

COMPARISON OF WASTE MANAGEMENT SYSTEMS IN WESTERN AND TRANSITION ECONOMIES WITHIN THE PROJECT WATRA

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SUMMARY: Transition from planned to market economy has been a great challenge for all post-socialistic states of the former Eastern Block. Public services which were previously to a major extent subsidised by the state needed to be adapted to the new economic realities. In this paper some results of a country overview report are presented. This report represents the first working package of the WaTra project, which aims to help understand and develop waste management system of selected transition economies. 13 European and post soviet countries are chosen which different starting conditions and economic state to investigate which are the crucial factors enabling development to a modern waste management. The considered countries are compared with each other by indicators of waste management. Waste collection, waste treatment, landfilling, recycling, composting and incinerated waste per capita are the main aspects which are taken into account and set in relation to economic indicators. Western EU countries generate higher waste amounts per capita and have higher recycling rates. Landfilling is the major waste treatment method in the post soviet and eastern European countries, even among the EU states. The change from practices with only landfilling to modern waste management system with high recycling and recovery is more recognisable. The more a countries waste management system is developed the more waste is generated according to the rising its economic

1. INTRODUCTION

1.1. WaTra Project

Transition from planned to market economy has been a great challenge for all post-socialistic states of the former Eastern Block. Public services which were previously to a major extent subsidised by the state needed to be adapted to the new economic realities. In this respect, the municipal waste management sector (WM) is usually the most problematic due to its chronic state underfinancing, noticeable influence on the urban image, as well as significant negative impact on the environment. The goal of the currently running WaTra project (**W**aste in **T**ransition Economies) is to support the sustainable reformation process of the waste management sector in Belarus and Ukraine through enhancement of international cooperation and capacity building of the partner universities and other stakeholders in the field of waste management. (See projects homepage: <http://watra.boku.ac.at/>)

1.2. Overview Report

As first step of the WaTra project waste management systems of 13 post-socialistic and post-Soviet countries as well as non-socialistic EU countries are described and analyzed. Countries for analysis were selected based on population size, varying waste management performance, preferred treatment technologies and governance system (decentralized/centralized, democratic/autocratic), availability of information (for post-Soviet states). The results of this data collection are merged within the Task 1.2: "Comparison of WM Systems in Western and Transition Economies (Overview report)". It consists of 415 pages and gathers all information about the countries profiles and the waste management related information including the comments on data availability and scientific validation. The main results are presented in this paper. (Wohmann et. al. 2016))

Table 1: List of countries which waste management systems have been described in the WaTra project

	Country	Political Development	Selection Reason for the Analysis
1	Poland	post-socialistic (EU)	well-developed medium-performing large post-socialistic country
2	GDR / Germany	post-socialistic (EU) / non socialistic (EU)	-best performing large post-socialistic country (former GDR) -best performing large non socialistic country with highest recycling rates (western Germany - former FRG)
3	Estonia	post-Soviet (EU)	best performing small post-Soviet country
4	Austria	non socialistic (EU)	best-performing mid-size non socialistic country with highest composting rates
5	Denmark	non socialistic (EU)	best performing small non socialistic country with highest WTE rates
6	Italy	non socialistic (EU)	typical medium performing large non socialistic country with decentralized governance
7	UK	non socialistic (EU)	medium performing large non socialistic country with centralized governance
8	Belarus	post-Soviet	Project main country; mid-size post-Soviet country with centralized/autocratic governance
9	Ukraine	post-Soviet	Project main country; large post-Soviet country with democratic governance (EU accession candidate)
10	Russia	post-Soviet	WM-system determining country before transition; large post-Soviet country with centralized/autocratic governance
11	Kazakhstan	post-Soviet	mid-size post-Soviet country with centralized/autocratic governance
12	Moldova	post-Soviet	typical small post-Soviet country with democratic governance (EU accession candidate)
13	Georgia	post-Soviet	typical small post-Soviet country with democratic governance (EU accession candidate)

The considered countries are compared with each other by indicators of waste management. Waste collection, waste treatment, landfilling, recycling, composting and incinerated waste per capita are the main aspects which are taken into account and set in relation to economic indicators. In that case, the years 1995 and 2014 are considered. Over the period from the 90s until to today, the post-socialistic EU states and the Soviet states had the same requirements in the beginning. However, the waste management systems differ strongly. The few available data for the period before 1990s are also taken into account.

It will be shown how and for what reasons the post-socialist EU states and "old" EU countries developed much better than the post-Soviet states after collapse of the socialistic block, from a

waste management point of view. Performance of the old socialistic centralized waste management system and challenges of the transition period in the post-socialistic / post-Soviet states are addressed. The development paths of the waste management in the considered countries during the last 25 years are compared and main influencing factors (economic, governance etc.) are determined.

