A thesis submitted to the Department of Environmental Sciences and Policy of Central European University in part fulfilment of the Degree of Master of Science

Municipal Solid Waste Management in Azerbaijan: Present Practices and Future Challenge

Sevil HAJIYEVA

July, 2009

Budapest

Notes on copyright and the ownership of intellectual property rights:

(1) Copyright in text of this thesis rests with the Author. Copies (by any process) either in full, or of extracts, may be made only in accordance with instructions given by the Author and lodged in the Central European University Library. Details may be obtained from the Librarian. This page must form part of any such copies made. Further copies (by any process) of copies made in accordance with such instructions may not be made without the permission (in writing) of the Author.

(2) The ownership of any intellectual property rights which may be described in this thesis is vested in the Central European University, subject to any prior agreement to the contrary, and may not be made available for use by third parties without the written permission of the University, which will prescribe the terms and conditions of any such agreement.

(3) For bibliographic and reference purposes this thesis should be referred to as:

Hajiyeva, S. Ch. 2009. *Municipal Solid Waste Management in Azerbaijan: Present Practices and Future Challenge.* Master of Science thesis, Department of Environmental Sciences and Policy, Central European University, Budapest.

Further information on the conditions under which disclosures and exploitation may take place is available from the Head of the Department of Environmental Sciences and Policy, Central European University.

Author's declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Sevil HAJIYEVA

TABLE OF CONTENTS

List of Tables

List of Figures

List of Abbreviations

AZN	Azerbaijan New Manat
CCA	Common Country Assessment
CoM	Cabinet of Ministers
CRP	Country Review Report
CTP	Cleaner Technology Program
DHCS	Department of Housing and Communal Services
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EPB	Executive Power of Baku city
ESP	Environmental State Program
FSU	Former Soviet Union
GoA	Government of Azerbaijan
GoN	Government of Norway
IDP	Internally Displaced Person
MED	Ministry of Economic Development
MENR	Ministry of Ecology and Natural Resources
MIE	Ministry of Industry and Energy
MoA	Ministry of Agriculture
MoH	Ministry of Health
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NEA	National Executing Agency
NEAP	National Environmental Action Plan
NGO	Non-Governmental Organization
NSDS	National Sustainable Development Strategy
PAB	Project Advisory Board
PEG	Project Executive Group
PMT	Project Management Team
PMU	Project Management Unit
RPF	Resettlement Policy Framework
RRR	Reduce Reuse Recycle
SSC	State Statistics Committee

SWD	Solid Waste Database
UNCED	United Nations Conference on Environment and Development
UNECE	United Nations Economic Commission for Europe
UNDP	United Nations Development Program
USD	United States Dollars
WtE	Waste to energy

Acknowledgements

First of all I would like to express my sincere gratefulness to my supervisor Professor Zoltan Illes for his guidance and constructive feedback, and to my external supervisor Dr. Telman Zeynalov for his valuable advices and permanent readiness to help.

Further, I want to express my extreme gratitude to all the Faculty and Staff of the CEU Department of Environmental Sciences and Policy for continued support and a warm atmosphere.

I would like to thank all the interviewees for their contribution: for their time and willingness to share their knowledge and ideas.

Last but not least, this work would have never been possible without the continued support and encouragement of my dear parents and my beloved husband.

CENTRAL EUROPEAN UNIVERSITY

ABSTRACT OF THESIS submitted by:
Sevil HAJIYEVA
for the degree of Master of Science and entitled: Sustainability of Municipal Solid Waste Management in Azerbaijan

Month and Year of submission: July, 2009.

Nowadays, amount of municipal solid waste is rising around the world. The problem that humanity faces is how to manage this waste in a way that there is a minimum negative impact on the environment. In Azerbaijan, this is also a critical issue, as current waste management practices fall behind the global standards and, as a result, have substantial negative effects on local environment and public health.

The main focus of the present thesis is to evaluate the current state of municipal waste management system in Azerbaijan, with a particular case of its capital, Baku.

As a result of comprehensive analysis of the collected data, the main existing barriers and constraints preventing from the sustainable development of the municipal waste management sector in the country are identified and grouped into the four following categories: technical, financial, institutional and social.

In this context, an adequate approach, including multi-step pathway to design a sustainable MSWM system compliant with EU standards, and thus aimed at the environmental and human health protection, is proposed.

The recommended actions are structured according to the priority principle and realistic timeframes within which they could be implemented taking into account specific local conditions of the country.

Keywords: Municipal Solid Waste Management, Sustainability, barriers and constraints, waste generation Azerbaijan, Baku.

CHAPTER 1: INTRODUCTION

1.1 Introduction and Background

Since the last few decades, rapid economic development, population growth and changing consumer behavior lead to considerable increase in total generation of solid waste. As a result, environmentally sound practices of constantly rising amounts of municipal solid waste became among the issues of priority concern in most countries. This called for establishment of the new policy and mechanisms to deal with solid waste problem.

The UN Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, proposed an integrated approach highlighting four main areas towards solution of the waste management problem: (i) waste prevention and reduction, (ii) maximizing waste reuse and recycling, (iii) minimize negative environmental impact of the system, (iv) ensuring environmentally sound waste treatment. Significant positive changes have been already achieved in many OECD countries, both in reduction of the total amount of municipal solid waste generated and ensuring more sustainable waste management practices.

However, waste management still remains to represent a serious environmental and health concern in all of the post Soviet countries and Azerbaijan is not an exception. The major problem is related to the fact that during Soviet times the concept of sustainable waste management was absent or was not perceived in its contemporary meaning. Consequently, Azerbaijan has no experience in sustainable waste management practices.

The overall situation with waste management in the country could be described as the following: lack of the national policy and strategy on waste management, insufficient local technical expertise, unclear responsibilities among different authorities responsible for waste

management, inefficient data collection, unsustainable waste collection, transportation and treatment, lack of economic instruments to incite waste generators to produce less waste, etc.

However, in the last few years, the government announced new waste management strategy in the country, as well as updated legislation, and established an individual body "Temiz Sheher" (Clean City) responsible for the strategic improvement of the overall current situation with solid waste management in the country. In addition to, several major projects are being prepared by the government and donor organizations, such as UNDP and World Bank.

In 2004, Azerbaijan was included into European Neighborhood Policy, taking over responsibilities towards improvement of the environmental protection in the country. Among other issues of environmental priority stated in the EU Neighborhood Policy, waste management system is one of the most priority ones.

Improvement of the waste management system in the country will not be an easy and rapid pathway. In order to establish waste management systems compliant with international environmental and health standards, high continuous efforts should be applied.

1.2 Aims and Objectives

The main objective of this thesis is to assess the current situation in municipal solid waste management sector, determine and analyze main barriers and constraints towards successful improvement of the current municipal waste management systems in the country.

In order to reach the primary objectives of the thesis, the following research questions will be addressed:

- What is the current situation in municipal solid waste management in Azerbaijan?
- What are existing primary barriers and constraints in municipal waste management sector?

- ❖ What particular measures should be taken in Azerbaijan in order to promote improvement of the situation?
- ❖ What are the specific benefits that these actions will bring?
- ❖ Which of these actions could be implemented in a short term and which in a long term, considering the specific local conditions and opportunities of the country?

1.3 Methodology

The thesis is structured around four main sections: a) current situation with MSWM in developed countries; b) current situation with MSWM in Azerbaijan, and c) analytical frame d) recommendations. Each of these stages involves the use of several tools, such as: data collection, site visits, interviews and data analysis, which are discussed in details below.

1.3.1 Data collection

Initial stages of the research included collection of the data related to the current waste management practices used in developed world. In addition to, in order to obtain a full picture of the present situation in municipal waste sector, the data related to current waste composition and waste generation trends in the world have been also obtained.

Most part of the literature materials used during the first stage of the research relates to the hard copy publications, scientific articles, internet sources and reports by International organizations, such as UNDP, World Bank, OECD, EIONET, EC, UNEP and others.

Essential part of the materials was obtained from the library of Central European University (CEU).

Second part of the research dedicated for exploring of the current waste management situation in Azerbaijan was also initially focused on collecting the secondary data. The collected materials have been mostly represented by the following: reports, publications, legislation and

policy documents, published survey results, journal articles, internet sources and projects information documents.

Significant published sources was obtained through the libraries of the: Ministry of the Ecology and Nature Protection, newly established "Temiz Sheher" governmental authority responsible for implementation of the new municipal solid waste management strategy, and Environmental NGOs (such as *"Sustainable Development Public Union", "National Center of Environmental Forecasting", "Independent Research Center – ELS" and "Ruzgar"*). Several sources were recommended and provided by the interviewees.

1.3.2 Site visits

The period between 16 May to 24 May was assigned for a field research in Baku. During this time, several field visits were conducted in order to observe current situation with municipal solid waste management practices in the country. Site visits were conducted to the main and the largest official city waste disposal site – *Balakhany Landfill,* as well as to several illegal dumpsites.

Non-participant observations were also used to observe municipal solid waste collection and transportation practices, as well as behavior patterns of the citizens towards the use of the waste separation containers placed in several places across the city.

Conducted site visits allowed to see the whole picture of municipal waste management system in the country as it is in reality and better understand and analyze data collected throughout the literature review and interviews.

1.3.3 Interviews

Taking into account the lack of the available secondary data reflecting the current waste management situation in the country, conducted personal interviews allowed to fill in these

gaps. Besides obtaining additional data on the current waste management situation from the interviewees, it was crucial to hear diverse knowledge, experiences and alternative viewpoints on the current state, problems and solutions towards sustainable municipal waste management practices in the country.

Primary data collection was organized through conduction of the eight personal interviews and two electronic communications with relevant stakeholders responsible for waste management.

Initial interviewees were chosen from the three main sectors involved in the processes of municipal waste management in the country, namely: governmental sector, international organizations and environmental non-governmental organizations (NGOs). Additional interviewees were selected based on the "snowball sample" technique. The list of interviewees is presented in Appendix 1 at the end of the thesis.

Most of the conducted interviews lasted about an hour, and were principally of a semi-formal or informal nature. Identified preliminary set of questions was different from one stakeholder to another depending on the institution that the interviewee represents, i.e.: governmental sector, International organization or NGO. The basic scheme of the questionnaire was constructed around the following main topics: 1) policy aspects; 2) legislation; 3) financial aspects; 4) control and monitoring of the waste management practices in the country.

In addition, several informal interviews were conducted with the households aimed at the better understanding of the citizens' view on the waste management system, in particular their opinion about present waste collection and transportation practices as well as their awareness level on the importance of sustainable waste management system and willingness to participate in the future waste separation schemes.

Conducted personal interviews considerably assisted in more deep understanding of the whole picture of the waste management sector, current obstacles and barriers existing, such as technical, financial, institutional and social, as well as helped to better analyze and understand which problems could be solved in a short term period, and which need much more time. In addition to, what solutions could be better applied and give more improvements from the realistic viewpoint, taking into consideration the specific local conditions of the country.

1.3.4 Data analysis

All the data collected during the different stages of the research was carefully examined and analyzed.

First of all, the analysis was based on the examination of the country waste policy and strategy, legislation and current municipal waste management system practices (starting from waste amount generation trends and composition to disposal), as well as ongoing projects aimed at the improvement of the existing situation.

Afterwards, analysis of the primary obstacles and barriers towards sustainable development of the waste management sector was conducted, involving technical, financial, institutional and social problems.

Finally, potential solution ways have been analyzed considering the world practices and taking into consideration the specific local characteristics of the country. As a result, priority actions have been proposed aimed at the considerable improvement of the current situation. Based on the realistic affordability, these actions have been divided as per short term, medium term and long term solutions.

In broad terms, the process of data analysis was mainly based on the Comparative and Gap Analysis method, which included dividing it into the smaller parts, examine them individually

and afterwards, compare them on main crossings and variations. Based on the final analysis, main recommendations and conclusion have been made.

1.4 Scope and Limitations

Several limitations have been encountered during this research. The major limitations faced throughout the research relate to the availability of the data related to the waste management sector in the country (such as waste generation trends, composition, etc.). Another problem was the reliability of the collected data, since sometimes different official sources reported significantly different data. In this cause, author attempted to make a comparison between as much sources as possible and to identify the most reliable data stated by the majority of the sources.

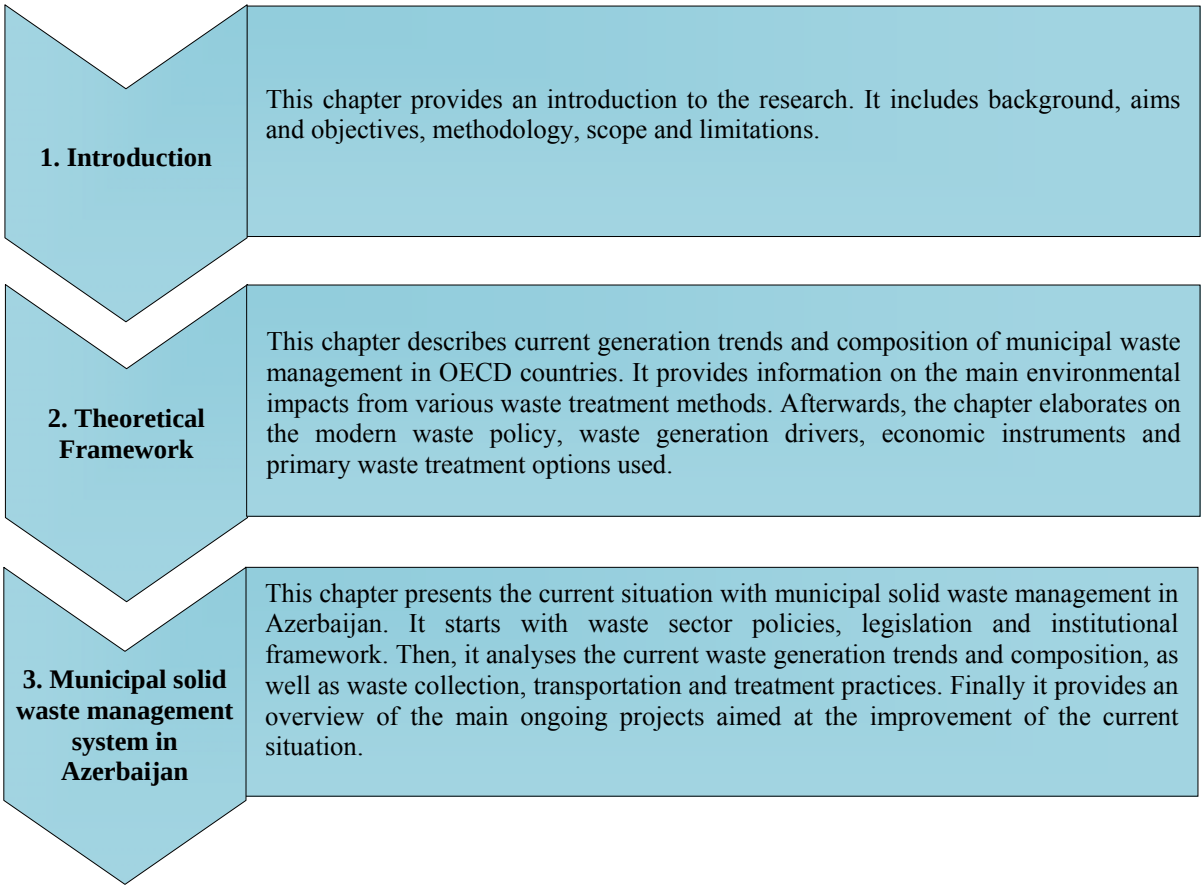
Another limitation relates to geographical boundaries, since the research was mainly structured around the capital of the country, Baku city. This is explained by the following reasons: 1) Baku is the largest city in the country with more than 30% of the total population, moreover the capital experiences constant flow of the people coming from different regions of the country with the purpose to find a better job and education here, so the total population is rapidly growing as well as the total GDP per capita causing considerable increase in the generated amount of the waste 2) most of the existing data on waste management in the country, such as waste generation trends and composition referred to the capital; 3) governmental power is concentrated in the Baku, and thus all the policies and strategies are adopted here by the local authorities ; 4) the problems of unsustainable waste management practices existing in the country are especially critical, since Baku is the economical, educational and industrial center of the country.

In addition, the fact that the author was born and has been living in the capital made it more feasible to evaluate and analyze current situation, as well as to identify relevant stakeholders.

Due to the fact that the scope of the study involves focusing on the situation in the capital, thus major part of the analysis and recommendations are also referred to the Baku. Consequently, the total situation in smaller cities and other regions may be somewhat different and therefore have other priority recommendations to promote change.

1.5 Thesis Structure

The following scheme describes the thesis structure with the brief outline of each chapter (Fig. 1).



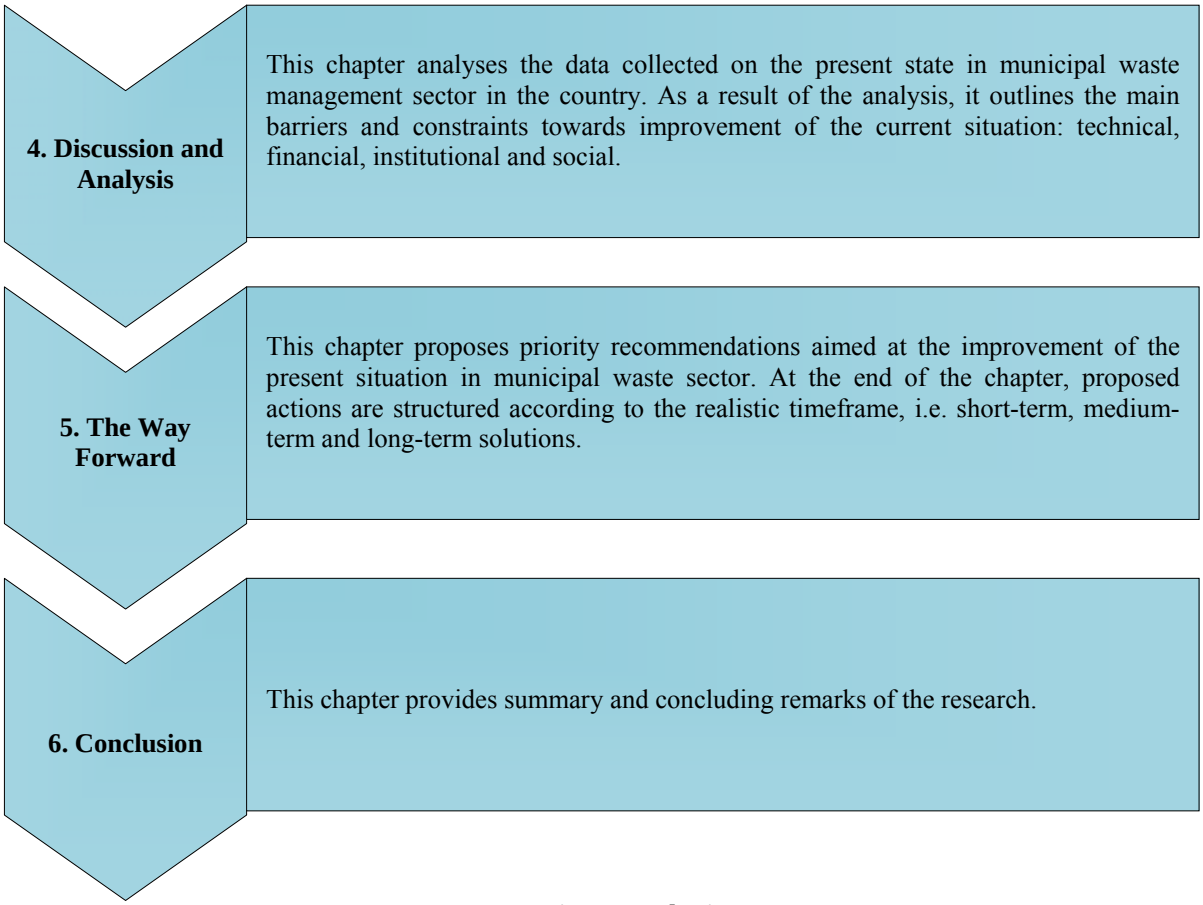


Figure 1. Thesis Structure

CHAPTER 2: THEORETICAL FRAMEWORK

2.1 Waste generation trends

It is a known fact that waste generation is having a tendency to increase along with the economic growth and development. The future forecasts are also unfavourable and it is expected that generation of both municipal and industrial waste will be further increasing.

Municipal waste is considered as a "traditional domain" in waste management , and therefore provide relatively the most reliable quantitative and qualitative data. However, the data collection system is still not perfect and there are some gaps preventing from the creation of a detailed exact picture of the current waste management situation in the world (European Comission 2003).

Municipal waste generation represents around 14% of the total generated waste (EIONET 2008). The Figure 1 presents the total municipal waste generated per person around different regions in the world in year 2002. The biggest amount of waste is currently produced in China where the biggest population lives. In 2004, the total generated waste in urban areas of China

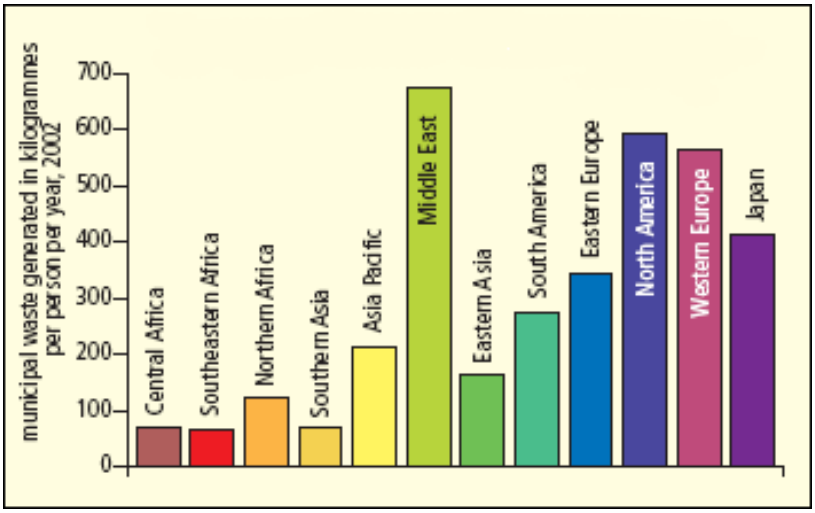


Figure 2. Municipal waste generation per capita across different world regions in 2002.

