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**Comparison of waste management in the city of Brno and  
Vitoria-Gasteiz**  
Bachelor thesis

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## **ABSTRACT**

This bachelor work studies and compares the development of the waste management systems in two European cities, Brno (Czech Republic) and Vitoria-Gasteiz (Spain). Nowadays waste management takes a very important role in environmental, economic and social aspects. The aims of my work are (1) Collect information about development and present the situation of waste management in the area of Brno and Vitoria-Gasteiz, (2) Compare the situation of waste management in this two European cities by means of a questionnaire and SWOT analysis, (3) Propose arrangements and strategies to improve current situation of waste management in the city of Brno resulting from the analysis and measures used in Vitoria.

**Keywords:** waste management, municipal waste, waste disposal, recycling, development, the city of Brno, the city of Vitoria-Gasteiz

## **ABSTRAKT**

Táto bakalárska práca študuje a porovnáva vývoj odpadového hospodárstva v dvoch európskych mestách, Brno (Česká republika) a Vitoria-Gasteiz (Španielsko). V súčasnej dobe, odpadové hospodárstvo hrá veľmi dôležitú úlohu v environmentálnom, ekonomickom a sociálnom aspekte. Ciele mojej práce sú (1) Nazbierať informácie o vývoji a súčasnej situácii odpadového hospodárstva na území Brna a Vitorii-Gasteiz, (2) Porovnať situáciu odpadového hospodárstva v týchto dvoch európskych mestách pomocou výsledkov dotazníka a SWOT analýzy, (3) Navrhnuť opatrenia a stratégie na zlepšenie súčasnej situácie odpadového hospodárstva pre mesto Brno vychádzajúc z analýzy a opatrení použitých vo Vitorii.

**Klíčová slova:** odpadové hospodárstvo, komunálny odpad, spracovanie odpadov, recyklovanie, vývoj, mesto Brno, mesto Vitoria-Gasteiz

## **ABBREVIATIONS**

<b>ABP</b>	Animal by-products
<b>BIR</b>	Bureau of International Recycling
<b>BW</b>	Biodegradable Waste
<b>BMW</b>	Biodegradable Municipal Waste
<b>CR</b>	Czech Republic
<b>DPG</b>	Deutsche Pfandsysteme GmbH
<b>EU</b>	European Union
<b>ICC</b>	International Chamber of Commerce
<b>ISWA</b>	The International Solid Waste Association
<b>ISNO</b>	The integrated waste management system (Integrovaný Systém Nakladania s Odpadmi)
<b>MBT</b>	Mechanical Biological Treatment
<b>MSW</b>	Municipal Solid Waste
<b>MW</b>	Municipal Waste
<b>OSN-UNEP</b>	United Nations Environment Programme
<b>UNIDO</b>	United Nations Industrial Development Organization
<b>WHO</b>	World Health Organization
<b>WM</b>	Waste Management

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# 1 INTRODUCTION

Municipal waste is without any doubt an integral part of every household. This is a product derived from human activities and now forms one of the major global problems in the world. There is a big effort of society to prevent this waste or minimize it so that there is no threat to the environment.

People produce waste at an alarming rate and therefore the sustainability, recycling and waste management take an important role in environmental issues and in our life. Directive 2008/98/EC obliges European member states to reach a recycling rate of 50% in 2020. However, the current increase of the recycling rate shows that Czech Republic will not reach that goal.

Nowadays, many urban areas face with problems associated with waste management. Citizens are not accurately conscious in the field of waste treatment, collection and recycling and thus there is a low morale in the separation of municipal waste and overall low public awareness. A stabilized communication to cooperate better with the citizens and appropriate measures used in waste management could help to strengthen morale and a proper communication strategy could raise awareness about issues of waste management and - For this reason, the following work was established to compare the present situation and development of waste management in the city of Brno with the "European Green Capital" Vitoria-Gasteiz, introducing new measures and communication strategies that will lead to more effective waste management planning. The city of Brno, thanks to its size is candidate toward the award "European Green Capital", however, in order to obtain this prize they should start to look more at sustainable development.

This study focuses on the comparison of the waste management systems used in these two European cities – Brno and Vitoria-Gasteiz and has been divided into two parts: At first a comparison of the systems of waste management and second the measures that have been developed to raise awareness and improve the present situation in waste management.

## 2 AIM, MOTIVE OF WORK

The main objective of my bachelor thesis is to compare the present situation and development of waste management in the area of Brno and Vitoria using collected data and information. At the same time the main objective is to collect information on the development and current situation of waste management. I obtained results from studies on waste management, legislation and plans, the amount of waste produced, methods of waste disposal, recycling, development and current situation.

I chose the comparison of these two European cities because I lived in both cities at least 10 months, and at the same time I had access to relevant information and data. The city of Brno which is the seat of the South Moravian Region with an area of 230.22 km<sup>2</sup> and a population of 377,508 inhabitants can be well compared with the city of Vitoria-Gasteiz, the seat of Álava, with an area of 276.81 km<sup>2</sup> and a population of 241,386 inhabitants.

Secondary objectives of the thesis are the proposed measures and strategies to improve the waste management situation in the area of Brno. Based on the collected results I was able to assess the level of waste management, development, level of recycling, public awareness about waste management and communication system of public to citizens.

The research hypothesis of the thesis is that Vitoria-Gasteiz verifies better conditions in the field of waste management and sustainable development than Brno. It is likely that citizens of the city of Vitoria separate more waste than the citizens of Brno. The city of Vitoria received the award "European Green Capital" 2012-13 and was nominated for the best city in waste management and water in Spain. Since 2010 the city has applied collection of organic fraction. On the other hand, Brno can be proud of one of the best incinerator within Europe, which uses waste-to-energy technology to produce thermal energy and electricity from municipal waste.

## 3 LITERATURE REVIEW

This chapter provides information about historical facts of waste management, waste management in general, present situation of waste management and amount of municipal waste in Czech Republic, Spain and other European countries. The last subchapter is devoted to the legislation of waste management at European, Czech and Spanish level.

### 3.1 *Brief description of waste management*

This subchapter gives brief information about history of waste management and waste management in general, methods of waste disposal and information in relation to municipal waste.

#### 3.1.1 History of waste management

"The production and disposal of waste are as old as humanity itself." (Worrell, 2012). When humans left the nomadic way of life, around 10,000 BC they began to live in the communities, resulting in mass production and accumulation of waste. Waste was discarded and lounged everywhere. To recall on the importance of waste management in history, some examples of measures adopted in early civilizations: Around 200 BC in some cities of China there was a sanitary police, whose task was to enforce the law on waste disposal. In ancient Greece and Rome there precise communal services were implemented. Moreover, in Rome there was a form of occasional general cleaning and adjustment of streets and local spaces called– *lustratio urbis*.<sup>1</sup>

In medieval times European cities were characterized by unimaginable mess. The plague which swept Europe around 1300 was largely result of dirt and impurity and significantly reduced the urban population. The Industrial Revolution eased this problem in the middle of the 18th century.

The 18th century, and especially the second half of the 19th century brings technical and organizational measures to improve the hygiene and order in the cleaning of roads and unbound waste. This was positively reflected in Czech countries. At the beginning of the 20th century a technologically and organizationally rubbish disposal site was mastered. However, in Prague in 1920 there were still 170 open waste disposal areas to dump waste on the edge of town. The container system was not introduced until 1923.

The hygienic disposal of municipal waste was carried out based on three core technologies - Composting, Incineration and Managed landfilling of waste. Composting has operated since the early 20th century. First incinerators were commissioned in the late 70s of the 19th century in England.

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<sup>1</sup> These actions contributed to ensure satisfactory and hygienic conditions in Rome.

Incineration began in Brno in 1905 being it one of the firsts in the entire Austro-Hungarian Empire. The incinerator in Prague, built in 1933, belonged in its time to the most modern in Europe. Controlled landfills appeared in England in the middle of last century. Landfilling was gradually spread to all the industrialized countries of the world and is gradually introducing in developing countries. (Kuraš, 2014, p. 16-18)

### 3.1.2 Waste management in general

The term „waste management“ was firstly officially introduced in our country by norm CSN 83 8001 (Terminology waste) and prior Waste Act (no. 238/91 Coll.).

**Waste management** is a set of activities aimed at prevention and reduction of generation of waste and their disposal. The primary rule is to prevent the creation of such waste by introduction of new technologies (non-waste) and if the generation cannot be avoided, it is necessary to reduce their production to a minimum (low-waste technology).

The resulting waste should be primarily used as a secondary raw material and only non-utilisable share defuse by the gentlest way regarding environment. Nowadays this strategy is a matter of global nature, dealt with by various governmental and non-governmental organizations such as the OSN-UNEP (United Nations Environment Programme), UNIDO (United Nations Industrial Development Organization), WHO (World Health Organization), ICC (International Chamber of Commerce), BIR (Bureau of International Recycling), ISWA (The International Solid Waste Association).

Constantly loading of environment and with it associated raw and energy crisis led to an attempt to solve this issue follow-up:

- Waste generation reduction
- Reducing losses in production
- Rational use of natural raw materials and energy
- Utilization of waste as secondary raw materials or recycling
- Complex processing of raw materials
- Extension of product performance and extension of life of products
- Utilization of consumer waste
- Introducing of non-waste and low-waste technologies

The picture on page 14 illustrates waste hierarchy. It classifies five waste management actions from top to bottom in order of preference. The most preferable action is waste reduction and the less desired is landfill disposal. Most of the European countries use this hierarchy to operate with municipal solid waste. After three “R” we can use the waste as a fuel (waste-to-energy). This technology recovers energy from municipal waste to produce renewable energy. (Covanta, online)

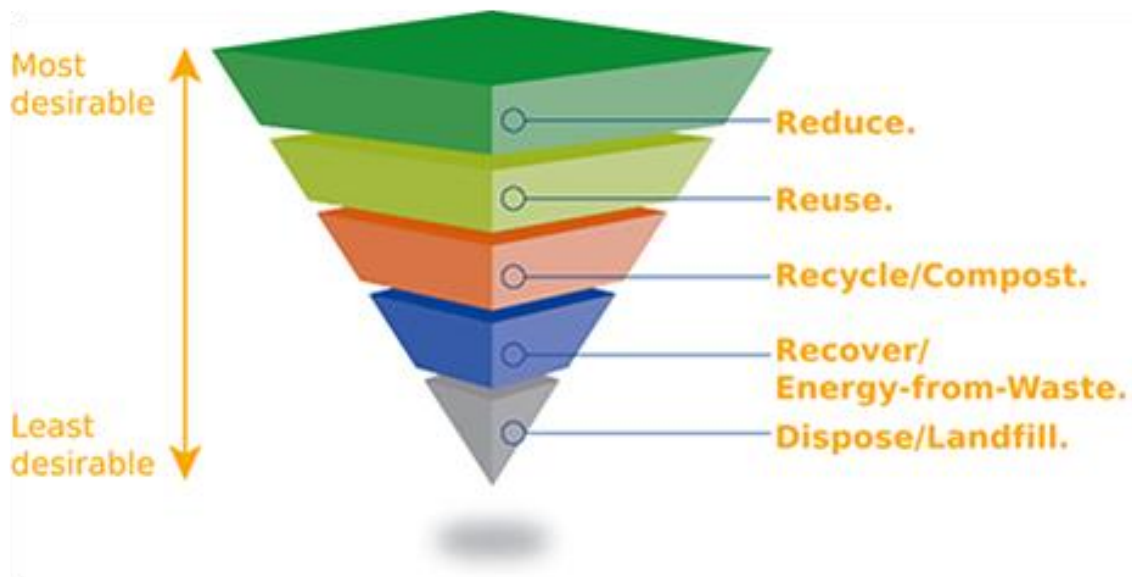


Figure 1. Understanding the waste hierarchy (Covanta, online)

**Non-waste technology** enables recycling of waste and their return back into production within closed technological cycles. An important factor in the design of non-waste technologies is the amount of energy required because energy production is associated with the use of limited natural resources and pollution.

**Recycling** (return back to the process) is an important method that can be used as a part of non-waste technology, because it returns the waste to the production process in which they arise (e.g. the waste paper for production of paper, waste glass into a new batch), or also for other purposes (e.g. manufacture of floor coverings from worn tires).

The importance of recycling consists of both saving natural resources and energy and reducing environmental damage by harmful substances. The disadvantage is that in most cases the prerequisite for recycling consists in waste separation, removal of pollutants and their collection, factors that can negatively reflect in an economic aspect.

**We know these main methods of waste disposal:**

- Recycling
- Landfilling
- Thermal treatment of waste (thermal method)
- Physico-chemical methods
- Biological methods (composting)

Each type of waste can be disposed in different ways, which have their advantages and disadvantages. It is therefore important that the chosen method is optimal not only to the environment but also economically. In the territory of Czech Republic (henceforth “CR”) the most widely used method of waste disposal is landfilling and incineration. In one district there is an average of two landfills. (Kudelová, Jodlovská, Šarapatka, 1999, p. 15-20)

**Landfilling** is a method of waste disposal, where the waste is carried away to a landfill and regularly overlapped by inert material. Nowadays the landfilling removes the bulk of the waste in CR.

Although the policy of the European Union (henceforth “EU”) aims to radically restrict landfilling of biodegradable waste (henceforth “BW”), landfilling is still considered to be the dominant method of waste treatment. Approximately 50% of the 243 million tonnes of municipal waste produced in 25 EU countries is still landfilled. (Bilík, 2006, s. 25 In Kuraš, 2008, p. 82). Landfilling is not definitely identified as the best way of waste treatment, especially in the current scope and form. Huge amounts of materials which end up in the landfills could be used with the current knowledge and technological advancement. (Žák, 2007, p. 41)

According to Kuraš (1994) under the term **thermal treatment of waste** primarily incineration and different processes of gasification and liquefaction of waste is included. Incineration of waste in current modern facilities using highly effective measures for energy production can be legitimately described as energy recovery from waste (waste-to-energy).

Nowadays combustion is regarded as an integral part of waste management, which should prevent waste from going to landfill. However, on the other hand combustion has some limitations of economic, technical and environmental nature. Sustainable waste management requires a combination of complementary measures in the form of material recovery, biological treatment (composting) and heat treatment. (Kuraš, 2008, p. 89-90)

**The physico-chemical treatment** of waste is meant in particular for the treatment of industrial and chemical wastes, particularly hazardous. (Kuraš 2008, p. 101)

BW with an annual production of approximately 12 million tonnes is an important group of waste in the Czech Republic. It mainly comes from agricultural and forestry production, processing industry and includes also biodegradable municipal waste (henceforth “BMW”). Among the organic waste animal by-products (ABP) are included, and also waste from catering and kitchen from residents (catering waste). The predominant part of these wastes is intended for material or energy recovery and the need to limit them to go to landfills. (Matějů 2007, p. 123)

**Composting** is a way of using BW to product organic fertilizers (compost). In the Czech Republic composting has been eagerly early implemented , being among the oldest traditions in Europe.<sup>2</sup> (Váňa, 2007, p. 67 In Kuraš, 2008, p. 77-78)

The aim of the development of **Mechanical Biological Treatment** (henceforth “MBT”) is a mixed municipal waste treatment, eventually trade or industrial waste by mechanical distribution into usable and unusable waste. After this treatment follows a biological treatment to separate biological components. Mechanical-biological treatment is sometimes regarded as an alternative to their combustion.<sup>3</sup> (Matějů, 2007, p. 123)

MBT is practically used mainly in Germany and Austria. So far, the biggest annual quantity of waste processed by MBT technology in Germany was 1.8 million

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<sup>2</sup> The first composting plant with controlled technology was introduced in our country in the year 1912.

<sup>3</sup> It should be point out that the MBT does not replace incineration or landfilling, but only in connection with such technology can streamline particular material waste treatment.

tonnes. It represents more than 10% of the total amount of combustion. General capacity of MBT in Europe is estimated to be 20 million tonnes.

