A CHALLENGE IN THE WASTE SECTOR: THE USE OF ORGANIC URBAN WASTE FOR BIOMETHANE PRODUCTION

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ABSTRACT: The simultaneous energetic use of organic waste, such as municipal solid waste (MSW) and catering/food waste, and the creation of a closed nutrient cycle is one of the main advantages of anaerobic digestion (AD) biogas plants as they turn waste materials to "desirable" feedstock. When compared to other treatment opportunities of the organic fraction of MSW, AD has several advantages. In comparison to waste incineration plants, AD plants usually need lower investments and the distances for feedstock transport are generally shorter. Nutrients can be easier recovered for agricultural production and wet feedstock does not have to be dried which is required for incineration. Similar to household scale or industrial scale composting, AD processes also recover nutrients, but the energy content of the biomass is not utilised.

In many European regions waste management is still a large problem and only few biogas plants use organic waste for biogas production. Insufficient waste management practices are more dominant in many urban areas. At the same time, European countries have to comply with the Landfill Directive 1999/31/EC and with the Waste Framework Directive 2008/98/EC to considerably reduce land filling of the biodegradable part of MSW. They also have to comply with the Renewable Energy Directive (RED) 2009/28/EC. However the implementation of European targets is still lacking behind.

AD from waste has the potential to contribute to the European targets of the above mentioned directives. Adjacent upgrading to biomethane quality and grid injection in the natural gas distribution network is an opportunity to efficiently use renewable energy in urban areas. This approach, Waste-to-Biomethane (WtB), is promoted by the UrbanBiogas project (Urban waste for biomethane grid injection and transport in urban areas; May 2011 – April 2014) which is supported by the Intelligent Energy for Europe Programme of the European Union.

The objective is to prepare European target cities for the production of biomethane from urban waste which will be fed into the natural gas grids and optionally used for transport. The target cities are: City of Zagreb (Croatia), Municipality of Abrantes (Portugal), City of Graz (Austria), City of Gdynia and Rzeszów (Poland), and North Vidzeme Region including the City of Valmiera (Latvia). Core of the project is elaboration of five WtB concepts for the target cities.

The present paper gives an overview on options for the use of organic waste for biogas production and presents the approaches in the target cities to promote the WtB concepts. It furthermore addresses the main challenges faced during the development of the concepts, as the interaction with different stakeholders from the waste, energy and public sectors are very difficult. In addition, these projects largely depend on the political support that is influenced by public perception and awareness. The present paper is an update of the paper from Rutz et al. (2012) [9].

Keywords: biogas, biomethane, bio-waste, cities, Waste-to-Biomethane

1 INTRODUCTION

Although considerable achievements were made in several European countries, a major environmental challenge in Europe still remains in the field of sustainable waste management. In order to reduce the amount of waste and to valorise waste as much as possible, the European Union has introduced several legislations such as the Landfill Directive 1999/31/EC [1] and the Waste Framework Directive 2008/98/EC [2]. Both Directives also include details on the treatment of bio-waste.

Nevertheless, several countries still lag behind their

waste targets and are currently requested to introduce suitable measures to fulfill their targets. Thereby, different options for the collection and treatment of bio-waste exist in order to avoid landfilling of bio-waste. These options include separate collection, segregation of bio-waste from mixed waste, incineration, composting, and anaerobic digestion. The selection of these options depends on many different factors whereas a major influencing factor is the national legislation.

Since generally most positive environmental impacts are associated with separate collection of bio-waste and with adjacent anaerobic digestion to produce biogas and biomethane, this approach "Waste-to-Biomethane" (WtB) is promoted by the UrbanBiogas project [3], which is presented in this paper.

2 OVERVIEW ON BIO-WASTE IN EUROPE

About 14% of all generated waste is Municipal Solid Waste (MSW) [4]. The collection of MSW is usually in the responsibility of local public bodies such as municipalities and cities. It consists of waste generated by households as well as by smaller businesses and public institutions whose waste is similar to that of households. The characteristics of MSW highly depends on the local situation, season, waste management system and waste producers. It consists of residual waste, bulky waste, secondary materials from separate collection (e.g., paper and glass), household hazardous waste, street sweepings and litter collections. It includes paper, cardboard, metals, textiles, bio-waste, glass, plastic and other materials. According to Figure 1, the largest fraction of MSW is paper and cardboard with about 35%, followed by bio-waste with about 25% of the waste stream [4].