Source: World mapper 2002

was amounted to 190 million tones. According to the forecasts, this amount to be at least 480 million tons by 2030 (World Bank 2005). In terms of the biggest amount of the waste generated per person, Russian Federation is currently at the first place in the world.

In contrast, the least amount of the municipal waste per capita is produced in Madagascar, Burkina Faso, Nepal and Costa Rica (World mapper 2002).

Regarding the member states of the Organisation for Economic Cooperation and Development, many of them have been already shifted to so-called "waste hierarhy" approach, the main aim of which is to prioritize waste prevention.

It is noteworthly to mention that, nowadays, household participation in recycling schemes has reached its highest levels in many developed countries. However, in most of the developing countries, there are no significant improvements in the waste management systems due to the lack in financial capital designated for imrovement of the waste management infrastructure and technology.

Despite high efforts being taken in OECD countries to improve waste management systems, such as waste technology improvement, environmental awareness rising, waste fees increase etc., there is still a need in further urgent efforts.

According to OECD statistics, the total amount of generated municipal waste has been constantly rising starting from 1980, accounting to more than 650 million tones in 2006, which constitued around 560 kilograms of municipal waste per person (OECD 2008a).

Based on data presented in OECD Environmental Outlook statistics published in 2008, municipal waste generation increase rate within OECD region from 1980 to 2000 amounted to 58% which corresponds to an average of 2.5% per year, and 4.6% increase from 2000 to 2005.

Recent estimated projections provided by European Topic Centre on Resource and Waste Management suggest that total amount of generated municipal waste within the OECD region will increase by almost 33% during the period from 2005 to 2030 with the annual estimated increase amounted to 1.3% and the total estimated population number increase by 11% (OECD 2008).

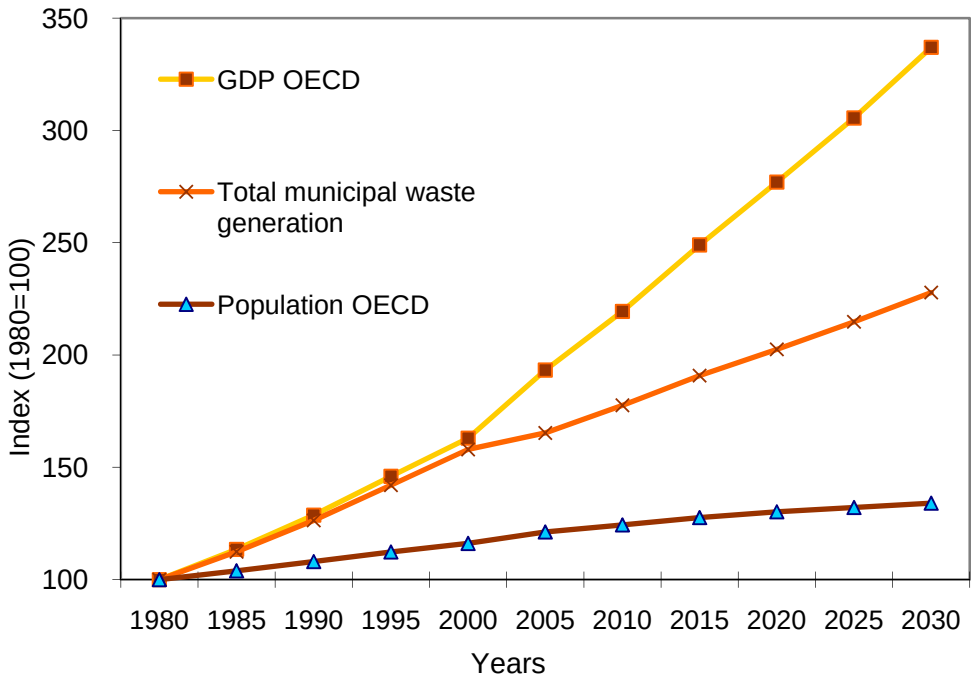


Figure 3. OECD country Municipal Waste Generation, 1980-2030

Source: OECD 2008

An average EU citizen within EU-27 produced around 522 kilograms of municipal waste in 2007 (Eurostat 2009).

The total generated amount and the composition of the municipal waste, however, is very different from one EU country to another and mostly depends on the consumption patterns, as well as on the local waste management practices. For example, according to Eurostat data, municipal waste production per capita in 2006 varied from 259 kilograms in Poland to 804 kilograms in Ireland (Fig. 4) (European Union Portal 2009).

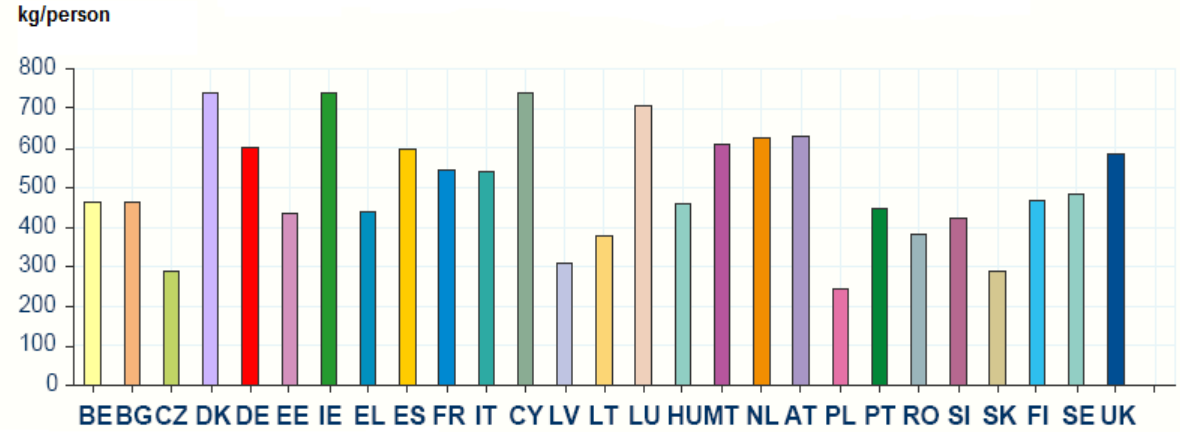


Figure 4. Annual Municipal waste generation in kg per person, EU-27

Source: European Union Portal 2009

In most European countries, the average share percentage of household waste within municipal waste is around 60 %, with the maximum 72% in Poland and a minimum 32% in Estonia (European Commission 2003).

When comparing the data on the total municipal waste generation rates between old and new

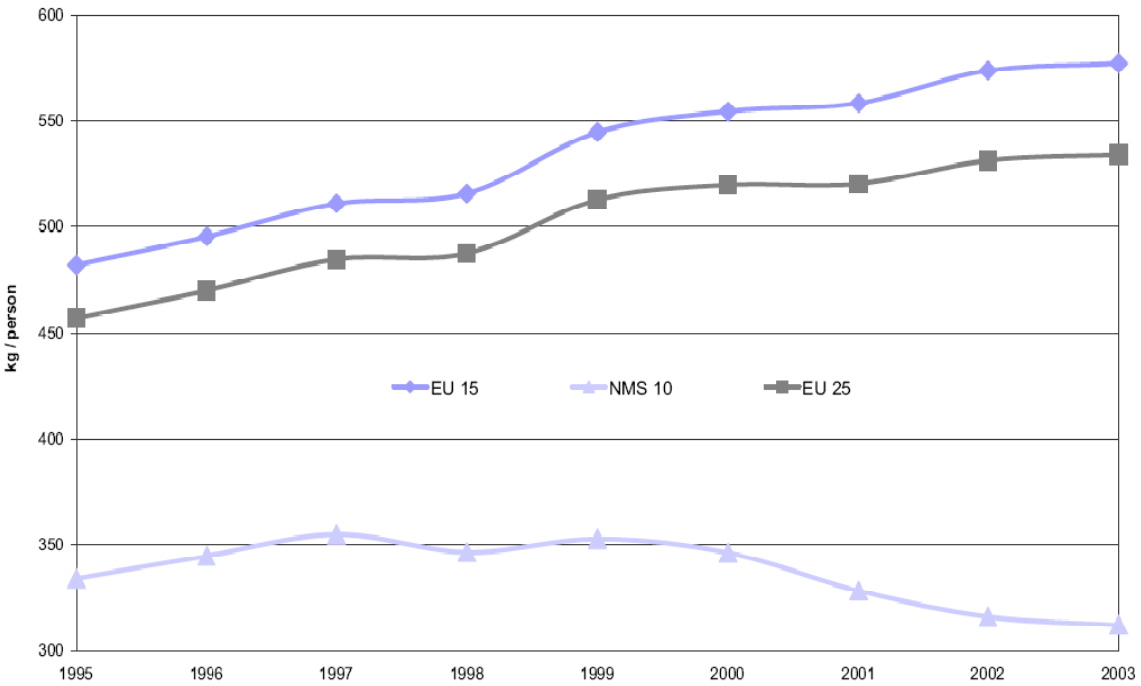


Figure 5. Generation of municipal waste in the European Union from 1995 to 2003 (kg/person)

Source: (European Commission 2005)

EU Member States, it can be concluded that the overall growth rate of waste generation comes as a result of the relatively high development rates occurring in the old EU Member States (Fig. 5) (European Comission 2005).

Total waste generation amount in EU 15 increased by 23 % from 482 generated kilograms per person in 1995 up to 577 kilograms in 2003.

In opposite to the above mentioned generated waste increase rates, the data for new EU Member States even suggests a slightly decreasing trend since 1999. For instance, while in 1995 total waste generation amounted to 334 kilograms per person, eight years later, i.e. in 2005 new EU Member States 10[1] produced only 312 kilograms of waste per person (European Commission 2005).

With regards to the estimated projections related to the EU member states, municipal waste generation rates are considered to grow even much faster than in OECD countries. It is estimated that the generation rates will increase up to 66% by 2030. The main rationale for such a high rated projections was the estimated increase in the total final private consumption rate or its subcategories, such as beverages, food and etc.

This is evidenced by the fact that not only the total weight of the municipal waste is rising,

which could be explained by the population growth factor, but also the total amount of generated waste per person is constantly growing (OECD 2008).

2.2 Waste composition

The composition of municipal solid waste experiences significant changes over the time. It also noticeably depends on on the consumption patterns.

[1] The NMS 10 - countries that became members of the European Union (EU) in 2004: Poland, Czech Republic, Slovakia,Hungary, Slovenia, Estonia, Latvia, Lithuania, and the island nations of Cyprus and Malta

The Figure 6 presents data on the average municipal waste composition in the world expressed as the percentage share of different waste materials based on the total weight (EIONET 2008).

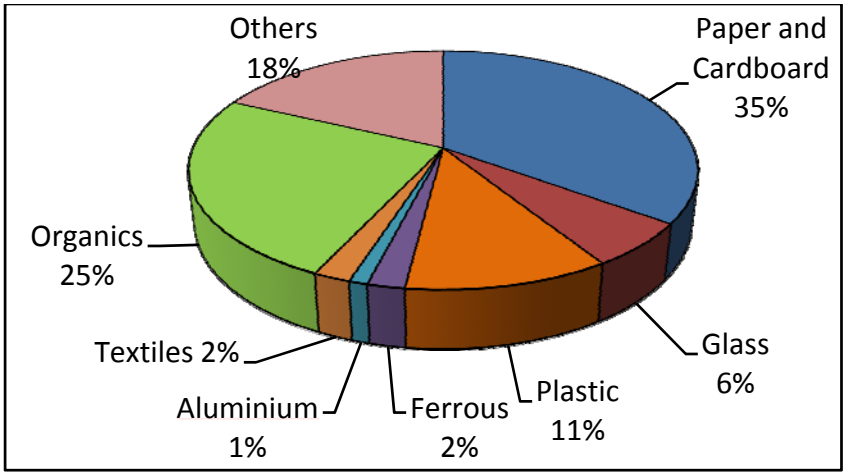


Figure 6. The composition of the average municipal waste stream around the world

Source: EIONET 2008

However, it is worth to mention, that this is rather estimated and approximated given the fact that the actual methodology that used to obtained the data may vary significantly from one country to another, as well as due to the substantial problems related to adequate waste related data collection and storage , still existing in many countries Therefore, different used methods may differently influence the final provided statistics (European Commission 2003).

Nevertheless, the dominant components in the municipal waste are usually paper and cardboard fractions (35%) followed by organic compounds (25%).

As can be concluded from the presented graphics below, the main difference between Western European countries and new EU Member States with regards to the municipal waste composition is in the share of paper and organic materials. While in the Western European Countries, paper and cardboard accounted for almost a 25% from the total municipal waste composition, in the new Member States this share stands only at 14%. In contrast, the share for the organic waste compounds is almost twice higher in the new Member States than in the

Western European Countries, referring to 43% and 27% accordingly (Fig. 7) (European Commission 2003).

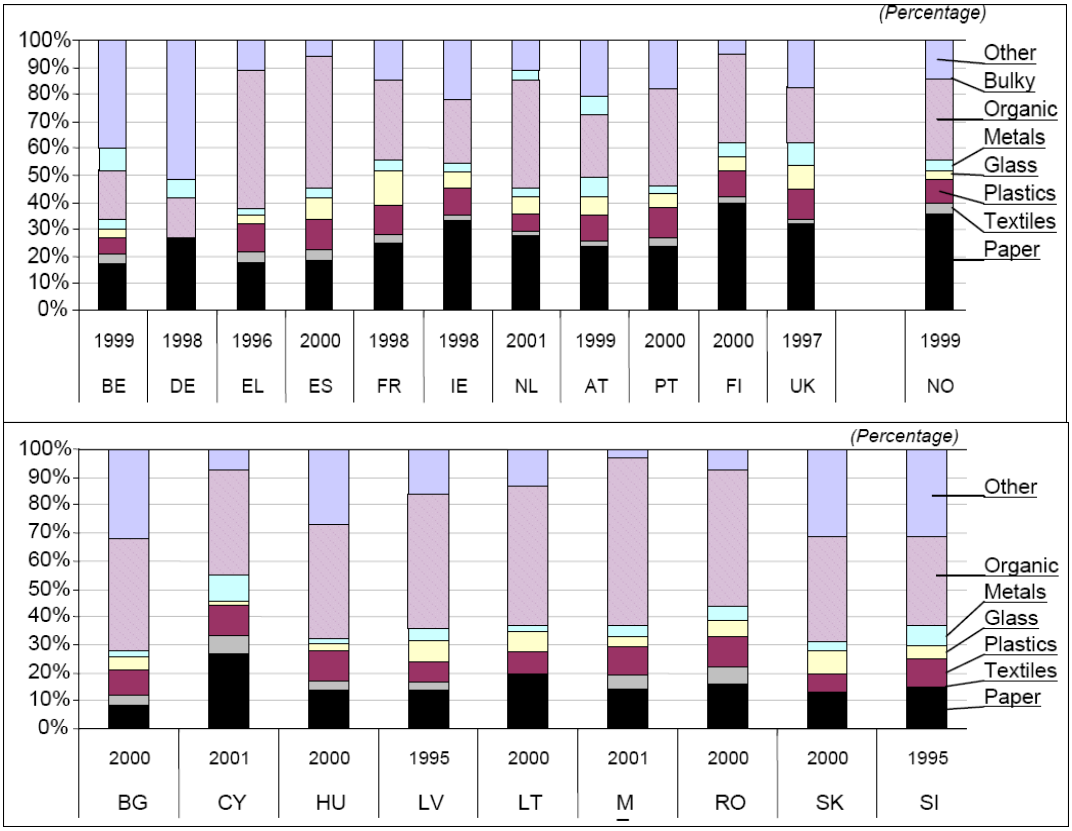


Figure 7.Comparison of municipal waste composition between Western European countries and new EU Member States[2]

Source: European Commission 2003

At the national level, organic waste compounds can be accounted up to half of the total municipal waste share, as for example in Spain and Greece, as well as much lower percentage ,as in Belgium – only 18% of the total share. As for paper waste, the composition varies between the highest share in Finland (accounts up to 40%), and the minimum share in Belgium with only 17%.

There is a distinguished trend towards increase of the packaged household goods, including pre-packed food, as well as service packaging (OECD 2002).

[2] In the original document, new EU member states are mentioned as "candidate countries" since they had not been yet entered EU by that time.

It is also noteworthy to mention that waste composition is considered as an important factor which is used for selection of the appropriate waste management options design, such as reuse, recycling, energy recovery and safe disposal.

2.3 Environmental impacts of household waste management

Since it is difficult[3] to provide the comparative assessment of the environmental impacts of the waste management system, thus only general environmental impacts related to waste generation and treatment will be discussed below.

2.3.1 Air Pollution and Greenhouse Gas Emissions

From environmental perspective, waste incineration causes significant emissions into the air.

Among the major air pollutants emitted through the waste incineration are the following: acidic gases, dioxins and furans, poly-aromatic hydrocarbons, heavy metals and dust (OECD 2001). There was a significant reduction in the level of emissions from incinerators in the EU after 1990 following from the the closure of many small incinerators and the introduction of the new cleaner technologies, such as higher temperature incineration that reduce the amount of the emitted toxins.

Apart from the fact that waste incinerators reduce the total mass of the waste for up to 70%, they are widely used for the energy recovery. In addition they reduce the negative effects of the methane gas emissions that are released when the waste is simply dumped into the landfill. Nevertheless, waste incineration is still highly criticised as the waste treatment

[3] Many approaches for comparative assessment of the environmental impacts of the waste management have been developed back in the late 1960s. Today there are great variations of the standards, methodology and approaches (e.g. Life Cycle Analysis) to evaluate the environmental impacts of a product, but still yet no common agreement exists on the best available methodology . They vary from one country to another and from institute to institute. The OECD and the EU are continue to work towards the harmonisations of these issues (OECD 2002).

method due to the high environmental burdens caused by flue gases (e.g., carbonates, NOx, Sox and dioxins), toxic solid residues, such as fly ash, flue gas gypsum, slag and ashes containing heavy metals, fluorides and chlorides, as well as the high waste management fee for the inhabitants as the result of the high technology investment fee (Lorek et al 2001).

Landfills are known as significant contributors to the greenhouse gas emissions. For instance, in 1998, total amount of the waste derived methane emissions in OECD countries was approximated to 34 % of the total methane emissions.

Based on the data provided by OECD Environmental Outlook, it is expected that amount of the methane emissions derived from the waste will raise by up to 20% starting from 1995 to 2020. It is forecasted that waste derived methane emissions will increase by 140% in non-OECD countries over the same time period as landfilling is expected to remain the main and, often, the only available waste disposal method (OECD 2001).

2.3.2 Soil and Water Pollution

In addition to air pollution, soil and water pollution also constitutes environmental and health problems associated with the inadequate methods of the waste treatment. The problem aggravates by the fact that the contamination of the soil and water often leads to the soil degradation and groundwater pollution. The level of these problems usually varies depending on the different parameters, such as waste type, construction type and geological conditions of the landfills.

Direct waste disposal or waste disposal into the land methods that do not meet environmental requirements lead to the leaching of the toxic substances and nutrients. This in turn leads to ground and surface waters contamination with the toxic chemicals and heavy metals.

New generation of the modern so-called "sanitary landfills" are designed, constructed and operated in a way that allow solid waste to be disposed using such sanitary techniques as waste compaction and covering so to avoid leaching of the toxic substances to the ground waters. In addition to, some of the sanitary landfills are also equipped with the pipeline system that allows collecting methane and carbon dioxide – product of the waste decay, thus reducing the amount of the greenhouse gas emissions (UNEP 2005).

2.4 Municipal Waste generation drivers

Waste generation patterns are usually the result of a set of specific driving factors. The following factors are accounted to be the most crucial drivers: 1) economic drivers (economic growth and household income); 2) demographic and cultural drivers; 3) environmental awareness level; 4) technology and infrastructure for waste management. Moreover, there are additional drivers that contribute to waste generation reduction, such as, for example, products eco-design and availability of recycling facilities. In this regard, technology and infrastructure for waste management are crucial drivers that allow more effective waste management by the means of better waste separation, recycling and disposal.

In this section specific drivers for waste generation and waste management will be discussed.

2.4.1 Economic drivers

While there are many different factors that constitute the demand for goods and services,

household income and products and services prices are major determinants that shape this demand level.

The stable economic growth after the Second World War, trade globalization and rapidly spreading information technology incited the growth of the consumption level per capita, and thus resulted in the increasing level of the generated municipal waste (Harjula 2001).

Despite the fact that nowadays waste treatment systems are considered to be more environmentally sustainable, however the total amount of generated municipal waste not only is not reducing, but also is constantly growing.

The case study from the Netherlands, as seen from the illustrated graph below, shows that while consumption rates were noticeably increasing from 1985 to 1999, the total amount of the disposed waste remained almost stable (Fig. 8).