The share of biodegradable components in mixed municipal waste in Europe has been an average of 32%. (Durdil, Kovaříková, 2006, p. 13 In Kuraš, 2008, p. 81). Bilitewski (2007) claims that MBT is possible way of reducing the share of biodegradable waste in landfills. Vyštejnová (2006) points out that the energy use of waste in incinerators are less expensive and less risky than MBT technology.

### 3.1.3 Municipal waste

**Municipal waste** (henceforth “MW”) is in accordance with the law on waste treated as any waste generated in the area of municipality in the activities of natural persons. With exception of waste generated by natural or legal persons authorized to do business. (Benešová, 2011 In Kuraš, 2014, p. 90). A part of MW is household waste (domestic waste), which is produced in the territory of municipality and has origin in the activities of natural persons. By isolated collection we can obtain useful components of MW, which can be used directly after modification as a secondary raw material (paper, glass, plastic, iron, textiles and biological waste).

We distinguish several groups of MW. **Bio-waste** is a BW from gardens, public green spaces, food and kitchen waste from households, restaurants, caterers and retail businesses and waste from the food industry. **Biodegradable Municipal Waste** (henceforth “BMW”), represents waste that is capable of anaerobic or aerobic decomposition (food, waste from green, paper). This group mainly includes waste from green, but also sorted BW from kitchens, canteens and households (catering waste), waste paper, wood and natural textiles.

**Household waste**, which due to its size or weight is not able store in ordinary bins is called bulky household waste. This includes for example furniture, carpets, sanitary ware and bulk packaging. **Mixed municipal waste** is decremental waste that remains after sorting usable components, hazardous components and bio-waste from municipal waste.

**MW disposal** has undergone many development stages, of which the oldest and still the most widely used is exactly landfilling. In terms of use of raw material and energy potential of waste we use material utilization (recycling) and energy recovery (incineration). Currently, the CR recycles about 15% of municipal waste. In the future, it is foreseen a substantial increase in recycling and gradually decrease of share of BMW placed on landfills. One measure of the BMW diversion from landfill is to support the construction of facilities for energy utilization of mixed municipal waste from EU funds.

**MW collection** presents technical and organizational waste collection systems, which remove waste generated and prevents the creation of uncontrolled landfills. It can also determine the appropriate technology for more successful treatment of wastes. Waste collection represents two thirds of the total cost of waste treatment, and therefore it must be very cost effective. (Kuraš, 2014, p. 91-92)

**Packaging waste** is collected in the Czech Republic within the so-called integrated collection, which means that in certain containers commonly sorted



packaging and non-packaging waste constituents are classified. In 2011 each citizen of the CR sorted through packaging systems on average 58.8 kg of waste, representing an interannual increase of almost 7 kg per capita. The degree of recycling of packaging in the CR is at a relatively good level (fifth in Europe). The main obstacles to successful recycle packages are a financially guaranteed collection, cleaning, reprocessing and particularly appropriate public enlightenment. (Trylč, 2013, p. 22)

### ***3.2 Present situation of waste management and amount of municipal waste***

This subchapter includes presents the situation of waste management and amount of municipal waste in Czech Republic, Spain and other European countries (e.g. Austria, Slovakia and Germany).

#### **3.2.1 Present situation in the Czech Republic**

The situation in waste management (henceforth “WM”) in connection with the new regulations over the last twenty years in CR improved significantly. WM works in the long term based on the free market. There work quite a large number of companies that provide environmentally safe waste management services in accordance with EU legislation.

The so-called sanitary landfills were built corresponding international standards, modern incineration plants (equipment for energy recovery from waste - waste-to-energy) with a perfect catching of pollutants in emissions.<sup>4</sup> Building more facilities for energy recovery from waste, however, has a number of problems and their development is unclear. Currently there are in operation modern recycling plants assigned for certain specific types of waste (e.g. the processing of PET bottles, recycling of waste paper and lead and the like). (Kuraš, 2014, p.19-20)

The production of municipal waste has long been around 3 million tonnes and do not record significant fluctuations (in 2011 it was 3.4 million tonnes, thus 14.3% of the total amount of waste). Increasingly we use the possibilities of waste separation and collection of bulky waste. In 2002 the created separable waste was 6% of municipal waste production, in 2011 this proportion was already 14%. (Sobková, Sequensová, 2013, p. 12-15)

The current trend is headed to integrate comprehensive services provided within the implementation of an integrated waste management system (ISNO). The aim is to create ISNO at regional levels and link them to a national network of facilities for waste management facilities within the territory of CR on behalf of WM.

Hřebíček (2009) states that the CR requires a regional waste management plan for its own territory. Regions in their waste management plans advise municipalities to use the current associations of municipalities to create ISNO and consequently process one common WM plan defining the scope and method of municipal waste management. (Hřebíček, 2009, p.17)

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<sup>4</sup> Their capacity is far from satisfying the requirements of the integrated WM.

In CR produced in 2011 3.4 million tons of a MW, it is 320 kg per capita. In comparison with a majority of EU states, the production of MW in the CR is lower. According to Eurostat the average production of MW in the EU is 503 kg / year per capita. (Christensen, Fruerggard, Matsufuji 2010, s.95). Poulsen (2013) states that globally there are more than 2.5 billion of tons of municipal waste generated by year.

Kuraš (2014) states that the production of municipal waste in CR is less than in numerous states of EU. While in the CR, likewise in Slovakia and Poland, these values move steady around 300 kg per capita, in Austria and Germany these values are almost double.

In the following picture there is a graphic illustration of development of MW generation in CR from 2002 till 2010. The production of MW in CR increased from 275 kg in 2002 to 315 kg in 2010.

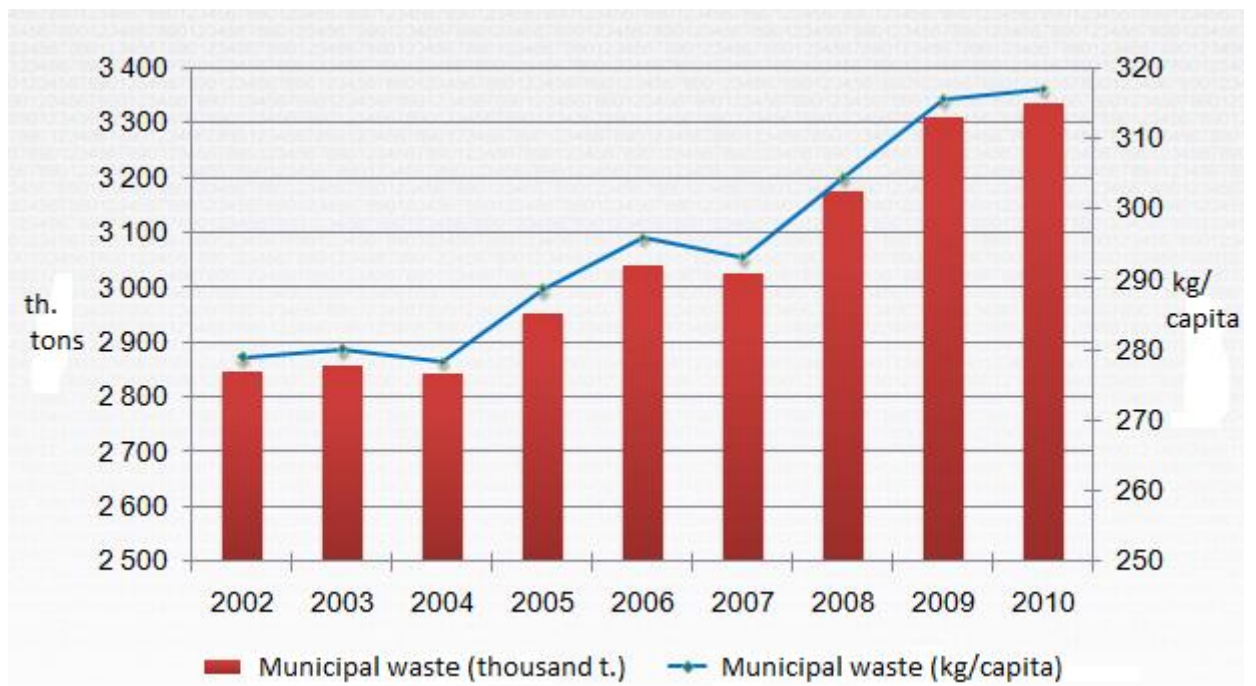


Figure 2. Development of municipal waste generation in Czech Republic (Český statistický úřad, online)

### 3.2.2 Present situation in Spain

Spain is considered as the ninth country in the EU with higher value of MW/capita/year with its 547 kg/year. However a significant decrease in generation of MW was confirmed in Spain by National sources. (Desenvolupament Sostenible, online)

Spain still holds up very high rates of landfilling, when 50 % of municipal solid waste (henceforth “MSW“) produced in 2010. Nonetheless, Spain has been successful in fulfilling the objectives set by EU Landfill Directive of BMW alteration from landfills in 2006 and 2009. The last 10 years the recycling has progressed in Spain displaying an increase from 21 % in 2001 to 33 % in 2010. In spite of this improvement, Spain is still required to put a particular effort to meet 50 % objective of the Waste

Framework Directive by 2020. In the improvement of MSW recycling have been useful by the so called National Municipal Waste Management Plans for the periods 2000-2006 and 2008-2015. The most hugely populated regions of Spain accepted the Landfill tax which contributed to the diversion of MSW from landfills through recycling. (European Environment Agency, online)

The picture below illustrates MW generation per capita within Spain. The production of MW among years 2001-2010 slightly decreased. In the year 2001 the annual production of MW was 650 kg/capita while in the year 2010 the amount dropped to 550 kg/capita.

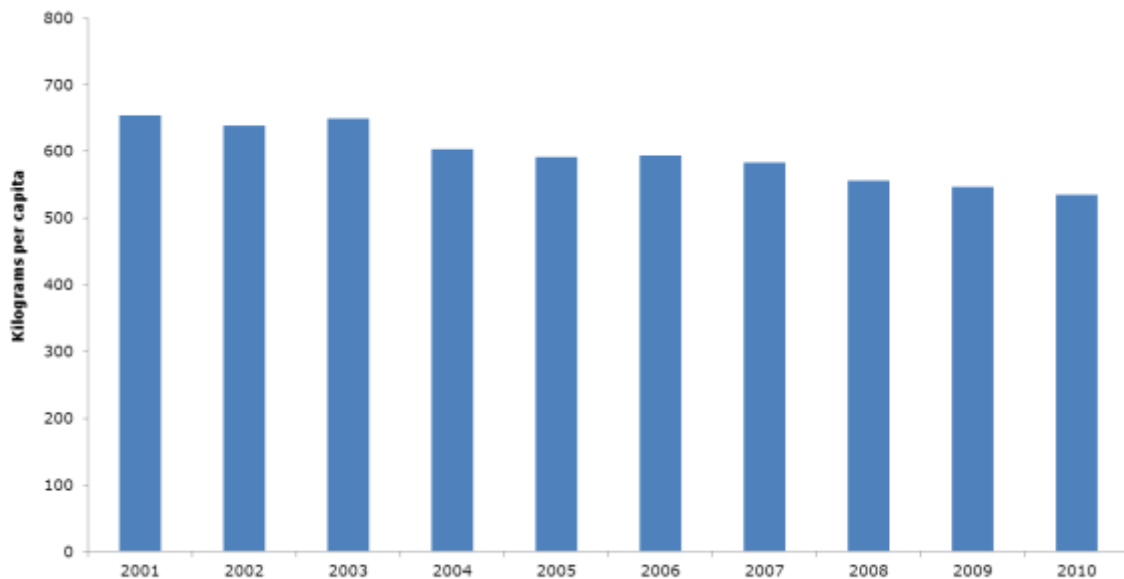


Figure 3. Municipal waste generation per capita in Spain (Eurostat, 2012)

### 3.2.3 Present situation in other European countries

Every household in the EU produces an average of over 500 kg of waste per capita per year. During the decade, the amount of waste produced has grown faster than gross domestic product. No less in recent years, the rising rate decreases. (Hřebíček, 2009, p.101)

The significant difference in production of municipal waste is the amount of waste generated by capita. Countries having a major tourist activity hold out higher per capita generation. So then there are a large number of tourists who generate waste. Otherwise, we take into consideration that the countries with very low generation have very low percentage of population with systematic collection of waste too. (Desenvolupament Sostenible, online)

#### **Austria**

Austria is characterized in regard of Czech Republic with greater economic development, common border with the CR and with similar geographical conditions. Production of MW in 2008 in Austria was 597 kg per capita per year. In Austria there is a network of district organizations called Gemeindeverband für Umweltschutz (GVU), established by municipalities. These organizations have a role to comprehensive care of

WM. Its funding wage of relatively high fees for waste treatment. In 2006 there were 12 operated incinerators in Austria. The most important measure for sustainable waste management is considered prior treatment of waste before their landfill. For processing of MW in Austria are in operation primarily incinerators, further there are facilities of MBT. In 2001, the questionnaire survey found that selective collection is part of daily life and does not require extra effort. (Hřebíček, 2009, p.102-103)

### **Slovakia**

Production of MW according to Hřebíček (2009) was in 2008 in Slovakia 330.86 kg / capita / year, representing an increase of 21% compared to 2004. In 2008, 17.62% of MW was used and 82.38% was removed. Most of MW was used incineration with energy recovery and material use. The most widespread method of removing of MW in Slovakia is landfilling. In 2008, was removed 99.9% of MW by landfilling. In Slovakia, the MW is burned in two incinerators and that in Bratislava and Košice.

Recycling Fund was established in Slovakia to support projects of founding and developing separate collection and utilization of waste in the form of grants and loans. However, the EU uses a different method of implementing the responsibility for waste than the one chosen in Slovakia. It can therefore be said that recycling fund offsets with the regime by the EU legislation.

### **Germany**

Germany can be characterized as a state with more developed economy as compared to CR. Annual production of WM in Germany in 2008 was 564 kg / inhabitant / year. (Hřebíček, 2009, p.113). Germany provides two types of landfills for MW - Class I, II. From 2005 in Germany there is valid restriction on landfilling of organic matter and mixed municipal waste which contains organic material. (Municipal Solid Waste Management, online). Typical for Germany is a high proportion of MBT facilities processing MW as compared to other European countries. In 2006, there worked 58 incinerations of mixed municipal waste and over 45 MBT facilities.

The objectives of the German system **Green point** is the collection and accumulation of waste and its classification. Joint implementation of both objectives determines the overall achievement level of recycling. The principle is to direct producers to waste prevention already at the design stage of the product. The green point proved in practice and clearly led to a reduction of the amount of waste produced in the nineties in Germany. While in the following years was implemented in other European and non-European countries. Nowadays there are over thirty countries using this system. (Hřebíček, 2009, p.119-120). Green point system is also implemented in the Czech Republic and Slovakia.

In 2005 the Federal Association of the German Food Industry (BVE) and the Main Association of German Retailers (HDE) founded the **Deutsche Pfandsysteme GmbH (DPG)** association. Its aim is to create a single backup system for one-way beverage packaging for the whole of Germany (centre of payment). Consumers are entitled to return to the trade network undamaged beverage packaging marked with sign DPG and EAN code. Re-collection is performed by a machine or by hand.

MW generation within Europe is very various. In figure 4 we can see that the lowest production of MW per capita is in countries such as Poland, Czech Republic, Slovakia, etc. On the contrary, the highest rate of MW production is in countries such as Netherlands, Denmark and Switzerland.