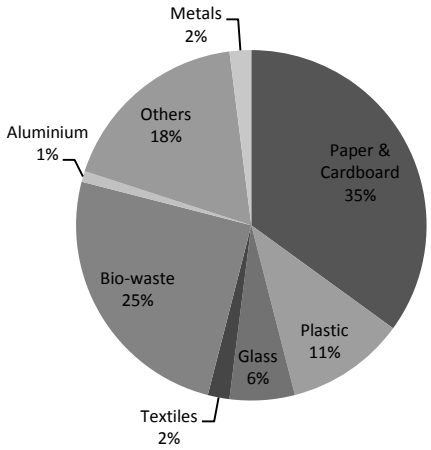

Figure 1: Typical composition of MSW (Data: Eionet European Topic Centre on Sustainable Consumption and Production, 2009)

As Figure 2 shows, many countries have still dumped large portions of MSW on landfills in 2010. The European policy asks Member States to ban landfilling of MSW within the next years. Besides other environmental problems associated with landfilling such as land use conflicts, water pollution and odours, a major environmental impact of landfilling is the production of methane mainly from bio-waste, which accounted for some 3% of total greenhouse gas emissions in the EU-15 in 1995 [5].

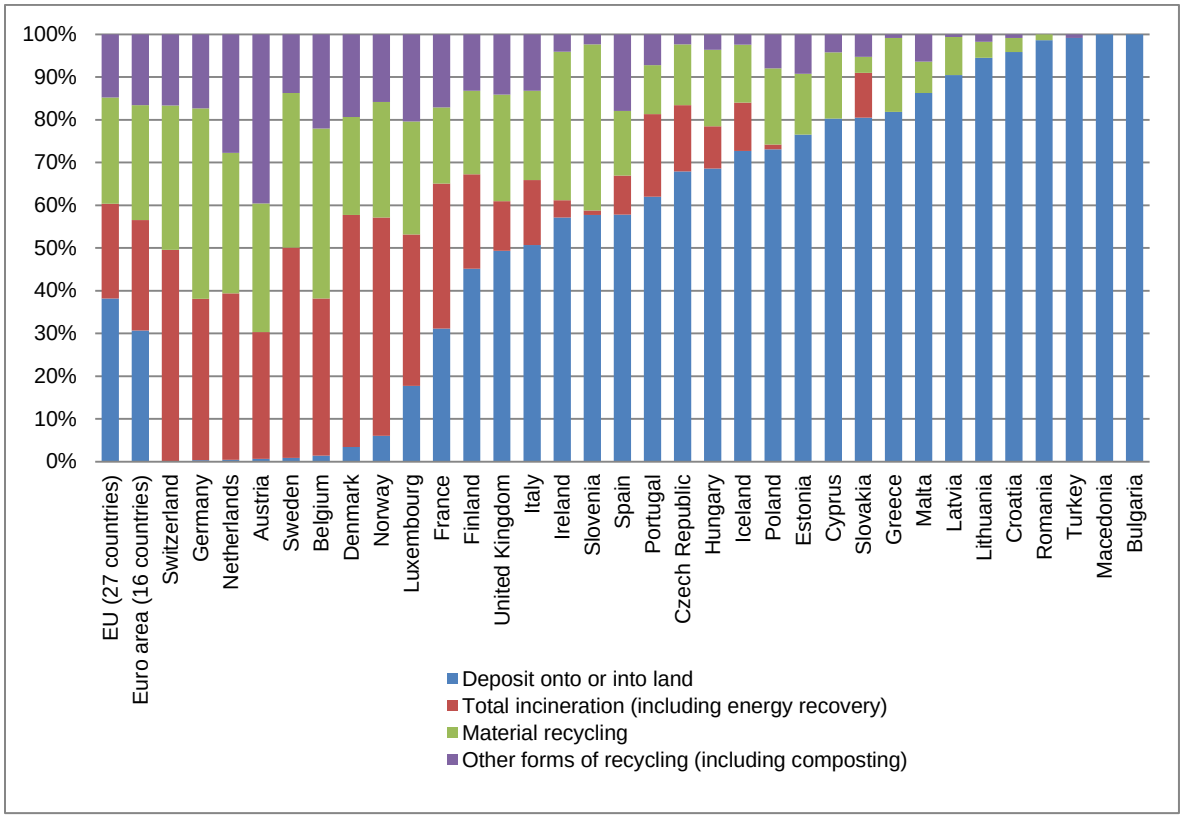

Figure 2: The share of different treatment options for municipal waste in Europe in 2010 (Data: EUROSTAT)

3 EUROPEAN LEGISLATION ON BIO-WASTE

This chapter summarises briefly the current legislation and debate on waste management aspects in the European Union. This provides the backbone and arguments for the promotion of the WtB concepts of the UrbanBiogas project, as it will be described in the following chapters.

The two most important directives in the field of MSW and bio-waste treatment are the Landfill Directive 1999/31/EC [1] and the Waste Framework Directive 2008/98/EC [2].

The objective of the Landfill Directive is to prevent or reduce as far as possible negative effects on the environment from the landfilling of waste, by introducing stringent technical requirements for waste and landfills. The Directive is intended to prevent or reduce the adverse effects of the landfill of waste on the environment, in particular on surface water, groundwater, soil, air and human health.

It defines "biodegradable waste" as "any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard". It obliges Member States to reduce the amount of biodegradable waste that they landfill to 35% of 1995 levels by 2016. The Member States have a number of choices that they can take in terms of alternative treatment for this biodegradable waste, taking into account local conditions such as climatic conditions to the composition of the collected biodegradable waste.