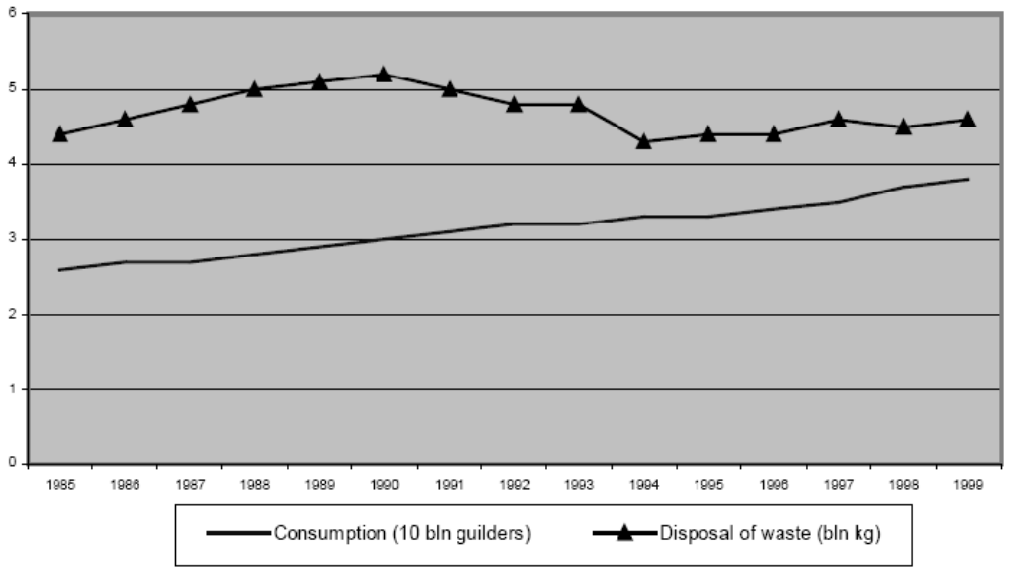


Figure 8. Consumption and Disposal of Household Waste in the Netherlands

Source: OECD 2002

This is due to the fact that the percentage of the recycled waste was significantly increased over the years, however the total amount of the generated waste was constantly increasing.

On the contrary, economic growth not only stimulates the private consumption and thus increase in the waste generation, but also allows for the better development of cleaner production technologies and better waste management technologies.

This is proven by the evidence that many developed countries have already shifted from landfill options to a more sustainable resource recovery options.

Increase in household income results in "better purchasing decisions" meaning that higher-income citizens prefer to buy so-called "green products" (products with fewer packaging, recycled and recyclable products, etc.). However, this tendency is not regular and may vary from one country to another (OECD 2002).

2.4.2 Demographic and Cultural drivers

Many socio-cultural factors may have an influence on the generation and management of household waste. Among these factors are those related to demographic trends, such as population age and structure, number of single households, work hours, etc., as well as level of education, cultural values, mentality and level of the environmental awareness.

According to Dutch study, different socio-cultural characteristics, in particular age structure has proven to account for significant changes in waste separation behavior. It was found that citizens that represent older generation usually acting with much higher responsibility towards waste separation rather than citizens representing younger age groups.

For instance, a study conducted in Germany[4] showed that 92% of the population in the over-thirties age range separates their waste, while this figure is only 87% for the 16-29 year olds. The study also reported that there are gender variations in waste separation behavior: women were found to be more enthusiastic and responsible separators rather than men. Another interesting finding is that families are considered to act in a more environmentally friendly manner in comparison with the single people – while 93% of the families separate the waste, for single people this figure account only for 84% (OECD 2002). Furthermore, Wierenga

[4] Source: DSD, Der Grüne Punkt (2001), Ressourcen und Mengenstomnachchweis 2000, Köln, Germany. (As cited in OECD, 2002).

shares interesting facts related to the correlation between two-earner small families and demand for "away from home" options, or alternatively, time saving food products consumption. As a result, there is a decrease in the organic compounds in the household waste stream, and the increased rate of the packaging production for the pre-prepared food.

2.4.3 Environmental awareness level

Environmental awareness level is a crucial factor that leads to the reductions in the generated amount of waste by means of the consumers' encouragement to buy "green products", i.e. products with less packaging, recycled or products that could be recycled, etc. (Chappells *et al* 2000).

Significant efforts towards increasing recycling rates in the developed world nowadays are associated as an environmental symbol. According to Dutch survey that was aimed at testing environmental behavior of the citizens, most of the respondents reported their involvement in the environmental sustainability actions through active participation in the waste prevention and recycling schemes (OECD 2002). Based on the data presented in another Dutch report[5], there is a strong link between environmentally friendly behavior and environmental awareness of the citizens. Despite the fact that environmental awareness level plays an important role in stimulating people towards more "environmentally friendly" behavior, experience from many countries show that provision of an effective infrastructure for recycling opportunities that does not provide high opportunity costs to households much stronger affects environmental behavior in comparison with the environmental awareness.

[5] Source: Sociaal Cultureel Planbureau (SCP) (1999), Verspilde Energie? – Wat doen en laten Nederlanders voor het milieu?, Den Haag. (As cited in OECD, 2002).

2.4.4 Technology and infrastructure drivers

The provision of the effective recycling infrastructure is a fundamental factor that determines citizens' participation in the household waste recycling. The following are two main systems for household waste collection: so-called "collect systems" and "bring systems".

"*Collect systems"* means that waste is collected at the household door, either mixed or sorted. In many developing countries, there is still no infrastructure for sorted waste collection, and the waste is collected unsorted.

Those countries that have their recycling infrastructure in place, mostly developed countries, ask their citizens to sort their waste at home by putting it into a different waste bins. The separated waste is then collected by the municipality or private companies.

"Bring systems" represent the method when citizens are asked to put their waste in specific containers differentiated according to the waste materials, such as glass, paper, plastic, textile, etc . Moreover, there are central waste collection stations that are specifically designated for all other kinds of the waste, such as toxic, bulky waste, etc.

An adequate provision and comfortable location of the containers has an important influence on the citizens' willingness to act environmentally friendly, i.e. actively participate in the waste separation and recycling activities. It is known that usually the participation level is decreasing when there is a need in further efforts, such as longer distance to waste collection centers, etc. (OECD 2002).

Table 1 below is briefly summarizes the influence of the main drivers on the waste generation and waste management, in particular, recycling activities.

Table 1. Drivers for household waste generation and waste management (recycling)

Driver	Waste generation	Waste Management (Recycling)
Economic Growth	+/-	Better opportunities for cleaner technologies and more effective waste management systems. Less amount of waste is disposed as a result of higher waste recovery rates. More waste is generated as a result of the increased private consumption.
Technology and Infrastructure for waste management	-	Adequate waste management technology and infrastructure leads to the improvement in the recycling schemes. Eco design of the products also decreases the amount of the waste.
Environmental Awareness Level	-	Plays an important stimulus role to encourage people to act in a more "environmentally friendly" way, i.e. buy "green products", participate in recycling schemes, etc.
Demographic and Cultural drivers (population growth, more/less hours of work, more single households, cultural values, etc.)	+	Results in increase of the pre-prepared food consumption, packaged products, and the total amount of the generated waste.

(+) more waste, (-) less waste

Source: Adopted from OECD 2002

It can be concluded from the table that as different drivers exist that influence waste generation and waste management, they can have either or both positive and negative effect.

Economic growth is considered as a factor that leads to more effective waste management options, as well as has better premises for reduction of the total disposed amount of the waste through effective recycling schemes. On another hand, economic growth and the increased household income results in the increased level of the private consumption, thus ends up with higher amount of the generated waste.

Demographic and cultural drivers, such as population growth, increased number of single households, more or less work hours, labor force are known to significantly influence

environmental behavior, and usually are considered as drivers for the increased waste generation.

Environmental awareness is an important driver that plays a crucial role in inciting people towards waste generation reduction behavior, as well as increase the level of participation in recycling activities.

And finally, technology and infrastructure drivers that are critically important elements for the better waste management. These drivers constitute the major element that determines household participation rates in recycling schemes.

It is very important for development of the effective waste management scheme to bear in mind these main drivers that could differently affect the waste generation and management issues, and more importantly, to take into consideration all of the possible factors and effects that they could lead to in a different circumstances.

2.5 Policy responses towards waste prevention and waste management

The success of any policy related to waste management and recycling primarily depends on the behavioral change of producers and consumers. It is known that authorities can influence the changes in the behavior through the introduction of different policy instruments.

While there is still no standardized and generally-accepted classification of the waste management policy instruments, the following three categories, though, could be considered as main ones (Opschoor and Turner 1994):

- *Direct Regulatory Instruments,* (alternatively called "command and control" regulations): influence the selection of alternatives by means of permission, prohibition, standard setting and enforcement, as opposed to economic instruments.

- *Economic Instruments:* fiscal and other economic incentives and disincentives that include environmental costs into the budgets of households and enterprises.

- *Communicative Instruments:* instruments that transfer knowledge for the purpose of informing, convincing, encouraging or tempting citizens to act in favor of the environment, i.e. buy products that pollute less, with less packaging, recycled products or products that could be reused or recycled, etc.

It is obvious that there is a need in an integrated approach (taking into account all the product life cycle phases and all relevant stakeholders), meaning the combination of the policy packages and selection of the relevant policy approach depending on the different cases. This approach not only includes environmental concern, but also considers financial, socio-economic, and technical aspects. Germany and Netherlands have been good examples of implementation of the integrated approach, covering entirely the whole "waste chain" and keeping all relevant stakeholders involved (OECD 2002).

The following four principles are the main current principles on which EU approach to waste management issue is based (EC 1999):

- *Waste Prevention principle – waste generation must be reduced and avoided where possible ;*
- *Extended producer responsibility (EPR) and polluter pays principle – those who produce waste or pollute the environment should bear the full cost of their actions ;*
- *Precautionary principle – when an activity raises threats of harm to human health or to environment, potential problems should be anticipated and precautionary measures should be taken ;*

❖ *Proximity principle – waste should be disposed of (or otherwise managed) as close to its place of generation as possible, thus aiming to achieve reduced waste movements and improved waste transports regulation.*

In 1996 these principles served as a base for the formulation of the EU hierarchy of the waste management operations (Fig. 9).

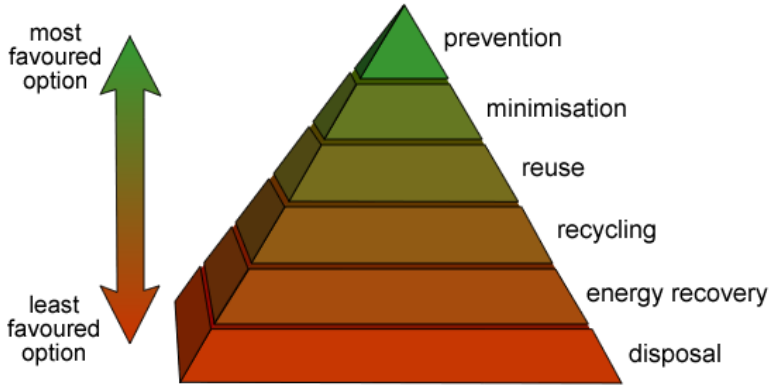


Figure 9. Waste management hierarchy

Source: Waste Online Information Library 2006

It is now widely implemented in the developed world, notably in the Scandinavian countries, as well as in Germany and Netherlands (OECD 2002).

Even though the waste management hierarchy has taken many different forms over the past decade, the main concept has remained the same, aiming to get as much practical benefits from products as possible, as well as to reduce the generated amount of waste to a minimum.

As it is not always possible to avoid the generation of waste and provide its reuse after initial use, the next relevant solution in the waste hierarchy is recycling. Recycling of the waste materials reduces the consumption of the energy, water and other resources needed to produce new materials, as well as it reduces the amount of greenhouse gas emissions (European Comission 2003). For instance, it has been calculated that recycling 1000 kilograms of

aluminium cans saves from mining up to 5000 kilograms of bauxite ore. Moreover, it saves 95% of the energy needed to refine it (Soni 2007). And only in the case if all the above mentioned options are not able to be implemented, the least favorable options, such as incineration with energy recovery and disposal should be considered.

Next in this section three main policy instruments for municipal waste prevention and management (*direct regulatory, economic and communicative)* will be further discussed and analyzed in more details.

2.5.1 Direct Regulatory Instruments

Direct regulatory instruments are known to be the key elements used towards reduction of the waste generation and waste management improvement.

The installation and operation of waste management facilities are usually regulated by legal requirements that are set to limit and minimize pollutants emissions. In addition to, numbers of regulations have been set to reduce the generation of packaging waste, limit the toxic heavy metal contents in batteries, as well as to safe waste collection and final disposal. During the recent decades, these regulations have been strengthened in most of the OECD countries. Despite this fact, there is a need in stricter monitoring over the waste management facilities and treatment methods in order to ensure that they are completely compliant with regulations (OECD 2001).

The OECD member countries adopted several Council Acts advocating for economically efficient and environmentally friendly waste treatment, among them: "Comprehensive Waste Management Policy" adopted in 1976 and "Integrated Pollution Prevention and Control" adopted in 1991. In 1994, EU member states adopted *Packaging and Waste Packaging Directive,* highlighting boundary conditions and objectives to be transported into national legislation. The primary goal of this Directive was the reduction of the packaging waste in

Europe by 50% by 2001, and this goal was successfully achieved (Council Directive 1999/31/EC)[6].

The last amendment of the Directive made in 2004 sets out the following targets for the member states:

- ❖ "no later than 31 December 2008 60 % as a minimum by weight of packaging waste will be recovered or incinerated at waste incineration plants with energy recovery;
- ❖ no later than 31 December 2008 between 55 % as a minimum and 80 % as a maximum by weight of packaging waste will be recycled;
- ❖ no later than 31 December 2008 the following minimum recycling targets for materials contained in packaging waste will be attained:
- ✓ 60 % by weight for glass;
- ✓ 60 % by weight for paper and board;
- ✓ 50 % by weight for metals;
- ✓ 22,5 % by weight for plastics, counting exclusively material that is recycled back into plastics;
- ✓ 15 % by weight for wood" (Council Directive 2004/12/EC)[7].

Another EU waste related policy directive that worth a mention is the *Directive on Landfill of Waste* aiming to prevent or reduce negative impact on the environment and human health caused by landfilling of the waste. This Directive sets out the obligations for the member states to establish national strategies towards the reduction of the landfilled biodegradable waste, as well as indicating the precise targets that member states are expected to achieve (OECD 2007). By 2016, member states are required to reduce the absolute amount of the

[6] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste. *Official Journal L 182 , 16/07/1999 P. 0001 – 0019*

[7] Council Directive 2004/12/EC of 11 February 2004 is the amendment of the Council Directive 94/62/EC on packaging and packaging waste.

biodegradable municipal waste to 35% of the total amount of the biodegradable waste generated in 1995 (Council Directive 1999/31/EC).

The Incineration Directive adopted in 2000 unifies three previous Directives related to the waste incineration (Council Directive 94/67/EC[8], Council Directive 89/369/EEC[9] and Council Directive 89/429/EEC[10]). The primary aim of this Directive is "*to prevent or to limit as far as practicable negative effects on the environment, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste*" (Council Directive 2000/76/EC)[11]. In order to fulfill the requirements set by the Directive, member states are required to follow a number of procedures and to comply with emission standards set for waste incinerators, specifically those relating to the dioxins, SO_2, NO_x, mercury and other heavy metal concentrations. The Incineration Directive also stresses out certain obligations on the monitoring, control and measurements for incineration facilities.

The attention should be also given to *The Framework Directive on Waste* adopted in 1975 which provides uniform definition of the certain terms used in other waste directives. The Directive obligates the member states to incorporate the so-called "waste hierarchy" into the national legislations (OECD 2007).

Among other EU Directives relevant to the household waste management, the following Directives can be also mentioned:

[8] Council Directive 94/67/EC of 16 December 1994 on the incineration of hazardous waste (OJ L 365, 31.12.1994, p.34).

[9] Council Directive 89/369/EEC of 8 June 1989 on the prevention of air pollution from new municipal waste incineration plants (OJ L 163, 14.6.1989; p. 32).

[10] Council Directive 89/429/EEC of 21 June 1989 on the reduction of air pollution from existing municipal waste incineration plants (OJ L 203, 15.7.1989, p. 50).

[11] Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste**.** *Official Journal L 332 , 28/12/2000 P. 0091 – 0111*

- Council Directive 91/157/EEC[12] on batteries and accumulators containing certain dangerous substances ;
- Council Directive 2000/53/EC[13] on end-of life vehicles ;
- Council Directive 2002/96/EC[14] on waste electrical and electronic equipment ;
- Council Directive 2002/95/EC[15] on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

2.5.2 Economic Instruments

Different kinds of economic instruments usually play an important role in reduction of the generated waste and general improvement of the waste treatment methods. Economic instruments can vary from those encouraging waste prevention (such as packaging taxes, waste collection charges, etc.) to those that discourage the least desirable disposal practices (such as landfill practices).

Among the most commonly used and the most effective economic instruments are *taxes* and *fees* on municipal waste collection. Despite these instruments do not influence significantly an individual behavior, however they have already proven to lead to financial improvements in the technology and the organization of the municipal waste management, thus facilitating the increased waste recovery and reduced environmental impact.

[12] Council Directive 91/157/EEC of 18 March 1991 on batteries and accumulators containing certain dangerous substances. *OJ L 78, 26.3.1991, p. 38–4.*

[13] Council Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles - Commission Statements. Official Journal L 269 , 21/10/2000 P. 0034 – 0043

[14] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) - Joint declaration of the European Parliament, the Council and the Commission relating to Article 9. Official Journal L 037 , 13/02/2003 P. 0024 – 0039

[15] Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Official Journal L 037 , 13/02/2003 P. 0019 - 0023

In addition to the taxes and fees, the followings are also considered as economic instruments used for the waste generation reduction and improvement of the municipal waste management: *Deposit-Refund-Scheme (DRS)*, *Pay as You Throw* (PAYT), and *Tradable permits* for municipal waste (OECD 2002).

Fees and Taxes on Municipal Waste

There are different types of waste fees, among them are the following: general taxation regimes, specific taxes, fixed and general variable fees and variable fees linked to the waste production (ACR 2001). In Germany and Netherlands, fees collected from citizens are used to cover waste management systems' public expenses. While this system allows covering the existing waste management systems expenses, it does not provide a lot of incentives for the waste prevention.

As was previously stated, the main economic instruments aimed at reduction of the municipal waste generation are collection and disposal fees, especially in cases when the fee depends on the total amount (weight or volume) of the generated waste. Moreover, it is generally observed that households do not have much incentive for reduction of the waste generation due to the fact that they often are not aware of the waste fees or perceive them as negligible. Based on that, it seems reasonable to put taxes on products packaging rather than on waste. This will give a chance to consumers to choose themselves products with less packaging, and therefore will contribute to waste reduction. Germany and Netherlands have been succeeded so far in moving towards this direction with a planned tax on plastic bottles (Porter 2002).

Different kind of taxes can be also applied in landfilling and incineration. The main goal of these taxes is providing municipalities or private companies with economic incentives for waste recovery (re-use and recycling). In cases with landfill taxes, it is very important to ensure that waste producers and operating companies are provided with an adequate access to

alternative waste treatment options, otherwise the effectiveness of the landfill tax as a tool may not be proven.

Another important point related to economic incentives for incinerators to contract as much waste as possible. In case if the same parties involved both in waste incineration and waste collection, this will leave no incentives for them to perform waste reduction initiatives (OECD 2002).

Pay as You Throw (PAYT)

PAYT, alternatively called unit-based pricing, is a model for municipal solid waste management. According to this model, waste producers are charged a waste fee based on the total amount of waste discarded, rather than paying a fixed residential fee providing a direct economic incentive to reduce waste (Batllevell and Hanf 2008).

There are three main systems of PAYT model (Kelleher *et al.* 2005) :

- *Full-Unit pricing* – residents pay in advance for all the waste that they want to be collected based on the selected size waste containers or bags ;
- *Partial-Unit pricing* – municipality sets the fixed amount of waste per household that could be managed without advance payment. If the resident exceeds this amount, he/she is required to purchase additional waste bags or containers ;
- *Variable-Rate pricing* – householders are allowed to choose for rent waste containers of different sizes with the price based on the total amount of the generated waste. This program is considered as effective as it influence householders' behavior in a way that he/she adapts the consumption rates to fit the size of the waste container that they rent.

While research show that "tariff differentiation" improves waste reduction, there is also a risk that "public resistance" may take place resulting in the illegal waste dumping.

The positive experience in many countries shows that additional programs, such as awareness increase, recycling, and waste separation can have a positive influence on PAYT effects on waste reduction, reuse and discourage illegal dumping. Even though the success rate of the PAYT program varies across different countries, there are some impressive achievements that worth to be mentioned. According to different studies comparing the situation in Europe before and after the implementation of PAYT scheme, it has been found that source – separated waste material to rise at rates of 70% and more (Bilitewski *et al* 2004). Among remarkable achievements in increasing recycling rates, it can be appropriate to mention the example of Ireland: current recycling rates reaching 40% of the total collected waste to a rate of total reported landfilled waste of 90% in year 2000 (Ireland Presidency of the EU 2004). According to one successful example cited in OECD report, after just a year after the start of the PAYT program implementation in 2005, in small town Prejta in Slovakia, the total amount of municipal waste reduced by nearly 80%. Moreover, there have been significant improvements in source separation rated for recycling by residents (US EPA 2006).

According to Freeman and Kolstad (2007), PAYT communities on average report about 16-17% reduction in the waste amounts, including considerable increases in waste recycling.

To summarize, the overall influence of the PAYT scheme could be ranging from the significant waste reductions, higher transparency and reduced waste disposal costs and increased recycling rates to general environmental awareness increase.

Deposit-Refund-Scheme (DRS)

Deposit-Refund-Scheme was originally introduced to encourage high collection rates for the refillable containers by providing consumers with certain monetary incentive in the form of refundable deposit. Under DRS program, purchasers of the specific products are encouraged to return the containers to a designated collection centers in order to be refunded with the

deposit put into the price of the product (Tietenberg 2008). Deposit-Refund-Schemes are used for certain waste categories, such as glass, batteries, electronics, tyres, refrigerators and other durable goods (OECD 2002).