2. COMPARISON

The waste management situation and the development of the waste industry in post-socialist states, the “old” EU member states and the post-Soviet states in the past 30 years were explained in detail in the related report as outcome of the WaTra project. Waste sectors have developed different in considered countries – not only regarding treatment processes and operations but also the temporary state of development. Waste management development of a country undergoes different development phases. Klampf et. al. (2006) classifies 5 stages, see table 2.

Table 2. Phases of waste management development (Klampf et. al. (2006))

Phase 0	Neglecting
Phase 1	Collection and uncontrolled disposal
Phase 2	controlled disposal
Phase 3	Collection logistics
Phase 4	Recovery Solutions
Phase 5	Industrial cycle of (secondary raw) materials

The considered countries represent the whole range of these developmental stages. The western European countries can be seen almost to have reached phase 5 with some potential to higher quotas of secondary raw material streams. Most of new European memberstates or post soviet states are situated in phase 1 to 2, even phase 0 can be found in rural areas.

In the report generated waste, treated waste (which in this report means collected waste), landfilled waste, recycling, composting, incineration, the GDP and the unemployment rate of those countries will be compared.

For post soviet countries, which have no strict information policy data availability is poor. Want to becoming an EU member a comprehensive waste data management is required. Information from EU member states is easily available, although degree of aggregation has to be validated. Yet the information from post-Soviet states is fragmentary.

The countries Poland, Germany and Estonia will be regarded as post-socialist EU member states. As “old” EU member states are considered: Austria, Denmark and Italy. As post-Soviet states are included following countries: Belarus, Kazakhstan, Russia, Ukraine, Georgia and Moldova.

Municipal waste is considered as waste collected through waste removal systems in private households or public institutions. It is used synonymous with the term „collection of waste”. In case there is no waste removal system amounts are estimated by the participating research group. The “total waste treatment” depicts the treatment of the overall collected waste, therefore unrecorded waste will be excluded. The informal sector is estimated to differ strongly. Treatment methods of waste for this study are incineration, composting, recycling and tipping/landfilling.

Table 3 shows the percentages of incineration, composting, recycling and landfilling of the collected waste. The data are given in kg per head per year.

Table 3. Waste amounts according to treatment methods for the year 1995 and 2014 (k.A. = no data provided)

	waste generated [per capita in kg]		Landfill [per capita in %]		Recycling [per capita in %]		Composting [per capita in %]		total incineration [per capita in k%]	
	1995	2014	1995	2014	1995	2014	1995	2014	1995	2014
	Poland	280	272	99	52	0	21	1,8	11	0
Germany	623	618	42	1,5	26	46	13	17	17	34
Estonia	371	357	99	6	0	26	0,5	4,8	0	47
Italy	454	488	92	32	3,5	25	1,3	16	5	19
Austria	437	566	46	4	46	26	27	31	12	36
Denmark	521	758	18	1,3	14	26	10	17	56	54
Russia	101	330	90	90	10	10	k.A	k.A	k.A	k.A
Georgia	k.A	k.A	100	100	0	0	0	0	0	0
Moldava	k.A	268	100	100	0	0	0	0	0	0
Ukraine	195	268	99	99	0	0	0	0	0	0

Table 4. BiPRO Assessment for considered countries (BiPRO (2012) and own calculations within the project WaTra

	Decoupling	WPP	Amount of municipal waste recycled (Score doubled for overall scoring)	Amount of municipal waste recovered (energy recovery) (Score doubled for overall scoring)	Amount of municipal waste disposed (Score doubled for overall scoring)	Development of municipal waste recycling	Existence of ban/restrictions for the disposal of municipal waste into landfills	Total physical charges for the disposal of municipal waste in a landfill	Existence of pay-as-you-throw (PAYT) systems for municipal waste	Collection coverage for municipal waste	Available treatment capacity for municipal waste	Forecast of municipal waste generation and treatment capacity in the WMP	Existence and quality of projection of municipal waste generation and treatment	Compliance of existing landfills for non-hazardous waste	Fulfillment of the targets related to biodegradable municipal waste going to landfills	Rate of biodegradable municipal waste going to landfills	Number of infringement procedures – WFD and Landfill Directives	Number of court cases – WFD and Landfill Directives	Overall score
Poland	1	2	1	0	1	2	1	1	1	0	2	2	0	1	0	1	2	2	18
DDR / Germany	1	0	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	36
Estonia	2	0	1	0	0	0	1	1	1	0	2	0	1	2	2	1	2	1	37
Austria	0	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	39
Denmark	0	0	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	37
Italy	0	0	1	1	1	0	1	2	1	2	0	0	0	0	2	1	0	0	15
United Kingdom	1	2	2	1	2	2	0	1	1	2	2	2	1	1	2	1	2	2	32
Belarus (own Calculation)	2	2	1	1	0	2	1	0	0	0	1	0	1	1	0	0	not calculated	not calculated	14
Russia (own Calculation)	1	2	0	1	0	1	1	0	0	0	0	1	1	0	0	0	not calculated	not calculated	9
Kazakhstan (own Calculation)	2	2	0	0	0	1	1	0	0	0	0	1	1	0	0	0	not calculated	not calculated	8

As seen in Table 4 there was a evaluation established by BiPRO (2012) to assess the waste management developmental stage of a country. For the report 3 countries Belarus, Russia and Kazakhstan was calculated by the project team. It can be found, that like it is expected the 3 countries are on a low waste management level compared to the EU member states, for which the assessment was conducted.