The WFD lays down measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving the efficiency of such use. A core content of the directive is the application of the following waste hierarchy as a priority order in waste prevention and management legislation and policy:

(a) prevention;
(b) preparing for re-use;
(c) recycling;
(d) other recovery, e.g. energy recovery; and
(e) disposal.

The directive defines "bio-waste" as "biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants". Article 22 on bio-waste of the directive asks Member States to take measures to encourage:

(a) the separate collection of bio-waste with a view to the composting and digestion of bio-waste;
(b) the treatment of bio-waste in a way that fulfils a high level of environmental protection;
(c) the use of environmentally safe materials produced from bio-waste.

The directive highlights the importance in accordance with the waste hierarchy, and for the purpose of reduction of greenhouse gas emissions originating from waste disposal on landfills, to facilitate the separate collection and proper treatment of bio-waste in order to produce environmentally safe compost and other bio-waste based materials.

Furthermore, the European Commission has released a Green Paper [6] on the management of bio-waste in the European Union proposing measures on how to consider bio-waste in European legislation.

In 2010, the European Parliament called in a non-legally binding resolution for a Bio-waste Directive, with

mandatory separate collection, since this could generate major economic and environmental benefits [7]. According to the European Parliament proposal, compulsory separate collection and recycling of bio-waste should be core of the legislation, as every year, between 118 and 138 million tons of bio-waste is produced in the EU. Full implementation of existing bio-waste legislation could result in environmental and financial benefits of €1.5 billion to €7 billion. A specific directive for bio-waste would offer greater clarity, better monitoring and enforcement of implementation and legal certainty in this area. A bio-waste directive should include:

(a) the establishment of a mandatory separate collection system for the Member States, except where this is not the appropriate option from the environmental and economic point of view;
(b) the recycling of bio-waste;
(c) a quality-based classification of the different types of compost from bio-waste.

The resolution emphasizes that the separate collection of bio-waste needs to be increased to reach the targets for recycling and renewable energies and to help achieve the goals of the EU 2020 strategy, in particular resource efficiency.

Despite this initiative of the European Parliament, it seems that the European Commission sees bio-waste aspects already fully covered by the WFD, and thus does not promote the idea of a Bio-waste Directive. Thus, the set-up of such a directive remains uncertain.

4 EUROPEAN LEGISLATION ON RENEWABLE ENERGIES

Besides the European legislation on waste and landfilling, another important Directive which supports the WtB concept is the Renewable Energy Directive 2009/28/EC [8].

The directive establishes a common framework for the promotion of energy from renewable sources. It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport. It lays down rules relating to statistical transfers between Member States, joint projects between Member States and with third countries, guarantees of origin, administrative procedures, information and training, and access to the electricity grid for energy from renewable sources. It establishes sustainability criteria for biofuels (for transport) and bioliquids (for stationary use in CHP plants).

The production of biogas or biomethane from bio-waste could contribute to achieve the targets of the RED, independently if the biogas is used for electricity and heat production in a CHP plant, or for upgrading to biomethane and grid injection or use in transport.

Biomethane as transport fuel is defined by the RED as "biogas from municipal organic waste as compressed natural gas". Its potential to mitigate greenhouse gases is considered as very high, as the typical and default numbers for greenhouse gas emission savings of the RED are very high:

(a) Typical greenhouse gas emission saving: 80%
(b) Default greenhouse gas emission saving: 73%

This is an important aspect, since the GHG emission savings from the use of biofuels for transport (including biomethane) need to be above certain thresholds in order to comply with the sustainability criteria set in the RED. They need to be for all installations at least 35 % and at least 50 % from 1 January 2017. In installations in which production started on or after 1 January 2017, GHG emission savings shall be at least 60 %. According to the typical and default values for GHG emission savings, biomethane from bio-waste is far above these thresholds and would be therefore very suitable for use in transport.

5 TREATMENT OPTIONS OF BIO-WASTE

As it was mentioned already, general options for the collection and treatment of bio-waste include separate collection, segregation of bio-waste from mixed waste, incineration, composting, and anaerobic digestion. Although still on-going practice in several European countries, landfilling of bio-waste is no future option due to EU legislation.

From the environmental viewpoint, clear prioritisation is given to the anaerobic digestion pathway of separate collected bio-waste. The following advantages of this pathway are highlighted and further described below:

- Production of high-quality fertilizer
- Substitution of fossil fertilizer
- Closure of nutrient cycles
- Renewable energy production
- Technology with high GHG emission savings in comparison to other bio-waste treatment technologies
- Production of transport fuel (biomethane) with high energy content
- Biomethane from bio-waste as transport fuel fulfils the GHG reduction mandates of the RED
- Smaller decentralizes treatment plants allow short transport distances of the bio-waste

AD of separate collected bio-waste produces a high-quality product: digestate can be used as fertilizer, planting substrate and soil improver. It contributes to increase the carbon content of the soil and substitutes artificial fertilizer produced from fossil resources.

