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Landfill Benchmarking Study

Final Report

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ACRONYMS AND ABBREVIATIONS

EAR	European Agency for Reconstruction
KTA	Kosovo Trust Agency
MESP	Ministry of Environment and Spatial Planning
TOR	Terms of Reference
WWRO	Water and Waste Regulatory Office
PSP	Private Sector Participation
IAR	Instituto Regulador da Água e dos Resíduos
KEPA	Kosovo Environmental Protection Agency
KLMC	Kosovo Land Management Company
MSW	Municipal Solid Waste
HDPE	High Density Polyethylene

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1 EXECUTIVE SUMMARY

Overview

The disposal of waste in Kosovo is regulated by the Water and Waste Regulatory Office. It sets tariffs for waste collection and waste disposal service providers as well as for water and wastewater service providers. As part of its tariff review process, a benchmarking study was carried out on the disposal costs for landfilling municipal solid waste. The study was constrained to consider only the engineered sanitary landfills, ie those constructed recently by European Agency for Reconstruction (EAR) and managed by Kosovo Landfill Management Company (KLMC).

The main aim of the study was to evaluate the overall appropriateness of the current tariff levels applied to the KLMC managed landfill sites. The policy by WWRO (to date) has been to set a uniform waste collection tariff across Kosovo that does not reflect local conditions or operational costs. More specifically, the tariff set by WWRO for Kosovo is compared in this report to European Countries with similar levels of waste management practice; and a basic cost model has been prepared to estimate the likely disposal costs.

The study outlines the difficulties in assessing and comparing landfilling costs, both general economies of scale and more specific problems relating to operational standards, overhead charges, depreciation and aftercare. In addition, an assessment of three landfill sites was carried out which included site visits and suggested activities are being undertaken to preserve the asset value of the landfill.

A review of literature from Kosovo and other European Countries in the neighbouring region indicate that the disposal tariff **is within an expected range of costs (tariff).** Some further clarifications may be required to determine high cost operational items such as diesel and, repair and maintenance. Moreover, accounting for the depreciation of the asset or for future investments merits further consideration. A cost calculation model has been prepared separately to determine the likely costs of landfill and may be used to provide assistance with tariff consultations and future economic appraisals of MSW disposal projects.

Main conclusions

Table 5 indicates that based upon the Consultant's assumptions **a tariff covering investment replacements as well as some ongoing investments would be about 13,20 €/tonne, based upon the amounts disposed of in 2006 plus an assumed increase of 5 %.**

However, it should be noted that the investment costs for replacements and on-going investment are not accounted for in the current tariff. There is also considerable debate about depreciating or accounting for assets provided from grant from donor organisations[1]. It is unlikely that the situation presented in Table 5 would prevail. Assets that are essentially free (provided by grants from donor organisations) would not be depreciated as if they had been financed. Nor would an investment fund be established to pay for future landfill development. Removing these two cost factors reduces the costs from 13,20 €/t to 7,80 €/t. This revised estimated is directly comparable to costs from Macedonia of 5,65 €/t. Much of this difference could be accounted for by different site plant and diesel usage.

Operating costs (i.e. repair & maintenance, energy and staff) are about 6,60 €/t or almost 900.000 €/yr. Note: the contract value in 2006 of all private operators (who should perform

[1] This issue will be reviewed shortly by the WWRO support project and covered in a tariff policy document.

these operational tasks i.e. providing staff, energy and basic repair and maintenance for the equipment belonging to KLMC) was about 650.000 € (4,80 €/t).

2 BACKGROUND

2.1About assessing landfill costs

Compared to other elements of waste management (e.g. collection), the assessment of costs for landfilling is known to be difficult and by comparison, even more challenging. In this introductory chapter, some factors have been highlighted in respect to the present situation (Kosovo):

- *Construction standards differ …* …from country to country, and even within a country: The 4 landfills assessed herein - EAR donations managed by KLMC - differ amongst themselves, e.g. *combined bottom sealing i.e. clay + plastic liner* (the latter usually the most expensive single investment item) in *Gjilani* landfill, *clay liner only* in the other three.

- *Concepts of phasing investments differ…* …in Kosovo, the entire landfill bases (bottom sealing etc.) have been constructed (and paid) *at once* for an intended lifetime of say 20 years, in Central Europe the construction of a landfill is both technically and financially an ongoing process: say all 3 to 5 years an extension of the entire waste storage infrastructure (which in technical literature is also referred to as *airspace*) is done.

- *Operational standards differ …* …which might reduce costs in the short term (e.g. no or low efforts for covering) and produce higher costs in the long term (leachate treatment).

- *Accounting standards differ…* …or simply single cost components have not to be considered in one case – donated investments in Kosovo – but in the case its cost might be compared with.

- *Boundaries of economic assessments differ…* …to what extent do external costs (e.g. the drop of land price near a littering site) reflected in the calculation of the site's cost?

- *Economy of scale: Sizes of landfills to be compared with differ…* … the annual capacity of Dragash landfill (about 1,800 tonnes) is three times less than the daily capacity of Istanbul´s central landfill on the European side (Kemerburgaz, 5,000 tonnes). Although the two sites are comparable by construction standards, any cost comparison would be meaningless.

