Gate-fee:** 98 €/t
- **Biowaste treatment technology investment costs:** 33.5 M €; 8 M € for the biogas plant
- **Biowaste treatment facility operation:** n/a
- **Annual sales of compost:** 24,000 t/y
- **Price of compost:** 13 – 18 €/t
- **Investment expected payback period:** n/a

SUMMARY of PROJECT IMPLEMENTATION

- 1990 Ganser Entsorgung designed a testing plant for organic waste treatment in cooperation with the Technical University of Munich; after an one year lasting pilot phase Ganser Entsorgung decided to build an commercial plant.
- After the permitting process the building process was started in the year 1996.
- In 1997 the biodegradable waste treatment began.
- Since 1997 more than 300,000 tonnes of biological waste were treated and converted in useful feedstock such as biogas and compost.



VÄÄTSA PRÜGILA



GENERAL INFORMATION ABOUT THE PROJECT

Location: Estonia

Operating area: "Middle Estonian Waste Management Centre", Paide city and Turi city and surrounding rural areas

Operating company: VÄÄTSA PRÜGILA AS

Servicing area: 2,623 km²

Servicing population: 100,000 inhabitants

Website: www.jarva.ee/vaatsaprygila



TECHNICAL DATA

- Organic waste is collected by dedicated municipal waste collection trucks. Each household was provided with free kitchen waste collecting canisters and rolls of biodegradable bin liners. The kitchen canisters are emptied by the households in dedicated 240 – litre bins for biodegradable waste.
- Collected organic waste is composted in the fully closed and automatic "EnviCont 900" container.
- After enclosed composting, the compost is placed as windrow for maturation at the landfill site. Two composting areas are in operation. As a result of composting, a good quality product is obtained. However, the compost is currently not very good saleable.
- **Biowaste treatment energy expenditure:** no data available
- **Energy production:** no net energy is produced

ECONOMICAL INFORMATION

- **Biowaste treatment technology investment costs:** approx. 80,000 €
- **Biowaste collection charge:** 23 €/t
- **Biowaste treatment facility operation:** approx. 6.5 – 7.5 €/t
- **Annual sales of compost:** approx. 130 t/y
- **Investment expected payback period:** expected 10 years

SUMMARY of PROJECT IMPLEMENTATION

Collection of separated biowaste began in May 2007. VÄÄTSA PRÜGILA AS distributed 240 litre biowaste bins, and small kitchen canisters. VÄÄTSA PRÜGILA AS signed contacts with entrepreneurs, public institutions and block apartment house associations. VÄÄTSA PRÜGILA AS acquired Estonian Veterinary and Food Board permission for composting system for catering waste (food waste) so-called III category animal waste. So far the company has minor problems with clients who don't use appropriate biodegradable bags for composting waste. Till now, the demand for good quality compost in Estonia is low. Most of the produced compost is used as cover material for landfill sites.

ADVANTAGES FOR THE MUNICIPALITY/REGION

Estonia has adopted the European Directive for reduction of biodegradable waste in landfill sites. Landfill operators must follow the national Waste Act § 134 which regulates maximum percentages of deposited biodegradable waste. The percentage of biodegradable waste (in total amount of weight) of municipal waste deposited in a landfill shall not exceed:

- 1) 45 % by 16 July 2010 (however, it is at the moment approx. 60 %)
- 2) 30 % by 16 July 2013
- 3) 20 % by 16 July 2020

By implementing source separated biowaste collection VÄÄTSA PRÜGILA AS has moved towards the achievement of the set targets.

LESSONS LEARNT

The main focus must be set on public environmental education and awareness rising. Biowaste collection service providers must furthermore implement good communication strategies with clients in order to achieve good compost qualities. To motivate clients, the biowaste collection service charge must be lower than the charge for unsorted municipal waste collection.