2.1 Generated waste

The following figure shows the produced waste per head in 1995 and 2014. In 1995 more waste was accumulated in post-socialist countries than in 2014. Until 2014 a small decrease can be seen. For example, in Germany 623 kg of waste per head were generated in 1995, in 2014 it were 618 kg per head.

The “old” EU member states produced less waste in 1995 than in 2014. The amounts increased especially for Denmark. Whereas there were only 521 kg of waste per head in 1995, Danish population produced 758 kg of waste in 2014. The causes are known for Germany through the efforts of the environmental policy to decouple the economic growth from the generated waste in the last 20 years.

Also the post-Soviet states produced less waste in 1995 than in 2014. The biggest can be found for Belarus – the population produced in 1995 144 kg of waste per head, in 2014 it were 421 kg waste per head. This can be interpreted with the obvious positive correlation between economic

development and waste amounts, unless countries aiming decoupling explicit in the policies, like it is found in Germany.

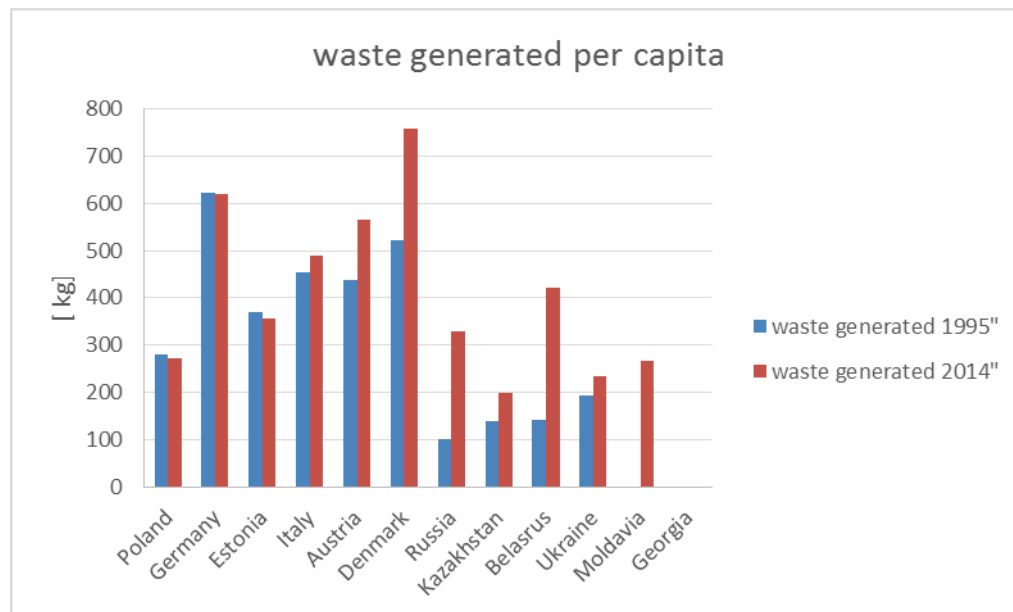


Figure 1. Waste generated per capita in 1995 and 2014 (for Moldova and Georgia no data available)

The increase for the transition countries can be explained by the industrial development and the improved living conditions of the respective populations. Due to a growing production, the ensuing supply of goods and the improved liquidity the consumption behaviour of people has changed.

One has to bear in mind that the figure is depicting merely the amount of collected waste. Any illegally collected or dumped waste cannot be taken into consideration and constitute unreported amounts.

2.2 Landfilling

Reducing landfilled waste amounts is always to be seen as one of the most important actions improving a countries waste managements situation. Landfilling leads to land consumption, landfill gas emissions and the depletion of resources that could instead be looped back into the economy through re-cycling and recovery. (Maletz 2017)

Figure 2 contains the tipped waste per head for 1995 and 2014. However, the figure falsifies the actual results as it depicts the amount of tipped waste per head in relation to the overall produced waste. One has to bear in mind that, for example, Russia produces less waste than Denmark.

In the post-socialist EU member states Estonia and Poland tipped 99 per cent of their waste in 1995 while Germany tipped 42 per cent of their waste in the same year. Until 2014, Poland reduced this amount to 50 per cent. The reductions were higher in Estonia and Germany – Estonia tipped only 6 per cent and Germany tipped 1.5 per cent of the overall produced waste. Especially for Estonia that is a remarkable improvement caused by a strong enforcement of environmental law. And economic development, too, which makes investments possible in environmental technology.