- *Difficulty to account for aftercare measures…* …do we know when setting current tariffs what emissions the landfill will produce after closure (in say 15 years), and over what time span these emissions will occur (another 30 years)? Such uncertainties would not occur when calculating e.g. the individual operation cost of Grlicë *transfer station.*

➢ *Landfills are good hiding places for costs…*

…not only due to its physical nature during construction, but – as a result of all the difficulties highlighted above: In many advanced European waste management systems landfill costs are raised using levies or environmental taxes, thus fostering (and potentially out of it also cross-financing) waste management activities *prior* to landfilling and saving landfill as the entire system's non-renewable resource.

2.2What is a landfill, & what landfills do we have in Kosovo?

The system landfill – notwithstanding its technical "standard" in physical and/or operational terms – represents the backbone of every solid waste management concept. Every advanced and sustainable solid waste management concept comprises a series of components (which are to be developed as generalized in the sketch on the next page), both

- *"soft" components*
  e.g. influencing the behaviour of waste producers by awareness campaigns, introduction of the polluter pays principle and separate collection schemes, and

- *"hard" components*
  (pretreatment and) final disposal facilities i.e. landfills requiring investments at a larger scale.

It should be noted that in Kosovo, the focus of assistance provided by European donors (via EAR or governmental donor institutions from individual countries) was for waste management infrastructure (e.g. hard components). With the last three years (2003-2006), a total volume of 10 million m^3 landfill volume has been installed, totalling about €12 million grants. This capacity could serve Kosovo waste disposal operations for approximately two decades.

However, this *calculated* landfill lifetime is based on two assumptions:

- A reasonable *connection grade* to this infrastructure – say 80 % – of Kosovo´s total population in the mid term, and

- the *availability of the provided infrastructure* over the projected lifetime [2].

[2] It is pointed out by the Consultants that considerable risks highlighted in Table 1 may jeopardize such an assumption.

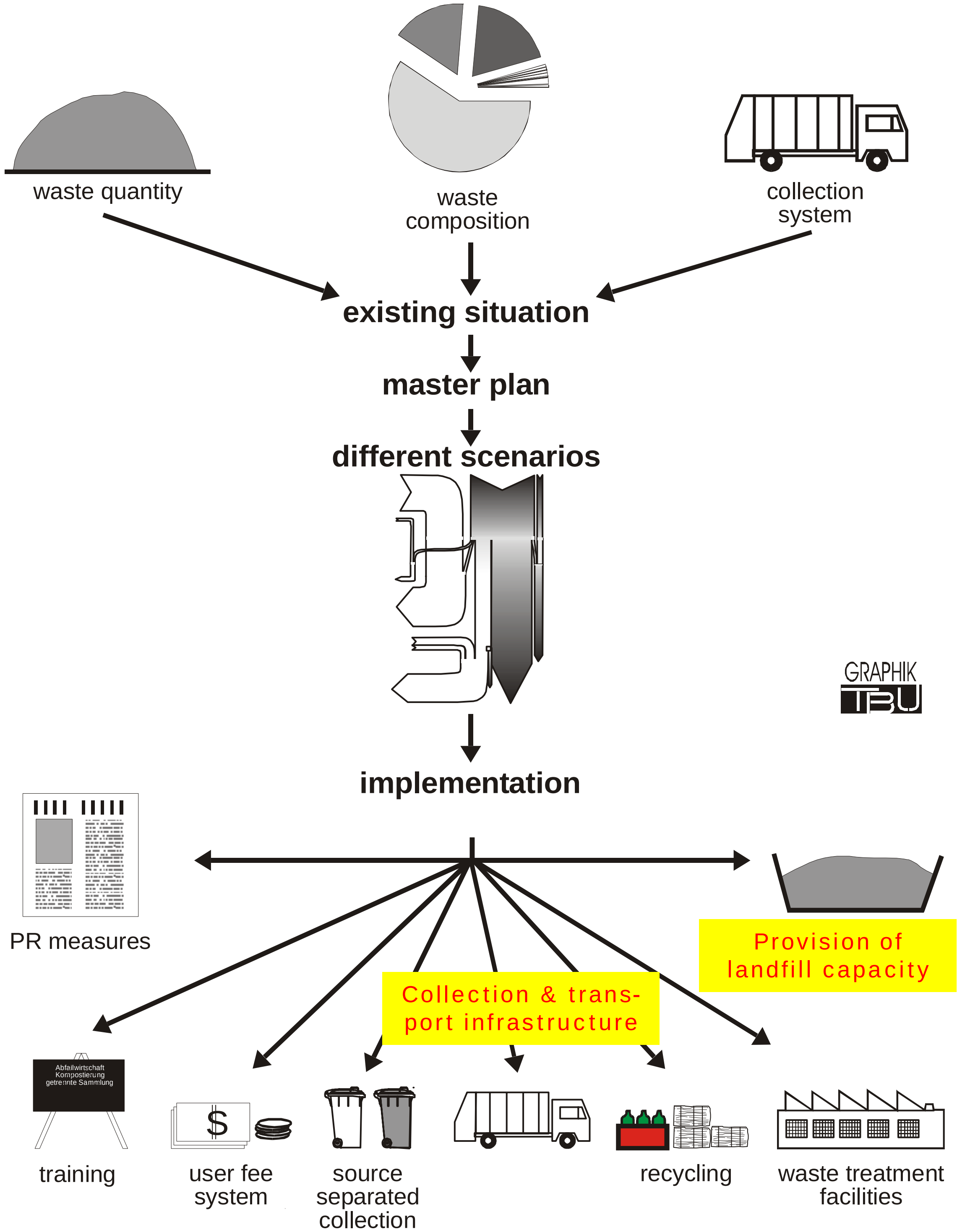


Fig. 1: Usual approach when developing a waste management concept.
Yellow boxes show elements emphasized in Kosovo during the last five years.