Digestate can be also produced from the organic fraction of MSW that is not collected separately, but sorted only at the waste treatment facility into organic and non-organic fractions. This can be done by different methods. One approach that is done in several biogas plants in Sweden is the use of differently coloured plastic bags for bio-waste and for the remaining MSW. Both bags are collected in joint bins. At the treatment facility these bags are sorted by colour sensors. Several problems are associated with this method, such as lower quality of the digestate, higher plastic consumption, high amount of impurities, and need of further treatment for impurities. Thus, the separate collection of bio-waste at the place of origin (household) is strongly recommended.

In comparison to composting of bio-waste, AD also valorises the energy content of the bio-waste and thus contributes to increase renewable energy production. This contributes to the achievement of the renewable energy targets of the RED and all other benefits associated with renewable energy production. Furthermore, in biogas

facilities nearly all methane is captured and used, whereas in composting facilities considerable amounts of methane emissions occur.

In waste incineration plants, no recycling takes place leading to a loss in nutrients and carbon stock for soils. Furthermore, incineration plants are usually large facilities requiring high amounts of investment. Bio-waste is generally transported for centralized incineration plants at longer distances creating several disadvantages. Finally, it is not possible to produce biofuels with high energy density like biomethane in incineration plants.

Although there exist many advantages for the AD treatment of bio-waste, it is also associated with several challenges, among the most important ones are:

- Introduction of a separate collection system or waste selector facilities
- Raising public awareness about the need of separate collection and getting public acceptance
- Education of households in waste separation
- Reduce investment and operational costs for AD facilities
- Introducing policies which allow the introduction of a profitable separate waste collection system with adjacent AD process
- Creating a suitable market for the sale of digestate as fertilizer, substrate, or soil improver

Several of the UrbanBiogas target cities are in the phase of introducing new waste management and treatment systems. Although the above described European policies clearly support the introduction of separate bio-waste collection systems with subsequent AD or at least composting, the current debate in some UrbanBiogas target cities is targeting towards other routes such as e.g. incineration or segregation of bio-waste from mixed MSW with subsequent composting or AD.

The objective of the UrbanBiogas project is to convince the local stakeholders of the UrbanBiogas target cities that the separate bio-waste collection with AD treatment is usually the most sustainable solution. The following chapter describes how this can be achieved.

6 THE WtB CONCEPT IN EUROPE

The simultaneous energetic use of bio-waste and the creation of a closed nutrient cycle is one of the main advantages of anaerobic digestion with biogas plants as they turn waste materials into “desirable” feedstock. In addition, the conversion of bio-waste in biogas plants has several other advantages in comparison to other bio-waste treatment options (landfill, incineration, composting), as briefly summarized in chapter 5.

Biogas production from bio-waste has the potential to contribute to the European waste and renewable energy targets. Adjacent upgrading to natural gas quality and use for transport (Figure 3) or for grid injection into the natural gas distribution network is an opportunity to efficiently use renewable energy in urban areas too. This approach, Waste-to-Biomethane (WtB), is promoted by the UrbanBiogas project. Figure 3 shows the Waste-to-Biomethane value chain promoted in the UrbanBiogas project.

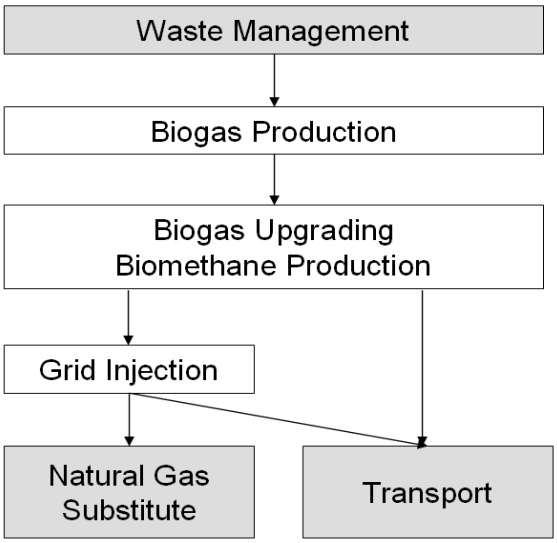

Figure 3: Waste-to-Biomethane value chain of the UrbanBiogas Project

7 THE URBANBIOGAS PROJECT

The objective of the UrbanBiogas project (Urban waste for biomethane grid injection and transport in urban areas) is to prepare 6 European target cities for the production of biomethane from urban bio-waste which will be fed into the natural gas grids or optionally used for transport: City of Zagreb (Croatia), Municipality of Abrantes (Portugal), City of Graz (Austria), City of Gdynia/Rzeszów (Poland), and North Vidzeme Region including the City of Valmiera (Latvia). Core of the project is the implementation of more than 130 events, including workshops, working group meetings, study tours and city exchange visits in order to elaborate five WtB concepts for the target cities. These concepts consist of detailed descriptions on measures how to implement WtB projects in the target cities.

