Implementation of the Shared Environmental Information System principles and practices in the Eastern Partnership countries (SEIS East) - Part on waste statistics

Pilot Data Sharing Exercise

Regional Validation Report

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Contents

1 Introduction

1.1 This report

This Regional Data Validation Report summarises the results of the Pilot Data Sharing Exercise for the six Eastern Partnership (EaP) countries Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine.

The implementation of the pilot data sharing exercise is a core element of the SEIS II East project. The overall objective of the exercise is to contribute to the improvement of waste statistics through performing a concrete and practical reporting exercise towards the production of harmonised waste data and indicators according to the SEIS principles.

The primary objective of this report is:

- to describe the approach of the data sharing exercise and in particular of the data validation carried out;
- to summarise the results of the data validation and the achievements of the exercise;
- to draw conclusions on the data quality and on areas for improvement.

The report is structured as follows:

- Section 1.2 describes the approach to the Pilot Data Sharing Exercise.
- Section 1.3 describes the validation approach.
- The chapters 2 to 4 present the validation results, structured according to the three areas of waste statistics addressed in the questionnaire:
    - Municipal waste (MW) collection and management (tables R3, R3a, R5).
    - Total (non-hazardous and hazardous) waste generation by source (table R1)
    - Hazardous waste generation and management (tables R1a, R2)
- The final chapter 5 summarises the key findings and conclusions of the validation.

Please note that the report presents the final data set, i.e. the data at the end of the validation process.

1.2 Approach to the pilot data sharing exercise

The pilot data sharing exercise consists of the filling of the UNSD (United Nations Statistics Division)/UNEP (United Nations Environment Programme) Questionnaire 2016 on Waste and of the validation of the data by the Consultant.

The waste part of the original UNSD/UNEP Questionnaire on Environment Statistics consists of the following six tables:

- Table R1: Generation of waste by source
- Table R2: Management of hazardous waste
- Table R3: Management of municipal waste
- Table R4: Composition of municipal waste
- Table R5: Management of municipal waste – City data
- Table R6: Supplementary information sheet

For the purpose of the data sharing exercise, the Consultant has added the following three data sheets:

- Table R1a: Hazardous waste generation by source
- Table R3: Total Population and Population served by Municipal Waste Collection

- Table R7: Methodological Information on Data Collection and Compilation

The questionnaire was sent out for completion on the 25 October 2016, prefilled by UNSD with data reported in previous surveys. The countries returned the completed questionnaires between December 2016 and March 2017. Subsequently, the Consultant has started the validation process, which consists of the following activities and outputs:

Activity	Output
Validation of data following the approach described in chapter 1.3. and formulation of a 1st set of requests for clarification by the countries	A comments and clarifications table with a 1st set of comments and requests for clarification
Sending of the comments and clarifications table to the countries, prior to the country visit.	
Preparation of a national draft Data Validation Report (DVR) for each country, prior to the country mission.	Description of the validation approach and the draft validation results (excl. assessment and conclusions).
Provision of 1st set of clarifications by the countries in writing, prior to the missions.	The clarifications table for each country, with answers/clarifications in writing
Discussion on the 1st set of answers/clarifications provided by the countries, including identification of additional issues, during the country missions.	Discussion during missions on the issues that required clarification and clarifications provided.
Review of the 1st set of answers/clarifications, including those provided in writing before the missions and those during the country missions, and formulation of additional comments and requests for clarification	2nd set of comments and requests for clarifications in the comments and clarifications table.
Finalisation of the national DVRs, incorporating the further answers/clarifications provided by the countries in writing and during the missions, and providing an assessment and conclusions.	A final national DVR for each country, including an assessment, i.e. a chapter on key findings and conclusions with regard to data quality.

Pursuant to the proceeding described in the above table, separate national DVRs were produced for five of the six EaP countries. No DVR was produced for Georgia because Georgia had not yet established a system for the regular production of waste statistics and could therefore provide only very few data.

1.3 Validation approach

Data validation is an integral part of the statistical production process that shall ensure the correspondence of the final (published) data with a number of quality characteristics, in particular the accuracy, coherence and comparability of the data, through the application of defined validation rules (see Table 1).

The objectives of data validation are two-fold:

- The main objective is to detect data errors and to correct them before the publication of the data.
- Data validation can also help to identify structural data errors resulting, for instance, from inadequate methodologies or inconsistent use of definitions. In such cases, the validation results may not necessarily lead to immediate data corrections, but they are important to

identify the main data quality issues and areas for data quality improvement and the potential approaches to improving the data quality.

The data validation encompasses:

- establishing a set of validation rules;
- detecting potential errors and data inconsistencies;
- communicating the detected problems to the reporting unit.

The validation rules aim at identifying potential errors and data inconsistencies. Some validation checks are integrated into the UNSD/UNEP Excel questionnaire so that the results of these checks are immediately available to the reporting country when the data are entered and allow the reporting country to change the data appropriately. The Consultant has carried out additional validation checks. An overview of the applied validation rules is provided in Table 1

Violations of validation rules are referred to as 'observations' in this report and in the national DVRs. 'No observations' means that no violations of the reporting rule has been observed, meaning that no indication of a quality problem was identified. It is important to note that observations may also result from economic, geographic or other particularities of a country. This is mainly valid for observations based on comparison with other countries.

Data validation is embedded in the Eurostat quality concept which characterises data quality on the basis of following quality criteria:

- Relevance
- Completeness
- Accuracy
- Timeliness and punctuality
- Coherence and comparability
- Accessibility and clarity, dissemination
- Cost and burden
- Confidentiality

Data validation is not able to address all quality criteria, in particular when the validation is based on the highly aggregated data as reported in questionnaire. Validation therefore concentrates on the aspects 'completeness', 'coherence' and 'comparability' of the data. A quality assessment that covers all quality aspects requires comprehensive meta-information (e.g. information on definitions, methods, data coverage and processes). Such information shall as far as possible be collected in the course of the country missions.

Table 1 gives an overview on the validation rules that the Consultant has applied and their relationship to the data quality criteria.