Deposit-Refund-Scheme has been proven to be one of the best solutions to significantly increase collection rates. Most of the traditional deposit-refund-schemes for beer and soft drinks in refillable bottles provide almost a 100% return rate.

Moreover, the general quality of the collected material is usually known to be higher under the deposit-refund scheme in comparison with other collection systems. As a sequence of that, the final prices of the recycled materials are usually also higher.

The Deposit-Refund-Schemes for large bottles and aluminum cans have been practiced for many years in Netherlands, Denmark, Sweden, Norway, Finland and USA.

An important aspect of the Deposit-Refund-Scheme is to ensure that the deposit included in the price of the product should be high enough in order to motivate consumers to return it rather than to throw it away. Beside the size of the refund, another important aspect ensuring the effectiveness of the system is the level of convenience connected with the container return process, as well as the public awareness regarding the scheme process (Lindhqvist 2000).

2.5.3 Communicative Instruments

Communicative instruments are aimed at influencing the behavior and willingness of citizens to act in a more environmentally sound way through increasing their environmental awareness level.

There are two main types of communicative instruments (Van Beukering and Brander 2001):

- *Information and education* – public-awareness campaigns, eco-labels, research and demonstration, and public procurements*;*

- *Covenants* – voluntary agreements

Information and education

Waste reduction can be achieved through persuading consumers to purchase more environmentally sound products, i.e. products with less packaging and toxic material, recovered products or products that could be reused or recycled.

In order to implement information and education communicative instruments, governments usually use different communication channels, such as television, radio, newspapers, internet, as well as direct or face to face communications. Among these instruments, face to face communication with consumers usually is considered as the most important source for waste management and reduction.

It has been observed in several countries that coverage of the environmentally sound waste management issues are not well covered in mass media sources, and is rather limited to occasional television broadcasts or sporadic coverage in newspapers and magazines. Therefore it has been recently agreed between governments to better improve cooperation between businesses, media marketing and advertising sectors and environmental institutions in order to establish sustainable consumption patterns (OECD 2002).

Another information instrument is eco-labelling. The aim of the instrument is to encourage producers to market products and services that are more environmentally friendly. This instrument defines a set of criteria according to which products are awarded with eco-labels by European Eco-label Organisation. Since the nature of the instrument is voluntary, it does not create any trade barriers. Moreover, it serves as an additional competitive advantage between different producers.

It is important to mention that eco-label criteria are based on the products life-cycle studies, beginning from raw material extraction and ending up with disposal stage (Bozowsky and Mizuno 2004).

Public awareness campaigns are also considered as important informative instruments aiming at increase of the public participation in waste management. Among important considerations that should be taken into account while preparing such awareness campaigns are the following: correct targeting of the audience, clarity of the message and the involvement of the relevant mass media sources (Van Beukering and Brander 2001).

Voluntary agreements

Voluntary agreements have been given a significant importance as an instrument for waste management and waste reduction. Many developed countries include voluntary agreements into their waste management policies. Inclusion of the voluntary agreements in the mix of the traditional regulatory instruments can make policies more flexible and cost-effective, as well as allows reducing administrative costs (OECD 2002).

Voluntary agreements have several advantages in comparison to regulatory instruments. One of such advantages is that the industry becomes involved into the waste reduction targets. This is very important due to the fact that industry is aware of the technological know-hows and therefore the key solution to the problems. Moreover, voluntary agreements are usually easier to implement in comparison to regulatory instruments due to the fact that it is difficult to make a voluntary agreement a political issue (EEA 2002).

Extended Producer Responsibility

"Extended Producer Responsibility is an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal of the product" (Van Rossem *et al.* 2006).

EPR programmes influence traditional set of responsibilities between producers and distributors of consumer goods, consumers and governments, particularly at the post-consumer stage.

In the very beginning the idea of EPR strategy was primarily connected with packaging waste. Nowadays, it has significantly expanded to a variety of products, product groups and waste streams. EPR plays an important role in final resource efficiency increase by making the most of materials that would otherwise go to the landfills and at the same time encouraging producers to reduce raw material inputs and to choose more environmentally products, i.e. those materials that are easily reused or recycled (OECD 2002).

Table 2 below summarizes various policy instruments, discussed above, and their application in "waste chains" aimed at waste reduction and improvement of the waste management systems.

Table 2. Policy Instruments for Waste Prevention and Waste Management

 **Production Patterns**	 **Household Consumption Patterns**	 **Waste Generation and Collection**	 **Waste Mngmt Systems**
Economic Tools * Tax on packaging * Economic incentives for cleaner production and waste prevention.	**Economic Tools** * Deposit-refund schemes * Taxes on disposable products and packaging.	**Economic Tools** * Waste fees & taxes * Pays as you throw	**Economic Tools** * Taxes on landfilling and incineration.
Regulatory Tools * Environmental Standards. * Eco-labelling	**Regulatory tools** * Eco-labelling	**Regulatory tools** * Extended Producer Responsibility * Regulation on waste collection and recycling schemes * Provision of	**Regulatory tools** * Framework based on waste hierarchy * Environmental regulation on waste management * Bans on landfilling * Target for reducing

		infrastructure for recycling	landfilling and incineration of waste * Targets to increase recycling rates
Voluntary Approaches and Technological Innovation * Triple bottom line * Eco-design * De-materialisation * Shift from products to services	**Social Tools** * Environmental Education * Information on green purchasing * Support to voluntary initiatives	**Social Tools** * Information on recycling schemes * Support to voluntary initiatives	**Technology innovation** * Energy recovery incinerators. * Cleaner technology

Source: Adapted from OECD 2002

2.6 Municipal Waste Management Systems

There are different waste management systems and usually they vary from one country to another. Many OECD countries have been already shifted their waste management strategies from a "simple collection and disposal" to a more sophisticated "waste hierarchy approach", focusing on the waste preventon, waste recovery and , finally, safe disposal in case if the waste recovery is not possible. With regards to recycling practices, they have been already proved themselves as successfull in many countries that provide adequate required infrastructure and increase awareness level at households (OECD 2002).

In the mid 1990s, around 95% of the OECD population were already provided with the access to municipal waste management services. According to statistical data, around 64 % of the total generated municipal waste were landfilled, 18% - incinerated and finally 18% went to recycling, including composting (OECD 1999). Despite the fact that nowadays landfill is still the most often used waste management method, recycling rates has significantly increased in many of the OECD countries. Continuing efforts are being taken in order to improve further existing waste management policies and, as a result, to further reduce landfilling and increase

recycling rates. According to OECD projections for the next 20 years, current situation with municipal waste management is likely to experience significant changes. It is expected that around 50% of municipal waste will be sent for landfilling, 17% for incineration and 33% for recycling.

Figure 10 below illustrates percentage share of used municipal waste treatment systems in 2002 in selected European countries. The graphic illustrates existing differences of waste treatment systems and strategies used in different countries. It can be well observed that landfilling is still the dominant waste treatment option in new EU Member States and

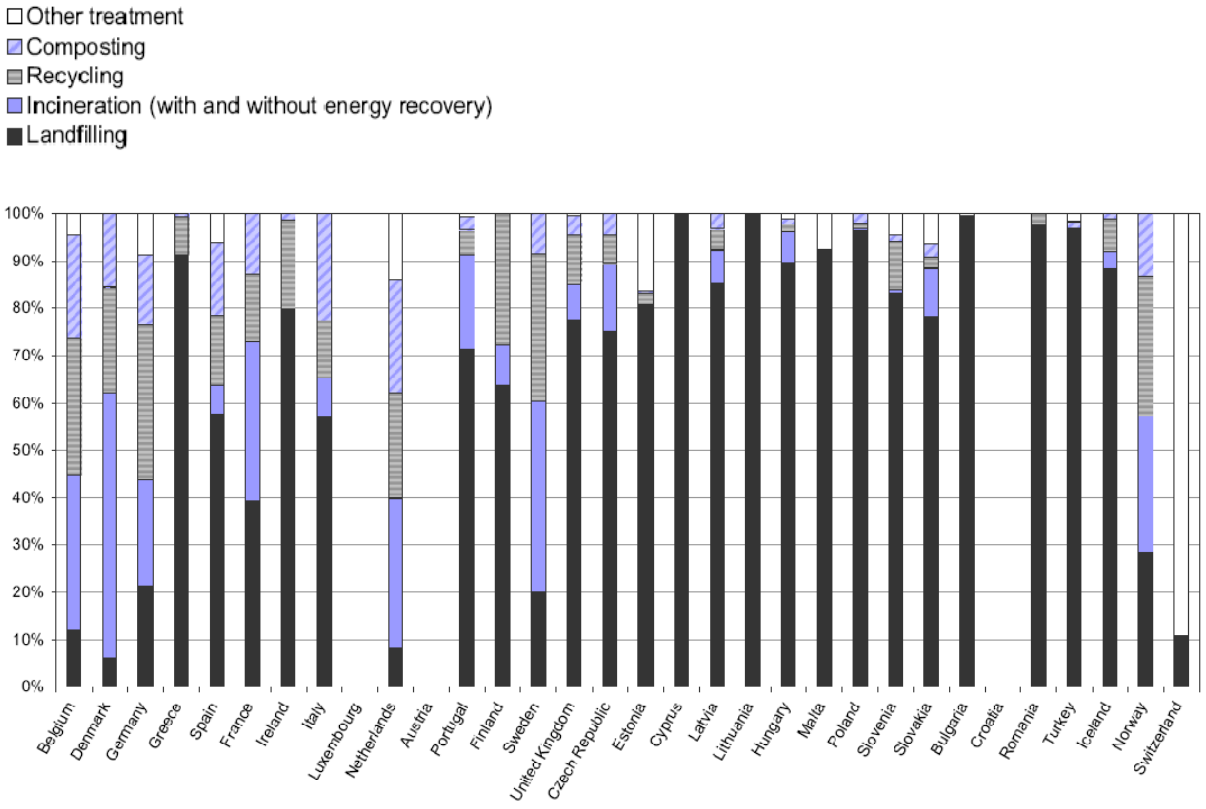


Figure 10. Municipal Waste Management systems in selected European countries, 2002

Source: European Commission 2005

Candidate Countries, an averagely accounted for about 80% of all the waste treatment methods. The same practice also observed in old EU Member States: Greece and Ireland.

The lowest share of landfill disposal is presented by Germany, France, Denmark, Netherlands and Belgium accordingly. These three countries reduced their landfill rated by 12% through the period from 1995 to 2003. This was mainly achieved by the means of integrated waste management options, such as incineration, recycling and composting. Denmark has the highest share of incineration rates, stated at 56%.

As for recycling, almost all old EU Member States have achieved high recycling rates. In Germany, share of recycling accounts up to 33% of the total municipal waste treatment. Composting also significantly contributes to the total waste treatment share accounting for 13% to 24% in the following countries: Netherlands, Italy, Belgium, Denmark, Spain, France and Germany (European Commission 2005).

According to OECD Environmental Outlook, the Reference Future Scenario for Non-OECD countries sounds quite optimistic: landfilled waste is expected to decrease from 80% in 1995 to around 70% in 2020, as well as there are estimated increase in recycling rates: from about 10% in 1995 up to 20 % in 2020 (OECD 2001).

2.6.1 Waste prevention

Waste prevention is on top of the waste management hierarchy as it considered as the most desirable option in waste management. There are a number of direct and indirect waste prevention measures and procedures exist that can be applied.

Direct measures are aimed at reducing the waste at point of it generation. Among these measures are the following: deposit-refund-scheme, eco-taxes, voluntary agreements, promoting of cleaner technologies through the introduction of the eco-certificates and eco-labelling, etc.

Indirect measures reduce the amount of waste to be taken care of by the public management systems. These measures are presented by the following: development of the recyclable market, introduction of home composting, introduction of direct reuse and etc.

In addition to, a number of economic tools also might be relevant as they are important for waste prevention support: pay as you throw economic instrument encouraging householders to provide less amount of waste; different fees and taxes, such as landfill tax in order to promote more environmentally friendly waste management options, such as reuse and recycle and introduction of full recovery cost for the amount of the produced waste (REC Estonia 2003).

In case with municipal waste, it is particularly very important to influence the consumption patterns in order to successfully achieve waste prevention. In this regard, the role of the public awareness campaigns should not be neglected.

In addition, the role of the packaging industry in the waste prevention issue is also very important, as there is a strong connection between the packaging patterns and the amount of the waste generated. Moreover, the combination of different voluntary agreements with the legal instruments can be also applicable towards the waste prevention strategy (UNEP 1996).

2.6.2 Reuse and recycling

After consideration of the waste prevention or waste minimization options, the next preferable options in the waste hierarchy are waste reuse and waste recycling.

Examples of reusing include: plastic bags, glass bottles, retreading and reusing partly worn tyres and etc. Extending the lifetime of the products not only reduce the waste generation, but also allows savings associated with energy, materials and transport costs. The introduction of the deposit-refund-schemes has significantly increased the amount of reused items. Despite

the fact that the reuse option is considered as more environmentally sound in comparison to the other waste treatment methods, it still has an environmental impact. For example, reuse of the glass bottle requires energy cost needed for collection and transportation, as well as large amount of detergents and water to provide adequate cleaning to obtain hygienic procedures (Williams 2005).

Recycling means collection, separation, cleaning and processing of materials to produce marketable products. The main advantages of recycling are the reduction in the input of raw materials, and as a sequence considerable energy savings and reduced air and water emissions, as well as the reduced soil pollution (Rhyner *et al.* 1995).

There has been a considerable increase in the recycling rates in most of the developed countries worldwide (OECD 2004).

In order to obtain successful implementation of the recycling programs, it is vital to obtain the purest possible waste fraction. In order to achieve this, source separation and collection should be well organized. In this regard, the role of the consumer behavior is critically important.

As a next step, it is needed to ensure that these products are sold on the market at a good price (Caarington 1996). The recyclable market needs a regular monitoring and possible stimulations through the following measures: a) tax reliefs for recycled goods and enterprises involved in waste recycling; b) application of the economic instruments, such as grants, credits and subsidies (REC Estonia 2003).

Before selecting the recycling as the treatment option, it is crucial to conduct a deep analysis based on the particular waste type and compare the processes involved in recycling versus treatment and disposal, since it is not always that the recycling is the best option from environmental and economic points of view.

2.6.3 Composting

Composting can be defined as a form of recycling. Similar to other forms of recycling, it allows decreasing the total amount of municipal waste through diverting it from the landfills or incinerators. In addition to that, composting brings a valuable product that can be used in agriculture, by government agencies, and property owners as a soil amendment, fertilizer or growth medium. The composting improves the texture and appearance of the soil, reduces erosion, and helps controlling several plant diseases (US EPA 1995).

Composting could be done both in a large and small scales. Different composting methods use similar characteristic features and processes. The main requirement conditions for composting are the following: oxygen supply and moisture content (around 30-50 %), microbial activity to breakdown the organic material, and development of high temperatures (e.g. 50°C and higher) enough to destroy pathogens and to produce a stable residue compost product (Rhyner *et al.* 1995).

The quality of waste material is also one of the important factors for the successful implementation of composting. High organic content and less contamination with heavy metals are the crucial requirements for the waste material to be composted. The most common types of waste that are included into the composting stream are the following: kitchen waste, garden and yard waste and paper residues. In addition, some mineral components are also vital to ensure adequate nutrient balance.

To conclude, while composting is considered to be among good waste management systems in the waste hierarchy, and is known to be another form of recycling, however there are many strict quality standards and infrastructure requirements for collection, transportation and processing of the waste that is needed to comply with in order to get the successful

implementation of the composting as the waste treatment option. Moreover, the adequate provision of the market for the finished compost product is also very critical (UNEP 1996).

2.6.4 Incineration

Incineration of waste materials, alternatively known as thermal treatment, is a waste treatment technology under which waste is treated thermally, thereby ending up with cinders and fly ash as end product. The primary benefit of waste incinerators is that they reduce mass of the original waste by up to 75% and the volume by 95% (REC Estonia 2003). The process of waste thermal treatment releases heat that could be used for energy production. Besides, during the process a flue gas is produced that usually contains many different pollutants, such as sulphur dioxide, carbon dioxide, hydrochloride and organic compounds. The nature and number of pollutants, however, depends on the waste content (Hester and Harrison 1994).

One of the main requirements of the waste that is going to be incinerated is that its calorific value should be higher than 6.5 GJ/tonne, which makes approximately 1550 kcal per kilogram (REC Estonia 2003).

The specific benefits of incineration are (Hester and Harrison 1994):

- *Significant reduction in the weight and volume of the original waste ;*
- *Possibility to handle a variety of solid and liquid wastes;*
- *Detoxification of toxic wastes to make them more suitable for final disposal;*
- *Destruction of the organic compound of the biodegradable waste which when landfilled generates landfill gas emissions ;*
- *Energy recovery ,as a result of the process, that could also contribute to the economy of the incineration plant ;*

- *Replacement of fossil-fuel for energy production with consequent beneficial impacts to the environment.*

The following are some of the incineration drawbacks (US National Research Council 2000):

- *Flue gas pollutants (particulates, acid gases, nitrogen oxides, carbon monoxide, organic and metal hazardous air pollutants);*
- *Expensive filters and other cleaning devices are needed to deal with flue gas pollutants which produce additional hazardous byproducts that should be disposed of;*
- *High building and operational cost ;*
- *May encourage more waste production to meet a minimum demand of waste incinerators.*

It is considered that modern waste incinerators with an adequate flue gas cleaning technology are regarded as environmentally friendly waste management facilities (REC Estonia 2003). According to the results obtained from a variety of waste incineration facilities in US, the modern air pollution control equipment can potentially reduce dioxins, furans, heavy metals, particulate matter and hydrogen chloride by up to 99%, sulphur dioxide by 90% and nitrogen oxides by 65% (UNEP 1996).

2.6.5 Landfill Disposal

Landfilling is the oldest and the most widely used form of waste treatment and is considered as the least favorable option lying at the bottom of the waste hierarchy. This treatment method is often regarded as low-grade solution to municipal solid waste management what results in carelessness in design and operation of landfills.

The following are the established facts related to the landfill disposal (Cheremisinoff 2003):

- *Landfilling is a complex engineering project rather that low-grade operation;*

- *Landfilling can be considered as environmentally friendly waste treatment method if properly designed and operated;*
- *Landfilling is currently the most cost-effective waste treatment option in most communities;*
- *Landfilling is often the only available waste treatment option for wastes generated from the end-of-pipe treatment technologies, such as, for example, incineration;*
- *Landfill gas can be utilized for heat and energy generation as a low polluting fuel;*

Until more advanced technologies do not exist, sanitary landfills are considered as the most favorable waste treatment options in Landfilling. Introduction and operation of a sanitary landfill presents the best combination of the minimized environmental risk and cost effective treatment option.

While the increasing number of uncontrolled illegal dumps is the clear sign of the institutional weaknesses, existing sanitary landfills well operating for at least a couple of years can be the evidence of mature institutional infrastructure and political responsibility (REC Estonia 2003).

Minimal sound practices for municipal solid waste landfills are the following (UNEP 1996):

- ❖ leachate management and environmental impact prevention and reduction
- ❖ landfill gas management
- ❖ daily cover and compaction
- ❖ well documented operating procedures
- ❖ personnel training and safety programs
- ❖ closure and post-closure planning

Landfills are part of an integrated waste management system. When properly designed and operated can provide environmentally safe and economically cost effective waste disposal of a solid municipal waste. However this could be only achieved in the case when all the strict standards and regulations related to the landfill design, construction and operation are followed. Otherwise, landfills can cause extreme consequences for human health and the environment.

Thus, landfills, being the last favorable option in the waste hierarchy, should be only considered if all other methods could not be applied.

2.7 Summary

Continuing economic growth rates, as well as changing tendency in production and consumption patterns caused a significant increase in total amount of the generated municipal waste during the last couple of decades. The forecasts suggest that this tendency will not be changed, at least in the near future.

Nowadays, the issues related to the increasing waste generation and improvement of the waste management systems are in the priority list for many developed countries. Many of the countries already introduced several approaches to promote changes in current production and consumption patterns, as well as in the waste management technologies. As a response for governments concern with the waste management issue, the concept of waste hierarchy has been introduced.

In order to promote sustainable waste generation and management, different policy approaches were introduced by the governments: direct regulatory, economic and communicative instruments.

Until now, no single solution exist that could be relevant to address all the challenges associated with the municipal waste management. The selection of the proper waste management system depends on the number of factors, starting from financial affordability and ending up with waste types waste generation patterns. Since every country and every region has its own unique waste profile, i.e. waste types, generation patterns, etc., consequently every country has its own the most favorable waste management option based on these factors.

In many cases, the combination and mix of different available treatment technologies can be regarded as the best option towards improved waste prevention and management.

CHAPTER 3: MUNICIPAL WASTE MANAGEMENT IN AZERBAIJAN

3.1 Waste sector policies

Azerbaijan has been steadily improving its environmental protection system after obtaining its independence. The legal, policy and institutional framework inherited from the times when Azerbaijan was a part of the Soviet Union did not pay much attention to the environmental protection issues, as well as was not appropriate to function within the conditions of the market economy.

During its years of independence, Azerbaijan made much progress towards update of the existing environmental legal framework, however there is still a need in significant further improvements, related to both policies, legislative and institutional frameworks (UN 2004).