There are still big differences under the “old” EU member states with similar developmental stage. Italy tipped in 1995 92 per cent of its waste, Austria tipped 46 per cent and Denmark tipped 18 per cent of its waste. Until 2014 there were reductions as follows: Italy reduced to 32 per cent, Austria decreased to 4 per cent and Denmark reduced the amounts to 1.3 per cent.

For the post-Soviet states, data was available only for Georgia, Moldova, Russia and Ukraine. These countries tip a similar amount of waste. Russia tips circa 90 per cent of its waste. (VDMA 2015)

If the waste accumulation is 330 kg per head, this amounts to 297 kg of tipped waste per head. Georgia and Moldova do not treat their waste, thus all waste is tipped. The Ukrainian numbers tell that currently around 230 kg waste is landfilled per capita and year.

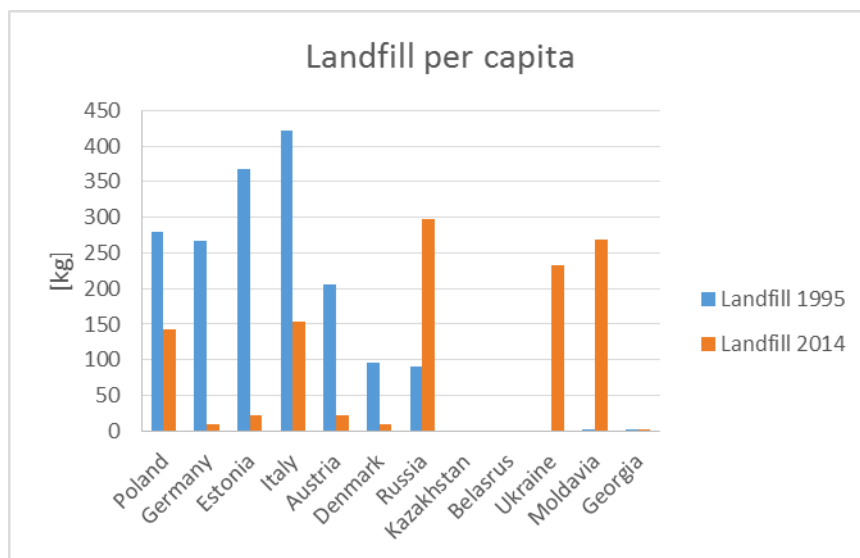


Figure 2. Landfill per capita in 1995 and 2014

2.3 Recycling

Figure 3 indicates the amount of recycling per head in 1995 and 2014. After collection, most of the produced waste goes through the procedure of material recycling. For the post-Soviet countries data could not be provided for all countries. Statements can only be made about the Ukraine, Russia, Moldova and Georgia.

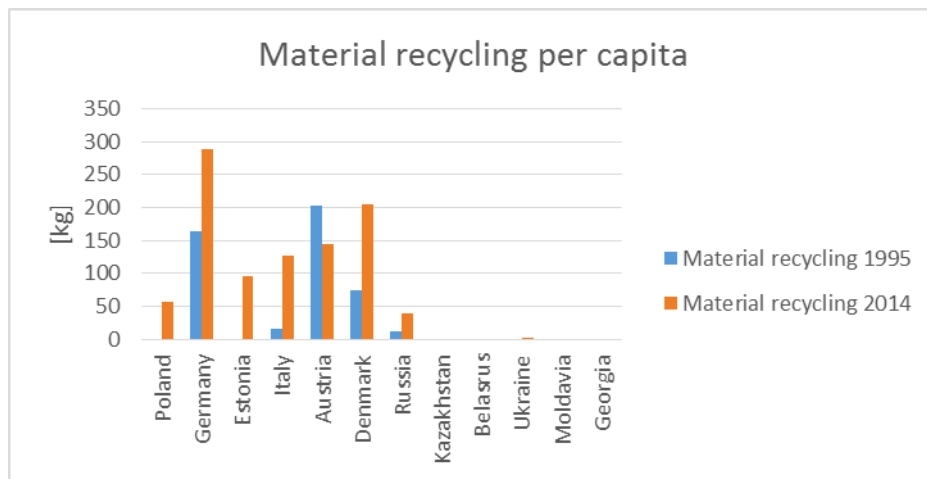


Figure 3. Material recycling per capita in 1995 and 2014

In 1995 there was no material recycling in Poland and Estonia. Compared to that, Germany recycled in 1995 26 per cent and in 2014 46 per cent of its overall produced waste. Around 50 per cent of waste is recycled in Germany and flows as secondary raw materials into the production cycle.

From the “old” EU member states Austria is most interesting as the recycling rate was 46 per cent in 1995 and after that followed a decline down to 25 per cent in 2014. This can be explained by the fact that Austria uses more of its municipal solid waste for waste to energy processes. Denmark and Italy show reversed trends, whereas Italy’s recycling increased from 3.5 per cent in 1995 to 26 per cent in 2014 and Denmark increased from 14 per cent to 26 per cent.