Figure 4: UrbanBiogas logo

UrbanBiogas officially started on 1 May 2011 and runs for 3 years. The project is coordinated by WIP Renewable Energies (Germany) and involves ten partners: Fraunhofer Institute for Wind Energy and Energy System Technology (Germany), Hrvoje Pozar Energy Institute (Croatia), Polish Biogas Association (Poland), IrRADIARE (Portugal), Câmara Municipal de Abrantes (Portugal), Ekodoma (Latvia), Zagreb Holding - subsidiary Čistoća (Croatia), North Vidzeme Waste Management Organisation (Latvia), Graz Energy Agency (Austria), and Podkarpacka Energy Management Agency (Poland).

UrbanBiogas is supported by the Intelligent Energy

for Europe Programme of the European Union (Contract No IEE/10/251).

8 URBANBIOGAS TARGET CITIES

The following chapters present the target cities in the UrbanBiogas project: City of Zagreb (Croatia), Municipality of Abrantes (Portugal), City of Graz (Austria), City of Gdynia/Rzeszów (Poland), and North Vidzeme Region including the City of Valmiera (Latvia). A map of the target cities is shown in Figure 5.

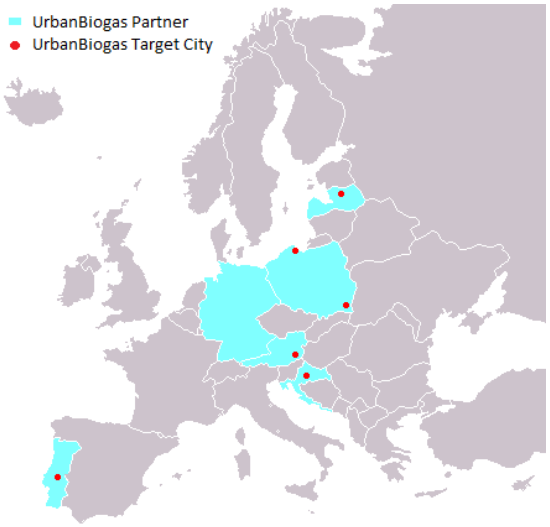

Figure 5: Involved countries in UrbanBiogas (blue) and target cities (red points)

8.1 Austria – City of Graz /Region of Styria

The target city of Graz is the capital of Styria. Graz is represented in the UrbanBiogas project by the partner Graz Energy Agency (GEA) which is owned by the city of Graz (47.5%) as well by the two energy utilities Energie Graz GmbH (47.5%, electricity), and Energie-Steiermark (5%; natural gas and heat). The regional energy utility Energie-Steiermark is operational in the whole region Styria, which is also the focus of the Austrian UrbanBiogas activities because of the existing good gas-grid and waste separation infrastructure in whole Styria.

Due to the good framework conditions of the Green Electricity Act, Austria has a well-established biogas market with currently about 344 biogas plants, which mostly use energy crops. Numerous changes of the Green Electricity Act have led to a decline of the feed-in tariffs, which led to a near stop of implementations of new biogas plants. This is also due to the worsening of the economic conditions at the agricultural market, and due to lack of public acceptance. In recent years first pilot upgrading-plants to produce biomethane were realized, to make research and to become familiar with the technology.

Although the Austrian biogas market is very advanced in comparison to the other UrbanBiogas countries, it is a target of the regional climate protection plan (Klimaschutzplan Steiermark) from 2010 to promote the energy utilisation of Bio-waste instead of composting. The protection plan also indicates the stronger utilisation of low-emission vehicles like CNG passenger cars or trucks as well as the stronger utilisation of renewable energies for industry and buildings. These targets also match the targets of the Austrian climate strategy 2010.

Bio-waste from separated municipal solid waste (MSW) collection in Styria is about 36,000 t/a. Currently, large parts of these wastes are composted to use the compost as agricultural substrate and fertilizer. Thus, they are not used energetically. The rest of the bio-waste is currently co-fermented in about 15 biogas plants. In total there are 47 biogas plants in operation.

In addition to the MSW, about 7,000 t/a sludge from wastewater treatment plants are produced of which 1/3 is land filled, 2/3 is used in agriculture. Waste from landscape management is about 5,000 t/a, which is mainly composted. Catering and food waste is about 9,000 t/a, wastes from dairy about 12,000 t/a, and wastes from meat production about 9,000 t/a.

Thus, in summary about 88,000 t/a bio-waste is produced in Styria. The estimated biogas potential (estimated by GEA and the energy utility of Styria) from industrial and municipal wastes is about 20 Million m³ biogas.

The circumstances are suitable in Graz for an urban waste to biomethane and use in transport sector: The waste management system is well developed, the political targets are favourable, the need for renewable transport fuels is urgent and some market actors are motivated to develop a project. Unfortunately the energy market situation is not suitable in Austria at the moment, because the natural gas price is low, there are no administrative support mechanisms, there are hardly any financial support schemes and biogas has a bad reputation in the public.