BIOGEN SOUTH SHROPSHIRE



GENERAL INFORMATION ABOUT THE PROJECT

Location: Ludlow, South Shropshire, West Midlands of England, United Kingdom

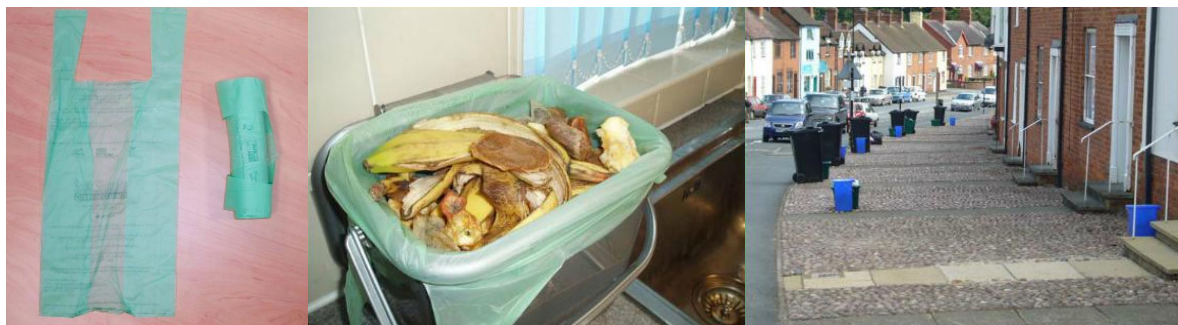
Operating area: area near Ludlow, Ludlow town

Serving area size: Ludlow town area 1.42 km² and other nearby towns in South Shropshire

Population: approx. 10,000 inhabitants in Ludlow

Households: approx. 5,300 households; also waste from educational establishments, other domestic properties, commercial properties, stores and markets is collected.

Website: www.shropshire.gov.uk



TECHNICAL DATA

Separate collection: only kitchen biowaste is collected from households and organisations.

Quantity of MSW: Biowaste: approx. 5,000 t/y

Composition of MSW: Biowaste: 100 %; solids content 15 – 25 %

Recycling rate: 100 % of the biowaste is used in the biogas plant

No. of bins: Every household is supplied with special blue bin

No. of vehicles: one electric powered collection vehicle

Collection rate: approx. 560 t/y from households; educational establishments: 2.1 – 2.5 t/week; commercial properties: 4.6 t/week; other domestic properties (outside Ludlow): 5.5 t/week; Cwm Harry Land Trust: 9 t/week; Somerset waste Partnership – 50 t/week; other food waste from stores and markets

Waste treatment: 100 % goes to AD plant

WASTE MANAGEMENT – LEGAL OBLIGATIONS

- The Climate Change Act 2008 requires the reduction of carbon emissions by 80 % by 2050 compared to 1990 levels.
- EU Renewable Energy Directive requires the UK to source 15 % of its energy and 10 % of energy used in transport from renewable sources by 2020.
- EU Landfill Directive requires the UK by 2020 to cut the volume of biodegradable municipal waste sent to landfill to 35 % of that produced in 1995.
- The target set by the Revised Waste Framework Directive to recycle 50 % of waste from households by 2020.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** Kitchen biowaste in caddy liners made from corn starch is collected every week by an electric powered collection vehicle from special blue bins outside households.
- **Utilization of biowaste:** First large and visible contaminants are manually removed. The waste is then pre-treated and stored in mixing tanks prior to its introduction to the digester. Biogas is produced, collected, upgraded and utilised for electricity and heat production. The digestate is de-watered and split into solid and liquid fractions and sent directly to local farmers for land application.
- **Energy utilization:** Biogas is used in CHP plants to produce green electricity and heat .
- **Energy production:** approx. 1,500 MWh/y of electricity is produced
- **Biowaste treatment energy expenditure:** 30 % of produced heat is used on-plant, 20 % of electricity is used on-plant and for electric powered collection vehicle, approx. 80 % of electricity is fed into grid

ECONOMICAL INFORMATION

- **Gate-fee (€/t):** 19,173 € for 570 t (33.64 €/t) or 48 – 72 €/t (may vary in time)
- **Biowaste treatment technology investment and operational costs:** 4 M € grant from government was given; Electric powered collection vehicle cost 43,139 €, insurance per year – 7,190 €; outdoor bins – 16,776 €; kitchen caddies – 8,987 €, corn starch liners 19,173 €, communications 8,388 €, staff cost 60,000 – 72,000 € (2 operators)
- **Annual sales of compost:** None, all digestate sent to local farmers
- **Price of compost:** n/a
- **Investment expected payback period:** n/a

SUMMARY OF PROJECT IMPLEMENTATION AND LESSONS LEARNT

- The South Shropshire Biowaste Digester at Ludlow is a large-pilot scale digester, the first of its kind in the UK. Its design and construction was overseen by Greenfinch, and was funded by the DEFRA New Technology Demonstration Programme and Advantage West Midlands. The plant was started up in mid-March 2006.
- High levels of contamination of the mixed garden and food waste created processing difficulties for the plant, and a comprehensive maintenance programme was undertaken during spring 2007, after that only source separated food waste was processed, and a small amount of source-separated green waste (approximately 5 % of the total throughput).
- A weekly, source separated food waste collection system was introduced by SSDC in Ludlow in May 2007. Odour complaints were received by SSDC in summer 2007 and were investigated by independent odour consultants commissioned by Biocycle. During autumn 2008 alterations were made to the plant in order to mitigate the odour issues. These changes included replacing of the odour treatment system and significant changes to the reception/pre-treatment area.