2.3EC Standard for MSW [3] Landfills

Under Annex 1 of the EC Landfill Directive[4], general requirements for landfills receiving MSW are described. These include:

- *Location* of the landfill should be a reasonable distance from residential and recreational areas, water bodies etc. The landfill should not be situated where there is a risk of groundwater or surface water pollution.
- *Water Control and leachate management:* control precipitation, surface water and groundwater from entering the landfill, and contain and treat collected waters prior to discharge to the environment.
- *Protection of soil and water:* protection of the environment through geological barriers and bottom lining systems (either clay or a geo-membrane or a combined system of the two barriers) to achieve a hydraulic conductivity of 1×10^{-9} ms^{-1}). A leachate collection and bottom sealing to include a drainage layer (0.5m).
- *Appropriate gas control measures* should be installed, and where necessary, gas treatment (or flaring) should be used.
- *Nuisance and hazards:* minimise emission of odours, dust, wind-blown litter, noise, birds and vermin and fires.
- *Stability of the waste mass.*
- *Barriers and security* to prevent free access to the landfill.

2.4Development of landfill standards, and terminology applied in Kosovo

Terminology on *landfill standards applied in Kosovo* is as follows:

1. Uncontrolled landfill (dumping)
2. Controlled dumping
3. Engineered landfill
4. Sanitary landfill (eg. to EC Standards).

This terminology, which outlines the phases of upgrading waste disposal facilities is based on the seminal work by *Philip Rushbrook*[5]. Through donor support, Kosovo has made a “quantum leap” from uncontrolled dumping to properly engineered sanitary landfills.

[3] MSW in technical English is a common term for Municipal Solid Waste

[4] EC Council Directive 1999/31/EC of 26 April 1999 on the landfilling of waste (OJ L182 16/7/99)

[5] Guidance on Minimum Approaches for Improvements to Existing Municipal Waste Dumpsites, WHO 2001

Stage 1 – Open dumping
This is represented by the uncontrolled operations seen at the majority of dumpsites in middle and lower-income countries. No consideration has been given to the geological or topographical suitability of the site. Most likely, the location of the dumpsite was chosen because it was the cheapest land available that did not affect interest groups within the municipality. No preparatory earthworks or site engineering has taken place and almost no control is exercised over the site operations or the manner in which the waste is deposited. Fires, pests, unconstrained horizontal spread of the landfill surface and slope failures are commonplace.

This is the present stage of landfill development found in many middle and lower-income countries and it widely recognised by government authorities that open dumping practices must be brought to an end.

Stage 2 – Controlled dumping
A controlled dump is usually what can evolve quickly from an open dumpsite when it is rehabilitated. The main features of a controlled dumpsite are: to reduce the working area of the site to a smaller and more manageable size; slope and cover with soil exposed waste on unneeded parts of the site; prevent new fires from being started; construct simple measures to intercept surface water; and establish some rules of on-site work with site workers, drivers and scavengers (if the latter cannot be removed).

The purpose and advantages of these operational improvements is that they can be introduced quickly, need little or no additional investment and introduces the concept of ‘control’ and ‘isolation’ into the waste disposal operation.

This is the stage of landfill development that can be achieved in most middle and lower-income countries in the short term at the existing municipal open dumpsites.

Stage 3 – Engineered landfill
An engineered landfill is characterised as a disposal site where, through planning before construction or through modifications at an exiting site, there is a gradual and obvious adoption of engineering techniques to control one or more of the following:

- Control and avoidance of surface water entering the deposited wastes by installing a well designed and constructed surface drainage system
- Extraction and spreading of soil materials to cover wastes
- Spreading and compacting wastes into smaller layers
- Collection and removal of leachate away from wastes into lagoons or similar structures. The recycling of leachate back into the wastes should be considered
- Passive venting of landfill gas out of the wastes
- Improvements in the isolation of wastes from the surrounding geology
- New parts of the landfill are prepared before receiving wastes.

A clear indication that a municipality has achieved this stage of landfilling is the routine development of detailed engineering designs prior to new landfills being developed. Also, the creation of detailed waste disposal plans showing how the site will be filled with waste and, subsequently, closed. This stage represents the longest transitional period in landfill development since it involves the gradual accumulation within a municipality of engineering expertise and operational experience.

All new, large landfill sites that are developed should incorporate, wherever practicable, the engineering techniques in this stage of landfill development.

Stage 4 – Sanitary landfill
The development of sanitary landfills, as recognised in high-income countries, involves the continuing refinement and increasing complexity in engineering design and construction techniques started in the engineered landfill stage. This can also involve a radical change in the operational practices at the site if the sanitary landfill is to be operated according to the flushing bioreactor or semi-aerobic concepts. Sanitary landfills typically have many additional features to those found on engineered landfills, for example:

- Pre-planned installation of landfill gas control and utilisation systems
- Extensive environmental monitoring and environmental protection obligations
- An organised and well-qualified work force
- Detailed record-keeping
- Where required, on-site leachate treatment as an additional feature to the leachate collection system
- Closed circuit television
- Wide range of specialised mechanical equipment used
- Complex, multi-layered lining systems to isolate waste from the surrounding geology.