8.2 Croatia – City of Zagreb

Zagreb is the capital of Croatia with approximately 800,000 inhabitants and a surface area of 640 km². The City of Zagreb is managed by Zagreb Holding, a company consisted of 18 branches, Čistoća being one of them and designated for waste collection and management.

Currently, the main portion of municipal solid waste (350,000 t/year) is disposed at the landfill site Jakuševec. Since 2010, large efforts have been made to increase the quantity of separately collected bio-waste in Zagreb - resulted with 2,600 t of separately collected biowaste in 2012 which is more than double the quantity collected in 2010. The still small fraction of currently collected bio-waste is used in a composting plant. It is planned to use a significant proportion as the basis for the planning of the construction of a biogas plant which will, in its first phase (by 2020), use 20,000 t/a municipal bio-waste. In the second phase the capacity will be increased to 60,000 t/a bio-waste.

As the past efforts in waste management in general are implementing at slower pace than expected and legal framework for overall national waste management is at the peak of its discussion, it is rather difficult to estimate the developments in the future in respect to the available feedstock for any place in Croatia. According to the Draft Sustainable Waste Management Law, article 19, it seems that the implementation of national waste obligations will be transferred to the local and regional self-government. The same Law will allow the private sector in waste management which is a novelty for the Croatian system.

In any case, the City of Zagreb will have to implement a waste management that will divert biodegradable waste from landfills as foreseen in the Accession Treaty (Council of European Union, 2011).

For the purpose of developing Biogas Production and Biomethane Use concepts for the City of Zagreb, the base quantity of calculating the share of the biodegradable fraction of municipal waste would be the quantity of waste landfilled on Prudinec - landfilling site of the City of Zagreb in 1997 which was about 209,000 t (Croatian Environment Agency, 2006). Under the project UrbanBiogas, 4 possible scenarios are developed regarding biogas production from biowaste:

- 1. Scenario: 20,000 t of biowaste is available by 2020
- 2. Scenario: meeting the IEE UrbanBiogas long-term goal by 2020 - tapping 70% of biowaste
- 3. Scenario: the City of Zagreb fulfilling the Landfill directive
- 4. Scenario: separation of biowaste at the Centre for Waste Management.

Scenario 1 considers inputs from Zagreb Holding - branch Čistoća. The other two scenarios are close and end up with 36,000 to 39,000 t of biowaste suitable for AD by 2020. Scenario 4, considered as worse-case scenario within this project, provides 74,000 t of biowaste. Each of these scenarios, except the first, has been evaluated with and without additional organic substances available from industry waste (brewery at most).

Developing a waste separation system along with the increased number of recycling yards (17 in total) will significantly increase the quantity of bio-waste suitable for biogas production. This will also decrease the amount of biodegradable waste currently land-filled in accordance with the EU Landfill Directive. Waste separation and sorting in the city is somewhat lagging behind the targets set by the Waste Framework (2008/98/EC) and Landfill Directives (1999/31/EC) due to insufficient funds allocated in the past to the implementation of modern waste separation systems. This resulted in the insufficient number of recycling yards, containers, vehicles and other equipment which are necessary for efficient waste separation systems. The lack of education and awareness among citizens and inadequate penalties for polluters, contributed to the unsatisfactory results in achieving goals defined by the above mentioned directives regarding the recycling of high-value materials such as bio-waste, paper, plastic, metals, glass etc. The actions taken in the last couple of years are changing and improving the situation: systematic approach for source separated bio-waste collection from restaurants, schools and kindergartens canteens, market places, shopping centres and green waste from households. In order to more precisely determine the possibilities and costs of citywide source separated waste collection, the two pilot projects are currently underway encompassing 10,000 households.

In accordance with the Renewable Energy Directive (2009/28/EC) as well as with participation of Zagreb in the Covenant of Mayors and with the participation in the Civitas Elan FP7 project, certain divisions of ZAGREB CH have already begun replacing part of fossil fuels with renewable fuel such as biodiesel. For that reason biogas produced from bio-waste and its upgrading to biomethane would diminish the consumption of fossil fuel (natural gas) in their vehicles. The natural gas grid in Zagreb is city owned, spread in the whole city, and managed by the company Zagreb City Gasworks (Gradska Plinara Zagreb). 81.7% of the households of the City of Zagreb is connected to the natural gas network. City industry is also using natural gas as one of the main fuels for its production.

The city of Zagreb is represented in UrbanBiogas by the "City of Zagreb Holding, Waste management division - Podruznica Cistoca" (ZAGREB CH) which is owned 100% by the City.

It is envisioned by Zagreb City Holding to use separately collected bio-waste in a biogas plant. The plan has not yet been approved by the City authorities. The proposal for the biogas plants includes a CHP unit and a unit for upgrading biogas to biomethane. Biomethane can then be used either for grid injection or for direct usage by the city owned fleets of vehicles.