VÄXTKRAFT PLANT



GENERAL INFORMATION ABOUT THE PROJECT

Location: approx. 8 km from Västerås city centre, province Västmanland, Sweden

Operating area: city Västerås, farmlands within 15 km of site or less (average distance 8 km)

Serving area size: more than 52.94 km²

Population: approx. 140,000 inhabitants

Households: 129,600 (90 % in the region)

Website: www.vafabmiljo.se



TECHNICAL DATA

Separate collection: only kitchen biowaste is collected from households

Quantity of biowaste: 17,550 t/y (+ 3,000 t grass silage per year)

Composition of biowaste: Household waste 15,400 t/y; Grease trap removal sludge 2,150 t/y;

Recycling rate: 100 % of collected waste is recycled in plant

Used bins: To ensure a high quality biowaste the source separation shall be based on a so called open and ventilated system in which small paper bags in combination with ventilated plastic bins are used for the storage of the biowaste.

Used vehicles: Kitchen biowaste is collected by side loaded refuse collection vehicles.

Collection rate: Apartment buildings once a week, in residential districts – every two weeks

Waste treatment: 100 % goes to AD plant, digester residues are used as organic fertilizer

WASTE MANAGEMENT – LEGAL OBLIGATIONS

Sweden's national legislation is stricter than the EC landfill Directive demands. A national ban on landfill of all organic wastes was introduced in 2005. Furthermore an energy tax for the incineration of municipal waste was introduced to promote the biological treatment of organic waste. Local regulations and waste plans prescribe source separation of biodegradable biowaste municipal waste for biological treatment. The collection and treatment of household waste is the local authorities' responsibility in Sweden. The municipality can decide to perform waste collection and pre-treatment itself within departments, or procure the services from contractors.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** Organic waste is reloaded, from Västerås as well as from other places in the region by refuse collection trucks, into containers and transported to the biogas plant. Grease trap removal sludge is transported by trucks from the delivery points to the biogas plant. Utilization of biowaste: Biowaste is used together with grass silage to produce biogas.
- **Pre-treatment of collected biowaste:** After a quality control the organic waste is crushed and bigger contraries, for example plastic bags etc., are sieved out. In a second step biowaste is diluted with water to a slurry. Thereafter impurities are removed by a wet screen and a sand trap. Before the slurry is charged into the digester it is sanitized at 70 degrees for one hour.
- **Biogas utilization:** The produced biogas is upgraded to bio-methane and used as vehicle fuel.
- **Biogas production:** 280 Nm³/h biogas are produce on average (approx. 15 GWh of biogas annually)
- **Biowaste treatment energy expenditure:** 30 % of produced heat is used on-pant, 20 % of electricity is used on-plant and for electric powered collection vehicle, approx. 80 % of electricity is fed into grid.

ECONOMICAL INFORMATION

- **Biowaste collection charge (per household):** n/a
- **Gate-fee (€/t):** n/a
- **Biowaste treatment technology investment and operational costs:** n/a
- **Annual sales of bio-fertilizer:** Bio-fertilizer is not for sale, it is used by individual farmers who grow ley crops for the plant, more than 20,000 tons of bio-fertilizer produced each year
- **Investment expected payback period:** n/a

SUMMARY OF PROJECT IMPLEMENTATION AND LESSONS LEARNT

- A system of source separation of biowaste from households and canteens were introduced in all municipalities in the region during 1997-2001.
- Since 2005 all biowaste generated in the region is treated at the biogas plant.
- In 2005 more than 90 % of the households in the region participated in separate collection of biodegradable waste.
- The voluntary nature of the arrangement minimizes the risk of the biowaste being contaminated by other wastes in unmotivated households.