Russia recycled only circa 10 per cent of the overall generated waste (VDMA 2015). Georgia and Moldova did not manage any kind of recycling in the past years. No statements can be made about Kazakhstan and Belarus, as data lacks for both countries. The Ukraine recycled a very small part of its collected waste, the recycling rate is given with circa 0.09 kg per head and year.

2.4 Composting

The following figure indicates the amount of composted waste per head in 1995 and 2014. A comparison ensues here merely between the “old” EU member states and the post-socialist EU states. In post-Soviet countries like Georgia, Ukraine and Moldova there was no composting amounts registered officially. For Kazakhstan, Russia and Belarus there are no figures available, too.

The figure shows the “old” EU member states compost much more than the post-socialist states.

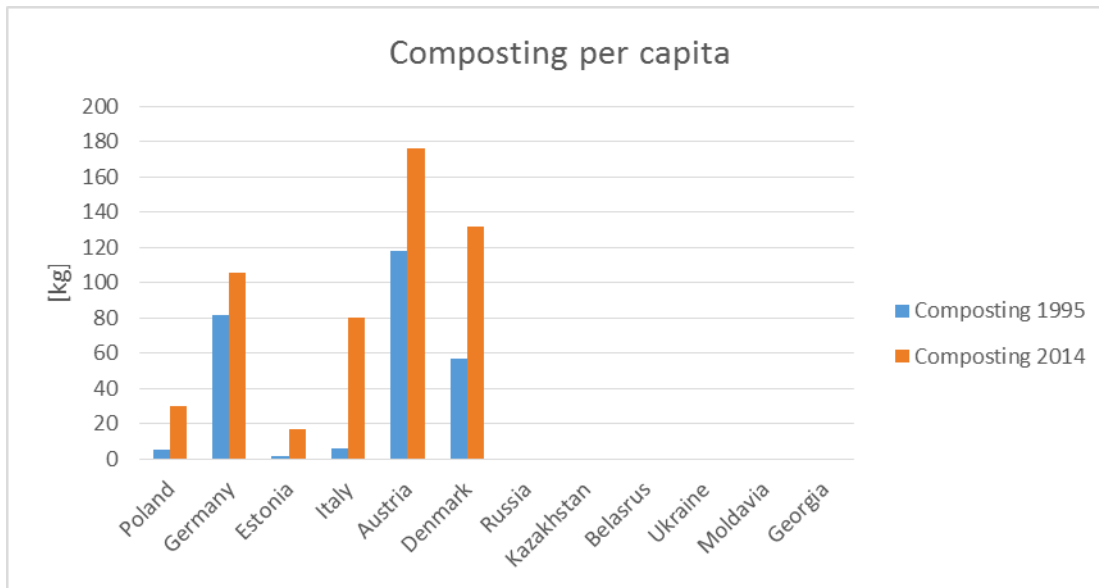


Figure 4. Composting per capita in 1995 and 2014

As of the post-socialist EU member states, Germany composted most of its waste both in 1995 and 2014. In 1995, 13 per cent and in 2014 17 per cent of the overall waste were composted in Germany. Poland and Estonia show a significant increase – especially Poland went from 1.8 per cent in 1995 to 11 per cent in 2014. Estonia composted only 0.5 per cent (1995) and 2.8 per cent (2014) of its overall waste. In 1995 neither the state-of-the-art nor the capacities were sufficient in order to build composting plants or provide the required capacities. A higher share of waste was treated with other methods. The population's own efforts to compost in their own garden are not included in the analysis, although they could raise the proportional amount of composting significantly as green waste and garden waste amount to a considerable amount of waste. Especially for Belarus and Ukraine as joined project partner countries a very high share of home composting could be identified, and exceedingly in the investigated rural areas.

Compared to the other “old” EU member states Austria has the highest share of composting of its overall produced waste. The share increased from 27 per cent in 1995 to 31 per cent in 2014. In Denmark, composting rose during the same period from 10 per cent to 17 per cent and in Italy from 1.3 per cent to 16 per cent.

2.5 Incineration

Figure 5 presents the incinerated waste amounts per head in 1995 and 2014. There was no data generated in the post-Soviet countries Russia, Kazakhstan and Belarus. Statements can only be made about the Ukraine, Moldova and Georgia. For the post-Soviet EU member states there is merely a comparable figure for Germany in 1995, as there existed no incineration plants in Poland and Estonia. In 1995, Germany treated only 17 per cent and in 2014 34 per cent of the overall collected waste in incineration plants. Energy for heating and electricity is gained through this thermal process. Estonia seized in 2014 still 47 per cent of waste per head as an energetic resource through incineration. Due to the possible energy gain, incineration has a high importance in Estonia. Poland treated in 2014 15 per cent of the overall produced waste per head in incineration plants. There are only few Polish incineration plants thus the waste has to be treated otherwise.