8.3 Latvia – North Vidzeme Region – City of Valmiera

The North Vidzeme region is located in the Northern part of Latvia and includes 22 municipalities in 4 former administrative districts – Valmiera, Cēsis, Limbaži and Valka. North Vidzeme region has – 159 564 inhabitants living in the 10,455 km^2 area. The biggest city is Valmiera with 25 130 inhabitants, located in the centre of the region. Valmiera is one of the target cities of the UrbanBiogas project.

The North Vidzeme Waste Management region has the most developed waste management practices in Latvia. The UrbanBiogas project partner "ZAAO" is the main waste company in the North Vidzeme Region. It has implemented waste separation systems for paper, cardboard, glass, plastic, metal and PET. ZAAO is owned by 28 municipalities located in the North Vidzeme region with 47% owned by city of Valmiera.

Currently all unsorted and sorted municipal solid waste in the region is collected and transported to the landfill site "Daibe" which is located in equal distance from 3 main region cities (35 km –Valmiera; 30 km – Cesis; 30 km- Limbaži). The separated packaging waste is recycled and sent to different producers for recycling. The organic fraction of waste is usually partly separated in private households in the country area. Kitchen waste in these households is usually composted for private use in the backyard. Households in the city area usually do not separate the organic fraction from the main MSW stream and it goes to landfill sites.

Although industrial organic waste (waste water sewage sludge, food and catering waste etc.) has national and EU regulations till now there is no substantial progress into practical implementation of regulations. Most of local governments have approved local binding regulations for waste management. It says that all companies which produce organic waste must have a contract with a specific bio-waste service company. Until now the local governments had not started actual control of these regulations. Two regional cities Cesis and Limbazi are doing open windrow composting of sewage sludge and use the compost in agriculture. Valmiera city delivers sludge to private biogas plant "Zemturi" (20 km from Valmiera) where it is fermented and afterwards digestate is used as soil fertilizer. According to official statistics in average 1,485 t/sludge/dry matter are generated annually in the region (which correspond to 7,500 t/wet sludge).

Shops and catering companies have contracts for the

animal by-products collection with the companies "Re Cikls" and "Reneta", but there are no sound data available about volumes and means of utilizations of these waste streams.

The annual amount of MSW produced in North Vidzeme Region is about 50,450 t/a. Most of this (about 40,067 t/a) is land-filled. The other parts are composted (4,344 t/a), sorted (3,286 t/a) and temporary stored (6,753 t/a). The main barriers for the implementation of waste separation systems in the North Vidzeme Region are:

- low tariffs for the collection of unsorted MSW which do not motivate the industry and private sector to implement advanced waste management options;
- low income of the inhabitants which does not allow an increase of costs for waste management services;
- low environmental awareness and education of the society;
- lack of legal, financial and administrative instruments for the implementation of advanced waste management options

By the end of 2007, Valmiera city approved the new Development Strategy for 2008-2014. According to the strategy, infrastructure and environment is one of the four priorities. There are no particular renewable energy targets for the city, but Valmiera and other cities in North Vidzeme have to contribute to the national renewable energy targets (40% of RES in final energy consumption by 2020).

Since 2006 ZAAO is working on the development of bio-waste management options. In 2008 ZAAO has made a feasibility study on bio-waste management in the North Vidzeme region. The organization had discussed different aspects of bio-waste management with all main governmental and private institutions involved in the regulation and management of this sector. From 2009 ZAAO had started a pilot project of bio-waste collection from private food companies.

There is a cross-country (magisterial) gas pipe going through the region. The natural gas grid in Valmiera is well developed. The gas grid is also available in Cēsis, but is not available in Limbaži and Valka. ZAAO has already done all needed administrative procedures for the connection to the natural gas grid in Valmiera city.

ZAAO together with the Valmiera City Council is very interested in the production of biogas that could be used as fuel in public transport. This would improve the air quality and the overall environmental quality in the city. Valmiera city and ZAAO acknowledge that there is a need for a pilot project which can stimulate interest of other market participants in the future.

8.4 Poland – City of Gdynia and Rzeszów

In Poland, currently (2010) 6 agricultural biogas plants, 78 landfill gas plants, 73 sewage sludge biogas plants, and 73 industrial waste water biogas plants are in operation. The annual electricity production from biogas is 276,500 MWh. However no biogas plant uses MSW and FW as feedstock. Furthermore, no upgraded biomethane is used or grid-injected.

The Energy Law Act of 1997, which after its most recent amendment mentions a privileged grid access for renewable energy, is currently being revised and foresees a large improvement of the situation in particular concerning biogas. Therefore, the Ministry of Environment and the Ministry of Economy have developed extensive program, which, amongst other aspects, will approve the construction of 2,000 biogas plants by 2020. However, legislation for biogas grid injection has to be established.