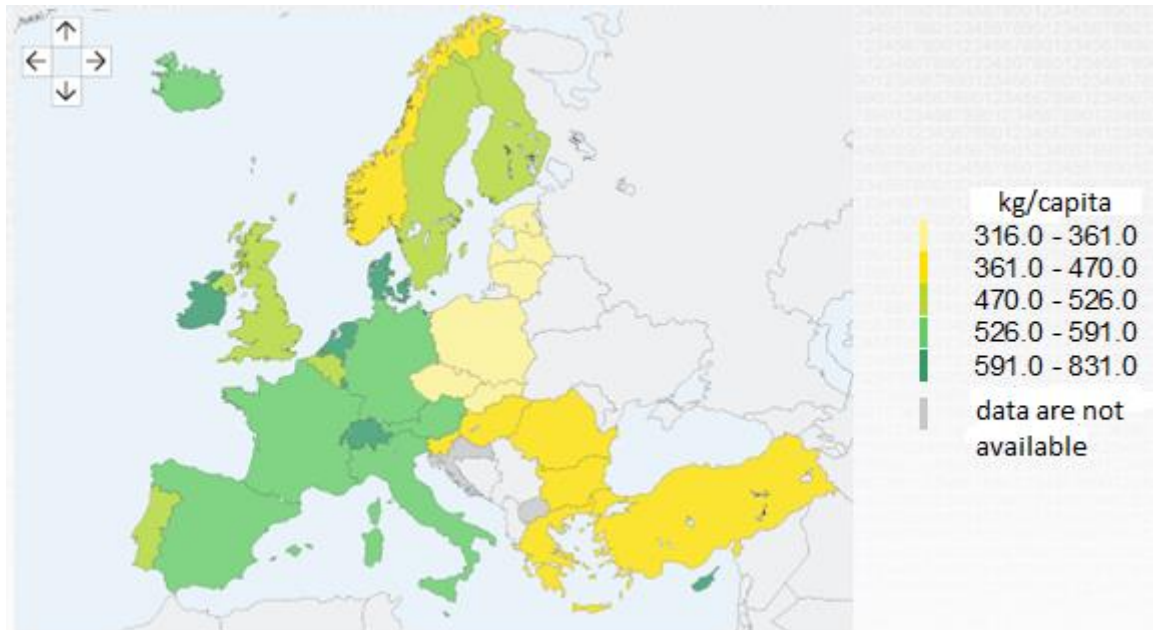


Figure 4. Municipal waste generation in Europe in 2009 (kg/capita) (Český statistický úřad, online)

### 3.3 Legislation of waste management

First of all I mentioned legislation of waste management in European Union, furthermore legislation in Czech Republic and Spain.

#### 3.3.1 Legislation in European Union

Since joining the EU in 2004, the CR must fully respect all EU legislations, including legislations on waste management. EU authorities issue the following legislations: directives, regulations and decisions. (Kuraš, 2014, p. 31)

##### **Directive 2008/98/ EC and the hierarchy of waste**

The most interesting contribution of this directive constitutes the "waste hierarchy" that serves as priority actions in legislation and policy on prevention and waste management. This waste hierarchy is composed of five actions (in order of priority), that States shall apply in their waste policy: *Prevention, Preparation for reuse, Recycling and Other recovery and disposal.*

In short, in the ideal model of waste management all limited resources are consumed, which largely come from recycled waste. The amount of waste generated would be much lower if almost all of these would be reused or recycled.

The same directive obliges EU member states to reach a recycling rate of 50% in 2020. (European Commission, online)

Table 1. The principal European regulations for waste disposal.

Indication of the source	Appliance of the regulation
<b>Directive of the European Parliament and of the Council 94/62/EC</b>	On packaging and packaging waste
<b>Council Directive 1999/31/EC</b>	On landfills
<b>Directive of the European Parliament and of the Council 2000/76/EC</b>	On waste incineration
<b>Directive of the European Parliament and of the Council (EC) no. 98/2008</b>	On waste
<b>Regulations of the European Parliament and of the Council (EC) no. 2150/2002</b>	On waste statistics
<b>Regulations of the European Parliament and of the Council (EC) no. 1907/2006</b>	On registration, evaluation, authorisation and restriction of chemicals

*Source: Kuraš, 2014, p.31*

### 3.3.2 Legislation in Czech Republic

WM in CR is defined mainly by Waste Act (Act no. 185/2001 Coll., as amended) and by the Packaging Act (Act no. 477/2001 Coll., as amended), as well as their regulations. The current law on waste was often revised (almost 40 amendments), and therefore today the situation is very unclear and many users have considerable problems to use it.

The law on waste management divides the waste into two basic categories (others and hazardous). Waste catalogue is used when we want to classify the waste by groups and types. Big attention is focused above all on the legislation of the EU with long-term effect for all member states. (Kuraš, 2014, p. 28-29)

To determine the fee paid for MW in CR, there are three specific types of fees that cannot be combined with each other. Three specific types charge MW:

- The payment for collection, transport, sorting, recovery and disposal of MW according to § 17 paragraph 5 of the Act,
- A local fee for operation of system for collection, transport, sorting, recovery and disposal of MW. In this case, as in one of the three types of charges is the statutory upper limit of 500 CZK / person / year,
- A fee for municipal waste, the fee payer is the owner of the property where the MW origins. (Hřebíček, 2009, p. 26-28)

### **3.3.3 Legislation in Spain**

The Spanish legislation on waste is composed of the basic laws of state and the rules adopted by the autonomous communities. The most relevant standards at the state level are Law 10/1998, on basic waste, developed by the Royal Decree 833/1988, by which the regulation was adopted toxic, and hazardous waste, and Law 11/1997, on packaging and packaging waste, and implementing regulations, approved by Royal Decree 782/1998. Nowadays a draft law is being processed on waste and contaminated soils, aiming at the transposition of the Waste Framework Directive (Directive 2008/98/EC).

In December 2008, the Cabinet approved the National Integrated Waste Plan of Waste (PNIR). This plan includes household and similar waste, waste with specific legislation, contaminated soils except some agricultural and industrial non-hazardous waste. (Competencias y coordinación en la gestión de residuos, online)

## 4 METHODOLOGY

This chapter deals with methodology and advancement of work. It provides all methods of analysis used to obtain the results.

Analysis of waste management in Brno and Vitoria was developed on the basis of primary data (results of the questionnaire and SWOT analysis) and secondary data (studies on waste management, official information from municipal authorities).

While writing this work, following methods of analysis were used:

1. Description - this method of analysis was used in the theoretical part. Concretely in the description of history of waste management, level and development, the amount of waste, legislation at European, Czech and Spanish level, description of the territory, present situation and development in waste management, etc.

2. The method of questionnaire - as a method of data collection the questionnaire was chosen because it is a efficient, quick and inexpensive method of obtaining empirical information. The first questionnaire on waste management was applied especially to students and citizens of the city of Vitoria-Gasteiz. The second questionnaire was applied to the same group of respondents in the city of Brno. As a target group representatives of academics and citizens were chosen because it was supposed that this group of people has sufficient knowledge and interest in problems related to waste management.

Responses were evaluated by means of questionnaire on waste management in both cities. For the survey brief, clear, definite and understandable questions were used. 158 questionnaires were collected in Vitoria-Gasteiz and 140 questionnaires in Brno.

The questions of the questionnaire were:

- Are you interested in the problems associated with waste management?
- Do you recycle the waste?
- If you recycle the waste which types of waste do you separate?
- Do you think that the Vitoria/Brno city council informs its citizens how to recycle and the ways in which urban waste is treated?
- Do you consider the city of Vitoria/Brno to be developed in the field of waste management and sustainable development?
- What would you like to change regarding the city council's communication with its citizens on the issue of urban waste treatment?
- How can you reduce the amount of waste that you produce on a daily basis?
- How would you motivate citizens to increase the separation of the household waste?

During the collection and evaluation of the questionnaire the following quantitative variables were processed: gender, average age, social status (student, worker,..) and quality indicators: quality of knowledge and attitudes (relation to the process of learning, knowledge and skills, motivation,..).

3. SWOT matrix – A method for strategic analysis based on consideration of internal factors of a company, in this case the city of Brno and Vitoria, were strengths and weaknesses and external factors such as opportunities and threats are analyzed.



Individual factors interact and affect their overall impact on the company. SWOT is a tool used mainly for developing the company strategy to identify the strengths and weaknesses of the company, opportunities and threats, from which the company may subsequently rise. (Kotler, 2004)

4. Comparison – A comparison of both the level and development of waste management was done for Brno and Vitoria based on collected data and information. Results are presented.

5. Proposals for action - On the basis of the results from the questionnaire and SWOT matrix measures and strategies are proposed to improve the waste management situation in the territory of Brno.

To show the graphic figuration I used Microsoft Excel spreadsheet editor, 2007.

## **5 DESCRIPTION OF THE TERRITORY**

The purpose of this chapter is to describe geographical conditions, waste management process and its development in the city of Brno and Vitoria-Gasteiz.

### ***5.1 Description of the territory of Brno and present situation of waste management***

In this part of the work fundamental aspects characterizing the current state of waste management in Brno have been identified. The individual parts are focused on (1) description of the territory, (2) incinerator and central composting plant, (3) waste collection centers and collection of municipal waste, (4) municipal waste charge, (5) waste management project (6) waste management plan, and in the very final part is analyzed (7) the communication strategy of Brno.

#### **5.1.1 Description of the territory**

Under the Municipalities Act no. 128/2000 Coll. Brno is a statutory city. Territorially, it is the second biggest city, after Prague in CR. The city is divided into 29 municipal districts. Brno is the capital of the Southmoravian Region with an area of 230.22 km<sup>2</sup> and a population of 377,508 thousands inhabitants. It is an innovative and fast growing city of science, research, business, industry and information technology. Geographically, Brno has a good strategic position within Central Europe and lies between the Bohemian-Moravian timbered highlands and South Moravian lowlands. The city has remarkable transport accessibility along with international airport. Thanks to its good location, the city offers its citizens high-quality and desirable natural environment for living. (Brno, online)

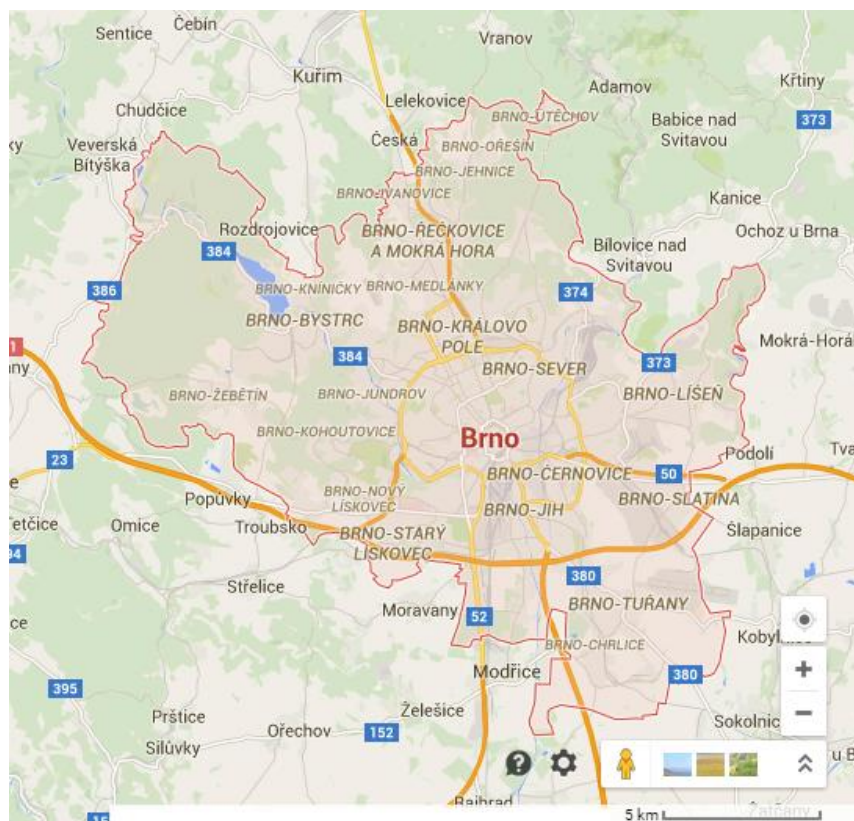


Figure 5. Map of the city of Brno (Google maps, online)

### 5.1.2 Incinerator and central composting plant

A municipal waste incinerator SAKO Brno, joint-stock company is dedicated to the collection and transport of municipal and selected industrial waste, waste disposal and material and energy recovery of waste. The company SAKO is 100% owned by the city of Brno. The incinerator is an European technology leader thanks to its sophisticated system and energy utilization of waste. The system waste-to-energy produces thermal energy and electricity for the city of Brno. The city features a low share of landfilling and that was only 2.6% in 2010. Throughout the CR share of landfilling was 67% in 2010. (Excursion in ENVicentrum)

The company Central Composting Plant Brno –SITA– provides treatment of biodegradable waste (biowaste) from Brno and its surroundings and offers all residents, municipalities and companies the opportunity to bring selected biowaste. The owner and operator of the central composting plant is SITA CZ, joint-stock company. This composting plant has the largest capacity in the CR - 70 000 tonnes of waste per year. (SITA, online)

### 5.1.3 Waste collection centers and collection of municipal waste

**Waste collection centers** are especially built for citizens in order to sort bulky waste, which normally can not be saved into containers. It is also used for the separation of usable components of municipal waste (PET bottles, composite packaging, aluminum packaging, paper, glass, textiles, metals) and dangerous waste (batteries, paint residues,

acids, etc.). 38 waste collection centers serve as recycling stations of return system of electric equipment coming from households. All information about how the waste is sorted in Brno can be found at the official page of Brno City Council. (Brno, online)

The city of Brno has established for all its waste collection centers collection of used vegetable oils. Citizens can surrender used cooking oils at any waste collection center, where there is placed for this purpose a black plastic bin with a sticker indicating the containers for storing oil from households. The condition for the collection is that the oil is placed in a resealable bag, for example, in PET bottles, etc. (Brno, online)

Since February 2014, the city of Brno initiated for its citizens sale of composters in order to reduce the amount of biowaste. Furthermore Brno develops home composting pilot project in the Brno-Žebětín implemented between 2010 and 2012. The family houses or recreational objects located in Brno can buy a composter of volume of 400 liters. (Brno, online)



*Figure 6. Sale of composters for separation of biodegradable waste in Brno (Miniwaste, online)*

The city offers to its citizens the possibility to sort biowaste on thirty-seven **waste collection centers** in the city. To improve the sorting of biological waste, there are two variants, first one is location of “brown” containers in the streets or second variant is selling composters. But the city tends to the second variant, because in “brown” containers often ends up mixed waste, which pollutes biowaste and that is further non-usable. There is an interest in “brown” containers among citizens, but the problem is that the city of Brno does not have enough money for containers and their collection. (Brnensky.denik, online)

In the city center, there are 11 stations of underground containers for separating glass, paper and a mixture of plastic packaging and tetrapak. Regarding to the generation of municipal waste in Brno, these values are around 300 kg / inhabitant / year. (Excursion in ENVIcentrum)



**Municipal waste collection** from citizens provide the company SAKO throughout the whole city. The company has a large vehicle fleet to ensure the collection of mixed municipal waste. For waste disposal the company provides special containers for glass, paper and plastics. The size and number of containers for mixed municipal waste for each property is determined by the production of residual waste (recommended residue production is 4 liters / person / day), and according to the frequency of collection. (Spalovna a komunální odpady, online)

#### **5.1.4 Charge for municipal waste**

The rate of the fee for municipal waste in Brno is 670, - CZK per taxpayer and per calendar year 2015. Taxpayers are: (1) persons having in the city of Brno a registered permanent residence, (2) individuals who were under the Act regulating the stay of foreigners in the territory of CR granted a temporary stay in the city for more than 90 days, (3) persons who, under the law governing the stay of foreigners in the CR are temporarily staying in the city for a period for more than 3 months, (4) natural persons to whom has been granted international protection under the law governing asylum or temporary protection under the act governing temporary protection of foreigners, (5) persons who own in the territory of city building(s) intended for individual recreation, apartment or house in which is not reported to stay any natural person in the amount corresponding to the fee for one natural person. (Brno, online)

#### **5.1.5 Waste management project**

The main objective of the project was the rebuilding and modernization of the company SAKO Brno. The intention of the project was therefore build a complex for sorting, recycling and energy utilization of municipal waste with combined production of heat and electric energy. The project of the reconstruction of the incinerator solved complex treatment of municipal waste both in Brno and in South Moravian Region and at the same time trying to fulfill the material and energetic use of waste (Waste-to-Energy) and reduce the landfilling of biodegradable waste. The main purpose of the reconstruction was to build the device so it does not burden the environment with emissions, meet emission limits and provides technical conditions for operation. The project was co-financed by the EU, the State Environmental Fund and the Statutory City of Brno. (Enviweb, online)

#### **5.1.6 Waste management plan**

The Waste Management Plan is a planning document for waste management in the city of Brno valid for the period 2005-2014, based on the priorities of: Waste prevention, Reduction of the amount and hazardous properties, Increase of material and energetic use of waste and Optimization of waste management.