Table 1: Overview of the validation approach

Quality criteria	Validation question	Validation rules
Completeness	Have all requested data been reported?	▪ Missing data are evident (empty cells) and need not to be identified by checks, unless the reporting instructions are not properly followed (see next question). ▪ Countries are asked for clarification when data for the most important variables (e.g. data on MW collection) are missing.
	Have the instructions concerning the use of 'zeros' and the use of empty cells been strictly followed?	▪ The questionnaire instructions define: "*If the requested data are not available, please leave the cell blank. If the requested variable is not applicable (the phenomenon is not relevant) to the country or the value is less than half the unit of measurement, the cell should be filled with "0".*" ▪ Countries are asked for clarification where the data context suggests that these instructions have not been followed.
Coherence within tables	▪ Do the totals correspond with the sum of the respective breakdown? ▪ Are differences explained?	Tables R1, R1a: ▪ The total amount of waste generated should be equal (or higher) than the sum of the quantities of waste from the economic activities. Tables: R2, R3, R5: ▪ The amount of waste managed in the countries should be equal (or higher) than the sum of waste by type of treatment. ▪ Where the total is higher than the sum of the breakdown, the countries are asked to explain the reason for the difference in in a footnote.
	Are the quantities of waste generated and managed, comparable?	Table R2: ▪ The sum of the stock of hazardous waste at the beginning of the year (line 1), the waste generated (line 2) and the waste imported (line 3) should equal the sum of the waste treated or disposed of (line 5), the waste exported (line 4) and the stock of hazardous waste at the end of the year (line 11). ▪ Countries are asked to explain any inconsistencies of the balance in a footnote.
Coherence between tables	Is related information in different tables reported in a coherent way?	Table R1/R3: ▪ The amount of waste generated by households (R1, line 7) and the total MW collected (R3, line 3) are closely related. Differences between both datasets should be explainable through differences in coverage of waste types and waste sources. Tables R1a/R2: ▪ The total hazardous waste generation in both tables should be equal. Tables R3/R3a:

Quality criteria	Validation question	Validation rules
		▪ The percentage of the population covered by MW collection reported in R3, lines 14 to 16, should equal the percentage of MW collection calculated on the basis of the population figures in table R3a, lines 1 to 6.
Comparability over time (consistent time series)	Is the time series consistent, i.e. are there breaks in the time series?	All tables: ▪ If there are breaks in the time series, the countries are requested to explain them in a footnote. ▪ The consistency of the time series is checked by calculating the relative change of amounts compared to the previous year (in percent). The thresholds applied depend on the waste flow. For the present validation the following thresholds were used as an indication for a break in time series: - Collection and treatment of MW : ± 15% - Generation and treatment of non-municipal waste : ± 25%
Comparability - geographical	Are the reported values particularly high or low compared to other countries?	Table R3: ▪ The amount of MW collected is compared with the other EaP countries and with EU-countries. For the comparison, the amount of the MW per inhabitant served (kg/cap) was calculated. Table R1, R1a: ▪ For each economic sector, the waste generation is compared with the other EaP countries and with EU Member States. In order to make the data comparable, the generated amounts per capita (kg/cap) are calculated. ▪ It is important to note that for the comparison of waste generation from economic sectors it would be more meaningful to use sector-specific economic reference values, as the number of employees or the Gross Value Added. As these data were not available, the amounts per capita were used as a measure for a rough comparison.
	Are the reported values particularly high or low compared to other cities?	Table R5: ▪ The amount of MW collected is compared with other cities in the same country and in other EaP countries. For the comparison, the amount of the MW per inhabitant served (kg/cap) is calculated.
Further aspects	▪ Are the data sufficiently commented in the footnotes? ▪ Is the information easily comprehensible?	Not applicable

2 Municipal waste collection and management

2.1 Municipal waste data at national data (tables R3, R3a)

Table 2 shows the data that were reported by the 6 EaP countries in table R3 of the UNSD questionnaire for 2015, i.e. for the latest reference year for which data were requested. The table illustrates the completeness of the reported municipal waste data. Data were reported in tonnes, as requested in the questionnaire, by all countries except for Moldova which reported the municipal waste data in m³.

Table 2: Municipal waste collection and management in 2015 (table R3), in 1 000 t

Line	Category	AM	AZ	BY	GE	MD*	UA
1	Municipal waste collected from households			3 095			
2	Municipal waste collected from other origins			758			
3	Total amount of municipal waste collected (=1+2)	493	1 535	3 853	697	2 834	11 492
4	Municipal waste imported for treatment/disposal	0					
5	Municipal waste exported for treatment/disposal	0					
6	Municipal waste managed in the country (=3+4-5)	493		3 853		2 834	
7	Amounts going to: Recycling	0		593			4
8	Composting	0		0			0
9	Incineration	0	509	0			256
10	of which: with energy recovery	0	506	0			254
11	Landfilling	493	946	3 260		2 834	6 233
12	of which: controlled landfilling	493	87	3 260		2 834	
13	Other, please specify in the footnote	0	80	0			6
14	Total population served by municipal waste collection	87%	65%	92%		28%	75%
15	Urban population served by municipal waste collection	99%	100%			61%	
16	Rural population served by municipal waste collection	67%	25%			4%	

* Amounts are reported in m³, not in tonnes

Data on the amount of **MW collected** were reported by all 6 EaP countries. Belarus is the only country that provided data on the origin of the waste, i.e. on the amounts of MW collected from households and from other sources.

Data **on MW management** were reported by all countries except Georgia where no regular waste data collection has been in place so far. The data on waste treatment largely reflect the status of development of the waste management systems in the countries:

- In two countries (Armenia, Moldova), landfilling is the only type of waste treatment for which data are reported.
- Two countries (Azerbaijan, Ukraine) have installed MW incineration facilities and report the amounts treated in these facilities.
- Two countries (Belarus, Ukraine) report the recycling of municipal waste: significant amounts of recycled waste in relation to the collected total are reported by Belarus, low amounts are reported by Ukraine. Informal recycling presumable takes place in all countries but is not covered by waste statistics. Accordingly, the other four countries have reported zero recycling or have indicated the data as missing (empty cells).
- None of the countries reported the composting of MW. The respective cells were left empty or zeros were reported.
- In all countries except Ukraine the amounts of MW collected equal the amounts of MW managed. The imbalance in Ukraine is related to the survey approach. Different from the other countries Ukraine has not established a specific data collection on municipal waste but retrieves the municipal waste data from a statistical survey that covers all waste. The reasons for the imbalance should be further investigated.