PONIKVE D.O.O ISLAND OF KRK



GENERAL INFORMATION ABOUT THE PROJECT

Location: Island of Krk, Croatia
Operating area: Island of Krk
Serving area size: 410 km²
Population: 18,000 (permanent); 140,000 in tourist season
Households: 20,000
Website: www.ponikve.hr



TECHNICAL DATA

Quantity of MSW (t/y): 18,000
Composition of MSW: glass 3 %, paper/cardboard 10 %, plastics 3 %, biowaste 15 %, bulky 4 %, others 65 %
Separate collection (t/y): 6,300
Recycling rate: 35 %
No. of bins: approx. 7,000
No. of vehicles: 25
Collection rate per week: 4 – 5 x (summer), 2 x (winter)
Waste treatment: Landfill and composting

WASTE MANAGEMENT – LEGAL OBLIGATIONS

Croatia shall ensure a gradual decrease in the amount of biodegradable municipal waste going to landfills according to the following scheme:

- by 31 December 2013, the share of biodegradable municipal waste deposited on landfills will be reduced to 75 % of the total amount (by weight) of biodegradable municipal waste produced in 1997;
- by 31 December 2016, the share of biodegradable municipal waste deposited on landfills will be reduced to 50 % of the total amount (by weight) of biodegradable municipal waste produced in 1997;
- by 31 December 2020, the share of biodegradable municipal waste deposited on landfills will be reduced to 35 % of the total amount (by weight) of biodegradable municipal waste produced in 1997.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** Biowaste is collected at 1,500 points all over the island, it is collected from brown bins
- **Utilization of biowaste:** Composting
- **Energy utilization:** n/a
- **Energy production:** n/a
- **Biowaste treatment energy expenditure:** n/a

ECONOMICAL INFORMATION

- **MSW collection charge (per household):** 0.05 €/l
- **Biowaste collection and treatment costs:** Separate biowaste collection and composting – 80 €/t
- **Gate-fee (€/t):** n/a
- **Biowaste treatment technology investment costs:** 15,000 €
- **Biowaste treatment facility operational costs:** n/a
- **Annual sales of compost:** n/a
- **Price of compost:** n/a
- **Investment expected payback period:** n/a

SUMMARY OF PROJECT IMPLEMENTATION AND LESSONS LEARNT

- Implementation of separate waste collection system started in 2005.
- Since then significant progress has been achieved, 35 % of total waste is not ending at the landfill.
- Still a lot of work is needed to be done in order to fulfil obligations and EU standards in waste management.
- The primary goal of the collection systems is to reduce the amount of waste at the landfill and long-term decrease in cost of disposal at central county landfill. Furthermore, the aim is to increase the amount of collected biowaste to 6,000 tons per year or up to approximately 35 % of the total municipal solid waste, which would mean a significant saving in landfill space.
- As a result, large quantities of compost could be placed on the market, which is still not the case.



**LILLE MÉTROPOLE
COMMUNAUTÉ
URBAINE - LMCU**



GENERAL INFORMATION ABOUT THE PROJECT

Location: Loos-Sequedin, Lille, France
Operating area: All Urban Community of Lille Métropole
Serving area size: 611,45 km²
Population: 1.1 M inhabitants
Households: n/a
Homepage: www.lillemetropole.fr



TECHNICAL DATA

Quantity of MSW (t/y): 108,000
Composition of MSW: Digestible components of household waste 46,500 t/y; Green waste from recycling centres 52,000 t/y; Food waste 3,000 t/y
Biowaste collection: 80 kg per capita per year
Recycling rate: n/a
No. of bins: Bins are provided by the municipality
No. of vehicles: approx. 300 vehicles
Collection rate per week: 1-2 times per week
Waste treatment: Biogas and composting

WASTE MANAGEMENT – LEGAL OBLIGATIONS

In France, local authorities are responsible for all kinds of household wastes. There are two main laws concerning waste:

- **Law of July 15, 1975 concerning Waste disposal and material recovery.** This law covers all aspects of industrial and municipal waste treatment, and the obligations of the producer and/or owner of the waste. All waste disposal installations require authorization;
- **Law of July 19, 1976 concerning Environmental permits for Classified Installations for the Protection of Environment ("ICPE" law).** This law covers all environmental aspects of industrial activity, including waste management, and requires large facilities to be authorized and smaller facilities to be declared. It also covers legal provisions for closing down industrial facilities and the discovery of contamination next to industrial plants.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** Green waste produced by private households is collected by door-stop biowaste collection with trucks. Green waste consists of a mixture of garden waste and kitchen waste. Furthermore LMCU collects food waste from public canteens and restaurants. Food waste collection is done with hydro cleaning trucks which are able to clean waste bins during the food waste collection. Transport of compost produced of digester residues and non-digestible parts of biowaste is done by barges (ships).
- **Pre-treatment of collected biowaste:** First step of the organic waste treatment is pre-sorting, where iron, plastic bags and other refused contraries are removed from the organic waste. The pre-sorted matter is milled and then pre-composted for 48 hours which warm the material and facilitates the digestion. Afterwards the pre-composted organic waste is directly inserted into the digester for approx. 21 days.
- **Utilization of biowaste:** Digestible parts of the biowaste are used for biogas production. Digester residues and the not digestible parts of biowaste are used to produce compost.
- **Energy utilization:** The produced biogas is upgraded to bio-methane, transported to a filling station and used as vehicle fuel.
- **Energy production:** Bio-methane is used as vehicle fuel for public transport (buses) and is implemented in the gas grid
- **Biowaste treatment energy expenditure:** n/a

ECONOMICAL INFORMATION

- **MSW collection charge (per household):** charge is included in taxes, 68 - 118.4 € per tonne (depends from collection type – voluntary, door to door)
- **Biowaste collection costs:** included in taxes
- **Gate-fee (€/t):** n/a
- **Biowaste treatment technology investment costs:** n/a
- **Biowaste treatment facility operational costs:** Organic Recovery Centre – 4.37 M € per year
- **Annual sales of compost:** n/a
- **Price of compost:** n/a
- **Investment expected payback period:** n/a

SUMMARY OF PROJECT IMPLEMENTATION AND LESSONS LEARNT

- In France, the Lille Metropolitan area was the first major urban area which has implemented a selective waste collection.
- Biowaste collection results during the first years have been shown that sorting waste fraction has to be explained again to the inhabitants, because it was not understood and practiced.
- For the inhabitants it was more difficult to sort the biowaste fraction than to sort packaging material for instance.
- The main issue of pre-collection of biowaste in the kitchen was soiling and odour generation of collection bins. This problem was solved by a spreading of biodegradable bags and 5 litre kitchen bins. Furthermore local authorities made efforts to explain the environmental interest of biowaste collection at home.



EKO-DOLINA SP. Z O.O.



GENERAL INFORMATION ABOUT THE PROJECT

Location: Łężyce, near Gdynia, northern Poland
Operating area: Łężyce and nearest area
Serving area size: 1,065 km² (0,629 km² in actual use)
Population: 440,000
Households: 146,666
Homepage: www.ekodolina.pl



TECHNICAL DATA

Quantity of MSW (t/y): 140,000
Composition of MSW: organics – 30.2 %; waste paper – 25.4 %; composites – 10 %; minor waste – 9.1 %; plastics – 8.6 %; glass – 6.5 %; textiles – 4.2 %; wood – 1 %; metal – 0.5 %; other – 4.5 %
Separate collection: no separate collection was enforced by municipality until end of 2011
Recycling rate: 8.1 %
No. of bins: n/a
No. of vehicles: n/a
Collection rate per week: 1 – 2 times per week
Waste treatment: landfill, composting, sorting of recyclables

WASTE MANAGEMENT – LEGAL OBLIGATIONS

Ekodolina is the operator of the waste disposal site at Łężyce. Local governments are the owners of the company. The company does not have any waste collection infrastructure (i.e. bins or waste-collection trucks). Collection and source separation is handled by private enterprises, which until 2012 had no legal obligation to dispose their collected waste at Łężyce.

New legislation gives local governments the right to force private waste collection companies to dispose waste at sites chosen by the government. These regulations will significantly increase the amount of waste handled by Ekodolina, as almost all the waste collected in counties which are co-owner of Ekodolina will be channeled to Łężyce site.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** The company accepts pure biowaste from local horticulturists and urban green maintenance and receives organic fraction from sorting of MSW.
- **Utilization of biowaste:** Separate composting of pure biowaste and organic fraction of MSW.
- **Energy utilization:** n/a
- **Energy production:** n/a
- **Biowaste treatment energy expenditure:** n/a