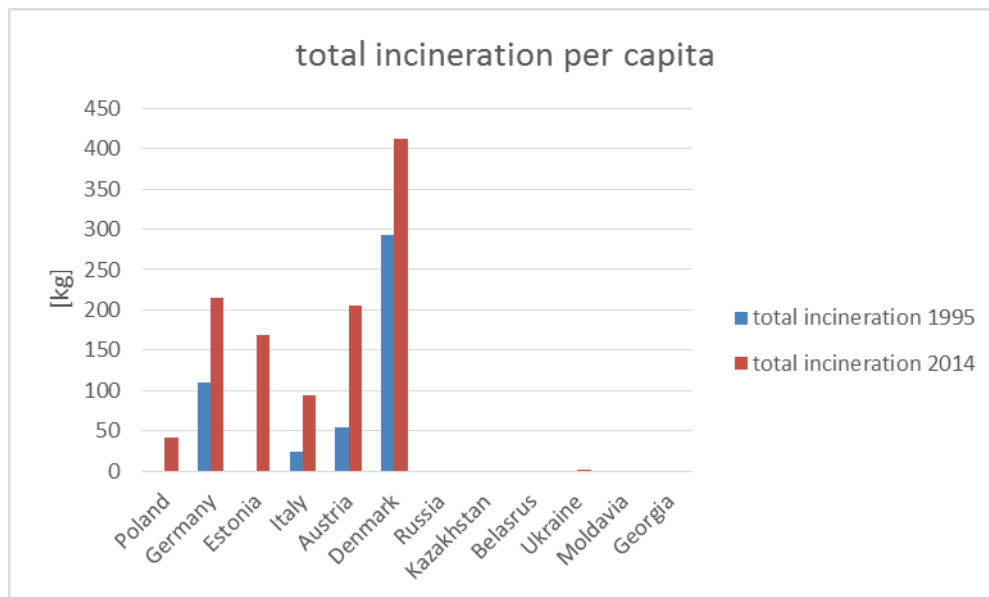


Figure 5. Total incineration per capita in 1995 and 2014

Denmark has under the investigated “old” EU states the highest amount of incineration. Small and economically strong countries like Denmark besides Switzerland and Netherlands concentrating on waste to energy for their residual waste stream because of less geographical space and a high energy and heat demand. In 1995, Denmark treated 56 per cent and in 2014 54 per cent of the overall produced waste per head in incineration plants, that is 100% of the residual waste. Both in Italy and Austria the amount of incinerated waste has risen significantly from 1995 until 2014. Italy treated in 1995 5 per cent and in 2014 19 per cent of its total waste with incineration. For Austria can be found: In 1995, 12 per cent and in 2014 36 per cent of the overall produced waste was incinerated. As of the post-Soviet states, only the Ukraine treated its waste with very small share in incineration plants with low technological standard. The figures amount here to 0.06 kg per head. In Moldova and Georgia there is no incineration of waste until the present day.

2.6 GDP and unemployment rate

Developing a country’s waste sector, social aspects and economic differences has to taken into account. Among others waste management development affects the gross domestic product (GDP) and the unemployment rate as the basic economic parameters. The following figures depict the differences concerning GDP and unemployment in the post-socialist EU states, the “old” EU member states and the post-Soviet states. The social and financial differences condense in the willingness of citizens to introduce new waste systems, especially waste collection schemes

The GDP summarises the value of all goods and services of a particular amount of time, which were generated in a people’s republic. It is of importance to check whether the economic effort is achieved by a national or foreign citizen.

Apart from that the GDP compares also often the prosperity of a nation. Yet it remains problematic that the GDP as an instrument to measure prosperity does not indicate whether the government’s funds are invested wisely. Environmental exploitation and waste of natural resources may have a positive effect on the economy and raise the GDP. Statistically, this would be an increase in the GDP. Apart from that, illegal employment, barter, shadow economy

and subsistence economy cannot be ignored as they form the livelihood for many poorer citizens. Yet these “industries” are not taken into the GDP’s figures.

Furthermore the GDP serves as an indicator for economic growth. It is indicated through the rise of the GDP. An increase of economic power is based on an increase in productivity which is influenced by:

- physical capacity (machines)
- human capacity (employees)
- natural resources
- technical knowledge

The ensuing Figure depicts the GDP per head in euro. Figure 7 shows that the GDP per head was lower in 1995 than in 2014. In addition, the GDP in the “old” EU member states and the post-socialist countries was significantly higher than in the post-Soviet states.

In the post-socialist EU states the GDP of 1995 was clearly below the GDP average in 2014. Germany’s GDP amounted to 23.000 euro per head in 1995 and to 37.100 euro per head in 2014.