A incentive for investment is the currently available direct renewable energy investment subsidies granted within the European Structural Funds 2007-2013 Program. It is possible to obtain up to 70% of the investment costs in the form of non-refundable subsidies, and in the case of the special Public-Private Partnerships Program, even more than that. Apart from that, investors can count on support from various national programs, special institutions such as the National Fund for Environmental Protection and Water Management as well as tax reliefs within special economic zones.

In Poland, the most common way to threat municipal waste is to dump it on landfill sites. Composting is only made very rarely and only for single households. Only very few projects are on-going on waste separation and adjacent biological processing. In Poland, waste water plants and landfills still burn off most of the biogas in flare stacks. If biogas is retrieved, it is usually used to produce electric and thermal energy.

Rzeszów is a city in south-eastern Poland with a population of 172,813 (2009). Currently no bio-waste is separately collected in Rzeszów. The wastes from the city area are transported to the landfill in Ostrów (about 60 km). Initially, Rzeszów was the target city of UrbanBiogas.

The municipal authorities in Rzeszów have recently commissioned a study researching alternative paths of waste disposal in the city. As a direct consequence of the study, a concept of thermal-disposal of municipal waste (incineration plant) has been officially adopted and thus became a guideline for local authorities involved in waste management. Thus, the authorities do not support a biogas project which is in their eyes much more expensive and in competition with the Waste – Incineration Plant. Moreover, there is strong conviction among the decision makers in Rzeszów that biogas plants and incineration plants exclude each other as solutions of waste management. The political backing for implementing the UrbanBiogas activities in Rzezów was lost, although the UrbanBiogas partners tried very much to consider a biogas plant in Rzeszow

As a consequence, the UrbanBiogas consortium decided in 2012 to implement its activities in a new target city in Poland: in Gydinia in the north of the country. This city was selected as the local framework seems to be promising and the political support available. Due to the introduction of new nationwide regulations the city will introduce source sorting of waste in June 2013. There will be two bins available for wet and dry waste. The test phase and the analysis of the source-separated waste will provide valuable input on the implementation of suitable waste treatment for the organic MSW. The UrbanBiogas project will assist in this process with its expertise on anaerobic digestion technologies and will develop a concept for the set-up of a biogas plant.

8.5 Portugal – Municipality of Abrantes

The Municipality of Abrantes, inserted in Médio Tejo and Pinhal Interior Sul region, occupies an area of about 700 km^2. Médio Tejo and Pinhal Interior Sul region is divided in 15 municipalities in a total area of 3,714 km^2

and 217,000 inhabitants.

The region in which Abrantes is inserted is located in the transition zone of Beira Baixa, Alto Alentejo and Ribatejo, being characterized by hydrographical irregularities, especially in what concerns Tejo and Zêzere rivers. Regarding tourism, the municipality is inserted in "Templars" touristic region with forest and reservoirs.

The economic activity in the region is diversified, being the main activities related to agriculture. The main products are olive oil, wine and cereals. Forestry is also very relevant in the area.

Another focus of this region is the industry, including automotive components, mechanical engineering, machinery, transport equipment, metallurgy, and industries of leather, garments, textiles, wood and cork.

In the last years, Abrantes entered in a new phase of growth. This was a result from the emergence of new companies, which contributed to a change on the existing framework.

Since 2012, nearly all of the urban solid waste produced in the region is separated, either at source or centrally. The waste collected on a selective basis such as paper, plastic and metal is sent to valuation and recycling. In 2011 6% of the MSW consisted of paper and cardboard, 3% of plastic, 2% of glass and 89% of remaining solid waste. Most of the remaining solid waste is sorted centrally at the waste management companies.

The organic fraction is sent to biological treatment in aerobic and anaerobic digestion processes. During the process of digestion, biogas and compost are produced. The produced biogas is used for the production of electric energy and the compost is stabilized and used for agriculture.

Nowadays, around 1% of the waste collected in the region is sent to landfill. This waste corresponds to the non-recoverable and non-biodegradable fraction.

9 CONCLUSION

After two years of project implementation, the UrbanBiogas consortium has achieved several interim results. Major effort was put on the implementation of so called local Task Forces in each target city which are working groups consisting of local stakeholders from different sectors involved in the WtB value chain. These include representatives from the administrative sector of the cities, waste management sector, energy utilities, renewable energy agencies and associations, researchers, consultancies and other stakeholders.

A major challenge in this phase of the project is to convince local decision makers, that the set-up of a separate waste collection system with a biogas plant for bio-waste treatment is currently the most sustainable option. As the example of Rzeszow shows, it is very difficult to convince local decision makers about the benefits of AD. In that case, local authorities and politicians opted for an incineration plant and once the decision was made, it was not possible to reconsider other options. Therefore, the new target city Gdynia was selected in Poland in late 2012.

The UrbanBiogas Project clearly promotes biogas production, which allows nutrient recovery, carbon storage in soils, renewable energy generation and other related benefits.

With the proposal of dedicated WtB concepts for the five UrbanBiogas target cities, the consortium suggests alternatives to other less sustainable treatment options such as composting or incineration.

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