ECONOMICAL INFORMATION

- **MSW collection charge (per household):** n/a
- **Biowaste collection costs:** approx. 7 €/t for pure horticultural wastes; other biowaste 27 – 35 €/t depending on purity
- **Gate-fee (€/t):** approx. 55 €/t
- **Biowaste treatment technology investment costs:** 31 M € (sorting and composting infrastructure + 1 MW biogas plant)
- **Biowaste treatment facility operational costs:** n/a
- **Annual sales of compost:** 350 – 400 t (only pure biowaste compost is sold the rest is landfilled)
- **Price of compost:** 5 – 10 €/t
- **Investment expected payback period:** n/a

SUMMARY OF PROJECT IMPLEMENTATION AND LESSONS LEARNT

- Well managed municipal company;
- Located in large conurbation (Gdansk, Gdynia, Sopot) with several large suburbs (Rumia, Reda, Wejherowo)
- Already runs biogas electricity plant (only landfill gas);
- Composting procedure in accordance with EU directives;
- Number of households served for will increase significantly in 2012 due to legislative changes;
- Large area ready for expansion of infrastructure.
- Compost made of biowaste other than green biowaste, always contains traces of glass and smaller wastes, which makes it hard to sell. As a result most of it is landfilled;
- Falcons constitute a great repellent for scavenging birds and vermin.



GRINDSTED MUNICIPALITY BIOGAS PLANT



GENERAL INFORMATION ABOUT THE PROJECT

Location: Municipality of Grindsted, Denmark

Operating area: The Municipality of Grindsted

Serving area size: 382 km²

Population: approx. 18,000

Households: n/a

Homepage: www.grindsted.dk



TECHNICAL DATA

Separate collection: only source separated biowaste collected from households, sewage sludge and organic industrial waste is used in the plant

Quantity of waste: **Source separated biowaste:** 52.3 kg/week; **Sewage sludge:** 595 kg/week, **Industrial liquid biowaste:** 23.3 t/week, Total: approx. 670 kg/week; Annually approx. 3,500 t of sewage sludge and 3,500 t of sorted municipal solid biowaste

Composition of waste: **Sewage sludge:** 50 %; **Biowaste:** 44 %; **Organic industrial waste:** 6 %

Recycling rate: 100 % of waste is recycled in plant

No. of bins: n/a

No. of vehicles: n/a

Collection rate: n/a

Waste treatment: co-digestion of primary settled sewage sludge, organic municipal solid waste and organic industrial waste

WASTE MANAGEMENT – LEGAL OBLIGATIONS

- For the wastewater treatment it was possible to prove that it is possible to comply with the EU wastewater Directive, without needing an increased amount of fossil energy for the electricity for controlled nitrification.
- EU regulations for the hygienisation of treated waste are fulfilled.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** The household waste is collected in paper bags that can be processed along with the waste to avoid the problems of removing plastic.
- **Description of waste pre-treatment:** The incoming waste water is screened for sand and grease removal while the BOD and nitrogen are removed according to the BIODENITRO process. Phosphorous is removed by simultaneous precipitation.
The incoming sorted municipal solid waste is loaded into a storage silo from where it is transported to the primary shredder, which opens the bags and sacks and reduces the particle size.
The primary settled sewage sludge is pumped to a mixing tank where it is mixed with the shredded organic municipal waste (MSW) up to 10 – 15 % dry matter. From the mixing tank the sewage sludge/MSW mixture enters a buffer tank prior to passing through the heat recovery system to the digester. Liquid organic industrial waste is pumped from a reception tank, through the heat exchanger system directly to the digester. Hygienisation according to the EU regulations is ensured by a guaranteed retention time of one hour at 70°C in one of two hygienisation tanks. The waste mixture is digested in a mesophilic (35°C) biogas reactor. The digested biomass is finally treated in a screw press to remove any plastic and other inert material which has not been removed in the mixing stage and which will pollute the end product. The compost is further dewatered in a belt press. The liquid phase is recycled to the process and the sludge cake (compost) is recycled for applications as soil conditioner in agricultural operations. The soil conditioner fulfils all quality requirements especially for heavy metals concentration.
- **Utilization of biowaste:** Municipal solid biowaste is used in co-digestion
- **Energy utilization:** Stored biogas is used in CHP plant
- **Energy production:** 700,000 m³ of biogas, this amount of biogas enables to produce 4,000 – 45,000 MWh/y
- **Biowaste treatment energy expenditure:** The monitoring has confirmed that the THERMIE project in average can provide 102 % of the required electricity to the wastewater treatment plant and 66 % of the produced heat can in average be utilised.