The main sector policies set by the Government of Azerbaijan (GOA) relevant to waste management issues are mentioned in the following documents (UNDP 2005):

- ✓ *National Environmental Action Plan (NEAP), 1998* - stands at the following objectives: 1) improvement of the regulatory control over pollutants ; 2) overall improvement of the environmental monitoring ; 3) establishment of the computer-based analytical capacity for the environmental planning and protection ; 4) introduction of the economic incentives to promote environmental compliance.
- ✓ *National Program on Environmentally Sustainable Socio-Economic Development (NPESSED), 2002* – the primary goal of the program is to "preserve existing environmental systems, economic potential and effective use of natural resources for the sake of current and future generations." This goal is expected to be achieved through the following measures: 1) compliance with best practices and advanced experiences for separation, disposal and recycling of the municipal waste ; 2) introduction of appropriate technologies for bio-gas generation from municipal waste ; 3) construction of the waste

incinerators with "waste to energy" (WtE) technology 4) construction of the composting plants.

- ✓ *United Nations Economic Commission for Europe (UNECE) Country Review Report 2003 for Azerbaijan (CRP)* – points out five primary objectives: 1) development and implementation of the new comprehensive legal framework on waste management by the Ministry of Ecology and Natural Resources (MENR) and other relevant ministries ; 2) organization of the public awareness campaigns to promote separation of the recyclable waste ; 3) construction of the waste recycling facilities and ensuring the provision of the procedures needed for an adequate collection of the recyclable waste ; 4) construction of the new sanitary landfills compliant with the EU landfill directive requirements ; 5) for a long-term perspective, construction of the municipal waste incineration facilities in Baku.

- ✓ *Common Country Assessment (CCA) report* – defines its primary objective as the following: granting municipalities with more authority over local programs for environmental protection, as well as for the economic and social development.

The policy objectives and priorities stated in the Common Country Assessment report are considered to be most practicable in the short-term perspective taking into consideration the current state of the management and development of the municipal solid waste management sector, while other objectives are regarded as more appropriate for longer-term perspective (UNDP 2005).

3.2 Legislation related to waste management

There are different Laws, National and State Programs, Decrees of Cabinet of Ministers and Orders of the President of Azerbaijan Republic related to the waste management in Azerbaijan.

The main legislative framework on industrial and municipal waste in Azerbaijan Republic is based on the *"Law of Azerbaijan Republic on Industrial and Municipal Waste"*, Azerbaijan Legislature Collection 1998 and amendments made to some points of this law accepted by Milli Mejlis (National Assembly) and approved by the President of Azerbaijan Republic on 22nd May 2007. This Law defines the primary rules of the state policy in solid waste management and duties of the state bodies responsible for solid waste management. It also sets the rules for waste processing and disposal, control over waste recycling actions, defining rules for trans-boundary movement of wastes, licensing of activities connected with waste generation and property rights. Additionally, it defines the requirements for projection, reconstruction, building activities and for waste collection, transportation and disposal. Law analyses both public and state control over the waste generation and management, and sets costs for use, disposal, collection and waste processing (World Bank 2008).

The most important provisions of this Law are highlighted below. According to this law, waste management is set by the state policy and legal relationships of Azerbaijan Republic. Besides, it sets the requirements of development and adoption of the state standards and norms of waste management are also defined. The location, construction and equipment designated for waste recycling facilities should be certified and registered by the state organs.

The ownership right over the waste as a result of the production belongs to the one who generates it. This right can be transferred to another person via sale-purchase and other usual agreements.

All types of actions over the waste (collection, recycling, utilization, storage and transportation) have to be reported to the executive bodies. The law strictly forbids the disposal of waste in the urban and other residential territories, forests, parks, resorts and recreation zones. The landfill territories should be placed and settled only according to the approved master plan or project. The necessity of rehabilitation of the waste disposal territories is also stated in this law.

In accordance with the Law, individuals (workers) who are dealing with hazardous waste have to obtain certificates which legally prove their professional being. The Law forbids transit, disposal and import, to the territory of Azerbaijan Republic, the waste that cannot be safely processed.

Expenses on collection, transportation, placement and treatment of the waste is compensated by those who generate it, taking into consideration the amount, type and other characteristics of the waste (*"Law of Azerbaijan Republic on Industrial and Municipal Waste", 1998/2007*).

The significant disadvantage of this Law formulation is that there is not clear and detailed regulation identifying the environmental damage and specific compensation for it (ADB 2005).

Additional legal regulations related to the waste management sector are highlighted below:

- *"The Law on Environment Protection",* 1999 – defines the primary principles of environmental protection, the privileges and responsibilities of the State, public associations and citizens of the country towards the environmental protection. The rules and requirements which are needed for the preparation of SEE (State Ecological Expertise) – official Environmental Impact Assessment (EIA) procedure in the country, are also set by this Law. The basics of State Ecological Expertise in Azerbaijan is defined in the Law as a process of "*identification of the environment's correspondence with the quality norms and ecological requirements aimed at revelation, prevention, and*

prediction of possible negative impacts of economic activities on the environment and related consequences " (Article 50) (World Bank 2008).

- *"The Environmental Safety Law",* 1999– this Law states that the land users are liable for restoration of damaged land, soil and other natural resources. The import of radioactive wastes, processed reusable nuclear fuel and other radioactive substances is strictly prohibited by this Law.

- *"The Law on Sanitary and Epidemiological Safety",* 1992 – defines the rights and responsibilities of citizens and state monitoring bodies related to sanitary-hygienic norms and epidemiological requirements. Violation of this Law can lead to criminal conviction (Article 39).

- *"The Law on Protection of Atmospheric Air",* 2001 – defines specific norms aimed at reduction of physical and chemical impacts on atmosphere, as well as obligates for state registration on negative influence on atmosphere and control over air protection (World Bank 2008). Chapter 3 (Article 16) and Chapter 4 (Article 28) are specifically related to waste management issues (Mustafayev 2008).

- *"The Land Code",* 1999 – sets compulsory rules for rehabilitation of soils after their use, including damaged soils as a result of the mining works (World Bank 2008).

- *"The Soil Fertility Law",* 2000 – sets specific requirements for land users (leasers, landowners, etc.) to protect fertile top layer of soil during construction works. The restoration period is defined as 3-5 years time frame depending on soil characteristics.

- *"The Law on Public Health",* 1999 – defines the basic rules for protection of the public health. The liability for the harmful impact on public health as a result of environmental pollution includes compensation by the entity or person who caused this damage.

There are also several Decrees issued by the Cabinet of Ministers of Azerbaijan Republic:

- *"Determination of costs related to collection, transportation and treatment of the waste",* Decree of the Cabinet of the Ministers of Azerbaijan Republic, #185, 12 August 2008.

- *"The Regulations on regular collection, transportation, temporary storage and treatment of the waste in the residential territories in accordance with sanitary-hygienic and ecological norms and standards",* Decree of the Cabinet of the Ministers of Azerbaijan Republic #074, 21 April 2005 (Mustafayev 2008).

- *"State Strategy on the Management of Hazardous Wastes in Azerbaijan Republic",* Decree of the Cabinet of the Ministers of Azerbaijan Republic #117, 25 August 2004

- *"The Requirements on Management of Medical Wastes",* Decree of the Cabinet of the Ministers of Azerbaijan Republic #213, 28 December 2003. This decree sets outs regulations regarding the separate treatment of medical waste, since nowadays it is still sometimes disposed of together with the rest of the municipal waste (MENR 2009).

The Activity Plans, as well as National and State Programs related to waste management sector also exist in the country:

- State Program on *"Socio-economic development of the regions of Azerbaijan Republic",* 2004-2008. It highlights the need on improvement of public services provided to the population, including municipal solid waste management system.

- The Complex Plan of Actions on *"Improvement of ecology situation in Azerbaijan*

during 2006 - 2010 years", 28 September, 2006. Articles 4, 4.1, 4.5- 6.4.10-11, 4.24, 5.3, 7, 7.1, 7.6, 7.10-11 are all related to waste management issues.

- National Program on *"Continuous Socio-Economic Development in Azerbaijan from Ecological Aspect",* 2003. Article 4.6 is specifically referred to waste management problem (Mustafayev 2008).

- Activity Plan on *"Europe Neighborhood Policy"*, 2006. It is aimed at preparation of the laws in the sphere of waste management, quality of air, quality of water and its compliance with the European Union legislation.

The existing legislative acts in the sector should be conformed to the below listed legislative acts of European Union:

- ✓ Council Directive of 19 December 2002 establishing criteria and procedures for the acceptance of waste landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (2003/33/EC)
- ✓ Directive 2006/12/EC of the European Parliament and of the Council of 5 April on waste (this is the codified version of Directive 75/442/EEC as amended) (Mustafayev 2008).

Waste management issues are also mentioned in the official Orders issued in Azerbaijan Republic:

- Order of the President of Azerbaijan Republic on *"the improvement of municipal waste management in Baku city",* 6 August 2008. The establishment of "Temiz Sheher" (Clean City) joint stock Company responsible for improvement of the current waste management system, and its financial-technical base (Aliyev pers. comm.).

- Order of the President of Azerbaijan Republic on *"actions aimed on acceleration of socio-economic development in Azerbaijan Republic"*, #893, 25 March 2002. The purpose of this Order is to find out the main existing barriers in waste management sector in Azerbaijan Republic and develop recommendations on the improvement of the current state (Mustafayev 2008).

This is the main set of legal acts which regulates the waste management sector in Azerbaijan Republic.

3.3 Institutional framework in MSWM

The main policy over the waste management in Azerbaijan is executed by the Executive Power of Azerbaijan Republic, while it is regulated and supervised mainly by the Ministry of Ecology and Natural Resources (MENR) and other ministries of Azerbaijan Republic.

The Order of the President of Azerbaijan Republic on *"the improvement of municipal waste management in Baku city"* (6 August 2008), states that despite the executed works and reached goals aimed on improvement of municipal services, there are still serious deficiency in the sphere of collection, transportation, placement and treatment of municipal wastes. Lack of the existence of the centralized system in the sphere of the transportation of the municipal waste, disposal of the municipal waste into the landfills without preliminary separation, the growing number of illegal dump sites, all these factors nowadays create serious concern (Mustafayev 2008).

According to the above mentioned Order, regardless of the source of its generation, collection and transportation of the municipal solid waste should be executed by the Executive Power of Baku city. All institutions which have their own independent housing funds (such as, State Oil Company of Azerbaijan Republic, Caspian Maritime Company, Ministry of Defense and

others) are obliged to transfer all their functions, waste disposal sites, equipment and facilities on collection and transportation of the municipal wastes to the Executive Power of the Baku city.

After this, the primary obligations over the management of municipal waste which is generated on the territory of Baku city should be transfered to the newly established "Temiz Sheher" joint stock company (registered by official state bodies on 12th March 2009) (Alizade 2009). "Temiz Sheher" is a State enterprise and the control over it's operation is given to the Supervisory Board created by the Ministry of Economic Development. This organization has to ensure distribution, treatment and also complete utilization of municipal waste. (Kaspi 2009).

The main governmental bodies involved in the municipal waste management sector of the country are the following:

- Ministry of Ecology and Natural Resources – is responsible for the permanent monitoring over the industrial and municipal waste management. Ministry is also responsible for making inspections over the epidemiologic and sanitary conditions of industrial and municipal waste territories (UN 2004).

- Cabinet of Ministers – is responsible for defining the economic incentives aimed at improvement of the municipal waste management. In addition, it sets out norms and standards on the control over the impacts of the waste management on the environment, as well as over the transboundary movements of the waste (UNEP 2005a).

- Sanitary-Epidemiologic services of Ministry of Healthcare – responsible for elaboration of epidemiologic and sanitary norms and standards referred to the collection, transportation and disposal of the municipal waste (USAID *et al*. 2007).

- Ministry of Economic Development – its main responsibility in the sector is to attract investors and facilitate the execution of the projects in the waste management sphere (Order of the President of Azerbaijan Republic on *"the improvement of municipal waste management in Baku city"*, 6 August 2008).

- State Statistical Committee – responsible for data collection relevant to the generation rates and waste management options used for different types of waste (municipal, hazardous, etc.), and , consequently, for the establishment of the country database based on the collected data (Mustafayev 2008).

According to the State Program on Improvement of the Official Statistics in the Republic of Azerbaijan in 2008-2012, confirmed by Decree of the President, the following activities are to be implemented towards improvement of the total statistical indicators and their methodology in the field of social sector and ecology statistics (State Statistical Committee 2007):

Table 3. Activities related to improvement of the waste related statistics in Azerbaijan in 2008-2012

Activity	*Aim*	*Expected Results*	*Executing organizations*	*Term of execution*
Improvement of the waste statistics and creation of the indicators system	Working out of the new waste classification and obtaining of the new statistical data in this field	Data collection on waste statistics according to international standards	State Statistical Committee, Ministry of Ecology and Natural Resources	2008-2009

Preparation of the indicators system on domestic wastes	Organizations of the statistical observations on domestic wastes	Availability of the statistical data on domestic waste	State Statistical Committee, Ministry of Ecology and Natural Resources, Ministry of Industry and Energy, State Committee on Urban Planning and Architecture, municipalities	2010

Source: State Statistical Committee 2007

The private sector in the sphere of recycling and other waste treatment options is very limited and fragmentary.

Non-Governmental Organizations (NGOs) are mostly pariticpating in the tenders of international and state grants, referred to recycling and other municipal solid waste treatment options. Some NGOs have established the production of biogas from the wastes and recycling of plastic wastes aimed at production of the plastic sewage tubes. Despite the fact that there are good prospects arising in this sphere, it still exists on a very primitive level.

To conclude, in spite of the recent improvements, institutional framework still have major problems, mainly related to vague distribution of responsibilities between state and local institutions, as well as other relevant stakeholders involved in the waste management sector.

3.4 MSW amount and composition

Increased population growth rates and urbanization in Azerbaijan caused considerable increase in the total amount of the generated municipal waste. According to statistics as of January 1st, 2009, the total number of population in the country constituted 8,073000. Currently, the total amount of the municipal waste generated in the country per year is around 2,5 million tones. Taking into account current population statistics, this number approximately amounts to 310 kilograms of waste per person. According to MENR statistics, around 580-600,000 tones of municipal waste is generated in Baku annually (MENR 2009).

The volume of municipal waste generated in major cities in 2008 is presented in Table 4.

Table 4. Municipal Waste Generation in major cities, 2008

City	Population	Municipal Waste Generated Total ('000 tonnes)
Baku	8,073000	580-600
Ganja	311,000	310,0
Sumgayit	305,100	170,0
Mingechevir	96,200	49,4
Shirvan	76,600	50,8

Source: MENR 2009

However, it is worth to mention that according to other official sources, this number sometimes may reach up to 1 million tons of waste (Nurmamedov 2005).

According to MENR, the amount of municipal waste generated in other urban centers, other than capital of the country, is negligible (Table 5). This could be explained by the fact that data related to waste collection, storage and reporting in different regions of the country is mostly not reliable. Moreover, there are many illegal dumpsites exist that are also not taken into account. In this regard, setting up a reliable reporting system for municipal waste generation in these cities should be a first step towards the overall improvement of the municipal waste management system.

Table 5. Municipal Waste Generation in different regions of the country, 2008

Region	Population	Municipal Waste Generated Total ('000 tonnes)
Lenkeran	205,300	3
Masalli	196,400	49,8
Shamkir	190,400	59,6
Xachmaz	158,800	3,6
Sabirabad	151,200	2,1
Salyan	121,300	6,2

Zaqatala	115,300	7
Imishli	113,900	175
Goychay	108,500	12,2
Astara	96,100	8
Neftchala	79,400	8,8

Source: MENR 2009

The volume of generated municipal waste in Baku significantly depends on the season. Usually, more waste is produced during summer time. For example, while 54,822 m^3 of municipal waste was generated in February 2002, in July of the same year this amount considerably increased and reached around 144,842 m^3. It can be explained by the fact that during the summer time the total volume of municipal waste swells with more green waste (food residues, grass, bush cuttings, etc.), as well as with the non-recycled plastic bottles, which are collected and disposed off together with other municipal waste. In addition to, during the summer season tourism also contributes to increased generation of municipal waste (ADB 2005a).

Nowadays, waste generation rates constitute about 5% increase annually. According to the forecasts, it is estimated that the waste generation will increase 2.2 times of the current generation rates by 2030 (Guseynov 2008).

The detailed composition of municipal solid waste in Baku in year 2008 is illustrated below (Fig. 11). The percentage indicators reflect the total weight of the waste shared by different waste materials. Municipal waste composition in Baku is presented by flammable (80.8%), such as food residues, paper, polymers, textile and wood materials, etc. and nonflammable (19.2%) waste materials, ferrous, glass and ceramic materials.

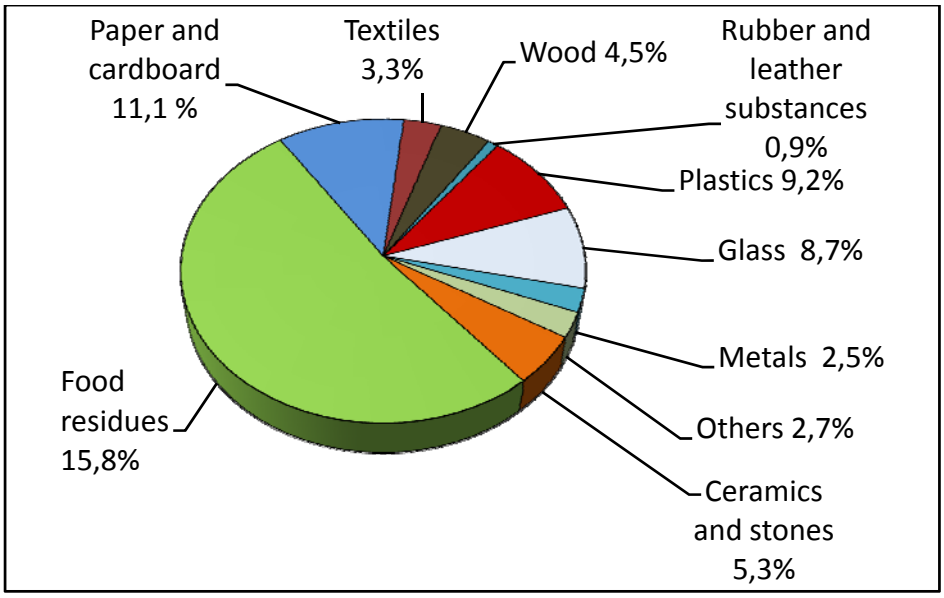


Figure 11. Municipal solid waste composition in Baku, 2008

Source: MENR 2009

As it can be observed from the diagram, food residues and paper waste constitute the biggest share from the total weight of the waste materials amounting to almost 30% , while rubber and leather substances shares only 0.9% (MENR 2009).

During the last decade significant changes have occurred in the municipal waste composition of Baku. Until 1990s, food residues shared the biggest amount of total municipal waste generated, while metal, glass and paper waste constituted only a small part of it. This is due to the fact that during the Former Soviet Union (FSA) times recycling system for several types of waste was established. Collection points for paper, metal and glass materials were widely spread and bringing these materials to the collection points by citizens was highly encouraged. Thus, the share of these materials in municipal waste composition used to be much lower than today (Jafarov and Makhmudov 2002).

All in all, even though it is expected that waste related data collection will be further improved as a part of an integrated municipal waste project (will be discussed in more details

in Chapter 3.7), current system is still very weak, and thus different sources state different statistics regarding total municipal waste generation and waste collection.

3.5 Waste collection and transportation

There were certain improvements made in the sphere of waste collection and transportation during last several years. Despite of these activities, there are still problems existing in municipal solid waste collection. The collection services cannot handle the amount of generated waste and as a result, the waste is not collected on time. Another problem is that the transportation services do not follow the sanitary norms during the transportation of the waste. Both of these problems are creating the risk for environment and human health.

Waste collection in Azerbaijan on a centralized level is executed only in big cities – Baku, Ganja, Sumgait, and partly in other regions of the country. In residential areas (settlements, villages and etc.) waste is either burnt or disposed into the channels or uninhabited territories. The primary equipments used for municipal solid waste collection in the country are bins, bunkers and containers. The main problem of the bins and containers is that they are not covered and the waste usually gets spilled (approximately 25% from the total waste container's capacity) (USAID *et al.* 2007).

Currently, there are no waste separations practices exist in the country, so the waste is collected unsorted. Transportation of municipal waste in Azerbaijan is carried out by the Housing Services of the Executive Power of Baku city and partly municipalities. The major part of the transportation of wastes is done by the contractors. At the present time there are three private companies operating under agreement with Housing Services of the Executive Power of Baku city. "UP Azerbaijan" and"Casco" (operating in Baku) and "ADES" (in Sumgait) are responsible for collection and transportation of municipal solid waste (Zeynalov A. pers. comm.). The biggest one is Azerbaijani-German Joint Venture "UP Azerbaijan"

company. The company provides the required equipment (special trucks and containers) for the municipal waste collection and transportation (UN 2004).

In order to improve the collection and transportation of municipal solid waste in Baku and other regions of the country, the GoA recently purchased 200 new "Faun Rotopress-522", "Bobcat-T40140", "Isuzu", "Kamaz-43255", "Kamaz-43253", "KO-440" vehicle brands (Aliyeva 2008). The total number of waste bins in Baku now is 6651, the number of areas where containers are placed is 2781(Rashid 2006).

The current waste collection scheme operated by different providers is illustrated in the Figure 12 below.