All countries except Georgia reported data on the **coverage of the MW collection system**. The coverage rates in 2015 ranged between 28% in Moldova and 92% in Belarus. Armenia, Azerbaijan and Moldova reported separate figures for urban and rural areas in addition to the total coverage. None of the countries produced an estimate on the uncollected waste, i.e. the waste generated by the population that is not served by a MW waste collection system.

Table 3 shows the time series of the MW collected for all countries from 2005 to 2015. In order to compare the data across countries, the Consultant calculated the amount of MW collected per number of inhabitants that were served by the MW collection system in the respective year. Moldova is not included in the graph because the data are reported in m³.

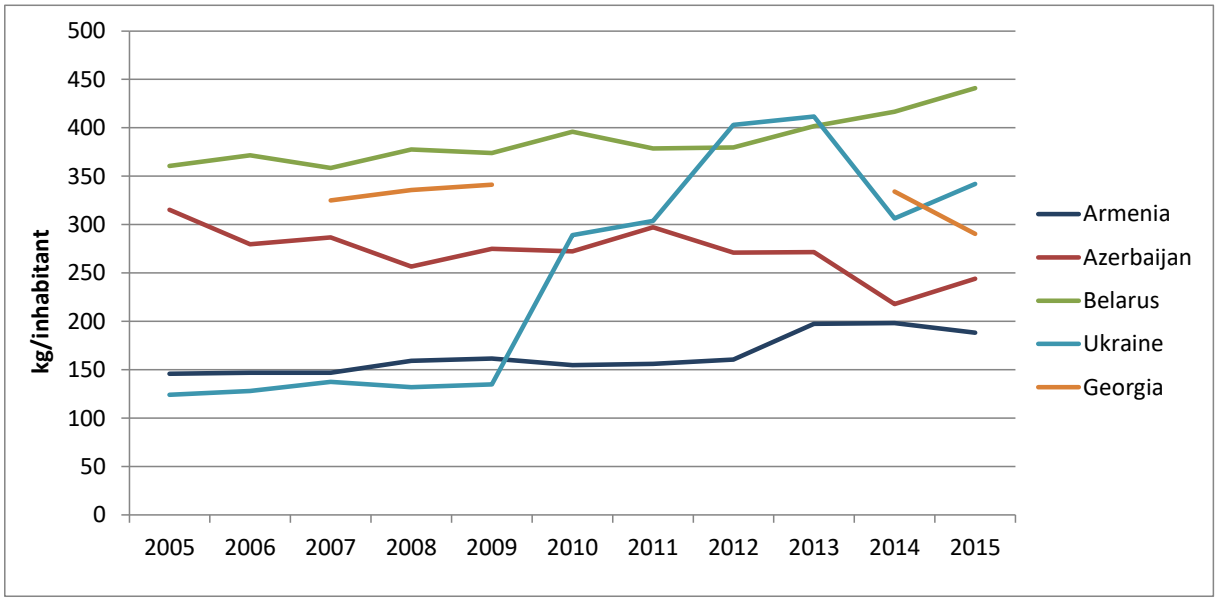

Figure 1: Amount of municipal waste collected per inhabitant served, since 2005, in %

As described in chapter 1.3, the consistency of the time series was checked by calculating the relative change of waste amounts compared to the previous year (in percent). For the collection of municipal

waste a relative change of more than 10% within one year was considered as noticeably high and countries were asked for an explanation for these changes.

Changes of more than 10% were observed for at least one year in all countries, except for Belarus. The dramatic fluctuation in Ukraine is caused by a complete change of methodology in 2010 and by the political conflict in Eastern Ukraine (as of 2013). Further fluctuations between 2010 and 2013 are assumed to result from reporting errors.

Different from other countries, the per-capita amount of MW collected in Azerbaijan has decreased between 2005 and 2015 is lower in 2015 than in 2005. For 2015, Azerbaijan reported the second lowest MW amount of the EaP countries. The decreasing trend in combination with the fluctuation of the data might point to data quality problems with. The decreasing trend is mainly caused by the data from the city of Baku. The data from Baku have a strong impact on the national total as waste collected in Baku accounts for more than 50% of the MW total in Azerbaijan (see also chapter 2.2).

The time series in Armenia is largely consistent but the values seem generally low compared to other countries.

For 2015, the MW collection varies across the six countries between 188 kg/inh. (Armenia) and 441 kg/inh. (Belarus). For comparison: In the EU, the MW collection in 2014 amounted to 478 kg/inh. at average, ranging from 272 kg/inh. in the country with the lowest generation (Poland) and 789 kg/inh. in the country with the highest MW generation (Denmark).

2.2 Municipal waste data at city level (table R5)

Data on the collection and management of municipal waste at city, as requested in table R5 of the questionnaire, were reported for 12 cities by Armenia (Yerevan, Gyumri, Vanadzor), Azerbaijan (Baku, Sumgayit, Ganja), Belarus (Minsk), Georgia (Batumi, Kutaisi, Tbilissi) and Moldova (Kishinev, Beltsy). No data at city level were reported by Ukraine.

Table 3: Municipal waste collection and management in 2015 by city (table R5), in 1 000 t

Line	Category	Yerevan (AM)	Gyumri (AM)	Vanadzor (AM)	Baku (AZ)	Sumgayit (AZ)	Ganja (AZ)	Minsk (BY)	Beltsy* (MD)	Kishinev* (MD)	Batumi (GE)	Kutaisi (GE)	Tbilisi (GE)
1	Total population of the city	1 073	118	83	2 226	336	330	1 949	151	814	153	148	1 109
2	Percentage of city population served by municipal waste collection	100	97	95				85	100	100	100		
3	Municipal waste collected from households							866					
4	Municipal waste collected from other origins							142					
5	Total amount of municipal waste collected (=3+4)	295	10	17	854	150	94	1 008	332	1 883	66		
6	Amounts going to: Recycling	0	0	0				159			0		
7	Composting	0	0	0				0			0		
8	Incineration	0	0	0	509			0			0		
9	of which: with energy recovery	0	0	0	506			0			0		
10	Landfilling	295	10	17	265	150	94	849	332	1 883	66	59	363
11	of which: controlled landfilling	295	10	17	87			849	332	1 883	66	59	363
12	Other, please specify in the footnote				80			0					

* Amounts are reported in m^3, not in tonnes

The data reported for 2015 are shown in Table 3. All countries reported the data in 1 000 tons except for Moldova which reported data for Kishinev and Beltsy in m^3.