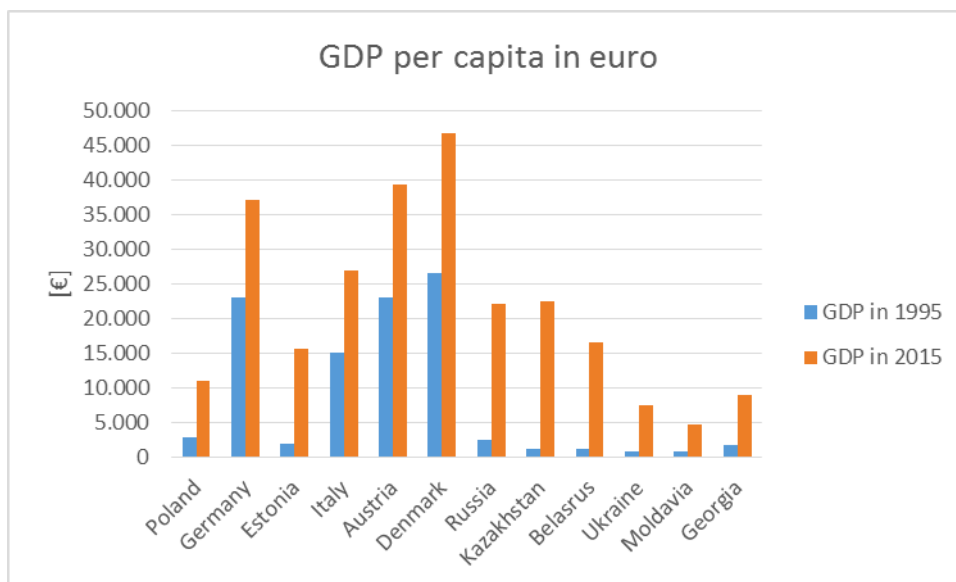


Figure 6. GDP per capita in 1995 and 2015

The GDP of the “old” EU member states is clearly above the overall average of the other compared countries. In 1995, Denmark’s GDP marked 26.600 euro per head and in 2014 it were 46.800 euro per head.

The GDP of post-Soviet states is distinctively below the average of the EU member states. The Ukraine had the lowest GDP in 1995 – only 875 euro per head. In 2014 the Ukrainian GDP rose to 7.500 euro per head. The lowest GDP was in Moldova – 4.700 euro per head.

From the figure emerges that countries with a longer EU membership have a clearly higher GDP. Examples are Denmark, Austria, Italy and Germany. Poland and Estonia joined the EU later.

Unemployment is the lack of employment opportunities for parts of the population that is both

able to work and seeking work. In many countries around the world, unemployment is one of the biggest macroeconomic challenges, as it causes high social costs.

Figure 7 illustrates the unemployment rate in 1995 and 2014. The unemployment rate is higher in 1995 than in 2014 in post-socialist countries. 8.2 per cent of the German population fit for work was unemployed in 1995. Until 2014 the unemployment rate sank down to 5 per cent.

In the “old” EU member states a similar tendency prevails. Italy has the highest unemployment rate: it was 11.2 per cent in 1995 and 12.7 per cent in 2014. The Danish unemployment rate is, however, identical for 1995 and 2014 – 6.6 per cent.

For the post-Soviet countries, the unemployment rate of 2006 and 2014 are compared as no earlier data is known. There was a higher unemployment rate in 2006 than in 2014. Georgia had the highest unemployment rate: in 2006 it was 13.6 per cent and in 2014 it was 13.4 per cent. The biggest decrease of unemployment happened in Moldova – from 7.4 per cent in 2006 to 3.9 per cent in 2014 with their strong industry sector as one explanation possible.

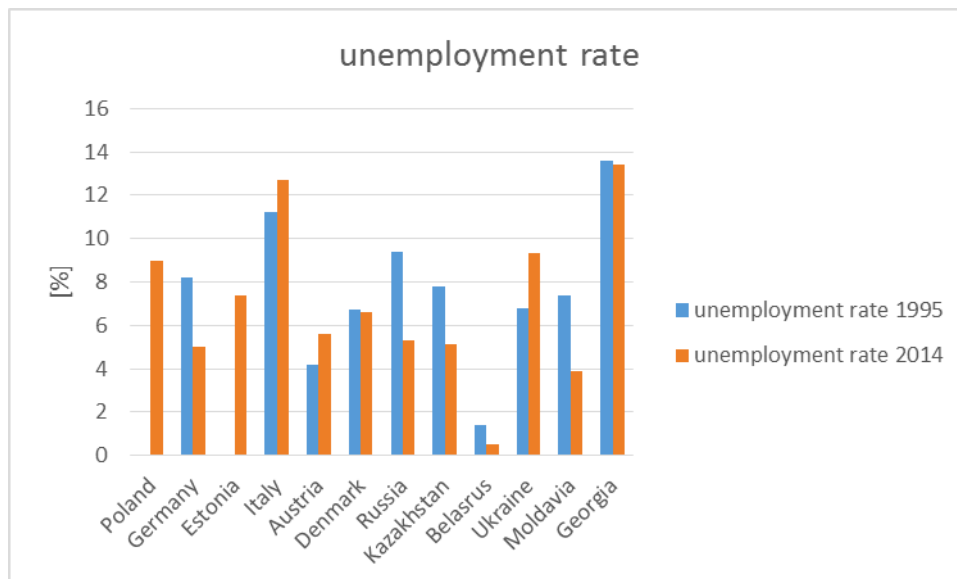


Figure 7. Unemployment rate in percent in 1995 and 2014

The figures for unemployment are closely related to the financial concerns of the population. The more unemployed people, the more people struggle with financial problems and existential fears. This is a factor that influences the population’s willingness to implement and accept a new waste industrial system.