ECONOMICAL INFORMATION

- **Gate-fee (€/t):** n/a
- **Biowaste treatment technology operating and maintenance costs:** 58,840 €/y
- **Project economy:** Total 391,516 €/y consisting of savings in electricity consumption: 136,777 €/y; savings in heat consumption: 30,467 €/y; avoided disposal costs : 224,272 €/y
- **Annual sales of compost:** None, compost is given for free to farmers
- **Price of compost:** For free
- **Investment expected payback period:** 10.8 years

LESSONS LEARNT

- The THERMIE project and the wastewater treatment plant could in principle supply the excess heat to a public grid of central district heating.
- The plant offers significant environmental benefits even when compared to alternative disposal routes for the waste streams treated in this project.
- The Danish experience of co-digesting source-separated organic household waste with other organic wastes shows that, with the proper technology, it is possible to operate biogas plants profitably. However, the thoroughness of the source separation is crucial. With the proper technology, it should be possible to increase the amount of waste processed.

KOMPOGAS BIOWASTE TREATMENT SITE IN OTELFINGEN



GENERAL INFORMATION ABOUT THE PROJECT

Location: Oteltingen, district of Dielsdorf, canton of Zürich, Switzerland

Operating area: Oteltingen

Serving area size: Oteltingen area is 7,17 km²

Population: approx. 100,000 inhabitants, waste is collected from supermarkets too

Households: n/a

Website: www.axpo-kompogas.ch



TECHNICAL DATA

Separate collection: All collected waste is source separated biowaste

Quantity of waste: Biowaste: approx. 12,500 t/y

Composition of waste: 80 % from households, 20 % from supermarkets

Recycling rate: 100 % of the biowaste is used in the biogas plant

No. of bins: n/a

No. of vehicles: n/a

Collection rate: 1 per week

Waste treatment: 100 % goes to the biogas plant

WASTE MANAGEMENT – LEGAL OBLIGATIONS

- No legal obligations to EU Directives, but Switzerland has committed to harmonise its legislations with the EU rules
- All citizens are encouraged to recycle as much as possible, in many cantons there are special taxes for amount of waste put in bin
- Since January 2000 all non-recyclable, combustible waste in Switzerland must be incinerated

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** Biowaste has been separately collected from households in the Zurich region since the late 1980s, and contains kitchen, garden and yard waste. Biowaste is collected from households once weekly and delivered to the facility.
- **Description of biowaste pre-treatment:** The waste is tipped directly from the collection vehicles into a reception pit. There it is picked by crane, placed on a conveyor and passed through a coarse shredder and a ferro-separator. After the waste stream passes through a hand-picking stage, where stones and plastics are removed before the wastes pass through another fineshredder. The waste is stored in an intermediate storage bunker, where recycled process water is added to achieve the preferred total solids content. From this storage bunker waste is fed to the reactor via long inlet tubes in which the waste stream is heated to 55 – 60°C.
- **Utilization of biowaste:** The digester is 32 metres long, with a 6 metre diameter and a volume of 900 m³. Digestion is at 55°C and retention time is 14 days. Total solids content is 30 %. The process is monitored on-line. Samples are taken for off-line analysis if the on-line parameters pass out of an acceptable range.
- **Energy utilization:** The biogas is used to produce electrical and thermal energy, and also is upgraded and used as a vehicle fuel. Kompogas company vehicles use this fuel, as does a large proportion of the Migros fleet. The biogas fuel is also available to the public.
- **Energy production:** 100 – 130 m³ of biogas per tonne of incoming waste with approx. 60 % of CH₄, a proportion of the biogas upgraded and used as vehicle fuel, a proportion used in CHP plant, approx. 2,078 MWh/y of electricity and 3,240 MWh/y of heat.
- **Biowaste treatment energy expenditure:** Kompogas site uses approx. 10 – 15 % of its electricity production for its own operational needs and exports 85 – 90 % to the grid.

ECONOMICAL INFORMATION

- **Collection charge for biowaste:** n/a
- **Gate-fee (€/t):** n/a
- **Biowaste treatment technology investment and operational costs:** Capital cost € 4.17 million
- **Annual sales of compost:** n/a, bulky fraction of digestate sold to local CHP plant, best quality grades are bagged and sold to gardeners and industries, intermediate grades removed from site by local farmers and public for their own personal use
- **Price of compost:** n/a
- **Investment expected payback period:** n/a

SUMMARY OF PROJECT IMPLEMENTATION AND LESSONS LEARNT

- Continuous public education is required not only to lower the percentage, but to increase the proportion of kitchen waste in the biowaste stream (as opposed to in the residual wastes scheme).
- Swiss citizens pay for the collection and treatment of their waste by volume. Therefore the more waste you produce, the more you pay for.
- The introduction of this system produced immediate and dramatic reductions in terms of personal waste arising.