The coverage of the MW collection systems seems to be generally high in the cities. However, no information on the coverage was provided by Azerbaijan for Baku, Sumgayit and Ganja, and by Georgia for Kutaisi and Tbilissi.

In all cities, except Baku and Minsk, the whole municipal waste collected is landfilled, predominantly on controlled landfills. Baku is the only of the 12 cities with an incineration plant where about 60% of the collected MW are treated. In Minsk, around 16% of the collected waste was recycled.

Figure 2 displays the time series of the MW collection in 9 of the 12 cities from 2005 to 2015[1]. As in the previous chapter, the amounts of MW collected are related to the number of inhabitants served for better comparison. The graph shows an astonishingly high fluctuation for several cities that is unlikely to reflect real developments.

In Yerevan (Armenia), the MW collection has increased from 2011 to 2012 by 47%. Armenia assumes that this increase is related to an improved registration system and to high construction activities in Yerevan at that time. This explanation suggests problems with the registration of collection companies on the one hand and the inclusion of significant amount of construction waste in the MW data, which would not comply with the UNSD and EU definition of municipal waste.

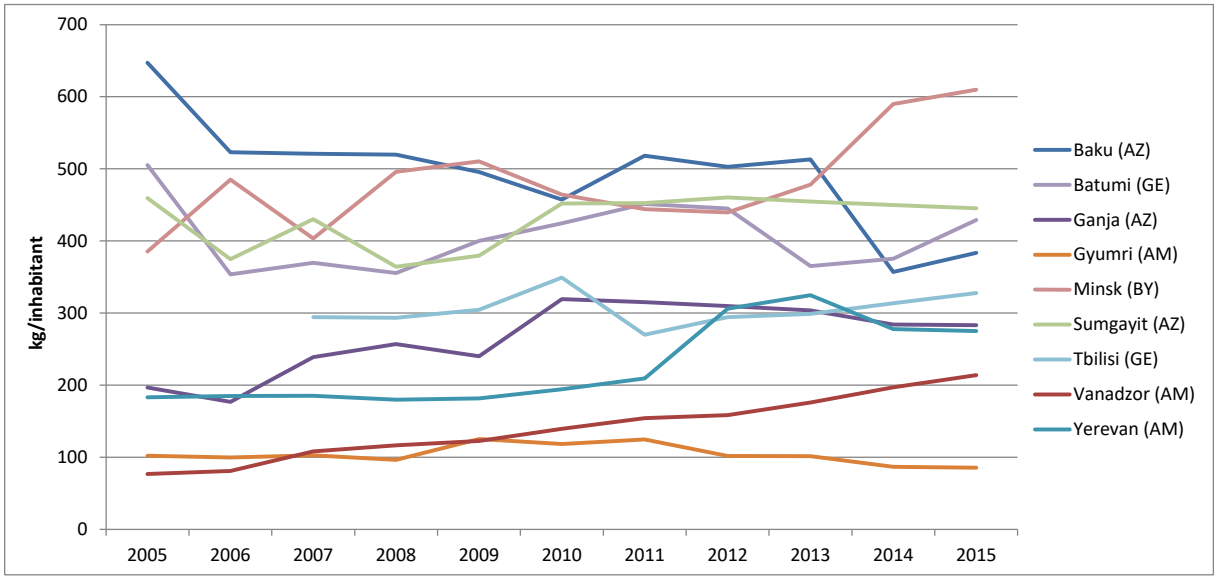

Figure 2: Amount of municipal waste collected per inhabitant served by city since 2005, in %

With an amount of 86 kg/cap, the MW collection in Gyumri (Armenia) in 2015 was very low compared to all other cities. Furthermore, the MW collection in Gyumri has shown a strong decrease since 2011. Armenia explained that in this period private companies that are not covered by the registration system were engaged in waste collection activities indicating a incomplete coverage of the MW collected.

In Baku (Azerbaijan), the amount of municipal waste collected shows not only a high fluctuation but also a decreasing trend over the last ten years although the population is growing. Azerbaijan could not provide a satisfying explanation for this development. A further investigation of the reasons for this development is strongly recommended.

In some cases, the fluctuations of the data are not caused by a changes in the collected amounts but by changes of population figures, e.g. on account of the adjustment of population data on the basis of a

[1] Not included in the figure are the cities Beltsy (MD), Kishinev (MD) and Kutaisi GE) because the data for Beltsy and Kishinev were reported m³, and for Kutaisi data were reported only for landfilling but not for collection of MW.

census or through the change of administrative borders. The drop of the amount of MW collected per inhabitant in **Batumi** (Georgia) from 2012 to 2013 by 18%, for instance, was caused by a sudden increase of population on account of changes of the administrative borders of Batumi City.

3 Total generation of waste by source (table R1)

Table 4 shows the data the countries reported in table R1 ' Generation of waste by source' of the UNSD questionnaire. Except for Georgia which is currently building up a waste data collection system, all countries reported the total waste generation and the breakdown by economic activities (lines 1 to 6). Data on waste generation by 'households' was reported by the countries Armenia, Azerbaijan and Ukraine. Armenia and Azerbaijan use the amounts of MW collected (incl. the MW from other sources) as approximation of the waste from household. Ukraine does not use the MW data but compiles specific data for the sector households.