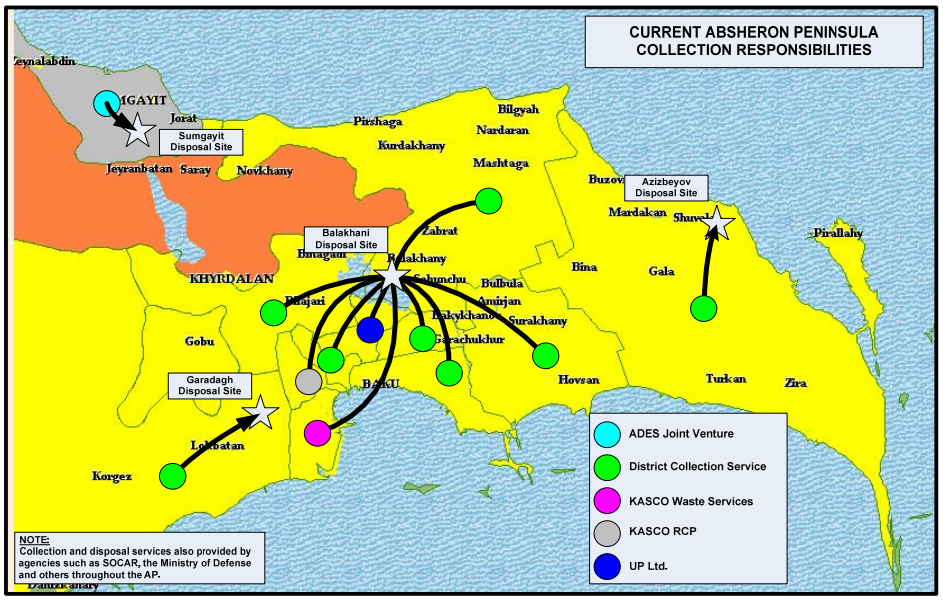


Figure 12. Waste collection scheme at the Absheron peninsula

Source: World Bank 2008

3.6 Waste treatment

Currently, the main treatment method for municipal waste in Azerbaijan is landfilling. As it has been already mentioned earlier, there is no municipal waste separation practices that take place on a country level, and consequently no recycling schemes are present. In this regard,

the only exceptions constitute small privately owned glass, paper, plastics, ferrous and non-ferrous metal scrap recycling plants, such as "AzerSun" Paper Recycling plant, "Baku Steel Company", "Plastmass Tara Zavodu" and etc. (Makhmudov pers. comm.). According to Asian Development Bank research conducted in 2005, the share of recycled materials constituted only around 1,5-2% from the total amount of collected municipal waste. The most part of it is a glass bottles recycling (ADB 2005a).

In total, there are around 200 landfills in the country which cover approximately an area of 900 ha. Among them, four official landfills are located in the capital, Baku (USAID *et al*. 2007).

Table 6 presents the general physical characteristics of the four main landfills for municipal waste located in the Baku.

Table 6. Landfill Facilities for municipal waste in Baku

MSW Landfills	Operation Start Year	Total surface area (ha)	Surface in operation (ha)	Percentage of area in operation
Balakhany Landfill	1963	200	30	15%
Azizbeyov Landfill	1980	5	1,75	35%
Surakhany Landfill *(operation suspended)*	1994	21	5,3	24,3%
Garadagh Landfill	1994	25	3	12%

Source: MENR 2009

Most of the collected municipal waste is disposed of into the Balakhany Landfill, which started its operation back in 1963 and has been in continuous operation since then. The overall conditions of the landfill do not meet minimal environmental and sanitary standards.

It is almost 50 years passed since it started its operation and nowadays, only 30 ha is used out of the total 200 ha area. Balakhany Landfill is located nearby Boyuk-Shor Lake. During the windy days, solid waste accumulations from the landfills are blown towards the adjacent lake causing lake contamination (Fig. 13) (World Bank 2008).

Figure 13. Vicinity of Landfill to the Lake

The Azizbeyov Landfill receives around 2.5% from the total municipal waste generated in the Absheron peninsula, excluding Sumgait. It is located on the hillside to the east of the Shuvelan village. The landfill started its operation back in 1994. Around 35% of the total area of the Azizbeyov Landfill has been already filled, and currently another 35% is in operation. According to the estimations, the remained capacity of this landfill is equivalent to around 20 year period.

Garadagh Landfill is divided into three individual locations operated by the Department of Housing and Communal Services (DHCS). This landfill is located northeast to the Lokbatan settlement. The area is surrounded by the ravines that cause the surface water to flow over the waste disposal area. Nowadays, only around 3% of the main landfill area is filled. The disposed solid waste is not compacted. The practice of waste covering after disposal is sporadic despite the fact that the topsoil cover is readily available.

Surakhany Landfill is located around 3 kilometers south from the Surakhany settlement, and started its operation in 1994. Initial landfill cell was used by 2002. It was then covered with

top soil cover. The operation of the landfill has been just recently suspended as a result of complaints from the nearby located residential settlements about its operation and conditions.

Until its closing, the landfill received around 9% of the total municipal waste, collected in the Absheron peninsula area. The municipal waste that was previously brought to Surakhany Landfill for disposal now is transported to Balakhany Landfill. Prior to its closure, landfill had a remaining capacity potential for around 2 years. Further expansion potential of the landfill was negligible due to the fact that it was constructed in quarry excavation which establishes its lateral constraints (World Bank 2008).

It is worth to mention that the total number and area of the landfills is rather approximate, since in addition to official landfills, there are also a number of informal dumpsites (USAID *et al.* 2007). It is approximated that there are around 80 illegal dumpsites with an area of 140 ha located in the Absheron peninsula. In Sumgait, the third largest city in Azerbaijan, there are around 19 illegal landfills covering the total area of 120 ha. The same situation with illegal dumpsites can be observed in other large cities of the country, including Baku (Guseynov 2007).

Figure 14. Illegal dump site in the Baku's surrounding area

Nowadays, there are no landfills in Azerbaijan that meet International Sanitation Standards and Norms (ECO 2007). In addition, there are no new official standards and requirements set for landfills operation, and old standards are not followed. The concept and meaning of the "official landfill" and "permission" is quite formal, since it relates to more or less organized landfills used by municipal solid waste collection and transportation services.

Figure 15. Open burning of the waste at the Balakhany Landfill

Design of these landfills is quite primitive: most of them are neither fenced, nor protected from unauthorized access. Usually waste is disposed of without further leveling and coverage. In most cases, waste is burnt at the disposal site to reduce its volume, causing air contamination with dioxins and other toxic substances.

Due to the Absheron windy conditions, the smoke from the landfills often scatters and reaches the suburb areas (Fig. 15).

Medical waste is disposed of together with the other municipal waste after being disinfected.

Furthermore, there are no drainage systems and protective layers in place to prevent hazardous substances to cause soil and groundwater contamination.

Since most of the landfills in the country were designed during Soviet times, neither an adequate geomorphologic research of the territory, nor Environmental Impact Assessment (EIA) was properly considered (USAID *et al.* 2007).

Currently, no analysis and monitoring are conducted on physical properties of the soil in the landfill areas. Given the above mentioned, nowadays both official and illegal landfills in the country are almost equally hazardous for the environment and human health.

At the moment, government is preparing a big project that will result in the construction of new municipal waste incinerator. It is expected that the operation of the incinerator will comply with EU standards stated in the relevant Directives and thus will be designed based on the principles on environmental protection. The project details and the outcomes will be further discussed in the next chapter.

3.7 Current projects related to waste management

There were not many projects and programs aimed at the improvement of waste sector in Azerbaijan in the past. Nowadays situation has changed and several major projects are being implemented in the waste management sector.

Integrated Solid Waste Management Project

In 2006 the Government of Azerbaijan Republic (GoA) started activities directed at restoring the oil contaminated environment and cleaning up the polluted lands. This was done through the introduction of the Environmental State Program (ESP) which aims at addressing the activities referred to continuous environmental pollution from the oil. One of the requirements for achieving the ESP goals is the improvement of solid waste management system in the country. This requirement led to the appearance of the *"Integrated Solid Waste Management Project"*.

This project is a part of the *"Absheron Rehabilitation Program"* aiming at the cleaning up of the environment in Azerbaijan**.** It is jointly implemented by World Bank (WB) and Ministry of Economic Development of Azerbaijan Republic (MED). The primary objectives of the project are the following: 1) improvement of the municipal solid waste management system for the whole Absheron Peninsula in accordance with national legislation on solid waste management and international environmental norms and standards; 2) organizing the system

of effective and sustainable collection, transportation and disposal of municipal solid waste collected from the districts around Baku and improving the overall control of Balakhany landfill site and three other local dump sites; 3) decreasing environmental harm and risks to the people's health occurred as a result of improper treatment of wastes; 4) strengthening the public awareness about environmentally sound practices of municipal waste management.

As a result of the negotiations, five main components of the project have been defined (World Bank 2008):

1) Institutional Reform, capacity building and project management - the primary goal is to support the creation and build-up (provide organization with management tactics, analytical skills, coaching and promotional actions) process of "Temiz Sheher" (Clean City) joint stock company as an independent governmental authority responsible for municipal solid waste management sector (Mamedli 2008).

2) Balakhany Landfill Rehabilitation and Management – under this component it is expected that current operations at Balakhany Landfill will be enhanced and thus its environmental impact will be reduced. This is to be achieved by the means of: purchasing the necessary equipment (such as weighbridges, bulldozers, etc.) and conducting civil works (such as fencing, drainage control, waste coverage, etc.) in order to increase the overall efficiency of the landfill. It is also expected that upon the completion of the works, the operational capacity of the landfill will be extended for at least another five years. The following documents were prepared by MED in support to this process: Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) (World Bank 2008a).

3) Closure and management of other dumps – this component aimed at the closure and cleaning activities of the illegal dump sites and strengthen the control over the other three official landfills in the capital. All the waste collected from these illegal dump sites will be

directed to the central Balakhany Landfill. At this point, it is not yet known whether other three official dump sites (Surakhany, Garadagh and Azizbeyov) will be closed or rehabilitation works will be executed at their territories for extension of their functioning period. This is to be known as soon as relevant consultancy services funded by the project are fully mobilized and the sector strategy is prepared and approved (Van Woerden and Huseynov pers.comm.). MED has prepared Environmental Management Framework (EMF) in support to this component (World Bank 2008).

4) Urgent collection equipment for 5 outer Baku districts - aimed at increasing the level of the collection services in the region, especially at the territories which lack efficient collection. This will be achieved by financing the provision of special equipment (such as trucks, containers and bins) needed for effective collection services. There is a big need for improved waste collection even in Baku, as at the present time only 60% of the total waste is collected (World Bank 2008a).

5) Technical Preparation of post - Project investments – includes the financing of technical-economic basis for creation of new landfills, the evaluation of its influence on the environment and establishment of the transfer stations needed for warehousing of the growing amount of the municipal waste (Mamedli 2008).

An important attention in the project is also given to the Resettlement Policy Framework (RPF). The Framework covers the issue of possible need to relocate six IDP families residing at the areas located nearby the Balakhany landfill. In addition to, it states the importance of ensuring the income loss compensation for the people (approx 200-300 informal waste pickers) who are gathering waste at legal and illegal dump sites with intention to earn some money by selling different waste materials (World Bank 2008). One of the income compensation options discussed in the document is the hiring of these people by the

government to segregate the waste going for incineration (Van Woerden and Huseynov pers.comm.).

MED will have complete responsibility over implementation of the project and will have to execute day-to-day control through the Project Management Team (PMT) which operates within the Ministry. The total price of the project is around 41.5 million USD. From this amount 29,5 millions will be covered through credits provided by WB and the rest will be covered by the GoA (World Bank 2008).

The project was approved by WB's Board of Executive Directors on 17 June 2008 and is expected to be finished by 30 September 2014 (World Bank 2008b).

Solid Waste Management Improvement Project

Solid Waste Management Improvement Project is jointly implemented by the Ministry of Ecology and Natural Resources (MENR) of Azerbaijan Republic and UNDP in partnership with the Government of Norway (GoN) (Mustafayev pers. comm).

The main objectives of the project are the following: 1) to assist GoA technically to develop new policies and regulations for waste management, 2) to enhance data collection and 3) to introduce reuse and recycling strategies in the sphere of solid waste management system of the country (UNDP 2008).

The project objectives will be reached through implementation of the six following tasks:

1) Laws, Regulations, Norms and Standards and RRR Strategies, Cleaner Technology Program (CTP). The key activities are aimed at reviewing the present policies, laws, standards and norms and defining those which create major legal barriers towards proper management of municipal solid waste. Next important step is the preparation of the draft of EU type 'RRR strategies, which failed in the past mostly because of the lack of legislative

basis and instruments needed to support RRR activities. The last key activity is designated to assess whether it is reasonable to introduce CTP in Azerbaijan.

2) Waste Composition, Characteristics and Generation Survey – aimed at conducting research on determination of amount and generation rates of municipal solid waste. The laboratory experiments should be executed in order to define characteristics and composition of waste, identify the amount of generated waste daily per capita and calculate the seasonal variations.

3)National Solid Waste Data Bank – MENR, being the primary governmental body responsible for monitoring of the waste management and environmental protection in Azerbaijan, has to collect and analyze the waste related statistics in order to evaluate the current state of waste management system. This component of the project will assist MENR in establishment of the new Solid Waste Database (SWD) by the means of purchasing the needed software and providing the local staff with professional training. Based on the collected data, MENR will be able to identify and further improve waste management related standards and legislation.

4) Solid Waste Management Feasibility Study and Planning Guidelines – As was mentioned earlier, the current waste disposal facilities do not meet minimal international standards. Balakhany landfill for example, is approved to be used as disposal site for municipal solid waste by the Cabinet of Ministers (CoM) of Azerbaijan Republic, but still there an uncontrolled disposal takes place, while medical and hazardous wastes are thrown away together with other parts of municipal solid waste. In order to address this problem, the following key activities have been determined: conduct general technical, financial and environmental feasibility study of waste transportation, collection, disposal and 'RRR strategies; develop recommendations for selecting the appropriate solid waste management systems; prepare draft contracts for private sector participation in operation, financing and

management of solid waste system services and report guidelines for public awareness programs.

5) Local Solid Waste Management Project - the primary objective of this component is to prepare a project that can serve as an example of successful and practical municipal solid waste management system and 'RRR technologies. This should start with conduction of the workshop aimed at discussion of possible types of demonstrations projects with participation of different interested parties (official authorities, Steering Committee, associations and etc.). Afterwards, the selected projects should be evaluated, analyzed and sent to the Steering Committee for approval. Finally when demonstration project is approved, all financial, organizational and operational aspects should be identified.

6)Project management, skills and know-how – this component mainly contains administrative activities, such as: project coordination, monitoring, financial management, trainings, audits, inspections, public relations and final reporting, as well as cooperation with consultants and all other relevant stakeholders of the project (UNDP 2005).

The Project will be implemented by MENR who will act as the National Executing Agency (NEA) and will be responsible for the general management of the project events, monitoring, reporting and evaluation. Several authorities within the Ministry will be working over the project:

- *Project Advisory Board (PAB)* – will be responsible for the advisory activities throughout the project. It will have representatives from MENR, MED, Ministry of Industry and Energy (MIE), Ministry of Health (MoH), Ministry of Agriculture (MoA), State Statistics Committee (SSC), Executive Power of Baku (EPB), UNDP and Embassy of Norway.

- *Project Executive Group (PEG)* – will be the primary executive decision making authority. The main responsibilities will also include review and update of the project plans.
- *Project Management Unit (PMU)* – will be created by NEA and will be responsible for project coordination and monitoring, procurement, conduction of the trainings and workshops, financial control, annual audits, as well as cooperation with PEG, NEA, UNDP, Embassy of Norway and others.

The overall budget of the project is 900,000 USD which is co-financed by UNDP and the Norwegian Government (UNDP 2005).

"Waste-to-Energy Project" – aimed at construction of waste incineration plant in Baku. At the beginning of 2007, the GoA has announced a tender on construction of waste incineration plant in Baku. As a result of the tender, the french CNIM company was selected by the government (Aliyeva 2008). The company has been in operation during 40 years now and has already constructed more than 250 incineration plants in many different countries. Among them: incineration plant in Paris (the biggest in the world), Moscow, Brussels, Porto and other cities (Mammadov pers. comm.).

The annual output of the constructed plant will be 500,000 tons (2 lines each of 250,000 output, with a possibility to increase the output by creating one more line). At the same time the plant will produce electricity in the amount of 231,500 MWt/hour, where the 15% will cover the needs of the plant, while other 85% will be used to fulfill the energy needs of the country. The total cost of the project is estimated at 350 million EUR and will be completely funded by the GoA. The plant will be located on the 10 hectare territory of Balakhany landfill. Special concern is given to the environmental protection during design, building and

operation stages. The plant will follow the highest local and international environmental requirements and will be compliant with EU directives on environmental standards. It is noteworthy that it will be a DBO (Design-Build-Operate) type of the incineration project which is widely practiced in the world nowadays. It was agreed in the contract that the plant will be owned by GoA (namely by "Temiz Sheher" JSC), but will be entirely managed by CNIM for the next 20 years (with 10 years prolongation possibility) after its construction (Mammadov pers. comm.). During the first stage of the project, the newly created "Temiz Sheher" JSC will be responsible for proper define and calculation of the total amount of generated municipal waste in Baku (Guluzade 2008). Meanwile, CNIM will conduct geological and topographical researches on the territory of Balakhany landfill where the construction of the plant is planned. The construction will last three years and completion works are scheduled to be finished in 2012. During this time the local staff will be provided with professional training to be ready by the time when the plant will start to operate. CNIM is planning to install several mechanical waste sorters, so that to ensure that the waste is sorted before it is delivered to the incinerator for processing (Khalilova 2009).

3.8 Summary

During the Soviet times, the concept of sustainable waste management system did not have the same environmental values, and was different from the modern understanding of this term.

Azerbaijan, as a post Soviet country, lacks adequate basis and experience in environmentally sound waste management practices. In broad terms, the current situation with waste management can be regarded as the following: insufficient national policy, ineffective waste collection system, lack of adequate schemes and instruments, such as: regulatory, economic and communicative for promotion of the waste reduction. Moreover, existing landfill facilities

for municipal waste disposal do not comply with existing minimal sanitary and environmental standards. As a result of open air waste burning, not covering waste after its disposal, vicinity of landfills to the water basins, they cause significant air, land and water contamination.

The practice of landfills fencing is absent. Due to this fact, an unorganized access to the landfills is widely practiced by so-called “waste-pickers”, who are constantly involved in the illegal manual waste separation in search of different waste materials as a source of an income. Even several attempts of the government to close the landfills did not lead to any solution due to the protests of the waste pickers (Yagubova pers. comm.).

In addition to that, many illegal dump sites are present all over the country, and their number is constantly increasing.

Nowadays, significant positive changes have started to take place in the waste management sector of the country. As a result, different complex projects are planned aimed at the improvement of the national policy, legislation, waste collection, transportation, and waste treatment practices. The primary objective that government set in this regards, to reveal and then analyze major problems in according to the principles of sustainable waste management approach used in EU countries. Afterwards, based on the comprehensive analysis, possible ways of future improvements and recommendations on their achievements will be determined.

CHAPTER 4: DISCUSSION AND ANALYSIS

4.1 Major existing constraints and barriers towards sustainable municipal waste management practices in Azerbaijan

The main set of problems related to sustainable waste management practices in Azerbaijan can be concluded to the following: ineffective municipal waste collection, open dumping with the consequent contamination of the air, land and water basins, lack of the adequate control and monitoring over the existing official landfills, growing number of illegal dumpsites, informal waste picking activities and etc.

In this chapter, author provides a comprehensive discussion over the existing barriers and constrains existing nowadays in the country's waste management sector. During the analysis of the collected data regarding the current state of the municipal waste management system in the country, the following main barriers in the country have been identified: 1) technical; 2) financial; 3) institutional and finally 5) social constraints. Most of the identified constraints are interrelated and therefore need a complex consideration.

4.1.1 Technical Constraints

In Azerbaijan, as in many other post Soviet countries, main technical constraints in waste management system are related to the fact that the country lacks trained and qualified personnel, both at the national and local level, to deal with waste management planning and operation (Zeynalov T. pers. comm.).

Since the main waste related policy in the country inherited from the Soviet times, when the issues of waste management and environmental protection have not been prioritized, most of the current authorities dealing with waste management do not have sufficient experience,

technical background and expertise in waste engineering and management issues. Even in the cases, when the initiated projects are managed by foreign qualified waste consultants, lack of the local trained human resources can lead to the project failure.

Another important constraint related to the lack of efficient waste related strategy in the country. As was already mentioned earlier, recently the GoA has been started to develop a comprehensive waste related strategy aimed at the overall improvement of the waste management practices in the country. Establishment of the appropriate waste related strategy compliant with the strategy practiced in EU countries and the rest of the developed world, is an important step, since it guarantees selection of the right direction, in general, and selection of the appropriate waste technology, in particular, taking into consideration the country specific characteristics, such as economic, environmental and technical.

The construction of the waste incinerator in Baku is the biggest municipal waste related project since the Soviet times. It is regarded as a part of the country's waste related strategy, and is aimed at an overall improvement of the waste management system. However, at the same time this project creates many concerns among country's environmentalists on the basis of its environmental impact (Jafarov pers. comm.). One of the major reasons of these concerns related to the fact that currently there are no waste separations practices exist in the country. Thus, the operation of the municipal waste incinerator without prior waste sorting will cause a hazardous air contamination, namely by dioxin emissions. Beside environmental concern, there are also those related to economic aspect of the incinerator construction, since this option is often considered as one of the most expensive ones, and thus is not regarded as the most favorable option in the condition of the developing country.

Having a proper waste strategy allows looking into the waste management problem in a complex way, and making a best appropriate decision towards improvement of the waste management effectiveness.

Studies and research activities in the waste management sector, being a low priority, also cause significant barriers towards the proper selection of an appropriate waste treatment technology in the country taking into consideration local physical, financial, technical and social characteristics. This technical constraint is related to the above mentioned lack of the local qualified personnel in the waste management sector. Significant efforts should be made in order to develop local research institutions, so that they can serve as a basis in creation of the local waste related experts.