It is recognised that the development and operation of a sanitary landfill in this ultimate stage of landfill development requires considerable capital investment and high operational costs. Many municipalities and territories are not able to achieve and sustain this stage of landfill development in the foreseeable future.

It is recognised that the full development of sanitary landfills is a long-term goal since sufficient physical and financial resources are only likely to be available in a limited number of places over next few years to reach this standard of waste disposal.

2.5Observations and impressions gathered by site visits

Site visits were conducted to three of the four large landfills managed by KLMC.

When referring to the *investments* which are characterized by certain *design & construction standards*, the visited landfills would be best described as engineered landfill although certain aspects, notable containment, use of daily cover, leachate collection are more appropriate to sanitary landfill.

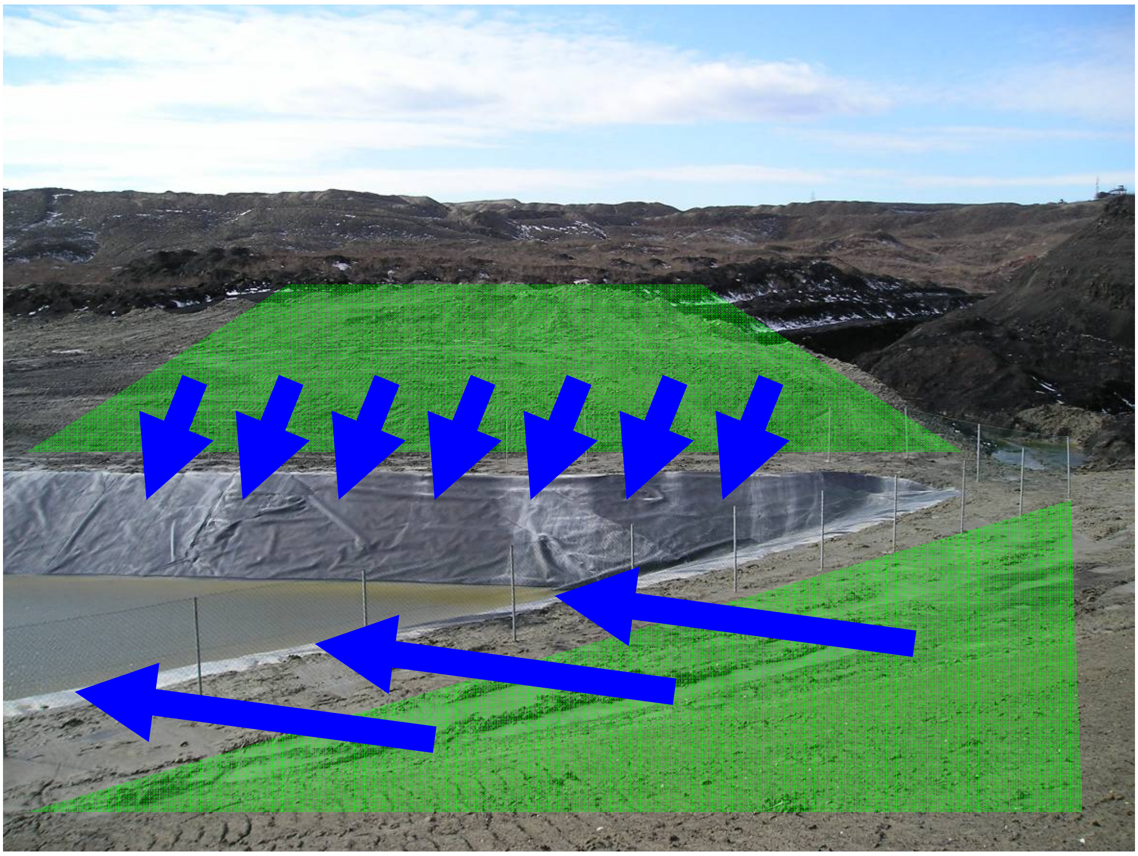
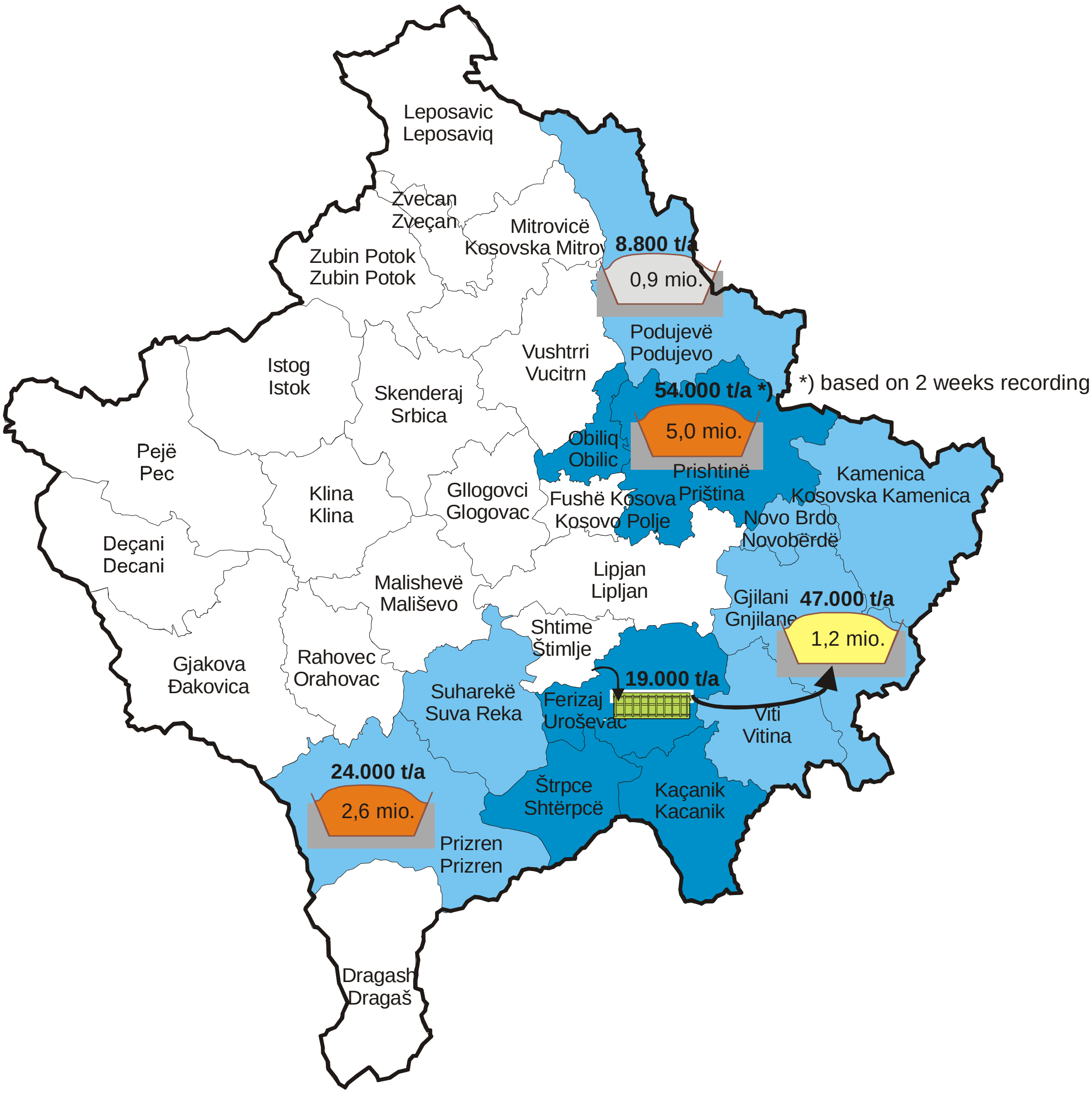