Table 4: Generation of waste by source in 2015(table R1), in 1 000 t

Line	Category	AM	AZ	BY	GE	MD	UA
1	Agriculture, forestry and fishing (ISIC 01-03)	1.5	0.0			0.5	93.6
2	Mining and quarrying (ISIC 05-09)	35.2	103.3				37.6
3	Manufacturing (ISIC 10-33)	15.1	76.4			0.5	404.5
4	Electricity, gas, steam and air conditioning supply (ISIC 35)	0.9	1.7			0.0	6.4
5	Construction (ISIC 41-43)	3.7	0.0			0.0	1.1
6	Other economic activities excl. ISIC 38	5.9	81.2			6.3	43.9
7	Households	492.8	0.0				0.2
8	Total waste generation	**555.1**	**262.6**	**1 207.8**		**7.3**	**587.3**

In Table 5, the generated amounts are related to the population in order to compare the data across EaP and EU countries and to check whether the data are within a plausible range.

When comparing the data in Table 5 across countries, the following aspects have to be considered:

- Relating industrial waste generation to the number of inhabitants is the easiest but certainly not the most meaningful way of standardising the industrial waste data. Depending on the sector, the number of employees, the gross value added (GVA) or other variables would be more appropriate but were not available for all countries.
- The EU data in the right part of Table 5 illustrate that the waste generation in different economic sectors can actually vary within in a very broad range which makes it difficult to judge the plausibility of data on the basis of the comparison.

In spite of these limitations, the comparison provides useful indications about data quality problems. Such observations include:

- The huge differences between EaP in the sector **mining and quarrying** seem plausible. The amounts in Armenia are well explained by the importance of the mining sector and in particular the waste-intensive mining of non-ferrous metals.
- Belarus reports a very high waste generation in the **manufacturing industry** that is beyond the highest value of EU Member States. This is explained by Belarus with significant amounts of mining waste that is reported under the manufacturing industry and not in the mining sector, pursuant to the main economic activity of the generating companies in the Business Register.
- Waste generation in the **energy sector** is very low in the Armenia, Azerbaijan and Moldova. All three countries explained the low values with the use of low-waste forms of energy sources like hydroelectric power plants, gas-fired power plants or nuclear power plants.
- The very low values reported in the **construction sector** clearly indicate a significant underestimation of waste generation in this sector. This is confirmed by several comments from countries indicating that data coverage and reporting is particularly poor in the construction sector.
- The big differences between EaP countries with regard to waste generation by '**other economic activities**' suggests that there exist serious differences with regard to sectors included under this category.

Table 5: Generation of waste by source in 2015 (table R1), in kg/inhabitant

Line	Category	AM	AZ	BY	GE	MD	UA	EU		
								Min	Median	Max
1	Agriculture, forestry and fishing (ISIC 01-03)	1	2	44		139	195	1	**23**	283
2	Mining and quarrying (ISIC 05-09)	15 672	20	438		84	5 190	0	**45**	22 049
3	Manufacturing (ISIC 10-33)	6	59	4 065		106	1 261	57	**469**	3 352
4	Electricity, gas, steam and air conditioning supply (ISIC 35)	0.3	0.5	106		1	147	0	**106**	5 408
5	Construction (ISIC 41-43)	3	0.3	52		2	2	44	**628**	10 748
6	Other economic activities excl. ISIC 38	6	9	547		646	37	86	**303**	656
7	Households	163	157				135	192	**536**	607
8	Total waste generation	**15 850**	**248**	**5 251**		**977**	**6 967**	879	**879**	24 872

Figure 3 shows the breakdown of the total waste generation by source in percent and thus visualises the considerable differences between the EaP countries which partly reflect structural differences but presumably also have methodological reasons.

In Armenia and Ukraine, waste generation is dominated by waste from mining and quarrying which accounts for 99% (Armenia) and 75% (Ukraine) of the generated total respectively. As indicated above, the high waste generation in this sector in Armenia is well explained by the extraction of metal ores. However, the low values in Armenia in all other sectors indicate a potential undercoverage that should be further investigated.

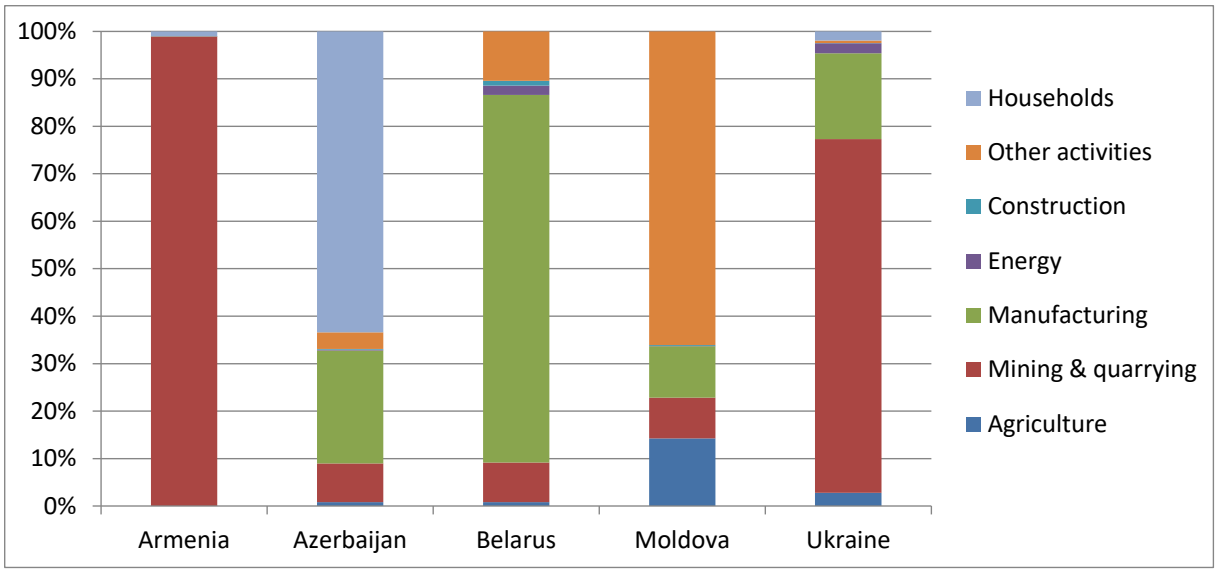

Figure 3: Breakdown of waste generation by source, 2015, in %

The data from Azerbaijan show an extremely high share of waste from households which accounts for about two thirds of the total quantity of waste generated. As the waste generation by households is not particularly high compared to other countries (see Table 5: Generation of waste by source in 2015 (table R1), in kg/inhabitant), the predominance of the sector 'households' supports the assumption that the industrial waste is underestimated

Moldova reports a very high share of waste generated by 'other economic activities' compared to other countries. Waste generation from 'other economic activities' fluctuates strongly over time and accounted in 2015 for two thirds of the total waste generation in Moldova. This is an unusually high value considering that 'other economic activities' mainly cover the service sector that is in general less waste intensive than other economic sectors like the mining or the manufacturing sector. The reasons for this observation should be further investigated by Moldova.