##### **Objectives of the plan:**

- Increase in material utilization of municipal waste,
- Minimizing the proportion of hazardous waste in mixed municipal waste,
- Recycling of construction waste,
- Limiting landfilling and promoting energy utilization,

-The introduction of separation of biodegradable waste in the event of sales opportunities.

**Types of measures:**

- Expansion and optimization of separate collection,
- The introduction of separate collection at institutions in the city,
- Public education,
- Optimization of operation of waste collection centres,
- Involvement of waste collection centres to back collection system,
- The introduction of separate collection of biodegradable waste for waste collection centres. (Brno, online)

### **5.1.7 Communication strategy of Brno**

The communication of Brno in waste management with its citizens is mainly carried out through the Internet portal of the company SAKO Brno and the webpage of the city of Brno. Internet channels include contact information for the responsible persons in the issue, who may provide additional information.

ENVIcentrum (Educational Environmental Center) helps Brno with communication with the public, organizing in the area of the incinerator educational workshops for professionals and the laic public, which aim to raise awareness of waste management. Further education of citizens is insured by the project MINIWASTE, which is focused on bio-waste and on domestic composting.

The city of Brno in previous years participated in the organization of promotional and special interest events, whose content should lead to increase awareness of the waste management. To raise awareness and inform citizens about the issue, the city has started to use leaflets and promotional materials on how to sort the municipal waste. In some parts of the city of Brno they were implemented on a bulletin board of households leaflets that indicate how to recycle. However, the feedback of the households said that these leaflets are confusing and many people do not even notice them. Therefore it would be worth if the leaflets about how to separate and benefits associated with recycling were innovated and subsequently spreaded to all districts of the city. Nevertheless, the problem may be in insufficient funds associated with the promotion.

The content of Brno communication with its citizens is in particular information on the obligations and rights that citizens have, the amount and due date of fees and information associated with their payment. Another objective of the communication was to raise awareness about the company SAKO Brno, location of containers, timetable for their collection and also information about waste separation system. But the City Council of Brno insufficiently inform about the recycling, methods of waste prevention, minimization of waste and its quantity. (Brno, online)



## ***5.2 Description of the territory of Vitoria-Gasteiz and present situation of waste management***

In this subchapter have been identified fundamental aspects characterizing summary of the city and current state of waste management. First of all, I described (1) territory of the city of Vitoria-Gasteiz, and next parts are focused on (2) present situation of waste production and developments, (3) integrated waste management plan (4) charge for municipal waste, (5) landfill Gardelegi and mechanical biological treatment plant, (6) collection and waste treatment, and the very final part is aimed at (7) communication strategy.

### **5.2.1 Description of the territory**

The capital city of the Basque Autonomous Community and of the province of Álava is situated on the north of Spain. The size is 276 km<sup>2</sup> and number of inhabitants is 239.361. It is the second largest city in the Basque country. Vitoria-Gasteiz is the winner of European Green Capital Award in 2012-2013. Vitoria-Gasteiz is the first Spanish city to obtain this award and is the third European city after Stockholm and Hamburg.

The capital of Álava has been rated the best city in waste management and water in the study of 25 Spanish sustainable cities. A report by Research and Analysis, sponsored by Siemens, and verified by KPMG. The study analyzed the main environmental parameters that are part of urban management. The situation of cities has been studied in seven different categories (CO<sub>2</sub> emissions, electricity, residential sector, mobility, waste, water and air). (Iresiduo, online)

These awards were given to the city:

- *“The city was chosen as a sustainability model in Europe at the 2nd Sustainable Cities Conference in Lisbon”.*
- *“1st Local Best Practices Award in climate issues of the Spanish network of Cities for Climate”.*
- *“Bioenergy Prize of the Technical Association for the Management of Waste and the Environment”.*
- *“2007 Sustainable City Prize for the most sustainable city overall. Environmental Forum Foundation”.*
- *“Blue Flag Sustainable City prize given for the eighth year in a row for the city's waste management policies”.* (Vitoria-Gasteiz, online)



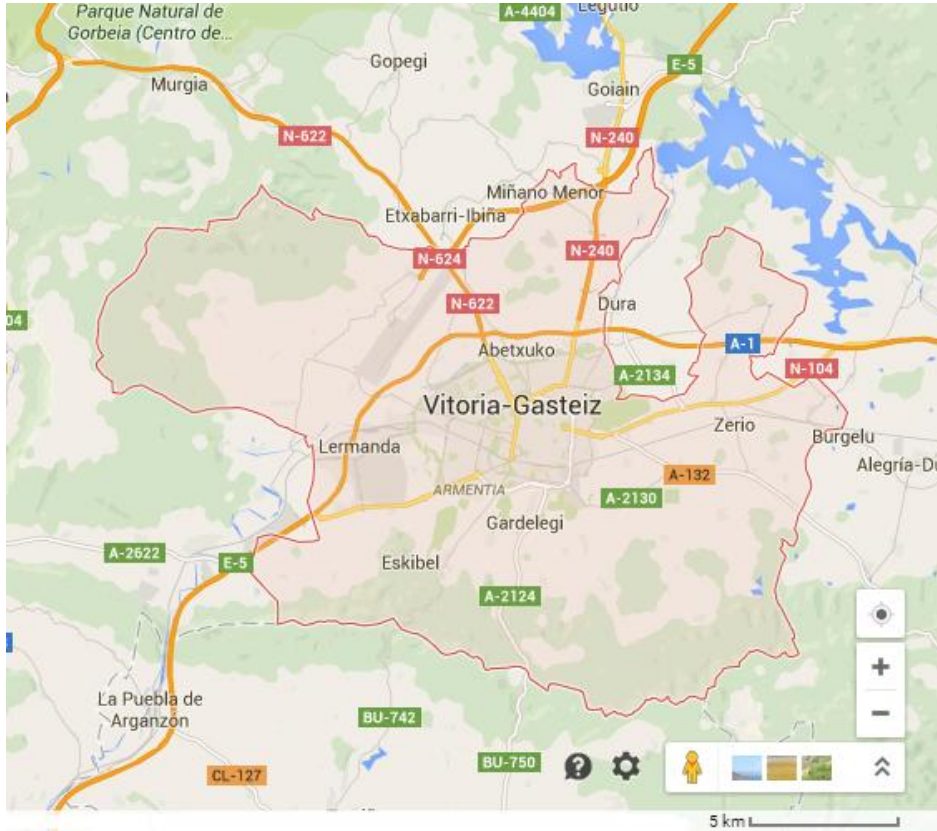


Figure 8. Map of the city of Vitoria-Gasteiz (Google maps, online)

### 5.2.2 Present situation of waste production and developments

The total volume of waste generated per capita in Vitoria is 375 Kg., making it the third city that generates less waste, with a difference of 25.7% below the average. Also, it is the leading Spanish city in recycling. (Iresiduo, online)

The table below demonstrates municipal and household waste generation in Vitoria among years 1999-2009. MW generation between yrs 1999-2009 increased about 40 kg/capita while the production of household waste increased in the same period about 27, 1 kg/capita.

Table 3. Municipal and household waste generation in Vitoria

	Municipal Waste			Household Waste		
	1999	2005	2009	1999	2005	2009
Waste generation (t/yr)	76.720	87.881	93.494	65.797	72.852	78.807
Waste generation per capita (kg/yr)	350,4	383,6	390,4	301,9	318,0	329,0

Source: European Green Capital Award Vitoria 2012-13, online

In 2009, the rate of recycling was 23.5% (92 kg/person/yr). Municipal waste generation in Vitoria-Gasteiz indicates the relevant wealth of its citizens and the large levels of consumption. Through the period 1999-2009, Vitoria-Gasteiz was able to extensively increase the level of recycling. Vitoria is on the way to obtaining a cleaner city, with awareness campaigns and promotions to raise separation at origin and achieve waste efficiently. The city is active in collaborating with NGOs, business cooperations from the food and recreation, pharmaceutical and electronics sectors.

The main **measures implemented** aimed at diminishing the amount of waste generated, the amount of waste given to landfills, especially biodegradable waste and proposals promoting awareness raising plans are attached in **annex II**. (European Green Capital Award Vitoria 2012-13, online)

### 5.2.3 Integrated waste management plan (2008-2016)

In 2000, Vitoria-Gasteiz permitted the new Integrated Waste Management Plan (2008-2016), found on the "5-Rs":

- *“Reutilise waste”*,
- *“Recycle”*,
- *“Reject, do not buy products that generate unnecessary packaging waste”*,
- *“Reduce the amount of waste produced”*,
- *“Make Responsible those who produce hardly recyclable or hazardous waste”*.

(Agenda 21 of Vitoria-Gasteiz, online)

The Plan suggests integrated and sustainable waste management by means of application of a cooperative management hierarchy in which the priority aim is prevention, coming after reutilisation, recycling, along with composting, use for energy purposes and in conclusion the disposition of the non-usable fraction to:

- (1) Maximise prevention: by programmes aimed at promotion of reutilisation and reducing the production of waste.
- (2) Maximise energy recovery: by putting preference to the energy valuation of materials (reuse, compost) above energy recovery.
- (3) Minimise disposal over dumping: discouraging the disposal of recyclable waste and constructing the preliminary treatment of all waste a responsibility so as to minimize its amount and toxicity, until the disposition of initial waste is minimized to zero. (Agenda 21 of Vitoria-Gasteiz, online)

### 5.2.4 Charge for municipal waste

Charge related to disposal of municipal waste in Vitoria-Gasteiz is 41 euros per household. (Departamento de Medio Ambiente y Política Territorial, online).

The share of this tax is annual and is determined by tariffs, depending on use and surface property. It is determined from a fee, collected by the Ordinance regulating the waste charge. The table of rates, description and quota of waste charge can be find in **Annex III**. (Vitoria-Gasteiz, online)

### **5.2.5 Landfill Gardelegi and Mechanical-Biological Treatment Plant**

The municipal waste in Vitoria-Gasteiz is disposed in two ways, first way of disposal is provided by landfill and second way of municipal waste treatment is MBT.

Gardelegi is a non-hazardous waste landfill owned by the city of Vitoria. The use of this municipal service requires prior authorization and it requires payment of a fee. It started its activity in 1975 and deposits the fraction of waste that can not be recycled or recovered, from MBT Plant Jundiz, sewage sludge WWTP Crispijana, rejections of the Waste Treatment Plant Construction and Demolition, as well as inert waste and non-hazardous industrial sources. The landfill has a facility using biogas and methane gas generated from the decomposition of waste in the landfill, which is used to generate electricity. Also, within its facilities take place one of the three recycling centers Garbigunes. Garbigune is a clean point for collection household and similar waste to be reused or recycled. (Vitoria-Gasteiz, online)

The MBT plant (biocompost) of municipal waste of Vitoria is located in the industrial zone of Jundiz. The plant has become operational in 2007 and has a capacity to treat 125,000 tonnes of waste (currently about 60,000). In this plant organic fraction of urban waste is separated mechanically and treated by biomethanation (recovery of waste through biogas production) and composting. (Vitoria-Gasteiz, online)

### **5.2.6 Collection and waste treatment**

The essential aim is to offer cleaning and collection waste services with the highest degree and with the least environmental result possible to ensure that the emissions produced are minimized to a least amount, inside a structure of social and economical sustainability. (Agenda 21 of Vitoria-Gasteiz, online).

Vitoria-Gasteiz since 2007 has a system of municipal waste collection, based on the collection through containers. This is completed by the pneumatic collection system distributed by different districts of the city and city is working on a master plan for the extension of pneumatic waste collection to consolidated city areas. The city of Vitoria-Gasteiz makes the collection and treatment of waste through these various services:

- Containerized: garbage bag and residual fraction, packaging, paper and cardboard, glass, biowaste, batteries, textile waste, vegetable oil,
- Pneumatic waste collection,
- Special collection: deals with special collection of batteries, dead animals, medicine, vegetable oil, household hazardous waste (films, paints, solvents, aerosols ...).
- Door to door: the shopping centres in Vitoria-Gasteiz have a special municipal waste collection service, door to door, to facilitate recycling,
- Bulky waste collection,
- Mobile green points and clean points Garbigune.

The figure below shows waste collection centres and mobile green points within the city Vitoria. The map is provided by the page of City Council of Vitoria-Gasteiz. The mobile green point is a service that collects all kinds of household hazardous waste such as motor oil and household bulbs, clearing products, aerosols, paints and solvents, herbicides, phones, toner printers, textiles and batteries. Municipal vehicles are going through the city to the places in specific locations adjusting to a calendar. (Vitoria-Gasteiz, online)

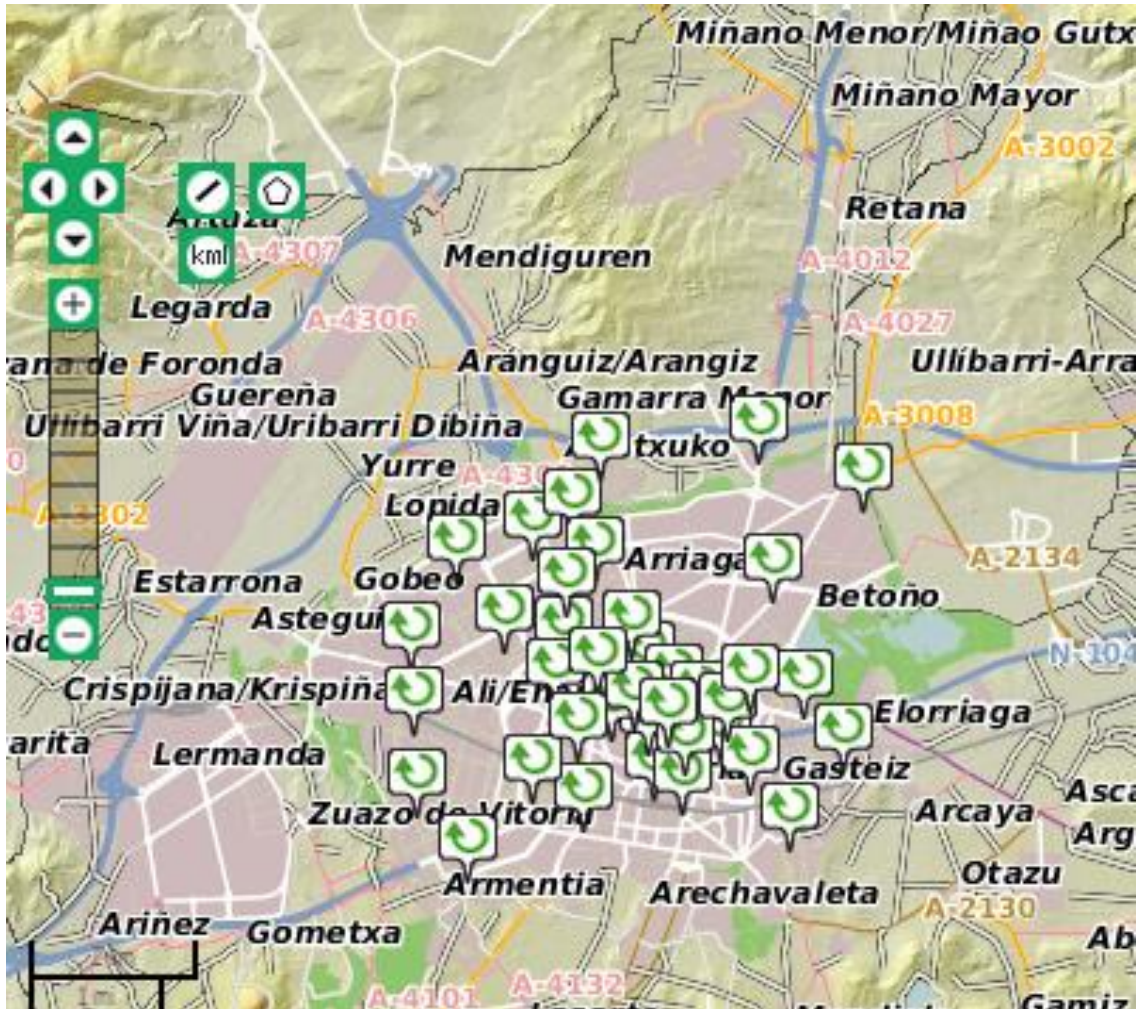


Figure 9. Waste collection centres and mobile green points (Vitoria-Gasteiz, online)