Fig. 2: *Pristina landfill*, view leachate pond (about one fifth of the entire structure visible):
As there is no drainage ditch on top of the pond (inside the fence), the run-off of a large area (sketched in green) enters the pond where it mixes with leachate *jeopardizing the concept chosen for treating tt (i.e. recirculation into the landfill body)*



10.000 t/a

Transfer station with waste amount transferred in 2006 (weighbridge data)

50.000 t/a

1,0 mio.

...current amount disposed of (2006 weighbridge data)

Landfill with ...reported total volume (m^3)

Colour indicates overall construction & operational standard:

good fair poor very poor Not assessed

Current catchment area of disposal site (not indicating that all settlements of the designated municipality are connected and/or delivering regularly to the disposal site)

Fig. 3: Map with overview data on KLMC´s disposal structure which was assessed during the preparation of this study

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Fig. 4: *Prizren landfill*, to the left view to a *single landfill cell* the start of using it might be in say 2017. To the right consequence of a "traffic accident" which happened in early 2007 caused by compactor driver (operational weakness) leading to the damage of essential infrastructure (leachate collector) which was not properly protected by eg. a layer of grabble (construction weakness), and too weak in terms of tube wall besides (design weakness). Note also that HDPE liner is exposed to UV radiation.

Fig. 5: *Prizren landfill*, view to lower landfill area (right), basement dam (center), intake leachate pond (left), piping system for *leachate* (black dotted line) and *surface water of the whole 25 ha site* (blue line). Due to a risky design (to conduct the whole surface water under the landfill body close to the leachate main) and poor construction (manhole structures not watertight and leaking from one into the other line) *untreated leachate is being discharged to the adjacent receiving water.*

Fig. 6: *Gjilani landfill* (by design, construction & operational standards altogether the better of the 3 sites): *View landfill gas collection,* gas domes built according to "lost scaffolding principle" i.e. steel pipe filled with grabble gets pulled up step by step according to growing landfill body: Landfill gas (with about 60 Vol.-% methane as the main component) leaves the landfill body by natural pressure via the grabble drainage and the perforated HDPE pipe – which is what landfill gas is supposed to do. However it was reported to the Consultant upon request by senior technical KLMC staff that no further gas treatment is foreseen for none of the landfills. Furthermore the provided investment description does not contain – for none of the landfills – landfill gas *treatment* equipment like a flare, or similar [6]. This practice – i.e. collecting the gas only, and ventilating it to the atmosphere – is usually applied for small sites only; from a certain waste volume onward (which should be verified in depth separately) representing a major safety issue (explosions) and might cause acceptance problems (odour) as well.