As described in 1.3, the consistency of the time series was checked by calculating the relative change of waste amounts compared to the previous year (in percent). For the generation of industrial waste a relative change of more than 25% was considered as peculiar enough to ask the countries for an explanation. Figure 4 shows the time series of the total waste generation for the period 2005 to 2015 as percentage change relative to the base year 2005. Armenia is not included in the figure because the high amounts and changes would dominate the picture.

The graphs shows significant changes of more than 25% form one year to another for three of the four displayed countries (Belarus, Moldova, Ukraine). The data fluctuation is even higher at the level of the different economic activities which are not displayed in the graph.

For some big changes the countries could provide specific explanations like methodical changes (increase in Ukraine from 2009 to 2010), changes of the production level in the mining industry (low value in Belarus in 2010) or political developments (decrease in Ukraine as of 2013). For other changes, no particular explanations were provided.

One general explanation for data variation that was mentioned by several countries is the incomplete and varying data return from reporting units. This leads not only to an increased data fluctuation but also to undercoverage of the data, as none of the countries corrects the data for non-responses.

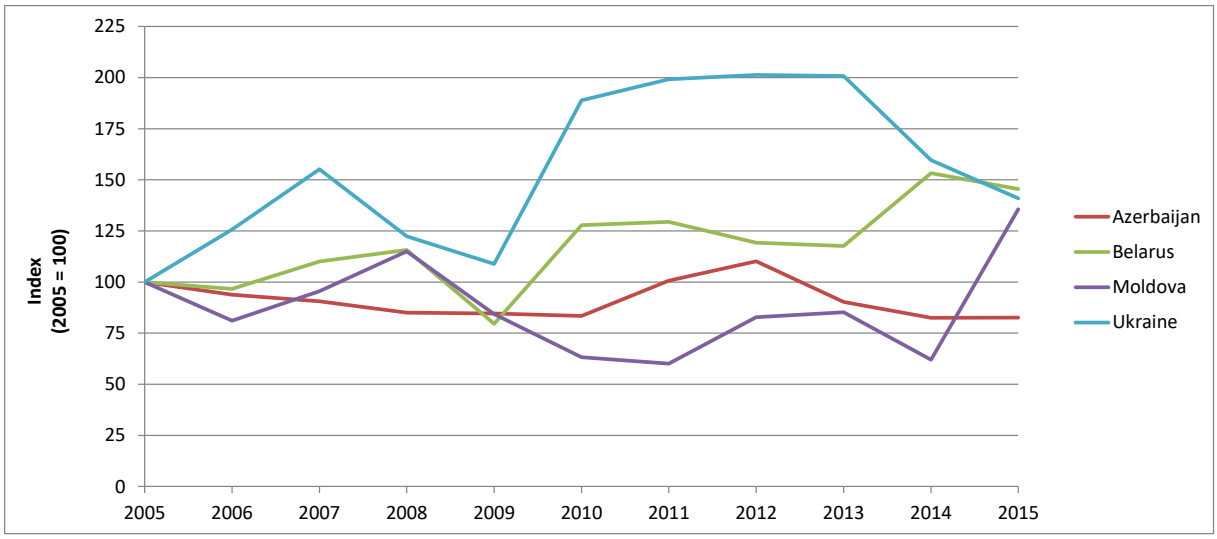

Figure 4: Total waste generation since 2005 (Index with base year 2005 = 100)

4 Generation and management of hazardous waste (tables R1a and R2)

Table 6 shows the data that were reported in table R1a of the UNSD questionnaire for 2015. Armenia, Azerbaijan and Ukraine provided data for the total hazardous waste generation and the complete breakdown by economic activities and by households. Moldova did not report data for the mining sector and for households. Belarus delivered the total but not the breakdown by sectors. Belarus explained that the problem to complete table R1a is related to the allocation of the hazardous waste to the economic sector and that this data will be reported in future. Georgia did not report any data in this table as a regular data collection on hazardous waste generation did not exist so far.

Table 6: Generation of hazardous waste by source in 2015 (table R1a), in 1 000 t

Line	Category	AM	AZ	BY	GE	MD	UA
1	Agriculture, forestry and fishing (ISIC 01-03)	1.5	0.0			0.5	93.6
2	Mining and quarrying (ISIC 05-09)	35.2	103.3				37.6
3	Manufacturing (ISIC 10-33)	15.1	76.4			0.5	404.5
4	Electricity, gas, steam and air conditioning supply (ISIC 35)	0.9	1.7			0.0	6.4
5	Construction (ISIC 41-43)	3.7	0.0			0.0	1.1
6	Other economic activities excl. ISIC 38	5.9	81.2			6.3	43.9
7	Households	492.8	0.0				0.2
8	Total waste generation	**555.1**	**262.6**	**1 207.8**		**7.3**	**587.3**

In Table 7, the generated amounts of hazardous waste are related to the population in order to compare the data across EaP and EU countries and to check whether the data are within a plausible range. Concerning the validity of the indicator "waste generation/inhabitant" for comparing waste generation between countries the same limitations apply as described in the previous chapter for the industrial waste generation.

Furthermore, it has to be considered that most of the EaP countries use a Soviet-based four-tier hazardous waste classification that is not compatible with the classification of hazardous waste in the EU and in addition difficult to apply for the reporting units.