The last but not least constraint is the lack of the reliable data and statistics related to the waste management. During the data collection and conducted interviews considerable inconsistency in data related to the municipal waste generation, composition and disposal, was revealed. Therefore, there is an urgent need to prioritize the improvement of the data collection system, since it is one of the most crucial aspects based on which it is possible to identify the primary problems and develop short and long term solutions.

4.1.2 Financial Constraints

Low charges[16] for municipal waste collection services in the country, as well as the low charges collection rates (only around 10-15% of the population pay for these services), lead to insufficient financial basis for the development of the sustainable public services, including waste management collection, transportation and management (Mamedov pers. comm). Such a low charges set by the government could be explained by the fact that citizens' ability to pay for these service is very low. Moreover, their willingness to pay is also not high since they are not ready to pay for the inconstant and not effective services. On the other hand, such a low

[16] Current monthly waste charges in the country are amounted approximately to 0.13 qepik (≈ 0.16 USD) per capita.

tariffs provide no economic incentives for citizens to generate less waste. The same situation can be applied to the institutions and commercial enterprises. They are required to

pay 3-5 Azerbaijan New Manats (AZN)[17] per cubic meter of generated municipal waste. The charge includes the waste collection and disposal services.

As was stated earlier in the Chapter 3.2, in the current Azerbaijan legislation related to waste management, no detailed fines are established for the illegal waste discharging into the environment.

Article 39 of the *"Law on Sanitary and Epidemiological Safety"*, sets out the responsibilities of the citizens and monitoring bodies over the sanitary and epidemiological safety and also basic rules of following the sanitary-hygienic norms and standards. The law also states that the violations of the stated obligations can lead to the criminal conviction. According to the recently conducted studies, waste containers in Baku contain such an aerobic spore-forming and nonspore-forming, pathogenic and opportunistic pathogenic bacterium as *Escherichia coli, Streptococcus faecalis, Aspergillus, Salmonella tifimurium, Poliovirus, Mucor, Tricho-derma, Penicillum* and many others. In addition, the studies conducted at the landfills revealed the presence of *Ascaris* parasites, which are very dangerous for human health (USAID *et al*. 2007). The above mentioned facts serve as an evidence of failure to comply with the stated by the government obligations by the releavant sanitation and monitoring bodies. So, the questions arise, who should be responsible for the violations of the stated obligations, what are the specific stipulated penalty and fines?

In addition to the limited funds, partly because of the low service charges collected from the waste generators, Azerbaijan also lacks good financial management and planning in the waste management sector. The author's attempts on identifying the state budget allocated for the waste management were not successful, both during the formal interviews and during the data

[17] 3-5 Azerbaijan New Manats are approximately equal to 4-6 USD accordingly.

collection.

To conclude, the country experience significant lack of economic instruments to promote the reduction in the generated waste volume. The households pay waste charges based on the "per capita" principle, rather than based on the generated amount of the waste, which also provide no incentives for the reduction of the generated waste. Therefore, the transfer to the payment system based on the waste volume/weight principle can lead to significant positive changes in terms of the consumer behaviors patterns in the short-term perspective.

4.1.3 Institutional Constraints

The primary institutional constraints in the country related to the waste management sector development are the following: unclear responsibilities shared by different authorized bodies, lack of the coordination between different bodies involved in the waste management (government structures, municipalities, private sector, NGOs, etc.), lack of the adequate and efficient control over the authorized bodies and non-inclusion of the population into the decision-making process.

Moreover, the country lacks an international cooperation with countries that employ "best practices in municipal waste management" (Yagubova pers. comm.).

As was stated in Chapter 3.3, in Azerbaijan several governmental agencies are involved in the waste management process. Despite the fact there is a set of general responsibilities shared by different governmental institutions, it was identified during the interviews and data collection, that while some roles and functions are not clearly defined, other responsibilities are overlapped or duplicated. For instance, it is known that the State Statistical Committee is responsible for the waste related data collection, such as amount, composition, etc.

Moreover, according to the Committee's project plan 2008-2012, it is expected that the statistics collection on municipal waste will be further improved and the indicator system will be created (State Statistical Committee 2007). However, in one of the project's document, it was stated that the MENR, as the governmental body responsible for the collection and analysis of the waste related statistics, is expected to create the National Solid Waste Database (UNDP 2005). So, in this regard, it appears as the duplication of the responsibilities shared by MENR and the State Statistical Committee.

In addition to, it is not clear which authority is responsible for the control and coordination over the projects and activities implemented by governmental bodies responsible for the waste management. The main reason for such uncertainties and duplications of responsibilities is ineffective regulatory provisions related to the waste management sector.

In order to ensure that the set legislation is enforceable and facilitates development of the sustainable waste management, there is a need to establish comprehensive set of rules that avoids vagueness and overlapping of duties/ responsibilities of different authorized bodies and fills the gaps of the crucial regulatory functions.

One of the significant technical constraints in waste management is the lack or an absence of the adequate coordination between different governmental authorized bodies, NGOs, private sector, etc. As a result, the policy is usually formulated and adopted by the limited number of agencies, while other relevant stakeholders are not involved into the decision-making process at all. The conflicts of interests among different authorized agencies, as well as the non-sharing of the information, is also quite common.

The lack of the centralized waste management system: collection, transportation and utilization of the municipal solid waste, brings to ineffective operation of different bodies responsible for waste management. In order to overcome these ineffectivenesses, the GoA recently introduced newly established "Temiz Sheher" (Clean City) JSC, aiming at

centralization of the responsibilities related to waste placement and treatment in Baku. The "Temiz Sheher" authority will manage the rehabilitation/closure and construction of the

new landfills corresponding to the modern environmental standards (Aliyev pers. comm.). However, waste collection and transportation will still remain under the responsibilities of the Executive Power of Baku city (Mammadov. pers. comm.).

4.1.4 Social Constraints

Public involvement problem is critical in the issues related to waste management. In Azerbaijan level of public involvement is still negligible. While several major projects aimed at the improvement of the situation in waste management sector are being implemented, the public is still not involved into the decision-making process on the required level (Zeynalov pers. comm.).

Considerable social constraints in improvement of the waste management issues in the country related to the low level of public awareness. The lack of sufficient public awareness about the importance of sustainable municipal solid waste management from environmental and human health perspective significantly limit the level of public participation and contribution to the improvement of the existing municipal waste management practices.

It was observed that the number of public awareness campaigns, as well as other awareness increase tools presented in the country is almost absent. One of the clear examples of the low level of public awareness, as well as the ineffective budget management, was the introduction of the waste separation containers, based on different waste materials: paper, plastic and metallic. While spending quite a solid amount of money on allocating these waste separation containers, the authorities did not provide a proper public awareness campaigns to ensure the

effective use of these containers. As a result, these containers are either not used at all, or filled with different types of the waste regardless the depicted symbols (Fig. 16).

Figure 16. Ineffective use of the municipal waste separation containers in Baku

Several existing projects are primarily organized by the NGOs, such as a recent project: "*Proposals and suggestions regarding the establishment of the waste separation system in municipal solid waste sector",* organized by the National Center of Environmental Forecasting aimed at assessment of the households' readiness level to the municipal waste separation. Besides, a survey was conducted in largest cities of the country in order to evaluate public awareness level on the waste management, as well as to ask for the proposed ideas towards improvement of the current waste management system in the country.

In order to achieve successful promotion of the municipal waste management issues, there is a need to organize special educational programs, trainings, advertisements, etc. Including waste management issues into the school education programs would be highly beneficial for the country, since it will facilitate awareness increase level from the earlier years and thus contribute to the behavioral change of the waste generators.

Another important social issue is related to the increasing number of waste pickers. Waste picking is widely used at the Balakhany and other landfills. People, who are involved into the waste picking activity without following any sanitation norms, are using collected waste materials as a source of income, since they do not have any other employment opportunities. As a result, they expose themselves and their families to a very high health risk. However, if there is a well set recycling structure in the country, these people could be involved into the manual sorting since mechanical sorting is not always effective. Alternatively, their activities

can be effectively incorporated into the waste separation for the waste incineration project being implemented by the government.

All the above mentioned barriers and constraints towards sustainable municipal waste management are interrelated in many aspects. For instance, inconsistencies in legislation weakens regulatory measures, uncertainties with the clear rules and standards for the municipal solid waste disposal limit the control of the relevant service providers, uncertainties with responsibilities of government bodies responsible for waste management weaken accountability. Ineffective financial, technical and administrative resources prevent from sustainable planning, management and improvement of the existing practices. The lack of public awareness does not facilitate the improvement of the municipal waste management, as well as does not allow participating in decision making process promoting community-based approaches.

CHAPTER 5: THE WAY FORWARD

5.1 Improvement of the human resources potential

As was mentioned in the Chapter 4.1.1, Azerbaijan significantly lacks qualified human resources potential in the sphere of waste management. Despite the fact that several higher education institutions such as, Azerbaijan Medical University, Baku State University, Azerbaijan State Oil Academy, Azerbaijan Technical University, prepare professionals in the sphere of environmental protection, urban planning and sanitary-hygienic, none of these institutions have programs directly related to the municipal waste management.

While training can play an important role for short-term results, advanced professional programs are required to build up a significant capacity of technical expertise able to deal with municipal solid waste planning and operation. In this regard, Azerbaijan can use successful examples of Turkey in municipal solid waste management. Despite the fact that current waste management system of Turkey still needs improvement, the situation with municipal waste management staff potential there, is considerably better than in Azerbaijan. Besides this aspect, there is a strong link between Turkey and Azerbaijan in terms of the language similarity, climatic conditions, neighborhood location and cultural links. These factors make a Turkey option the most attractive. Appropriate training programs and educational opportunities available in Turkey should be identified in order to train local environmental specialists with modern waste management practices. This will allow creating the local teaching potential in the country, and develop the municipal waste management programs at the relevant departments of local institutions. This option is valid as a long-term solution (3-5 years).

Meanwhile, existing capacity of the local staff responsible for municipal solid waste management should be trained to update their knowledge, as well as visit successful waste

management systems and discuss operated waste management practices with the counterpart staff and officials. This option will improve local decision-making process in the waste management sector by the consideration of the current successful practices used. This option is regarded as a short-term solution (3-6 months).

5.2 Introduction of the economic instruments

It was clearly defined during the research that the use of economic instruments in municipal solid waste management in Azerbaijan is not well established, although some instruments are used to a certain extent.

Primary economic instruments in the household waste management are charges for waste collection, transportation and disposal. Essential disadvantage of this instrument is that currently it is based on the "per capita" basis, rather than depends on the total amount of the waste generated. Thus, the same amount will be paid at the end of the month regardless the total amount of the generated waste. Thus, it does not provide any incentives to reduce the generated waste. While, it is hard to introduce significant increases in the tariffs (which are currently considered as being quite low) in the short term perspective due to the solvency of the householders, it is however would be very effective to introduce the tariff system, based on which householders will pay for the amount of the waste generated. This will incite those citizens who produce much waste to switch to the waste reduction schemes, and those who usually produce less waste, will be able to save money. On the other hand, this will allow generating public funds to add to waste management budget, and at the same time reduce the amount of the generated waste.

Another effective instrument applicable to the conditions of the country is an incentive pay scheme in householders' waste separation. As was already discussed, Azerbaijan is preparing

for a major waste incineration project, which is to be constructed by 2012. Currently, there are no large scale waste separations practices exist in the country. It is known that, in order to comply with modern incineration norms and standards, waste should be sorted before incineration takes place in order to reduce amount of hazardous emissions in the air. In this regard, introduction of the waste separation practices on a household level would be highly beneficial. These schemes could be easily introduced by providing citizens with economic incentives. Following from the world practice, there could be two options: either pay householders for sorted waste, or, alternatively, make them an exempt from the set taxes. In this case, both government and householders are in a beneficiary condition.

Deposit-Refund-Schemes are currently present in the country on a very limited basis. Main exception constitutes collection of the "Coca Cola" plastic bottles and wine glass bottles. The practice of Deposit-Refund-Scheme was successfully used in the country during Soviet times. Nowadays it could be successfully extended for the paper, cardboard, aluminum cans and tires.

Finally, it is noteworthy that at the present time there are no significant fines exist in the country for the illegal waste dumping. Moreover, the existed regulations are regarded as formal and not enforceable.

5.3 Lack of public awareness

Public awareness is a crucial factor stipulating the level of public participation in successful municipal solid waste management schemes, such as waste prevention, reduction and separation. Analyzing the current situation of public awareness level about the importance of proper municipal solid waste management system in the country, the author came up with several recommendations which can lead to an overall improvement of the present situation.

First of all, there is a need to incorporate at least basic information on waste management into the school education programs. The information could be reinforced in the form of an essay, debate or drawing competitions. If the growing generation would get the information in this sphere from the early years, it will be prepared to get involved in the processes aimed at the improvement of waste management system in the future. Moreover, children can influence their parents when they are not aware of or uninvolved into these activities. These campaigns should be highly publicized, so to ensure that other schools are encouraged to follow the implementation of similar campaigns.

One of the most effective ways in promoting sustainable waste management practices for households is using the door to door awareness campaigns. Such campaigns are usually very successful since they provide an opportunity to clear doubts and ask questions about the promoted practices.

Public awareness campaigns should be also systematically conducted through mass communication methods, such as local TV, radio programs, newspapers and magazines. One of the suggestions is to create the regular program on one of the public TV channels, which, besides providing the valuable information, will persuade people to actively participate in the waste management processes in the country. In this condition this will create an opportunity to implement "cleaning" campaigns in the city with participation of the local people. The use of national and religious values in this case, for example the implementation of the "cleaning" campaign during the Novruz ("Spring Holiday") holiday, will lead to more successfull results.

In addition to, the use of supplementary tools, such as brochures, posters, pamphlets, leaflets and handouts should be also highly considered towards promotion of the public awareness.

Several campaigns, which involved the participation of the local population, have been already organized during last several years by the GoA, NGOs and other relevant institutions. These campaigns did not have the large-scale character, as they were only organized in the

separate small regions of the country. However, in order to achieve successful results, these campaigns should include as big part of the community as possible.

Finally it is worth to mention, that public awareness campaigns should be systematic, since it takes quite a while until behavioral change takes place. For example, in Malaysia government conducted regular public awareness campaigns on waste separation practices during five years before people started to separate their waste.

5.4 Lack of reliable data

It is critically important to obtain reliable data reflecting the current situation of municipal solid waste management in the country. It is evident that nowadays, the system of the data collection on muncipal waste is very weak. During this research, author faced significant inconsistencies in the data obtained from different governmental institutions or NGOs. Taking into consideration the fact that Azerbaijan has recently introduced new strategy on municipal waste management, and several projects are being planned towards improvement of the current situation, it is therefore vital to relize now the critical importance of setting up a well operated waste data collection system. Following from this, there is a need to establish national waste registers and inventories compliant with the European methodologies, develop reporting system reflecting waste generation, composition and disposal practices, as well as set integrated waste indicators for data collection, analysis and decision-making.

5.5 Further improvement of the existing municipal waste management system

Current waste collection system needs significant improvements. Major problems are related to the sanitary-hygienic conditions of the waste containers, trucks, as well as the lack of the number of containers placed in the yards. In addition to, waste is often not collected on time,

what causes overfilling of the waste containers. Moreover, due to the frequent windy days at the Absheron peninsula, waste placed to the open air containers is often scattered negatively influencing sanitary conditions of the surrounding areas (Yagubova pers. comm.). Given the above mentioned, the minimum required number of waste collecting trucks should be purchased ensuring the timely collection of the waste. Furthermore, adequate disinfection system for waste collection vehicles, as well as for the waste containers should be introduced and implemented on a regular basis. Besides, it is vital to ensure normal safe conditions for the municipal waste collection workers by the means of acquiring special working equipment, such as: working clothes, masks, gloves and boots. Implementation of the above mentioned recommendations will considerably contribute to the overall improvement of the municipal waste collection system in the country.

5.5.1 Waste collection

Current waste collection system needs significant improvements. Major problems are related to the sanitary-hygienic conditions of the waste containers, trucks, as well as the lack of the number of containers placed in the yards. In addition to, waste is often not collected on time, what causes overfilling of the waste containers. Moreover, due to the frequent windy days at the Absheron peninsula, waste placed to the open air containers is often scattered negatively influencing sanitary conditions of the surrounding areas (Yagubova pers. comm.). Given the above mentioned, the minimum required number of waste collecting trucks should be purchased ensuring the timely collection of the waste. Furthermore, adequate disinfection system for waste collection vehicles, as well as for the waste containers should be introduced and implemented on a regular basis. Besides, it is vital to ensure normal safe conditions for the municipal waste collection workers by the means of acquiring special working equipment, such as: working clothes, masks, gloves and boots. Implementation of the above mentioned

recommendations will considerably contribute to the overall improvement of the municipal waste collection system in the country.

5.5.2 Waste treatment

Analyzing the present situation with municipal solid waste management, it is evident that landfills will remain one of the main sources of waste treatment in the country in the nearest future. Therefore, development of the more sustainable landfilling practices reducing environmental impact is critical for a short term perspective. Following from this, two main options should be put forward: improvement and rehabilitation of the existing landfill sites and construction of the new sanitary landfills compliant with the international environmental and health standards.

Optimization of existing landfills option seems more feasible from the financial point. This option should include the following procedures: ensuring the proper covering of the disposed waste with ground, fencing, rehabilitation of the roads, and reducing risk of spontaneous waste combustion. In addition to, this option includes closing of the illegal dumpsites and improved monitoring over the landfill operation.

Construction of the new sanitary landfills is more favorable from environmental perspective, however their construction and operation are very expensive. Besides, the construction requires exact data on physical and chemical characteristics of the waste, as well as level of waste toxicity, thus this option could not be regarded as a short term solution.

Recycling

It was already mentioned earlier that current recycling practices in the country are very limited to several privately owned enterprises in paper, glass and metal sector.

Number of studies conducted by several NGOs concluded that Azerbaijan has good premises for development of the recycling infrastructure on a large scale. It is estimated that the recyclable waste products in the country amounted to more than 50% (Makhmudov pers. comm.). Establishment of the recycling system for paper and textile materials is estimated to be highly profitable, both from environmental and economic perspective. However, several years of active awareness raising campaigns are needed in order to ensure the high level of public participation in separation schemes.

Incineration with energy recovery

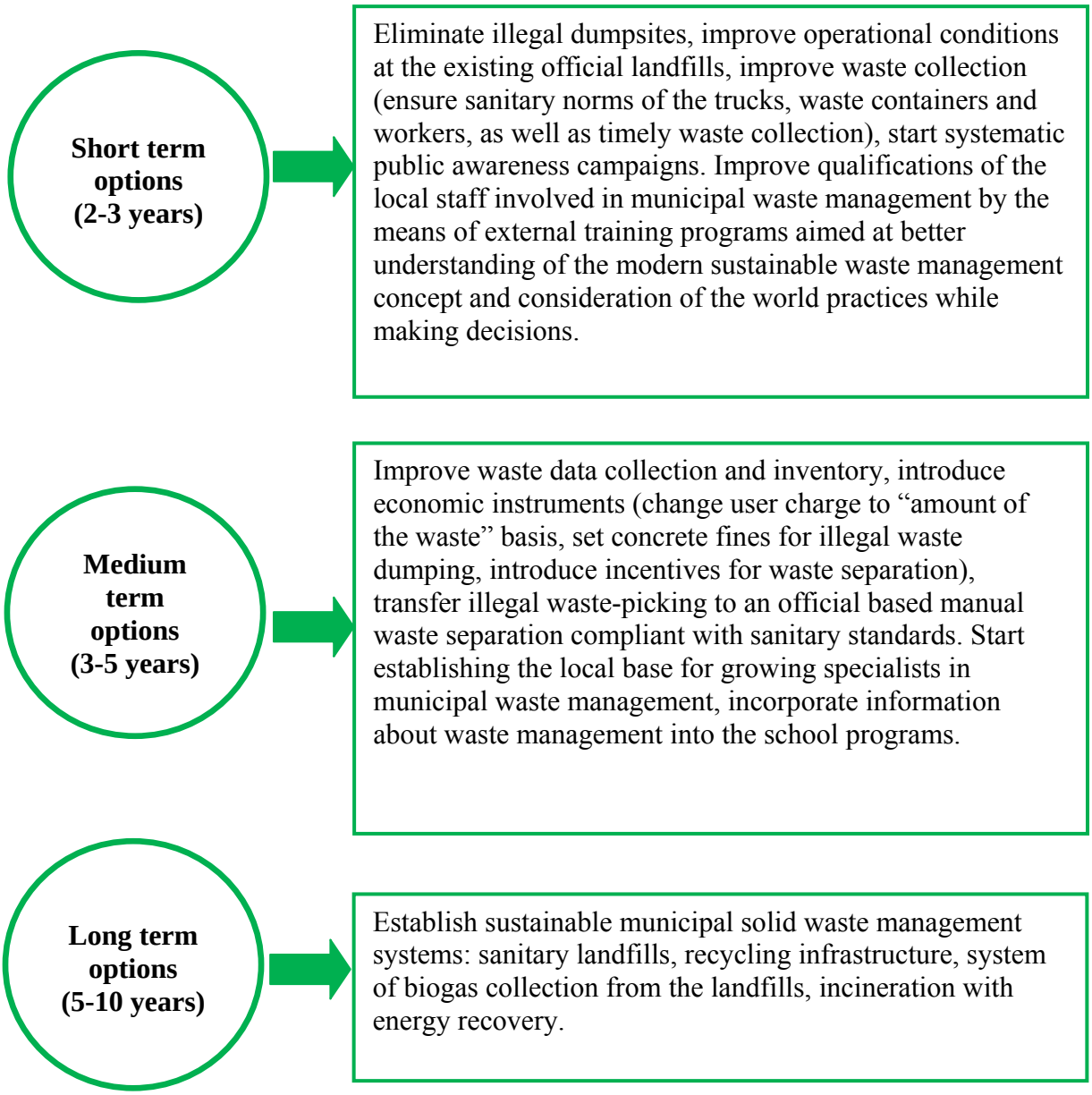
It is widely known that waste incineration as an option of waste treatment is highly criticized by the environmentalists all over the world mainly due to the hazardous air emissions as a result of their operation. Contemporary incineration standards aimed at the environmental protection require use of specific filters to avoid significant emissions. However, the use of these filters require separate disposal at the hazardous waste landfill. Besides, construction of the waste incinerator requires reliable data on waste amount generated and composition in order to estimate the thermal value. Nowadays, there are no emission standards and regulations are established in the country for waste incineration, so the standards compliant with international practices should be considered and enforced prior to the start of the waste incineration plant operation.