The city of Vitoria-Gasteiz has awarded the local company Ekograss Gasteiz to the new collection service of used vegetable oil. Throughout the city 155 orange containers were installed. A container with the capacity of 900 liters was adapted for people with disabilities. This service is performed in two ways: by container in the case of housing, hospitality venues, etc., while collecting this same residue that comes from the various municipal buildings, takes place with the door to door system. The City Council also ensured that the collected oil will be used for the generation of biodiesel with what is given a second life to that oil. (Gasteizhoy, online)





Figure 10. Implantation of containers for collection used oil (Gasteizhoy, online)

The pneumatic collection was first installed in Vitoria in 2001, in the historic center of the city. Due to the good reception of this infrastructure, it was decided to extend the pneumatic system to new areas of expansion of the city as a modern and convenient system of waste collection. Vitoria currently has six waste collection stations. The total length of the network is 53.2 km. (Vitoria-Gasteiz, online)



Figure 11. System of pneumatic collection of residual waste in distrikt Salburua (Vitoria-Gasteiz, online)

Since 2010 Vitoria separates biodegradable waste. The city gradually applied 527 brown containers serving to its citizens to recycle biowaste in 21 districts of the city. The placement of the fifth container was accompanied by an information campaign, distribution of brochures and compostable bags, in community centers, health centers and shopping malls. (Elcorreo,online)

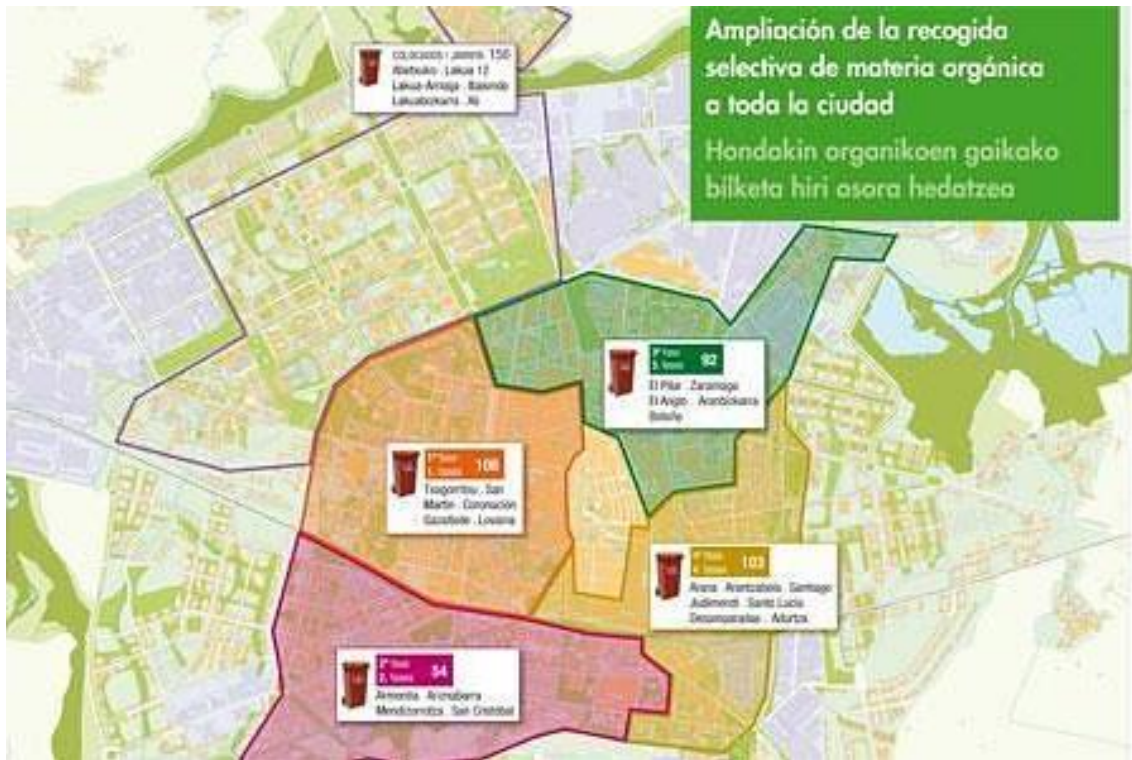


Figure 12. Application of the organic waste collection in Vitoria (Elcorreo,online)

### 5.2.7 Communication strategy of Vitoria

The communication of the city with its citizens about the problems related to the waste management is provided by the City Council of Vitoria-Gasteiz. All information about waste management process, amount of fee, timetables of waste collection, recycling, waste management plans, waste collection, treatment and educational activities is given on the internet portal of the City Council of Vitoria.

The City Council offer to its citizens wide range of workshops and chats so that they can get feedback from its citizens. The city provides various projects and plans, e.g. Strategic plan of waste (towards zero discharge), which focuses on promotion of recycling of paper and packaging, through monitoring and communication to the public of the result of individual containers, streets, neighborhoods. Another is Reuse project which deals with utilization of goods, appliances, and electronics from the municipal collection.

Vitoria-Gasteiz proposes measures which meet the needs of citizens and carry out educational activities developed by the different municipal departments in the publication Vitoria Educating City. Educational activities are focused on tours and

workshops in biocompost – waste treatment plant and landfill Gardelegi. (Vitoria-Gasteiz, online)

Since 2000, the city set out environmental campaigns to spread awareness and to guarantee that waste is separated and disposed of in the proper containers: Christmas Campaigns “La ecopegata” (1999), “Street theatre” Campaign (2003), “We recycle glass here” (2002), “Pre-cycling” programme aimed at schoolchildren (2004), “We put our batteries here” (2008), “By recycling light, we recycle life” (2008), house-to-house distribution of the guide “Recycle your habits” (2009). The calendar of mobile green points is sent each year to every household. (European Green Capital Award Vitoria, online)

## **6 RESULTS**

The intention of this very last chapter is to (1) process and interpret the results of the questionnaire, (2) set out the SWOT analysis for both cities, which is based on identification of the internal factors (strengths and weaknesses) and external factors (opportunities and threats), (3) compare the level and current situation of WM in these two cities and, (4) make a proposal of WM system for Brno to improve the present situation and enhance actual development.

### ***6.1 Questionnaire survey on waste management***

To determine at what level is the knowledge and awareness of citizens of Brno and Vitoria-Gasteiz on waste management, the questionnaire have been created covering key issues regarding this field. Therefore, a process of surveys was done to get the opinions on matters pertaining to this work, to know: the actuality of separation in source, the interest of inhabitants regarded to the problems associated with waste management and communication of the city council with its citizens about how to recycle and the ways in which urban waste is treated.

#### **6.1.1 Overall study design**

The survey was conducted to individuals enumerated or ordinarily resident in Brno and Vitoria-Gasteiz from 18 years or more. With a confidence level of 90% and an error 0.05 samples. In this case, the number of people interviewed is 298. From which 158 responses were taken in Vitoria-Gasteiz and 140 questionnaires were taken in Brno. Within the general data were collected gender, age and level of education. The survey was realized in the University, civic centre and via internet and with an attempt of choosing potential participants, there is no selection bias. The majority of the respondents were representatives of academics and citizens. The survey template is included in Annex I.

#### **6.1.2 Summary of survey content**

The survey can differentiate four small blocks, each oriented to obtain specific information.

The first block is set up to questions 1, 2 and 3. Its purpose is to meet the commitment of citizens with problems associated with waste management, waste separation and what kinds of waste do people separate.

The second section consists of questions 4 and 5, and aims to determine the degree of awareness of the population about development and to what extent city council informs its citizens about how to recycle and the ways in which urban waste is treated.

The third is made up of questions 6 and 7: both are free answers and the first seeks to know what citizens would like to change regarding the city council's



communication on the issue of urban waste treatment. The second question is about how respondents would reduce the amount of waste that they produce on a daily basis.

The last block, the last question 8, is aimed at getting feedback on motivation of citizens to increase the separation of the household waste. Among the choices were for example: competition in schools, environmental education and excursion, penalty for failure to comply recycling, system of returnable packaging and using of simplified separation with only two containers (“dry” and “wet”).

Although it is likely to encounter with many points of view, it is worth to know the opinions of citizens, which may indicate (in principle) the most efficient system.

### 6.1.3 Survey results

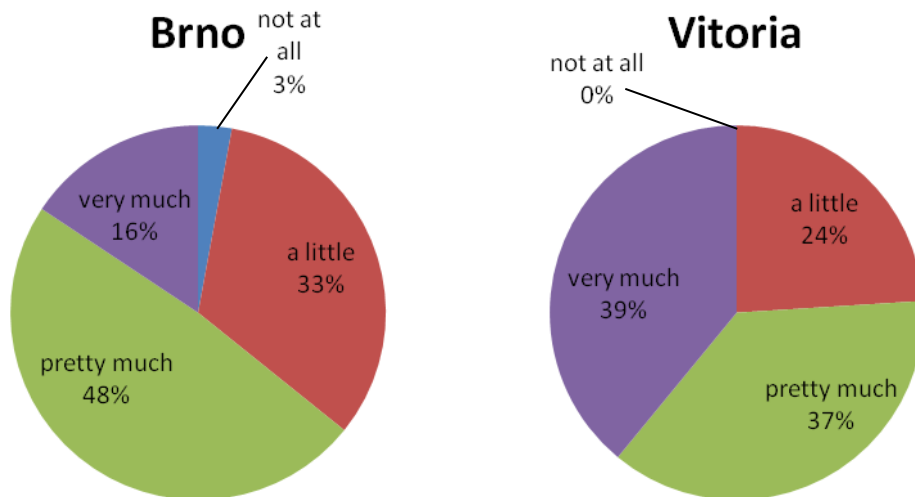
From the total number of 140 respondents in Brno are 65,7% (92) women and 34,3% (48) men and from 158 respondents in Vitoria-Gasteiz are 72% (114) men and 28% (44) women.

The most represented age category was between 18-30 years, which represents 81% (114) in Brno and 67% (106) in Vitoria. The second largest category was among 30-45 years old, which holds 13% (18) in Brno and 19% (30) in Vitoria. From this finding can be concluded, that the most effective target group for communication are students and people of working age, because they might be more interested in current problems, and are much more open to events and innovations.

Table 4. Primary results of the survey

	No. of respondents	Sex		Age			
		Male	Female	18-30	31-45	46-60	60+
Brno	140	48	92	114	18	8	0
Vitoria-Gasteiz	158	114	44	106	30	18	4

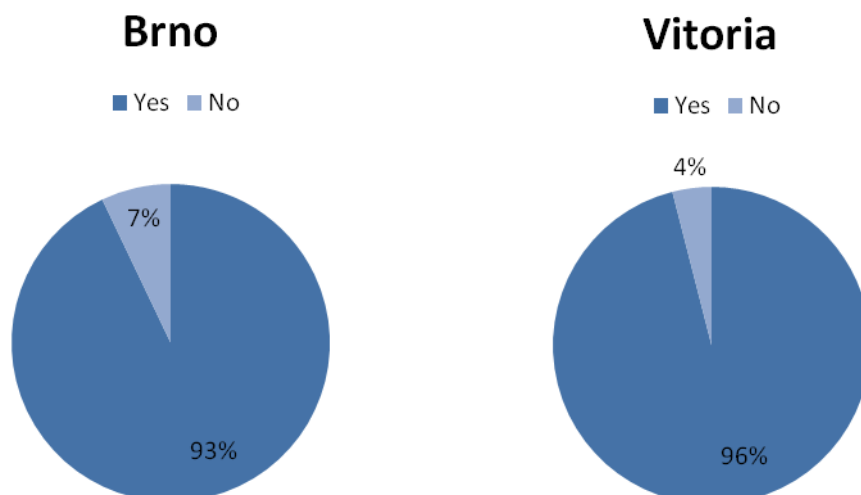
On the first question “*Are you interested in the problems associated with waste management?*“, 64% of respondents in Brno have high or medium interest in this matter, another 33% have lower interest and remaining 3% do not have any interest. In Vitoria, 76% of respondents have high or medium interest and remaining 24% have low interest. To sum it up, citizens of Vitoria are supposed to have higher interest in this matter than citizens of Brno.



Graph 1. No. of respondents interested in field of waste management

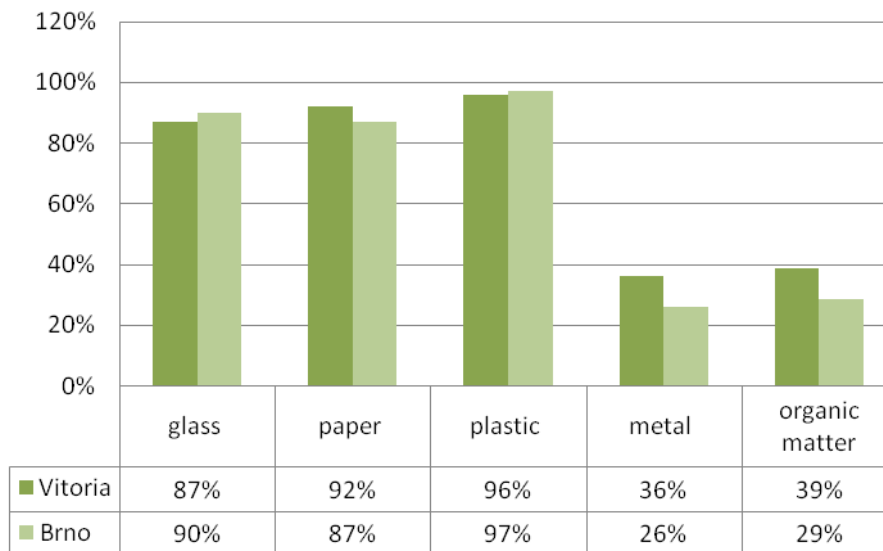
Regarding to the second question of the survey which deals with the number of people who do and do not separate the waste, the results are as follows: 93% of respondents do recycle and another 7% do not recycle the waste in Brno. In Vitoria, 96% of respondents answered that do recycle and remaining 4% do not recycle the waste. To compare these results, the level of recycling in Brno and Vitoria-Gasteiz is very equal and the majority of their citizens do separate domestic waste.

Through this questionnaire was founded that the respondents would be more motivated to separate, if they knew how to separate and to which container the waste exactly belongs. I met with the positive response that citizens of Brno would like to acquire the possibility regarding to sort of discount vouchers for sport centres and theaters as a result of good recycling.