Table 7: Generation of hazardous waste by source in 2015 (table R1a), in kg/inhabitant

Line	Category	AM	AZ	BY	GE	MD	UA	EU		
								Min	Median	Max
1	Agriculture, forestry and fishing (ISIC 01-03)	0.5	0.0			0.1	2.1	0	**0**	5
2	Mining and quarrying (ISIC 05-09)	11.6	10.6				0.8	0	**1**	1 659
3	Manufacturing (ISIC 10-33)	5.0	7.8			0.1	9.0	2	**37**	2 562
4	Electricity, gas, steam and air conditioning supply (ISIC 35)	0.3	0.2			0.0	0.1	0	**1**	5 271
5	Construction (ISIC 41-43)	1.2	0.0			0.0	0.0	0	**4**	199
6	Other economic activities excl. ISIC 38	2.0	8.3			1.5	1.0	4	**23**	60
7	Households	163.3	0.0				0.0	0	**8**	42
8	Total waste generation	**183.9**	**26.9**	**127.2**		**1.8**	**13.1**	**20**	**108**	**7 919**

The comparison shows that the reported hazardous waste generation in industry is generally low compared to EU countries, except for Belarus. Moldova explained the low amounts with the fact that data are collected on toxic waste and not on hazardous waste. This means that the reported data reflect only a subset of the hazardous waste and are thus not comparable with the other countries.

Figure 5 shows the breakdown of the hazardous waste generation by source in percent and visualises the existing differences between the EaP countries. The graph shows mainly two particularities:

- Hazardous waste generation in Armenia is dominated by waste from households which accounts for nearly 90% of all hazardous waste generated. This is caused by the fact that Armenia reports all municipal waste as hazardous waste. On request, Armenia confirmed the reported data and emphasised that the classification of waste from households as hazardous is in line with the national waste classification.
- In Moldova, the share of hazardous waste from the sector 'other economic activities' is implausibly high in relation to other sectors, which is basically the same observation reported for the total waste generation (non-hazardous and hazrdous) in the previous chapter. The reasons for this imbalance could not be sufficiently clarified during the validation.

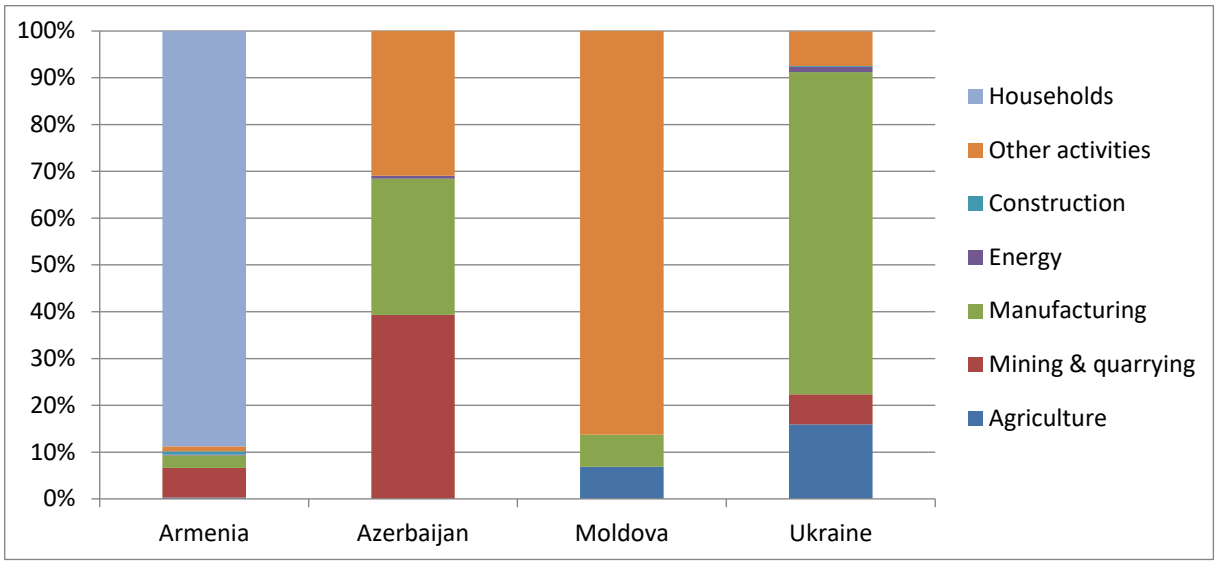

Figure 5: Breakdown of hazardous waste generation by source, 2015, in %

Figure 6 shows the time series of the total hazardous waste generation in kg/inhabitant. Similar to the data on total waste generation, the time series of the countries is characterised by significant changes from one year to the next. In Azerbaijan, Belarus and Moldova changes from more than 100% are observed.

Azerbaijan explained that the fluctuation of hazardous waste generation is real and closely related to activities of the oil industry. Belarus stated that the variation of the hazardous waste generation between 2009 and 2015 is related to problems of the reporting units to adapt to the hazardous waste classifier introduced in 2008 and with an increasing and varying number of reporting units from year to year. Ukraine indicated that the quality of the hazardous waste data is affected by the difficulty to apply the four-tier hazardous waste classification in a harmonised way. The validation results and the comments from Ukraine indicate that the classification may lead to rather subjective results with a significant impact the accuracy of the data. This is illustrated by the classification of livestock excrements, urea and manure parts which was reported as hazardous waste by some respondents.