The description of these shortcomings (expressed in this Report) are relevant to any discussion on tariffs and the need for immediate investment to preserve the functional aspects of the long-term investments. In a cross-check calculation (refer to page 22), a number of items have been taken into account in the contingencies section.

In addition to these three landfills, a *transfer station* was visited which can be seen as a front-end structure of one of the landfills (Gjilani).

[6] *conversion to electricity* in a gas motor & generator (same size and shape as the units already in use on all landfills) represents a proven technical concept to be found on many Central European landfills might be taken into consideration. Produced electricity might be used for leachate recirculation thus reducing cost for energy (diesel) in the long term.

Fig. 7: View waste transfer station *Ferizaj*

Name of landfill & total volume	Construc-ted by	Operated by	Technical characteristics *)	Observed shortcomings *(shown above by photos)* & problems to be expected
Pristina 3,0 mio. m^3	TSB	Kastrioti	Mono-cell landfill erected in former lignite pit. Clay liner.	Proper leachate treatment not possible at present (due to mixing of surface water with leachate water).
Prizren 2,6 mio. m^3	Doni & G.	Doni	Multi-cell landfill. Combined bottom liner (clay + HDPE)	Leachate collection as designed and executed results at present in flow-off of untreated leachate. HDPE liner exposed to sunlight will deteriorate and loose its function (impermeability).
Gjilani 1,2 mio. m^3	Alpenbau	Alpenbau	Clay liner. Gas collection in gas domes (erected by “lost scaffolding” principle)	Poor access conditions (40 tonne transfer trucks damaging a small road in a village nearby) results in acceptance problem. Considerable explosion risk if no gas treatment gets applied.
Podujeva 0,9 mio. m^3	TSB	Alpenbau	Not visited during the study	

Table 1: Data on landfills donated by EAR and managed by KLMC
*) at all landfills *leachate treatment* is done via *recirculation to the landfill body*

3 OVERVIEW OF LANDFILL COSTS

3.1Guide numbers on landfill costs

As a first orientation for estimating costs for landfilling MSW, the following data related to income is presented in Table 2.

Group of countries	*Low Income* (500 $/cap., yr)	*Middle Income* (3.000 $/cap., yr)	*High Income* (25.000 $/cap., yr)
Open dumping (US$/tonne)	0.5 to 2	1 to 3	Not applicable
Engineered … sanitary landfill (US$/tonne)	5 to 25	15 to 30	30 to 100

Table 2: Solid waste disposal costs (Source: UNEP: Solid Waste Management, Volume 1, 2005).

Costs presented are based on capital and operational costs (no provision of grants). The ranges are valid for larger sites > 150 tonnes/day (which due to experience is the value for landfills where the economy of scale curve starts to flatten [7]). The higher range of costs for landfill is for systems with HDPE bottom liners and leachate collection and treatment systems; while the lower range of costs is for natural attenuation landfills, where site conditions do not require leachate management.

Valuable information in respect to the study´s task was provided by the Ministry of Environment and Physical Planning of Kosovo´s neighbour *Macedonia*. The essence of a detailed and well thought out assessment of costs for sanitary landfills to be implemented for the country is given in the table below.

	Cost per tonne	*Comments in respect of KLMC landfills*
Infrastructure	€ 2,30	Not to be considered, as investments – also if not fully complete (access, etc.) – are subjects to *grants*
Airspace	€ 5,89	
Operation	€ 5,65	Performed by sub-contractors (private operators)
Municipal charge	€ 1,00	Not relevant for present discussion on tariff
Restoration	€ 3,68	
Aftercare	€ 0,35	
Total	**€ 18,87**	

Table 3: Unit cost calculation for sanitary landfills to be constructed in Macedonia
(Source: National Waste Management Plan Macedonia 2002 – 2006).

[7] for comparison: present values of the two larger KLMC landfills: Pristina 150 t/day, Gjilani 130 t/day.

3.2Examples of MSW disposal costs from Central and South Eastern Europe

3.2.1 Case study Austria

Figure 8 below provides an overview of solid waste disposal costs for a Central European country providing high environmental standards and protection.

The Austrian tariff map is based on:

- Data from the beginning of 2004, when, similar to Germany, a national ban on landfilling untreated waste was implemented. Three out of nine provinces received an extension from this regulation until end of 2008, and only one province (Tyrol), operates sanitary landfills for untreated waste (tariff examples of two publicly owned & operated landfills are given)

- All tariffs include a national landfill levy which is part of all disposal options (e.g. for incineration 7 €/t, for landfilling untreated waste 87 €/tonne).

Actual cost of landfilling has been estimated at 60 – 100 €/tonne, influenced by economies of scale. Comparison of the 2 given examples, however, shows that in reality a larger site (Innsbruck) might request for a higher tariff because of set-up costs (i.e. higher overheads, high aftercare efforts for former sites, and the like).