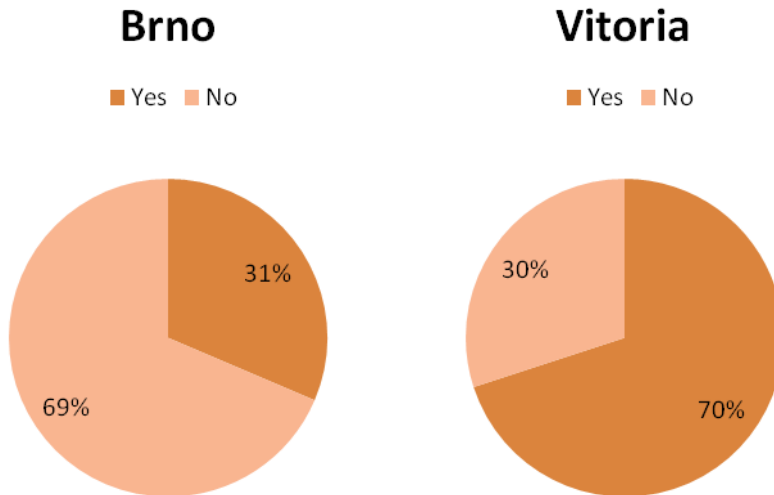
Graph 2. No. of people who do / do not recycle the waste

The largest representation of waste which is separated in Brno is plastic 97%, glass 90% and paper 87%. Among the least separated components are organic matter 29% and metal 26%. In Vitoria, the most frequently separated waste is plastic 96%, paper 92% and glass 87% and less separated type of waste is organic matter 39% and metal 36%. The results indicate that people living in Vitoria do separate organic matter and metal about 10% more than people living in Brno. But some respondents from Brno answered that they would separate more organic matter if they would have the possibility to have container for organic matter near to their home.



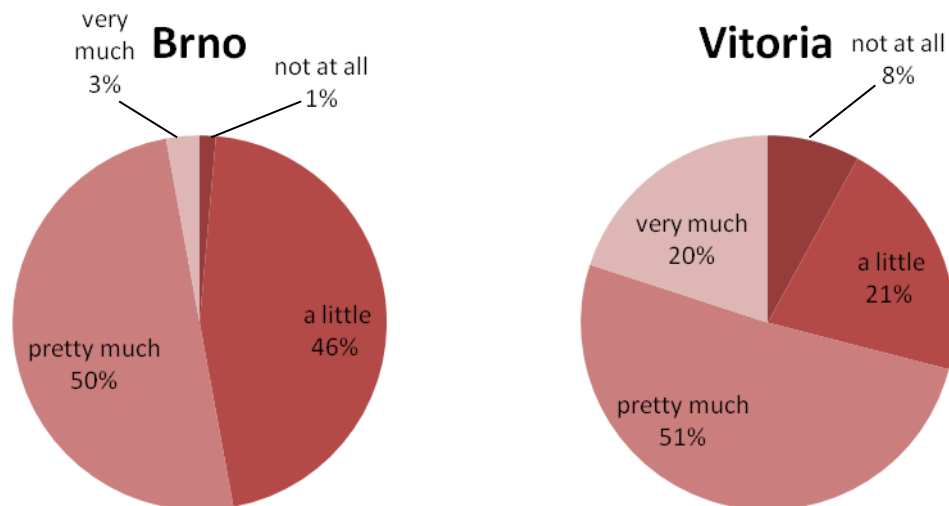
Graph 3. The amount and sort of waste separated within Brno and Vitoria

On the fourth question „Do you think that the city council informs its citizens how to recycle and the ways in which urban waste is treated?“ only 31% of respondents answered yes in Brno and up to 70% of respondents replied yes in Vitoria. From this graph results that knowledge of citizens of Brno about what is happening with municipal waste after collection from houses is small. There is a need to promote awareness and focus on promoting of strengths to which Brno disposes.



Graph 4. No. of respondents who think that City Council informs its citizens

Fifth question was focused on number of citizens who consider their city to be developed in waste management and sustainable development. In Brno, more than half of people (53%) replied positively and less than half of people (47%) replied negatively. On the other hand, in Vitoria, 71% of people are positively inclined and remaining 29% of people negatively. From this result it is obvious that citizens of Vitoria do consider the city to be developed more than citizens of Brno. The graph below provides percentual results.



Graph 5. No. of respondents who consider the city to be developed

The following two questions were open and on the first question „What would you like to change regarding the city council’s communication with its citizens on the issue of urban waste treatment?“ people answered:

The majority of respondents in Brno would appreciate greater public awareness related to measures on prevention of production of waste and recycling by means of leaflets into their postboxes, common areas of their housings, on the city's website, to the mailbox etc. Some of them mentioned that after paying fee for municipal waste they would like to receive a newsletter about measures, methods and innovations in waste management and what has been done with recycled waste. Moreover, considerable number of respondents would like the city to be involved in the implementation and promotion of separation of organic matter and used vegetable oil. Another significant comment put emphasis on greater cooperation of citizens with the city council through organizing discussion meetings for all ages, where people comment on current problems and propose solutions according to their own preferences.

Most of citizens of Vitoria responded that are pretty informed about treatment of waste and recycling in general, but they have some doubts about how to recycle (e.g. whether to wash the bottles and plastics before recycling) and where to recycle (map of containers for recycling). Great number of respondents would like to have a bigger feedback of what is happening with the waste after recycling, as well as more information to the society about economic benefits of recycling. Another suggestion is to put more importance to raise awareness related to environmental education, recycling and sustainable development.

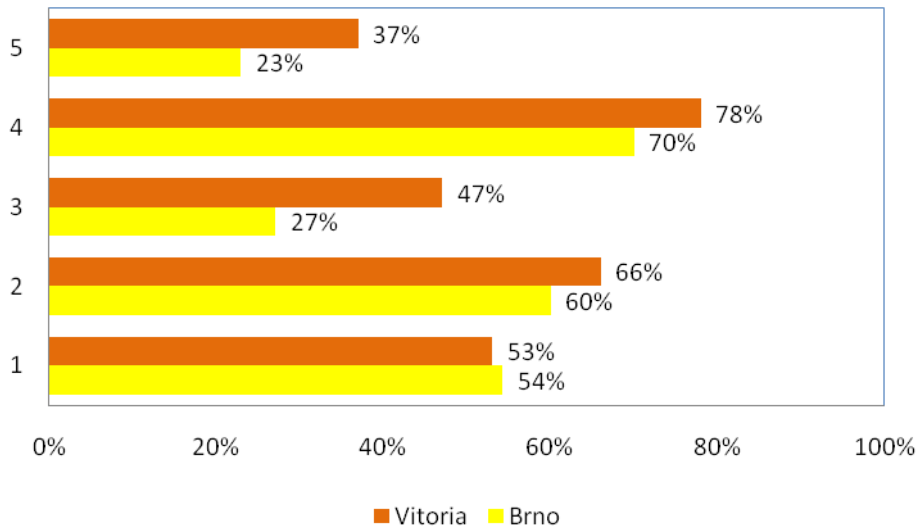
The second opened question was „*How can you reduce the amount of waste that you produce on a daily basis?*“ and responses of citizens in Brno and Vitoria were very comparable.

Most of respondents in effort of reduction of waste maintain the model of "3-Rs" Reduce-Reuse-Recycle and also place big emphasis on separation and composting of bio-waste. Further, most of them would like to have the possibility of return plastic and glass packaging to the supermarkets (this system is already operating in European countries such as Germany, Denmark, and Finland). Nowadays it is difficult do not produce so much waste, as far as the majority of the food in supermarkets is packaged in plastic bags or boxes. Positive change could also come from supermarket chains using less plastic packaging or using recycled packaging that are more friendly to the environment.

The very last question was aimed at study focused on through which type of medium respondents would motivate other people to higher rate of recycling of household waste. The most favourable medium to increase recycling in both cities is system of returnable packaging.

Respondents also impose great importance to medium of environmental education and excursion. There is a necessity to focus on the children and teach them the principles of how to recycle and how to behave towards the environment.

The most unfavourable medium among respondents is so-called system of two containers (wet and dry) along with application of penalty to citizens for failure to comply recycling.



*Graph 6. Types of systems which would citizens use to increase recycling of waste*

**Where:**

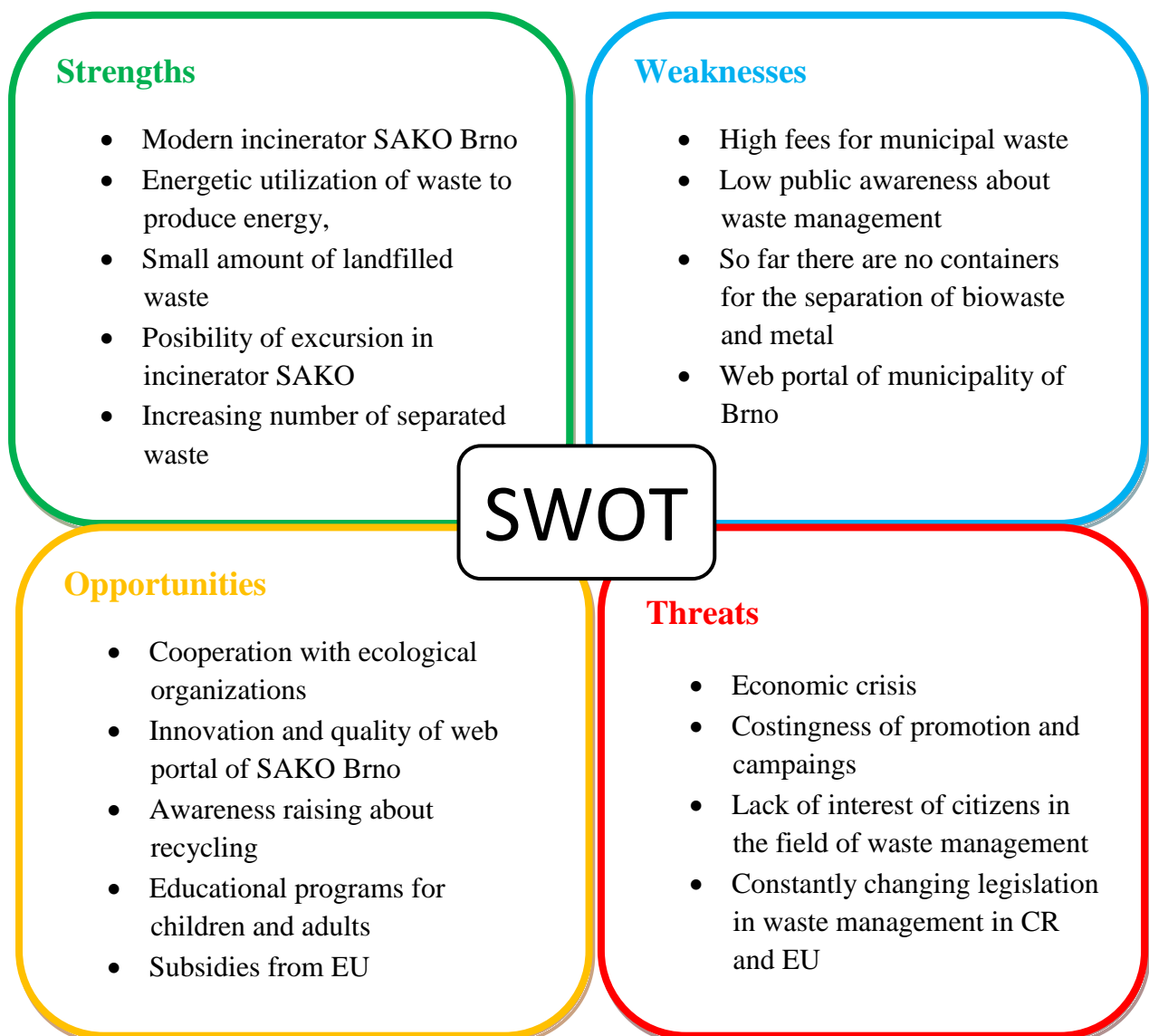
- 1** - competition in waste separation in schools
- 2** - environmental education, excursion
- 3** - penalty for failure to comply recycling
- 4** - so-called system of returnable packaging
- 5** - simplify the separation of introducing only two containers "dry" (all packaging, plastics, paper, cardboard, glass), and "wet" (kitchen waste and garden waste)

## 6.2 SWOT analysis

SWOT analysis about present situation in waste management was made for both cities. This strategy characterizes strengths and weaknesses, as well as opportunities and threats and is the basis for the further work on the proposals. Through the results of this analysis, I intended to propose some measurements to improve the current situation of waste management in Brno.

### 6.2.1 SWOT analysis of Brno

Table 5. SWOT matrix of Brno



Source: own work

Among the strengths of the city of Brno belongs especially the modern incinerator SAKO with its long tradition. The company has significant position in the waste management sector in the South Moravian Region; it is monopolizing municipal waste disposal. Thanks to its sophisticated technology and electricity production for own consumption it belongs to one of the best incinerator in Europe. Due to material

and energetic utilization of municipal waste, Brno has very low rate of landfilled municipal waste. SAKO also disposes with professional and trained staff and offers excursions for all age categories. The proportion of recycling is still increasing in Brno, what is reflected with purchase of new containers for paper, glass, plastic and textile.

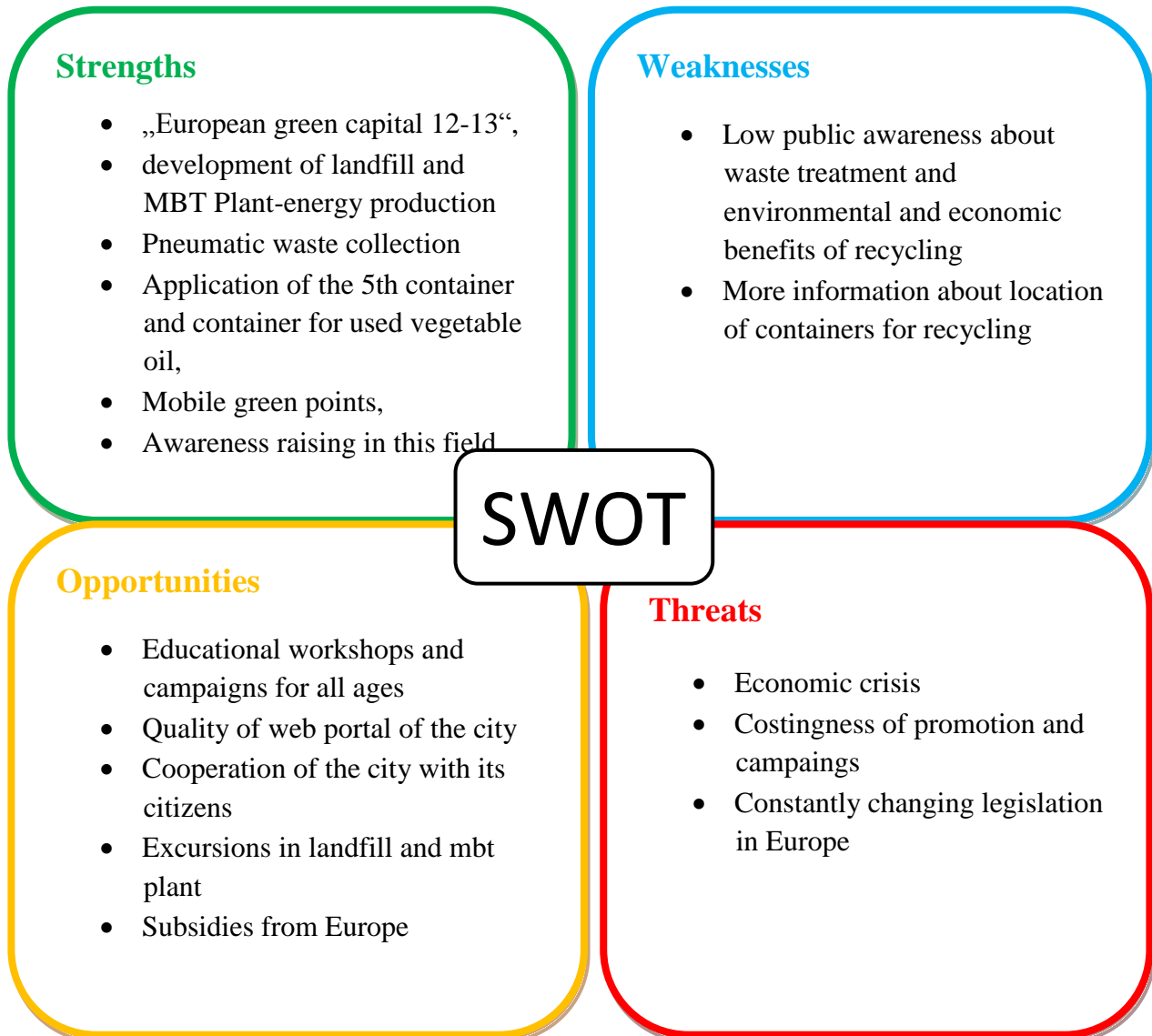
The most significant weakness, due to which some citizens of Brno refuse to separate the waste, is the amount of fee paid annually for municipal waste. In the last years these amount increased about 175 Czech crowns and thanks to this fee people lose motivation to separate the waste. Actual problems of communication strategy suggests on very low public awareness in waste disposal, existence of waste collection centres, ways of utilization separated waste, etc. Another significant deficit to mention is the separation of biowaste. In developed countries such as Austria, Germany or Netherlands, recycling of organic matter is a common thing, while in the CR a large amount of this waste still ends up in landfills. Nevertheless biowaste makes up a third of the container content. From the economic point of view the composting is the cheapest way of waste disposal, consequently is landfilling and waste incineration. The web portal of city of Brno involves all information about fee and payment for municipal waste, contacts on responsible persons, but still missing more reports and news about benefits of recycling (economic and environmental), what happens with the waste after recycling and more information about waste disposal.