Moreover, it is critically important to establish effective waste separation system so the waste is separated before it is incinerated. Systems of control and monitoring should be further improved.

Analyzing the discussed above main constraints and recommendations, author proposes the model on planning sustainable waste management in the country within 10 years period.

Improvement activities are structured according to the time frames that they are feasible to be implemented, i.e. short term, medium term and long term solutions (Table 7).

Table 7. Proposed model for planning sustainable waste management in Azerbaijan



CHAPTER 6 : CONCLUSION

Unprecedented growth of human population and consumption patterns followed by improved economic situation since 1980 resulted in significant increase in municipal waste amount generated around the world, particularly in OECD countries. Many developed countries introduced effective policy responses aimed at the reduction of the waste generation, as well as increase rates of diversion waste from the landfills to more environmentally sound practices, such as reuse and recycling.

Unlike many developed countries, Azerbaijan, as a young independent country lacks knowledge and experience in promoting sustainable municipal waste management practices. The overall system of municipal waste management in the country, inherited from the Soviet time is not compliant with the current international standards aimed at the environmental and human health protection.

The major existing barriers and constraints hampering the improvement of the current situation have been revealed as follows:

- ✓ *Lack of the local technical expertise in the municipal waste management sector*
- ✓ *Unclear responsibilities between different authorities responsible for waste management*
- ✓ *Lack of reliable data*
- ✓ *Inefficient economic instruments to promote waste reuse, reduction and separation*
- ✓ *Low level of public awareness*

All of the above mentioned obstacles are interrelated and thus should be addressed in a complex way. These constraints are the most essential, since they constitute the main base under which the further plan for sustainable waste management in the country could be built.

It is noteworthy, however, that the government now realizes the importance of the problem and thus, recently introduced new strategy aimed at the developing of more effective municipal waste management system which will be more compliant with international norms and thus will be aimed at the reduction of the environmental and human health impact.

This thesis elaborated a multi-step pathway promoting implementation of the sustainable municipal waste management system in Azerbaijan. The proposed recommendations are structured according to their priority and realistic timeframes of implementation. The specific local characteristics of the country also have been taken into consideration while developing these measures.

Finally, while it was revealed that problems of municipal waste management in Azerbaijan are quite complicated, at the same time it is evident that in case of application a good strategy and prioritization of the steps, it is possible to considerably improve current situation, and make it compliant at least with the basic environmental and health standards.

Significant contribution of this thesis related to the fact that until now, there have not been any comprehensive research aimed at the deep analysis of the current situation, as well as proposal of the policy recommendations promoting an effective improvement of municipal waste management sector of the country.

Reference List

Aliyeva, S. 2008. Razgresti gori musora [Dealing with municipal waste problem]. URL: http://www.azeri.ru/papers/zerkalo_az/25178/ [consulted 09 June 2009].

Alizade, F. 2009. Realizaciya proekta ot othodov k energii [Implementation of the "Waste to energy" project]. URL: http://azeri.ppd.spb.ru/papers/zerkalo_az/48600 [consulted 22 June 2009].

Asian Development Bank (ADB). 2005. *Country Environmental Analysis: Azerbaijan.* Philippines: Asian Development Bank.

_____. 2005a. *Azerbaijan: Urban Environmental Profile.* Philippines: Asian Development Bank.

Association of Cities for Recycling (ACR). 2001. *The Application of Local Taxes and Fees for the Collection of Household Waste: Local Authority Jurisdiction and Practice in Europe*. Brussels: ACR.

Batllevell, M. and Hanf, K. 2008. The fairness of PAYT systems: Some guidelines for decision-makers. *Waste Management* 28: 2793-2800.

Bilitewski, B., Werner, P. And Reichenbach, J., 2004. *Handbook on the Implementation of Pay-As-You-Throw as a Tool for Urban Waste Management.* Dresden: Dresden University of Technology.

Bozowsky, E. and Mizuno, H. 2004. Introduction to ecolabelling. Global Ecolabelling Network (GEN). Information Paper. URL: http://www.globalecolabelling.net/pdf/pub_pdf01.pdf [consulted 17 June 2009].

Caarington, R. 1996. Product recycling value and recyclabiblity index for product development: Case study at Electrolux AB. Master's Thesis, The International Institute for Idustrial Environmental Economics, Lund University, Lund.

Chappells, H., Klintaman, M., Linden, A., Shove, E., Spaargaren, G. and Van Vliet, B. 2001. *Domestic Consumption Utility Services and the Environment*. University of Lancaster, Wageningen and Lund.

Cheremisinoff, N. 2003. *Handbook of solid waste management and waste minimization technologies.* New York: Elsevier Science.

Economic Cooperation Organization (ECO). 2007. Ecological Situation of the Republic of Azerbaijan and measures taken for Environmental Protection. Environmental Bulletin. Spring 2007, issue number 5. URL: http://www.ecosecretariat.org/ [consulted 02 July 2009].

European Commission (EC). 1999. *EU focus on waste management.* Luxembourg: Office for Official Publications of the European Communities.

URL:http://ec.europa.eu/environment/waste/publications/pdf/eufocus_en.pdf [consulted 15 June 2009].

_____. 2003. *Waste generated and treated in Europe: Data 1990-2001*. Luxembourg: Office for Official Publications of the European Communities.

_____ .2005. *Waste generated and treated in Europe: Data 1995-2003*. Luxembourg: Office for Official Publications of the European Communities.

European Environment Agency (EEA). 2002. *Case Studies on Waste Minimisation Practices in Europe.* Copenhagen:European Environment Agency.

http://www.eea.europa.eu/publications/topic_report_2002_2 [consulted 4 July 2009].

European Topic Centre on Sustainable Consumption and Production (EIONET). 2008. What is waste? URL: http://scp.eionet.europa.eu/themes/waste [consulted 22 May 2009].

European Union Portal. 2009. Annual municipal waste in kg per person. URL: http://europa.eu/abc/keyfigures/transportenergy/protectingenvironment/index_en.htm#chart38 [consulted 12 May 2009].

Eurostat Webportal. 2009. Municipal waste generated - Kg per person per year. URL: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsien120&plugin=1 [consulted 3 June 2009].

Freeman, J. and Kolstad, Ch. D. 2007. *Moving to markets in environmental regulation: lessons from twenty years of experience*. New York: Oxford University Press USA.

Guluzade, Z. 2008. Interview with deputy Economic Development Minister of Azerbaijan, Mikail Jabbarov. URL: http://www.today.az/news/business/47820.html [consulted 17 June 2009].

Guseynov, S. 2008. Social and legal aspects of municipal solid waste management in Azerbaijan. URL: http://waste.com.ua/cooperation/2008/theses/guseynov.html#author [consulted 05 July 2009].

Harjula, H., De Tilly, S. and Stutz J. 2001. *Waste Trends and Outlook.* Paris: OECD Environmental Directorate.

Hester, R. and Harrison, R. 1994. *Waste incineration and the environment.* London: Royal Society of Chemistry.

Ireland Presidency of the European Union. 2004. Waste Management. Environment Bulletin. 60: 41. URL: http://www.environ.ie/en/Publications/StatisticsandRegularPublications/EnvironmentBulletins/FileDownLoad,2358,en.pdf [consulted 20 July].

Jafarov, F. and Makhmudov, K. 2002. Obespechenie ekologicheskoy bezopasnosti naseleniya Bakinskogo megapolisa pri reshenii problemi utilizacii tverdih bitovih othodov. [Ensuring environmental protection for Baku megalopolis while improving municipal solid waste management system]. Second International Symposium "Ecological and Technological problems in states of emergency", Baku. URL: http://www.sd.aznet.org/en/pubfovgalcon.html [consulted 07 July 2009].

Kaspi (online Baku daily newspaper). 2009. Avropa teleblerine uygun zibilyandirma zavodu [Waste incinerator construction compliant with EU Directives]. April 10. URL: http://www.kaspi.az/news/print-2220.html [consulted 28 May 2009].

Kelleher, M., Robins, J., and Dixie, J. 2005. Taking out the Trash: How to Allocate the Costs Fairly. *C.D. Howe Institute Commentary* 213: 1-22.

Khalilova, I. 2009. Domestic waste incineration plant in Baku to meet all environmental standards: interview with French CNIM SA Managing Director. URL: http://en.trend.az/capital/entrepreneurship/1513465.html [consulted 29 July 2009].

Lindhqvist, Thomas. 2000. *Extended producer responsibility in cleaner production*. Doctoral Dissertation, The International Institute for Industrial Environmental Economics, Lund University, Lund.

Lorek, S., Striewski, S. and Spangenberg, J. 2001. *Household Energy and Water Consumption and Waste Generation: German Case Study.* Vienna: Sustainable Europe Research Institute (SERI).

Mamedli, N. 2008. Her Bakiliya 350kg zibil dushur [In Baku around 350 kg of municipal waste is generated annually per capita]. *Azerbaijan Islam News (AIN)* (Baku), September 3. URL: http://deyerler.org/texts/news/cemiyyet/13339-hr-bakiliya-350-kq-zbbbl-diir.html [consulted 12 July 2009].

Ministry of Ecology and Nature Protection (MENR). 2009. Municipal Solid Waste Management. Official report. Available from the Ministry of Ecology and Nature Protection, Baku.

Mustafayev, I. 2008. *Meishet tullantilari ve etraf muhit* [Domestic waste and Environment]. Baku: Adiloglu.

Nurmamedov, Z. 2005. Reportaj s glavnoy svalki Baku. [Reportage from the main landfill of Baku].URL: http://www.seu.ru/members/ucs/ucs-info/2005/1367.htm [consulted 11 July 2009].

Opschoor, J. B. and Turner, R.K. 1994. *Economic Incentives and Environmental Policies: principles and practice*. Dordrecht: Kluwer Academic Publishers.

Organisation for Economic Co-operation and Development (OECD). 1999. *OECD Environmental Data: compendium 1999.* Paris: OECD Publishing.

_____. 2001. OECD Environmental Outlook. Paris: OECD Publishing.

_____. 2002. Household energy & water consumption and waste generation: Trends, environmental impacts and policy responses. Paris: OECD Publishing.

_____. 2004. *OECD environmental strategy: 2004 review of progress.* Paris: OECD Publishing.

_____. 2007. Instrument mixes for environmental policy. Paris: OECD Publishing.

_____. 2008. *OECD Environmental Outlook to 2030.* Paris: OECD Publishing.

_____. 2008a. OECD Key Environmental Indicators. Paris: OECD Publishing.

Porter, C. R. 2002. *The Economics of Waste*. Washington, D.C.: Resources for the Future.

Rashid, S. 2006. Problema – ne musor [Waste itself is not a problem]. URL: http://nashvek.media-az.com/387/vk.html [consulted 23 June 2009].

Regional Environmental Centre (REC) Estonia. 2003. Overview of Best Practices in Municipal Waste Management. URL: http://www.recestonia.ee/jaatmed/yle_eng.pdf [consulted 15 June 2009].

Rhyner, Ch., Schwartz, L., Wenger, R. and Kohrell, M. 1995. *Waste management and resource recovery.* Boca Raton: Lewis Publishers.

Soni, S. K. 2007. *Microbes: A Source of Energy for 21st Century*. New Delhi: New India Publication Agency.

State Statistical Committee of the Republic of Azerbaijan. 2007. The State Program on Improvement of the Official Statistics in the Republic of Azerbaijan in 2008-2012. URL: http://www.azstat.org/dovlatproq/indexen.php [consulted 15 July 2009].

Tietenberg, T. 2008. Environmental Economics. The Encyclopedia of Earth. ed. C.J. Cleveland. URL: http://www.eoearth.org/article/Environmental_economics [consulted 11 June 2009].

United Nations (UN). 2004. *Environmental Performance Reviews: Azerbaijan*. New York: United Nations Publication.

United Nations Environment Programme (UNEP). 1996. *International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management.*URL: http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/index.asp [consulted 29 May 2009].

_____ . 2005. Integrated Waste Management Scoreboard. URL: http://www.unep.or.jp/Ietc/Publications/spc/IWM_scoreboard-binder.pdf [consulted 10 May 2009].

_____. 2005a. Obzor nacionalnogo i mezhdunarodnogo zakonodatelstva v oblasti kontrola transgranichnih permesheniy opasnih othodov i ekologicheski bezopasnogo upravleniya imi v stranah SNG [Review of the domestic and international legislation related to the transboundary movements of the hazardous waste and its environmentally sound management in CIS countries]. Moscow: Centre of International Projects.

United Nations Development Programme (UNDP). 2005. Solid Waste Management Improvement Project (SWMIP) Azerbaijan. URL: http://www.un-az.org/undp/files/020305/prodoc%20v%203%20website.pdf [consulted 22 July 2009].

_____. 2008. UNDP and Norway to help Azerbaijan manage solid waste. URL: http://www.un-az.org/undp/xeberler.php?article_id=20080430084823910&page=0500&lang=eng [consulted 11 July 2009].

United States Agency for International Development (USAID), Department for International Development (DFID) and Eurasia Partnership Foundation (EPF). 2007. *Regional policy report on the European Neighbourhood Policy and Waste Management: Armenia - Azerbaijan - Georgia.* URL: http://www.epfound.org/index.php?article_id=53 [consulted 19 July 2009].

United States Environmental Protection Agency (US EPA). 1995. *Composting: Yard and Municipal Solid Waste.* New York: CRC Press.

_____ . 2006. The Rise and … Rise of Pay-As-You-Throw. URL: http://www.epa.gov/waste/conserve/tools/payt/tools/bulletin/spring06.htm#one [consulted 18 July 2009].

United States National Research Council. 2000. *Waste incineration and public health.* Washington, D.C.: National Academy Press.

Van Beukering, P. and Brander, L.M. 2001. *Policies to promote the waste management Hierarchy: With special attention to the paper cycle in Europe*. Amsterdam: Institute for Environmental Studies.

Van Rossem, C., Tojo, N. and Lindhqvist, T. 2006. Extended Producer Responsibility: An examination of its impact on innovation and greening products. Report commissioned by Greenpeace International, Friends of the Earth and the European Environmental Bureau (EEB). The International Institute for Industrial Environmental Economics. URL:http://www.foeeurope.org/publications/2006/Extended_Producer_Responsibility.pdf [consulted 23 June 2009].

Waste Online Library. 2006. Residual waste disposal, recycling and recovery. URL: http://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm [consulted 12 May 2009].

Williams, P. 2005. *Waste treatment and disposal.* Leeds: John Wiley and Sons Ltd.

World Bank (WB). 2005. Waste Management in China: Issues and Recommendations. Working Paper No. 9. Urban Development Working Papers East Asia Infrastructure Department. URL: http://www.emcc.cn/old/classweb/China-Waste-Management.pdf [consulted 04 May 2009].

_____. 2008. Absheron Rehabilitation Program - Integrated Solid Waste Management Project. Project Information Document, Baku 2008. URL: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/03/03/000333038_20080303082547/Rendered/PDF/E18270v10EA0P11al0February0210clean.pdf [consulted 27 July 2009].

_____. 2008a. Absheron Rehabilitation Program - Integrated Solid Waste Management Project. Environmental Management Framework. URL: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/03/03/000333038_20080303082547/Rendered/PDF/E18270v10EA0P11al0February0210clean.pdf [consulted 25 July 2009].

_____. 2008b. Azerbaijan: Rehabilitation Program (ARP) Contaminated Sites Rehabilitation. URL: http://web.worldbank.org/external/projects/main?Projectid=P104985&Type=Overview&theSitePK=40941&pagePK=64283627&menuPK=64282134&piPK=64290415 [consulted 15 July 2009].

World mapper 2002. Municipal Waste Generated. URL: http://www.worldmapper.org/posters/worldmapper_map307_ver5.pdf [consulted 12 May 2009].

Legislation

Activity Plan on Europe neighborhood policy, 2006

Complex Plan of Actions on Improvement of ecology situation in Azerbaijan during 2006-2010 years, 28 September, 2006.

Decree of the Cabinet of the Ministers of Azerbaijan Republic on determination of costs related to collection, placement, use and treatment of the wastes, #185, 12 August 2008

Decree of the Cabinet of the Ministers of Azerbaijan Republic on the Requirements on Management of Medical Wastes", #213, 28 December 2003

Decree of the Cabinet of the Ministers of Azerbaijan Republic on the Rules on cleaning, temporary storage, regular transportation and treatment of the wastes in the residential territories, in accordance with sanitary, hygienic and ecological regulations", #074, 21 April 2005

Decree of the Cabinet of the Ministers of Azerbaijan Republic on State Strategy on the Management of Hazardous Wastes in Azerbaijan Republic, #117, 25 August 2004

Land Code of Azerbaijan Republic of 1999

Law of Azerbaijan Republic on Environment Protection of 1999

Law of Azerbaijan Republic on Environmental Safety of 1999

Law of Azerbaijan Republic on Industrial and Municipal Waste of 1998, (last amendment in 2007)

Law of Azerbaijan Republic on Protection of Atmospheric Air of 2001

Law of Azerbaijan Republic on Public Health of 1999

Law of Azerbaijan Republic on Sanitary and Epidemiological Safety of 1992

Law of Azerbaijan Republic on Soil Fertility Law of 2000

National Program on Continuous Socio-Economic Development in Azerbaijan from Ecological Aspect, 2003

Order of the President of Azerbaijan Republic on actions aimed on acceleration of socio-economic development in Azerbaijan Republic, #893, 25 March 2002

Order of the President of Azerbaijan Republic on the improvement of municipal waste management in Baku city, 6 August 2008

State Program on Economic development and reduction of poverty, 2003-2005

State Program on Socio-economic development of the regions of Azerbaijan Republic, 2004-2008

APPENDIX 1

List of Interviewees

Aliyev, Isa. Head of Department for International cooperation, science and information. Ministry of Ecology and Natural Resources of Azerbaijan Republic. Semi-formal interview. Baku, 21 May.

Jafarov, FIkret. Chairman of Sustainability Development Public Union. Semi-formal interview. Baku, 18 May.

Huseynov, Hadji. Infrastructure Specialist. World Bank, Azerbaijan. E-mail communication. 12 June 2009.

Makhmudov, Kamran. President of Environmental Research Center. Semi-formal interview. Baku, 19 May.

Mammadov, Oktay. Strategic Development Specialist. "Temiz Sheher" JSC. Semi-formal interview. Baku, 20 May.

Mustafayev, Islam. Chairman of "Ruzgar" Ecological Society. Formal interview. Baku, 20 May.

Van Woerden, Frank. Task Team Leader for the Solid Waste Project. World Bank, Azerbaijan. E-mail communication. 12 June 2009.

Yagubova, Irada. Chairwoman of "ELS" Independent Research Center. Semi-formal interview. Baku, 21 May.

Zeynalov, Adil. Head Inspector of State Control Inspectorate for Environment. Ministry of Ecology and Natural Resources of Azerbaijan Republic. Semi-formal interview. Baku, 22 May.

Zeynalov, Telman. President of the National Center of Environmental Forecasting. Head of Ecological Groups of International Coalition in Azerbaijan. Coordinator at the Ecological Department of the NGO Forum of Azerbaijan. Semi-formal interview. Baku, 22 May.

APPENDIX 2

Interview Questionnaire

1. Legislation

1. What are the existing regulations regarding the amount and quality of the disposed waste?
2. Taking into account the new amendments into the legislation related to the waste management, how they will address specific problems and improve the current situation?
3. What are the major gaps and what kind of possible changes should be done to further improve existing waste management legislation?

2. Policy

1. Is there any waste management strategic programme that exists in the country?
2. Which are the primary responsible governmental authorities in the municipal waste management sector?
3. How the main responsibilities are divided between them?
4. To what extent international cooperation regarding waste management systems is developed in the country?
5. What are the main barriers/constraints that exist in the current waste management sector of the country?
6. What is the level of public involvement into the decision-making process related to the waste management?

3. Financial aspects

1. What amount is allocated in state budget for the municipal waste management sector?
2. What kind of economic incentives present to promote waste reduction/reuse, separation, etc?
3. What are the major ongoing or planned projects aimed at the improvement of the current situation?
4. What is the current user charge for municipal waste management (which includes services of collection, transportation and disposal)?

4. Monitoring

1. Which authorities are responsible for control and monitoring in the municipal waste sector?
2. To what extent the conducted control and monitoring is effective?

5. Data collection

1. Which authorities are responsible for data collection related to waste management (generation trends, composition, amount landfilled, recycled, number of illegal landfills, etc?)
2. How can you evaluate the effectiveness of the data collection system?
3. To what extent the collected data is reliable?
4. Is there any data exist about the total number of the illegal dumpsites around the country?

Recycling

1. What is the current situation in the country with recycling of the municipal waste?
2. Is there any waste separation facilities in Azerbaijan?

Recommendations

1. What are the main measures that could be taken to improve the current situation?
2. Which of these measures could be implemented in a short, medium and long term?