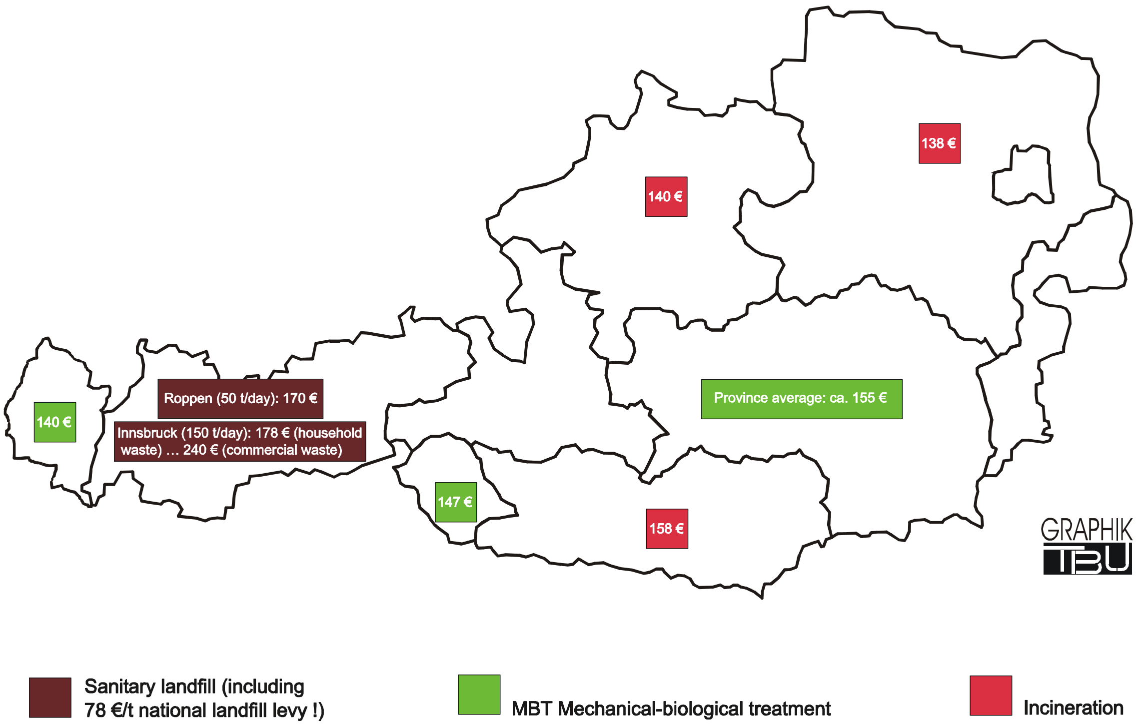
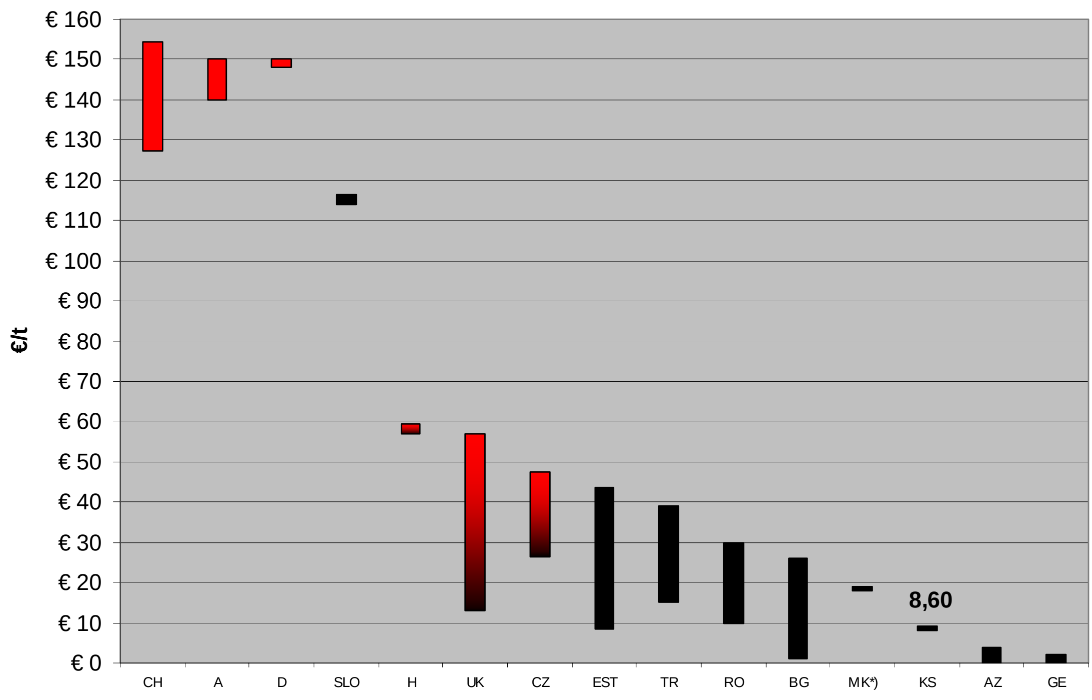


Fig. 8: Overview on solid waste treatment & disposal tariffs in Austria

3.2.2 Disposal costs out of 13 Central and South European countries

Fig. 9 confronts the current (February 2007) disposal tariff currently applied in Kosovo (8,60 €/tonne) with an overview on average disposal costs for 11 European countries, plus Azerbaidjan and Georgia (the two countries shown on the right margin of the table).

The Bulgarian MoE provided some information to WWRO following a data request for the present study by narrowing the herein reported wide range (1 – 26 €/tonne) to 12 €/tonne.



*) Calculated as a national average landfill cost which *includes eg. a municipal charge* and *aftercare,* for details refer to p.