The most important opportunity, which Brno disposes is particularly large number of environmental and educational organizations with which can cooperates. The innovation of the web portal and logo of the company SAKO was big step forward and now it is very easy for public to find required information. A major threat is costingness of promotion and campaigns what can lead to low public awareness. Additional threat is disinterest of the population in field of waste management and ignorance of the public to the environment.



## 6.2.2 SWOT analysis of Vitoria-Gasteiz

Table 6. SWOT matrix of Vitoria-Gasteiz



Source: own work

The award "European Green Capital" for 2012-13 has been granted to Vitoria as to first city in Spain and third city within Europe. The city also tends to sustainable development and Vitoria also received other awards for the climate issue, waste and water management and sustainability model for Europe. Within strengths of the city belong sophisticated waste collection system of the nature of using five containers for collection of separated waste (paper, glass, plastic and metal, textile and organic matter), pneumatic waste collection, door to door collection, clean points and mobile green points and novelty is implementation of containers for used vegetable oil. 100% of municipal waste is being processed by MBT Plant which also produces own electricity. Development of landfill was performed to meet EU regulations on landfills. The city also disposes good communication strategy with public through the medium of campaigns and educational projects.

On the other hand, as a result from the questionnaire people would appreciate more collaboration with the city council and put more emphasis on ways of utilization of separated waste and their real benefits for the city. The weakness is also insufficient information about distribution of containers inside the city. For this purpose could be helpful map of location of containers or a mobile application.

All the information about waste management towards its citizens is provided on the web portal of the city council of Vitoria. This opportunity allows the city to get feedback from its citizens. People can express their opinion or talk to the city via so-called “post box” and in section “frequently asked questions” can find useful information. Other opportunities are tours and workshops for public offered by landfill Gardelegi and waste treatment plant – biocompost.

Both cities refer the same threats, as an economic crisis and changing legislation at European level.

### ***6.3 Proposal plan for Brno***

The aim of this very last subchapter is to propose measures and strategies to improve the waste management system, communication strategy and reduce waste generation in the city of Brno. Measures and strategies were designed on the basis of results of the questionnaire and SWOT analysis. These measures also result from comparison of waste management in Brno and Vitoria-Gasteiz. Study on the current development of waste management have been defined in detail in the chapter description of territory, they have also been used further in this subchapter for the purpose of draft measures.

#### **6.3.1 Comparison of waste management**

In the table on page 51 the waste management system of Brno and Vitoria was compared through the medium of its main components.

Table 7. Comparison of waste management in Brno and Vitoria

	BRNO	VITORIA-GASTEIZ
<b>Overview</b>	<ul style="list-style-type: none"> <li>- The capital city of the South Moravian Region</li> <li>- 2<sup>nd</sup> biggest city in CR</li> <li>- Good location, the city offers its citizens high-quality and desirable natural environment for living.</li> </ul>	<ul style="list-style-type: none"> <li>-The capital city of the Basque Autonomous Community and of the province of Alava</li> <li>- 2<sup>nd</sup> largest city in the Basque country</li> <li>-European Green Capital 2012-2013</li> </ul>
<b>Size</b>	230.22 km <sup>2</sup>	276 km <sup>2</sup>
<b>No. of inhabitants</b>	377,508	239.361
<b>1) Amount of MW/capita/year</b>	Around 300 kg	Around 375 Kg
<b>2) MW disposal</b>	Incinerator, central composting plant and landfill	Non-hazardous landfill and MBT Plant
<b>3) Waste collection</b>	<ul style="list-style-type: none"> <li>- Waste collection centres (biowaste, used vegetable oil, batteries)</li> <li>- Containers (paper, plastic and tins, glass, textile, mixed)</li> <li>-Composters (pilot project)</li> <li>-11 stations of underground containers</li> </ul>	<ul style="list-style-type: none"> <li>- Clean points</li> <li>-Mobile green points</li> <li>- Containers (paper, plastic and metal, glass, textile, organic matter, used vegetable oil, batteries, mixed)</li> <li>- Door to door waste collection</li> <li>- 6 stations of pneumatic waste collection</li> <li>-Bulky waste collection</li> </ul>
<b>4) Recycling</b>	In 2014 was around 40,5 kg/person/yr	In 2009 was 23.5% (92 kg/person/yr)
<b>5) Fee for MW</b>	670, - CZK/taxpayer/year	41 euros per household
<b>6) Communication strategy</b>	<ul style="list-style-type: none"> <li>- Information about WM is provided by City Council of Brno and incinerator SAKO,</li> <li>- Environmental education and excursion in incinerator (open day)</li> <li>- Cooperation with many institutions (Schools, Miniwaste,etc)</li> </ul>	<ul style="list-style-type: none"> <li>- Information about WM is provided mainly by the City Council of Vitoria-Gasteiz,</li> <li>-Environmental education and excursion in landfill and biocompost</li> <li>-Chats and environmental campaigns</li> </ul>

### 6.3.2 Proposal plan for Brno

Considering the above described background, the present work of thesis is to design a model of optimal waste management for Brno, from the results of questionnaire, SWOT analysis and measures used in Vitoria. The major aim of this model is to enhance the development and level of WM system in Brno.

Firstly, these two cities belong to the similar socioeconomic stratum and therefore are comparable in the WM, they also generate the quality of services that municipalities offer to citizens who reside in them.

Secondly, they have own plans, measures and projects in WM, waste collection system, fees for MW, rate of recycling and amount of MW and constitute valuable materials to evaluate the present situation and development, identify new and update old problems, analyzing them in the light of local approaches.

Finally the purpose is to recommend specific measures for improving WM system to the case of the statutory municipality of Brno.

*Table 8. Proposal of optimal waste management plan for Brno*

<b>„Model Of Optimal Waste Management For Brno“</b>	
<b>1) Strengthening of communication strategy</b>	<ul style="list-style-type: none"> <li>- <b>Organization of discussion meetings</b></li> <li>- <b>Promotion of environmental education and social participation</b></li> <li>- <b>Cooperation with individual city districts</b></li> </ul>
<b>2) Empowering of campaigns and awareness raising</b>	<ul style="list-style-type: none"> <li>- <b>Environmental campaigns and programs</b></li> <li>- <b>Promotion of the re-usage and reparation of bulky waste, clothing, etc</b></li> </ul>
<b>3) Innovation of the web portal of the City Council of Brno</b>	<ul style="list-style-type: none"> <li>- <b>Provision of information about strategies, methods and innovations in WM</b></li> <li>- <b>Cohesion with other institutions such as SAKO</b></li> <li>- <b>Provision of information about recycling and utilization of separated waste</b></li> </ul>
<b>4) More information and propagation on recycling and its benefits</b>	<ul style="list-style-type: none"> <li>- <b>Information about what, how and where to recycle thanks to special leaflets</b></li> <li>- <b>Annual statistics on sorting and utilization of separated waste</b></li> <li>- <b>Implementation of system of returnable pet bottles</b></li> </ul>
<b>5) Innovation and public awareness of waste collection centres</b>	<ul style="list-style-type: none"> <li>- <b>Promotion and information about waste collection centres in Brno</b></li> <li>- <b>Giving more importance on what can citizens deposit there</b></li> </ul>
<b>6) Implementation of the 5th container for separation of biowaste and containers for used vegetable oil</b>	<ul style="list-style-type: none"> <li>- <b>Introduction of 5<sup>th</sup> “brown” container for separation of organic fraction with promotion on it</b></li> <li>- <b>Implementation of container for used vegetable oil.</b></li> </ul>

## **1) Strengthening of communication strategy**

Overall communication of the city with its citizens is largely an one-way, than a two-way communication. The current communication strategy lacks instruments that could receive feedback from citizens in the form of comments and suggestions for improvement. The importance lies not only in increasing the availability of information, but above all in creating a system of mutual communication and higher cooperation of city with citizens. Therefore these measures were proposed:

- Organizing discussion meetings of the city council with citizens, where people could comment on current issues and make suggestions.
- Information about innovations in waste management, measures on how to prevent waste through leaflets, website and in public places.
- Promote environmental education and social participation.
- Involve into the problems associated to wastes all age categories, especially older people and seniors, who prefer meetings in small groups and greater comprehension.
- Cooperation with children regarding to put into practise environmental education in schools which, however, must be attractive.
- Publishing a magazine about waste management once a year for taxpayer of municipality.
- Cooperation with individual city districts.

## **2) Empowering of campaigns and awareness raising**

Promotion of environmental campaigns and programs within the public is a crucial point for awareness raising and consciousness. Until now the city collaborated with some institutions such as „Voluntary centre Lužánky“ or „Ecological institute Veronika“ to spread awareness among the citizens. Incinerator SAKO also provides environmental education and excursion, which have positive impact on its further reputation. It is significant to point out on importance of environmental campaigns on citizens. The city of Brno could inspire from some campaigns carried out in Vitoria such as:

„Christmas Campaigns“, „Street theatre“, „We recycle glass here“, „Pre-cycling“ programme aimed at schoolchildren, „We put our batteries here“, „By recycling light, we recycle life“, distribution to houses the guide „Recycle your habits“.

Brno could carry out ecological days where citizens learn about waste treatment, about how recycling helps to environment and especially focus on proper sorting of waste. A lot of people do not even know what belongs to which container and throw them directly to the mixed container.

Other inspirational programmes on waste prevention and reduction of the city of Vitoria are:

- Promotion of the re-utilisation and reparation of bulky waste.
- Promotion of the reutilisation of clothing through the clean points, civic centres and parishes.

### 3) Innovation of the web portal of the City Council of Brno

The web portal of the statutory city of Brno provides most information in the field of fees for MW and matters related to them, location of containers, timetable for their collection and also raise awareness about company SAKO, however, the city unsatisfactorily informs its citizens about waste treatment, reduction and methods of waste prevention and recycling. Innovation of web portal of the city is therefore aimed at provision of information about:

- Strategies, methods and innovations in WM
- Cohesion with other institutions such as SAKO, energetic utilization of MSW
- Recycling and utilization of separated waste

### 4) More information and propagation on recycling and its benefits

Only few people know economic and environmental benefits of separation of waste. The majority of them do not know that particular commodities of separated waste bring the city money and benefits. Knowing these properties might motivate the citizens to separate more. Even the rate of recycling is still increasing in CR, some people do not know how and where to recycle domestic waste. Consequently these arrangements are proposed to promote recycling:

- Inform the wide public **what, how and where** to recycle thanks to special leaflets provided not only in web portal of disposal plants but also on web portal of the city. In **annex 4 and 5** are attached campaigns on recycling in both cities. In Vitoria, these mediums of communication are provided by web portal of the city council.
- Annual statistics on sorting and utilization of separated waste and news focus on communication about what is happening with the waste after recycling, plus its benefits for the city.
- Give place advertising posters some interesting info on waste (how much waste a day is exported, how much does it cost,..).
- Higher and most visible promotion of recycling by sending newsletters to mailbox, giving projects on recycling to households in all districts of the city.
- Introducing a system of returnable pet bottles (just as it is with a glass of beer). In supermarkets, they could then go back and plastic bottles, for which the citizens would get money (this system works e.g. in the Netherlands).

### 5) Innovation and public awareness of waste collection centres

Give more promotion and information about waste collection centres in Brno (no. of centres is 37), give more importance on what citizens can deposit there (biowaste, used vegetable oil, batteries, etc.) and more cooperation of individual centres with citizens (workshops, debates). The similar waste collection centres in Vitoria are “clean points”.

Vitoria-Gasteiz as a good example of waste collection services:

- **Door to door** waste collection of glass, paper and cardboard, which are separated through bigger commercial users,
- **“Clean points”** and **“Mobile green points”** recycling centres (fixed and mobile), where people can deposit household waste such as electrical devices, furniture, textiles, dangerous waste. Timetable and more information about mobile green points can be found on the web portal of city,
- **Batteries** collection is provided by sidewalk containers, battery shops, civic centres, along with clean points. The web portal of the city also provides list of containers, centres and shops where can citizens easily deposit batteries.

#### **6) Implementation of the 5th container for separation of biowaste and containers for used vegetable oil**

The very last and very important suggestion to optimal WM plan of Brno is introduction of 5<sup>th</sup> “brown” container for separation of organic fraction. Nowadays it is very known topic and even organic fraction creates one third of overall composition of trash, the city of Brno still do not dispose with containers. Some years ago, the city began to sell composters to citizens who live in suburb of the city. This project was, however, very successful, so that the city consider further sale of composters. The rest of the citizens (in the case when a people are unable to composting), can dispose organic matter as well as used vegetable oil in waste collection centres or central composter in Brno. So the majority of this waste ends up in mixed waste consequently in incinerator or landfill.

Very good example of composting in Vitoria is so-called „on-site composting scheme“ – what in practise means that areas which produce high level of biowaste (supermarkets, shopping centres) dispose own composting system.

## 7 CRITICAL PART

From the results of all of the work can be concluded that the city of Brno has in comparison to Vitoria in the field of waste management significant shortcomings. Brno could become due to its size other "European Green Capital", however, with regard to the development and sustainability this proposal is only the music of the future.

The document that may provide more clues about new vision is the Europe 2020 (the year 2011). Its aim is not only overcome the crisis but also address weaknesses in our growth model and create conditions to more intelligent, sustainable and inclusive growth. (Europe 2020, online). If one understands that a proper waste management is important for sustainability and for the maintenance of the economy, solving the question should be the establishment of the lines leading to such management.

Would it be possible to accomplish a recycling rate of 50% in 2020 according to directive 2008/98/EC of EU? From my opinion the implementation of the system of returnable packaging to supermarkets and shopping centres (this system already works in neighbouring countries such as Germany or Austria), together with implementation of the 5<sup>th</sup> container for separation of organic matter could be one of the best options toward achieving this goal.



## 8 CONCLUSION

The sustainable system of waste management is founded on 5 R's (Reutilise, Recycle, Reject, Reduce and make Responsible those, who generate hazardous waste). Through the use of this system could be saved natural resources, energy, pollution and environment.