The relationship between unemployment and GDP or the economic growth is explained through Okun’s Law. Arthur Okun first described the correlation between the two aspects based on his empirical observations. His law states that an increase of the unemployment rate by 1 per cent cost 2.5 per cent of economic growth. However, also a reversed scenario can be observed: It takes 2.5 per cent of economic growth in order to decrease unemployment by 1 per cent. One has to bear in mind that the exact percentage varies depending on the type of national economy and has to be adjusted anew.

To achieve a decrease in unemployment by boosting the economic growth it needs a so-called “employment surge”. This surge characterises a growth rate that is required as a minimum in order to secure current employment. Among other factors, the extent of the

employment surge is defined by technological progress – because the higher the productivity, the less human manpower is necessary in order to achieve the same GDP.

The ensuing figure depicts the dependency of the GDP per head and the unemployment rate in 1995 and 2014.

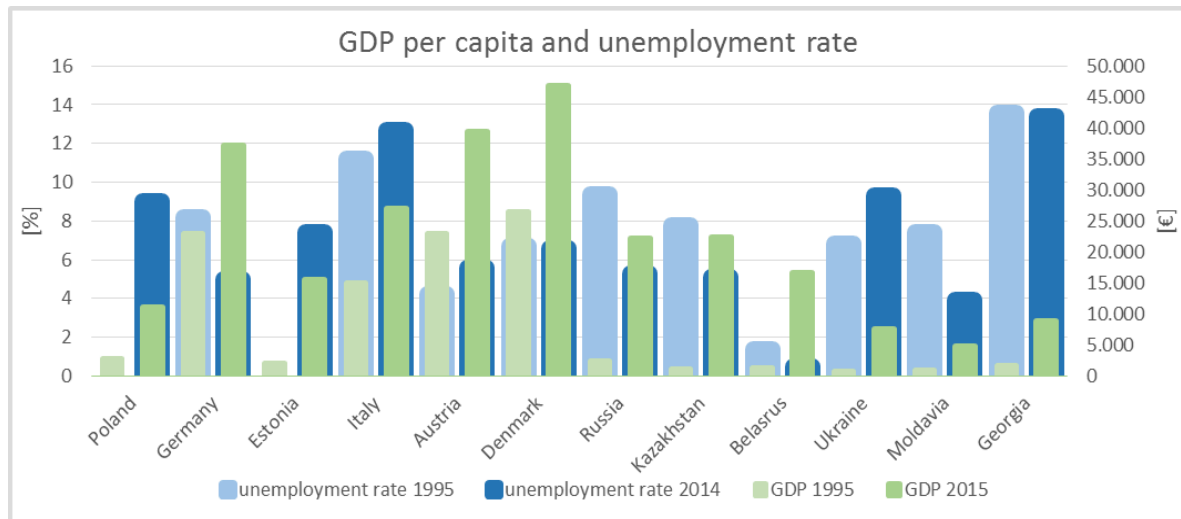


Figure 8. Relation of GDP per capita and unemployment rate

The figure illustrates the employment surge of 1995 and 2014. In 1995, Estonia, Germany, Austria and Denmark had a low unemployment rate and a sufficiently high economic growth. This means, the employment surge was successful. The economic growth is sufficient to curb or decrease unemployment. In 2014 this applies for Germany, Austria, Denmark, Russia, Kazakhstan and Belarus. In 1995 the following countries had no successful employment surge: Georgia, Moldova, Ukraine, Belarus, Kazakhstan, Russia and Italy. As a consequence, unemployment rates went up. In 2014 this can be observed to Poland, Estonia, Italy, Ukraine, Moldova and Georgia.

Germany, Austria and Denmark achieved an employment surge in 1995 and 2014. On the one hand, these countries show a constant social and financial standard and on the other hand a constantly positive development of the waste industry. It is to be speculated whether and how these factors are related to one another. However, based on that assumption, a broader support from the population for concerns of the waste industry is visible. Apart from that the economic and political interest pursues a constant improvement of the waste industry and the related improvements for the environment. Neither Georgia, nor Moldova, Ukraine or Italy had a successful employment surge in 1995 and 2014. This is another hint that poor social and financial standards are related to a lack of willingness and opportunities for citizens, politics and the economy to contribute to change and improvement of the waste industry and environment.

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