Holding Graz GmbH



GENERAL INFORMATION ABOUT THE PROJECT

Location: Holding Graz Services and Servus Abfall, Sturzgasse 16, 8020 Graz, Austria

Operating area: City of Graz

Serving area size: some 128 km²

Population: approx. 230,000 inhabitants

Households: approx. 110,000

Website: www.holding-graz.at



BIOABFALL-SAMMLUNG



TECHNICAL DATA

Separate collection: Holding Graz, a company of the city of Graz, is in charge for the waste collection and waste treatment for the area of Graz.

Quantity of waste: **MSW:** some 131,000 t/a; **Biowaste:** 18,200 t/a; **Green waste:** 6,700 t/a; **Glass:** 8,400 t/a; **hazardous waste:** 400 t/a; **Paper:** 26,200 t/a; **Recyclable waste (metal, plastic):** 20,400 t/a; **Non-recyclable waste:** 44,000 t/a; **Others:** some 7,000 t/a

Composition of non-recyclable waste: biowaste 40%, plastic 9%, metal 4%, glass 5%, paper 14%, textiles 7%, others 21%

Recycling rate: only 17,500 t/a are landfilled, others are used energetically or material

Number of bins: at approx. 34,000 sites are bins for non-recyclable waste, biowaste, paper, glass, metal and plastic located

Number of vehicles: n/a

Collection rate: approx. 2,500 t per week

WASTE MANAGEMENT – LEGAL OBLIGATIONS

- All European Member States have to fulfil the Landfill Directive 1999/31/EC and the Waste Framework Directive 2008/98/EC to considerably reduce land filling of the biodegradable part of MSW.
- Austria implemented on this basis the so-called Abfallwirtschaftsgesetz 2002 (AWG 2002) to fulfil the European directives.
- The federal region of Styria implemented the StAWG 2004, the so called Styria Waste Management Law, to regulate all belongings in the competence of the region.

BIOWASTE MANAGEMENT

- **Description of biowaste collection:** separate collection from households by brown bins; larger amounts of green waste can be deposited at the Recycling Centre Sturzgasse; chipping service for e.g. tree branches which can be directly used in the garden for wood-chip mulching; cooking oil and fat is collected separately by yellow buckets or bins.
- **Utilization of biowaste: Biowaste and green waste** is mixed and pre-treated (release from metals and plastic) in Graz and then treated in the composting plant ABEZ Frohnleiten. **Cooking oil** is recycled to biodiesel, soaps, cleaning agents and machine oils.
- **Energy utilization:** biodiesel is used for the public bus transfer in the city of Graz, the energy from biowaste cannot be used at the moment; the landfill gas at ABEZ Frohnleiten is used in two CHP plants for electricity and heat production.
- **Energy production:** only cooking oil is upgraded to biodiesel and used as fuel; no electricity or heat is produced from biowaste.

ECONOMICAL INFORMATION

- MSW collection charge (per 120 litre bin): 112.20 €/a + 4.72 €/collection (excluding tax)
- Biowaste collection charge (per 120 litre bin): 1.13 €/collection (excluding tax)
- Gate-fee (€/t): n/a
- Biowaste treatment technology investment and facility operation costs: n/a
- Annual sales of compost and price: n/a
- Price of compost: n/a
- Investment expected payback period: n/a

LESSONS LEARNT

- Inhabitants are very happy to use the Recycling Centre Sturzgasse to deposit green waste, bulky waste, large amounts of waste, recyclable waste or hazardous waste.
- Services like chipping of tree branches and collection of hazardous waste at several places is a nice service for inhabitants.
- Large numbers of different bins at 34,000 sites in the city are appropriate for the waste collection.
- Waste separation by inhabitants is good, but can even be better.
- Biodiesel from cooking oil was used over several years for public transport (in buses), but is not possible for the future because of air emission regulations.
- Biogas and biomethane from biowaste as fuel for public transport (in buses) is promising in the future, because there are already some fuelling stations and CNG-buses in Graz.



MBA Frohnleiten, Source: Servus Abfall