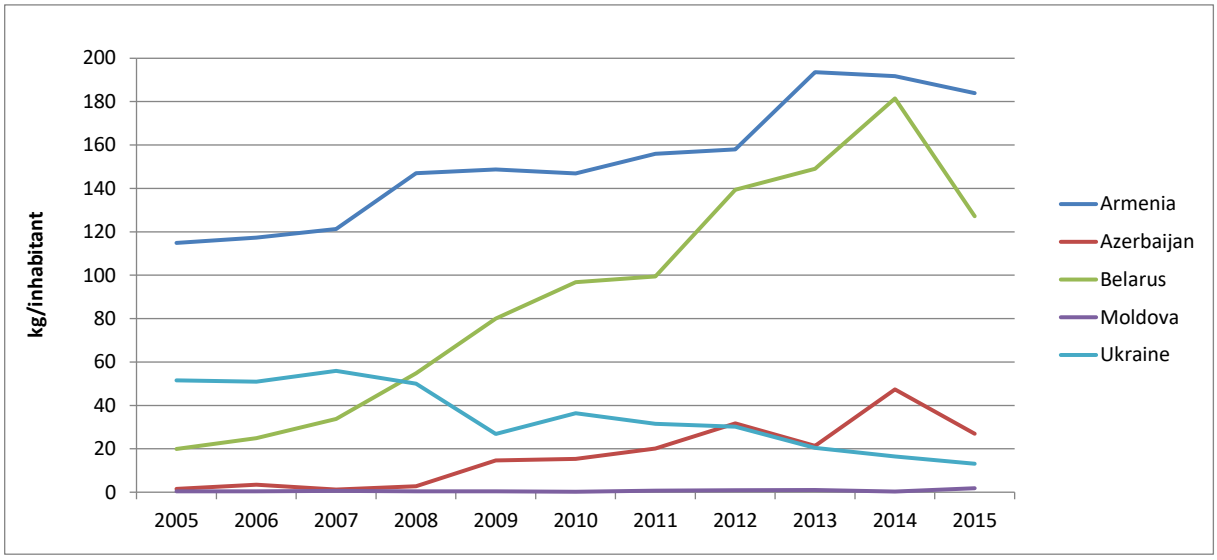

Figure 6: Hazardous waste generation since 2005, in kg/inhabitant

Table 8 shows the data on hazardous waste management as reported in table R2 of the UNSD questionnaire for 2015. With the exception of Georgia, all EaP countries provided largely complete and consistent data sets on hazardous waste management. Some data gaps exist with regard to the temporary storage of waste. Data on imports and exports of waste are partly taken from the Basel data.

The data validation showed that some EaP countries have problems to correctly report the hazardous waste management according to the breakdown in the questionnaire because of differences between the national terminology for waste treatment and the definitions in the questionnaire. Belarus indicated that it is difficult to distinguish between incineration, chemical-physical treatment and biological treatment of hazardous waste as these treatment operations are referred to as 'neutralisation' in Belarus. Furthermore, the term 'recycling' includes the use for production of energy. Similar problems were mentioned by Azerbaijan and are probably valid in the other EaP Countries.

Table 8: Management of hazardous waste (table R2) in 2015, in 1 000 tonnes

Line	Category	AM	AZ	BY	GE	MD	UA
1	Stock of hazardous waste at the beginning of the year		1 824	7 104		6	
2	Hazardous waste generated during the year	555	263	1 208		7	587
3	Hazardous waste imported during the year	0	7	44	0	0	2
4	Hazardous waste exported during the year	0	0	296	1	3	1
5	Hazardous waste treated or disposed of during the year (=6+7+9+10)	555	383	1 558		1	400
6	Amounts going to: Recycling	0	5	890		1	315
7	Incineration	4	211	25		0	6
8	of which: with energy recovery	0	0			0	0
9	Landfilling	551	167	99		0	79
10	Other, please specify in the footnote	0	0	544		0	1
11	Stock of hazardous waste at the end of the year (=1+2+3-4-5)	0	1 703	7 298		9	12 055

5 Key findings and conclusions

As described in chapter 1.3, the data sharing exercise and the data validation followed a two-fold objective:

- the detection and elimination of errors before data publication (short term objective);
- the identification and improvement of quality deficits resulting from inadequate methodologies or inconsistent use of definitions (mid and long-term objectives)

The exercise is considered as successful with regard to both objectives.

An immediate improvement of data quality was achieved for all countries. All six countries revised and improved the reported data at least once in response to the validation findings and clarification requests they received from the Consultant. Data revisions included the elimination of errors (e.g. data entry errors, measurement errors), the closing of data gaps, the improvement of data coherence and the introduction or improvement of explanatory footnotes. Thus, the data sharing exercise has led to an immediate improvement of the completeness and quality of the reported data and has promoted the understanding of concept and definitions of the UNSD questionnaire among the EaP countries.

Problems with regard to data quality and with regard to harmonisation with international/EU definitions and standards that have to be tackled in the mid or long term are highlighted in the following, separately for municipal waste, total waste and hazardous waste.

Data on municipal waste

Serious problems exist in view of:

- Differences in definitions and data coverage of MW (for instance the inclusion of construction and demolition waste);
- The accurate measurement and conversion of the collected and managed waste;
- The completeness of registries and the coverage of the reporting units.

Data on total waste:

- Several countries struggle with a poor reporting, at least in some sectors (e.g. in the construction sector) and/or with a varying data return from year to year, leading to either low amounts or to high fluctuation of data over time.
- In all countries, the national data reflect the sum of the data return from the responding companies. No procedures for the imputation of non-responses or the grossing up of data to companies not covered by data collection are established.
- The selection of the reporting units that are covered by data collection is often not transparent. As a result, the data coverage is unclear.
- Comparability of data across countries is certainly hampered by the lack of a harmonised and EU-compatible waste classification in most of the countries and clear definition of the scope of waste statistics (e.g. with regard to secondary raw materials or agricultural wastes)

Data on hazardous waste:

- All remarks listed under the previous section on total waste are valid as well for hazardous waste.
- The impact of the waste classification and differences in the scope of data collection on data quality and comparability seems to be particularly strong. The problem of comparability is well illustrated by the differences between Moldova and Armenia: Whereas Moldova reports data on toxic waste only, Armenia is reporting all household waste as hazardous waste.
- Furthermore, the complicated four-tier classification of hazardous waste is difficult to apply for the reporting units and seems to lead to subjective and varying results even within the countries.

In addition to the data quality issues addressed above, the reporting in the UNSD questionnaire could certainly be improved by paying more attention to the following aspects:

- The instructions of the UNSD questionnaire concerning the distinction between missing data and real zeros or low values should be closely followed. This would facilitate the data validation as well as the interpretation of the data by the users significantly.
- The provision of concise explanatory footnotes, in particular with regard to methodological changes, the coverage of the data, and the explanation of the reasons for considerable changes from one year to another are also extremely helpful for both, the data validation and final use of the data.