The main objective of this work was comparison of WM process in the territory of two European cities – Brno and Vitoria-Gasteiz. These cities were geographically and socio-economically good comparable. At the very beginning of the work were collected data about history, waste management, waste disposal, municipal waste, amount of waste and legislation on waste. At the same time were processed information about description of the territory of both cities, their actual situation in WM and development. Furthermore, these studies were brought together: type of waste disposal, level of recycling and waste collection, WM plans and measures in order to decrease the amount of MW generated and the very last communication strategy.

Partial objective was to propose measures and strategies to raise the level of waste management situation in Brno. Proposal plan of waste management for Brno resulted from the study on waste management, questionnaire, SWOT analysis and on the basis of comparison. Through the medium of SWOT matrix were indicated strenghts and weaknesses and further opportunities and threats of current situation of WM in both cities. The method of questionnaire was applied to students and citizens in the area of Brno and Vitoria. From these analyses resulted that the city of Vitoria fulfils superior assumptions of level and current situation of WM and public awareness than Brno. Citizens of Vitoria are more informed about WM treatment and do consider the city to be developed in this field.

Vitoria-Gasteiz is a good example of correct sustainable WM for Brno because the city obtained several awards for WM, sustainability. Besides of these prizes is winner of third green capital within Europe. Waste management measures and strategies used in Vitoria-Gasteiz were described and analyzed (Annex 3) to provide better comprehension towards progress in Brno. In this work was also analyzed document „The Integrated Waste Management Plan“ that was proposed in Vitoria and is founded on 5 R'.

Based on the comparison and collected results following „Model of optimal waste management for Brno“ was drafted to underline current situation of WM. Particular measures of proposal are as follows (1) strengthening of communication strategy to achieve that citizens do not consider WM only as a necessity or obligation but to show them how important this topic is for our life, to involve them in decision-making processes and accomplish that this issue will become to their daily routine, (2) empowering of campaigns and awareness raising, the next step is (3) revitalization of the web portal of the City Council of Brno, (4) more information and propagation on recycling and its benefits, (5) innovation and public awareness of waste collection centres, and the very last crucial point is (6) implementation of the 5th container for separation of biowaste and containers for used vegetable oil. Using the proposed

measures current situation of WM could enhance and ensure the improvement of current strategy. It would increase its attractiveness and advance towards sustainability and create a positive image of the city.

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## Annex 1.

Questionnaire survey on waste management (Source: own work)

Sex: Male Female  
Age: 18-30 30-45 45-60 more than 60

Level of education achieved: - Without education,  
- Primary education,  
- Secondary education without graduation,  
- Secondary education with graduation,  
- University education

1. Are you interested in the problems associated with waste management?

(1) not at all (2) a little (3) pretty much (4) very much

2. Do you recycle the waste?

Yes No

3. If you recycle the waste which types of waste do you separate?

- glass
- paper
- plastic
- metal
- organic matter

4. Do you think that the Brno/Vitoria-Gasteiz city council informs its citizens how to recycle and the ways in which urban waste is treated?

Yes No

5. Do you consider the city of Vitoria-Gasteiz to be developed in the field of waste management and sustainable development?

(1) not at all (2) a little (3) pretty much (4) very much

6. What would you like to change regarding the city council's communication with its citizens on the issue of urban waste treatment?

Free answer

7. How can you reduce the amount of waste that you produce on a daily basis?

Free answer

8. How would you motivate citizens to increase the separation of the household waste?

- competition in waste separation in schools
- environmental education, excursion
- penalty for failure to comply recycling
- so-called system of returnable packaging
- simplify the separation of introducing only two containers "dry" (all packaging, plastics, paper, cardboard, glass), and "wet" (kitchen waste and garden waste)
- other.



## Annex 2.

Measures implemented to decrease the amount of waste generated in Vitoria-Gasteiz (European Green Capital Award, online)

<b>1</b>	<b>Waste prevention and reduction programmes</b> <ul style="list-style-type: none"> <li>- promoting the re-utilisation and repair of bulky waste,</li> <li>- promoting the reutilisation of clothing via the Clean Points (fixed and mobile), three civic centres and six parishes,</li> <li>- on-site composting scheme (own composting in areas that generate high levels of organic waste such as the supermarket, shopping centres)</li> </ul>
<b>2</b>	<b>Pneumatic waste collection</b> <ul style="list-style-type: none"> <li>- Vitoria currently has six waste collection stations.</li> </ul>
<b>3</b>	<b>Door to door waste collection</b> <ul style="list-style-type: none"> <li>- specific service to collect certain materials such as glass, paper and cardboard, which are separated at source by larger commercial users.</li> </ul>
<b>4</b>	<b>Recycling centres “clean points”</b> <ul style="list-style-type: none"> <li>- council offers two Mobile Green Points that move around regularly to collect the items such as electrical equipment, furniture, textiles, dangerous or noxious household waste.</li> </ul>
<b>5</b>	<b>Outline management systems for hazardous waste from household</b> <ul style="list-style-type: none"> <li>- the collection of hazardous waste from households began in 1997 with the Mobile Green Points and consequently with the Clean Points.</li> </ul>
<b>6</b>	<b>Outline management systems to comply with EU WEEE Directive</b> <ul style="list-style-type: none"> <li>- since 2003, household appliances, computer and communications equipment are collected at the Clean Points.</li> </ul>
<b>7</b>	<b>Outline management systems to comply with EU end-of-life vehicles Directive</b> <ul style="list-style-type: none"> <li>- the pilot project to decontaminate abandoned vehicles began in 1997 and more than 5000 vehicles were decontaminated. Since then end-of-life vehicles have been left at Authorised Treatment and Decontamination Centres.</li> </ul>
<b>8</b>	<b>Outline management systems to comply with EU batteries Directive</b> <ul style="list-style-type: none"> <li>- batteries are collected in 170 sidewalk containers, 465 battery shops, civic centres and municipal buildings, as well as at three Clean Points.</li> </ul>
<b>9</b>	<b>Development of an integrated plant for construction and demolition waste</b> <ul style="list-style-type: none"> <li>- in 2007 construction and demolition waste plant was built to recover waste such as wood and metal. In 2008, were recycled 285.000 tonnes.</li> </ul>
<b>10</b>	<b>Development of a Mechanical Biological Treatment (MBT) plant</b> <ul style="list-style-type: none"> <li>- MBT plant processes 100% of the municipal household and commercial waste. It also produces electricity and in 2009, it supplied 75% of the electricity consumed by the plant.</li> </ul>
<b>11</b>	<b>Optimisation of the landfill site</b> <ul style="list-style-type: none"> <li>- the landfill site has been modified to fully meet the conditions of the EU directive on landfill of waste.</li> </ul>

12	<p><b>Awareness raising</b></p> <ul style="list-style-type: none"> <li>- since 2000, the city has set out regular campaigns to raise environmental awareness and to ensure that waste is minimised.</li> </ul>
13	<p><b>Regulatory and economic instrument</b></p> <ul style="list-style-type: none"> <li>- The Public Cleanliness and Collection and Transport of Waste Bylaw of Vitoria-Gasteiz (2007) oblige the public to separate waste flows at source.</li> </ul>
14	<p><b>Outline sustainability and climate change aspects of urban waste management plan</b></p> <ul style="list-style-type: none"> <li>- at-source separation (containerisation, door-to-door, clean points), allowing savings in raw materials and energy.</li> </ul>

### **Annex 3.**

Rates, description and quota of waste charge in Vitoria-Gasteiz (Vitoria-Gasteiz, online)

<u>Rate</u>	<u>Description</u>	<u>Annual Fee</u>
1-	Business activity, theaters, cinemas up to 100 m2	€ 57.97
2-	Business activity, theaters, cinemas of over 100 m2 to 200 m2	€ 92.81
3-	Business activity, theaters, cinemas of over 200 m2 to 500 m2	€ 144.97
4-	Business activity, theaters, cinemas of over 500 m2 to 1,000 m2	€ 231.91
5-	Business activity, theaters, cinemas of over 1,000 m2	€ 356.08
11-	Housing up to 120 m2 per cadastral unit.	€ 53.49
12-	Houses over 120 m2 to 200 m2 per cadastral unit.	€ 78.91
13-	Houses over 200 m2.	€ 100.93
19-	Trade, Office and teaching up to 25 m2	€ 80.15
20-	Commerce, office and teaching over 25 m2 to 50 m2	€ 120.21
21-	Commerce, office and teaching more than 50 m2 to 100 m2	€ 160.25
22-	Commerce, office and teaching more than 100 m2 to 200 m2	€ 256.38
23-	Commerce, office and teaching more than 200 m2 to 500 m2	€ 400.59
24-	Commerce, office and teaching more than 500 m2 to 1,000 m2	€ 659.69
66-	Commerce, office and education of over 1,000 m2	€ 1,314.12
31-	Banks and insurance up to 100 m2	€ 327.26
32-	Banks and insurance companies of more than 100 m2 to 200 m2	€ 523.69
33-	Banks and insurance companies of more than 200 m2 to 500 m2	€ 838.16
34-	Banks and insurance companies of more than 500 m2 to 1,000 m2	€ 1,380.38
67-	Banks and insurance companies of more than 1,000 m2 to 5,000 m2	€ 2,652.81
73-	Banks and insurance companies of more than 5,000 m2 to 10,000 m2	€ 5,305.62
79	Banks and insurance companies of more than 10,000 m2	€ 7,958.43
40	Power up to 50 m2	€ 112.46
41	Feeding more than 50 m2 to 100 m2	€ 224.94


42	Feeding more than 100 m2 to 200 m2	€ 388.20
43	Feeding more than 200 m2 to 500 m2	€ 676.46
44	Feeding more than 500 m2 to 1,000 m2	€ 1,321.07
69	Power over 1,000 m2	€ 2,887.60
46	Churches up to 120 m2	€ 54.47
47	Churches of over 120 m2 to 200m2	€ 76.27
48	Churches of more than 200 m2 to 500 m2	€ 92.67
84	Churches of more than 500 m2 to 1,000 m2	€ 326.82
85	Churches of over 1,000 m2	€ 653.64
50	Bars, hostels, hotels and similar to 50 m2	€ 140.82
51	Bars, hostels, hotels and the like of more than 50 m2 to 100 m2	€ 281.62
52	Bars, hostels, hotels and the like of more than 100 m2 to 200 m2	€ 450.65
53	Bars, hostels, hotels and the like of more than 200 m2 to 500 m2	€ 721.26
54	Bars, hostels, hotels and the like of more than 500 m2 to 1,000 m2	€ 1,187.88
70	Bars, hostels, hotels and the like over 1,000 m2	€ 2,770.74
55	Industries and Clinics to 50 m2	€ 140.82
56	Clinics industries and more than 50 m2 to 100 m2	€ 290.10
57	Clinics industries and over 100 m2 to 200 m2	€ 450.65
58	Clinics industries and more than 200 m2 to 500 m2	€ 704.09
59	Clinics industries and more than 500 m2 to 1,000 m2	€ 1,159.60
68	Clinics industries and more than 1,000 m2	€ 2,312.30
60	Restaurants to 50 m2	€ 168.95
61	Restaurants more than 50 m2 to 100 m2	€ 337.90
62	Restaurants more than 100 m2 to 200 m2	€ 543.92
63	Restaurants more than 200 m2 to 500 m2	€ 865.14
64	Restaurants more than 500 m2 to 1,000 m2	€ 1,424.93
71	Restaurants more than 1,000 m2	€ 2,815.13

## Annex 4.

Campaigns for recycling in the city of Brno (Sako, online)

# NÁPOJOVÉ KARTONY

**PATŘÍ DO TÉTO NÁDOBY**



Krabice od džusů, mléčných výrobků, vín a pod.

**PŘED VHOZENÍM STAČTE**


Nevhazujte obaly se zbytky nápojů!

Tříděním odpadu umožníte jeho další využití  
**DĚKUJEME VÁM, ŽE TŘÍDÍTE!**

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Sáčky, tašky, fólie

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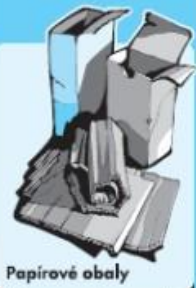
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# PAPÍR




Kancelářský papír, sešity



Papírové obaly

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Noviny, časopisy, reklamní letáky

Nevhazujte dětské pleny, uhlový, voskový, mokrý, mastný nebo jinak znečištěný papír.

Tříděním odpadu umožníte jeho další využití  
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SAKO

B | R | N | O | I

# INVAZE ZAČÍNÁ

CO BYCH SI  
DNES DAL?



**Třídoun modrohlavý**  
Separatus caeruleocephalus

**Snídaně:**  
Nakládané  
noviny  
a časopisy

**Oběd:**  
Krabice špičované  
lepenkou,  
obložené kartonem  
a s papírovými  
obaly

**Večeře:**  
sešity pasírované  
knihami  
bez tvrdé  
vazby

SAKO

B | R | N | O | I

# INVAZE ZAČÍNÁ

CO BYCH SI  
DNES DAL?



**Třídoun zelenohlavý**  
Separatus viridiscephalus

**Snídaně:**  
čiré sklenice  
od marmelád,  
zavařenin  
a kečupů

**Oběd:**  
drcené skleničky,  
lahvinku  
bílého skla

**Večeře:**  
Lahve od všech  
nápojů s přílohou  
z tabulového  
skla

SAKO

B | R | N | O | I

# INVAZE ZAČÍNÁ

CO BYCH SI  
DNES DAL?



**Třídoun žlutohlavý**  
Separatus flavocephalus

**Snídaně:**  
Sendviče  
z nápojových  
kartonů od džusu  
a mléka

**Oběd:**  
Mačkané PETky,  
omáčka z igeltek,  
sáčků a fólií

**Večeře:**  
Plastové výrobky  
na různé  
způsoby



## Annex 5.

Campaigns for recycling in the city of Vitoria-Gasteiz (Vitoria-Gasteiz, online)

### PAPEL y CARTÓN

**SI**

- Papel
- Cartón
- Periódicos
- Revistas

**NO**

- Envases de plástico, latas y briks
- Bolsas de plástico
- Papel de cocina usado
- Materia orgánica
- Vidrio

**¿Cómo depositar?**

- El cartón debe estar plegado
- Evita todo elemento que no sea de papel-cartón (grapas, portadas y caratillos de plástico...)
- No deposites bolsas de plástico

### ENVASES

**SI**

- Briks
- Envases de metal
- Papel de aluminio
- Envases de plásticos
- Envases de Porexpan
- Tapas, tapones y chapas
- Tubos de plástico (dentríficos...)

**NO**

- Cepillo de dientes y de peinar
- Cassetes, CD's y cintas de video
- Cartuchos y toners
- Biberones y pañales
- Recipientes reutilizables
- Guantes de goma
- Cubos y cazuelas
- Perchas y pinzas
- Juguetes

**¿Cómo depositar?**

- Los envases deben estar vacíos, enjuagados y plegados
- No introduzcas un envase dentro de otro
- Quita el tapón y deposítalo de manera separada

## VIDRIO

**SI**

- Botes de vidrio
- Frascos de vidrio
- Botellas de vidrio



**NO**

- Tapas, tapones, corchos y chapas
- Cristales de ventanas y espejos
- Bombillas y fluorescentes
- Cerámica y porcelana
- Cristalería (copas)





**¿Cómo depositar?**

- Vacíos y enjuagados
- Sin tapas, corchos ni tapones
- No deposites bolsas de plástico

## ORGÁNICO

**SI**

- Corchos
- Comida cocinada
- Comida no cocinada
- Restos de jardinería
- Papel sucio de cocina



**NO**

- Bolsas de plásticos
- Arenas de animales domésticos
- Paja
- Tierra





**¿Cómo depositar?**

- Utiliza siempre bolsas compostables
- Utiliza la llave que te entregaremos para abrir el contenedor
- Asegúrate de dejar el contenedor siempre bien cerrado