Fig. 9: Range of typical disposal costs - red: including pre-treatment (incineration or similar), black: landfilling / predominantly landfilling (UK, CZ, H) for MSW reported to the author in 2006 by national administrations in charge for solid waste management compared to the *present landfilling tariff* (8,60 €/t) set for disposal structures managed by KLMC

For countries that rely on landfill as the main disposal option, a upper cost of 45 €/tonne can be seen from the data. The high value in Slovenia can be explained with a countrywide shortage of landfilling capacity, currently waste is being stored in bales on “intermediate” landfills, or exported). The data shows disposal costs by country ranked from high (left) to low (right). These higher costs for waste management, result from higher technical and environmental standards.

3.3 About aftercare costs

The four landfills operated by KLMC will provide landfill capacity for at least the 15 years. When the landfill has reached capacity (e.g. their final profiles), they will need to be closed, restored to grassland or similar and managed and monitored for at least a generation, i.e. 30 years.

A *closure plan* for the site should be prepared and the costs should be accounted for in the disposal price of the operational landfill. A closure plan would typical address the emissions from the site, as set out in Fig. 10. Landfill gas (in active sites) requires management and, where necessary treatment. Likewise landfill leachate will continue to be generated for many years and requires a containment, collection and treatment prior to release into the environment. Structures for groundwater monitoring have to operated and maintained.

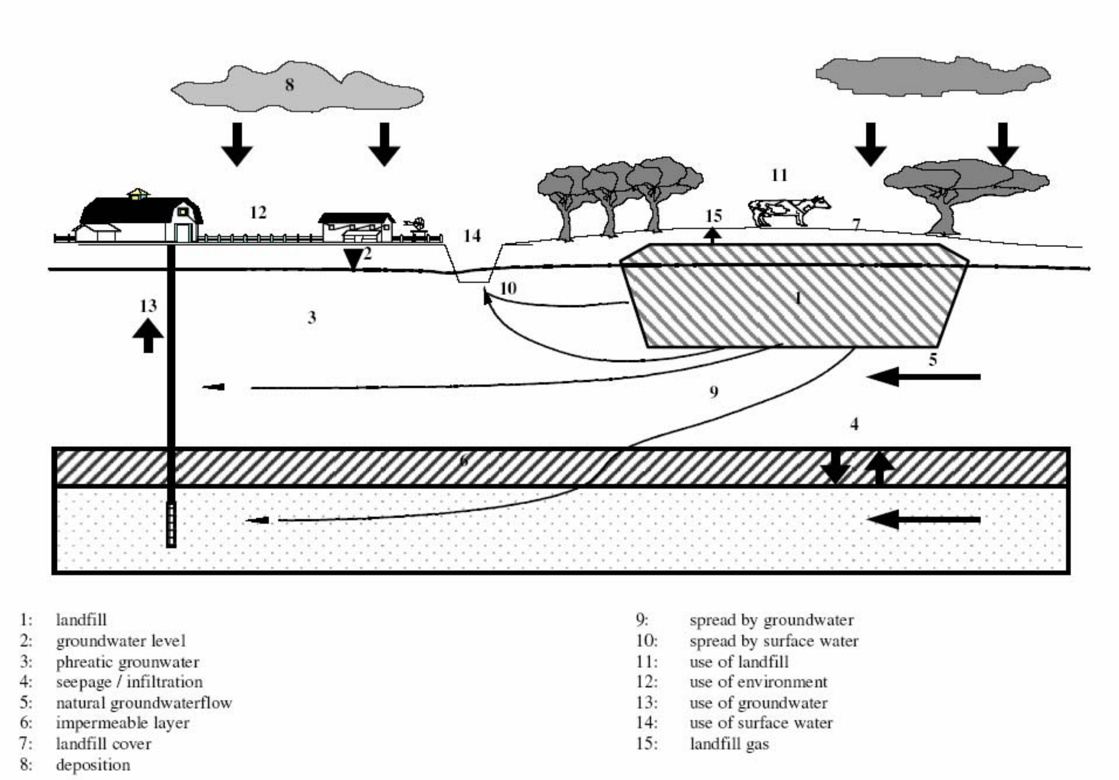


Fig. 10: Potential environmental pollution from closed (restored) landfills sites.
Source: Van Vosson, W. (2005). Aftercare of landfills, overview of traditional and new technologies

One cost figure for aftercare measures which was already given in Table 3 (cost calculation for landfills to be implemented in Macedonia) with 0,35 €/tonne.

The costs of aftercare (both closure plan and long-term management) were reviewed in more detail in *Hungary* for a number of sites using: (a) EC Landfill Directive standards and (b) a more pragmatic risk-based approach (Van Vosson, 2005). The costs between the two approaches were found to vary considerably, with the higher standards (as set out in the EC Landfill Directive) raising the aftercare costs, for an average landfill, from about € 280,000 to € 560,000.

Applying this range to the landfill volumes found in Kosovo – the lower end to Gjilani where about 1 Mio. t can be disposed of and the higher end to Pristina with say 4 Mio. tonnes total capacity – the respective values would be 0,15 and 0,30 €/t.

3.4 About the instrument landfill tax / landfill levy

Landfill levies can provide a economic steering tool to encourage or foster treatment prior to landfilling. They can also be used to finance clean-up measures for old sites. Fig. 11 shows that Austria is applying a very high levy (likely to be the highest waste disposal levy worldwide) which as an instrument generally gets applied at present in EU member states only, and by and large only in higher developed waste management systems (Germany is to be seen as a clear exception in this respect).

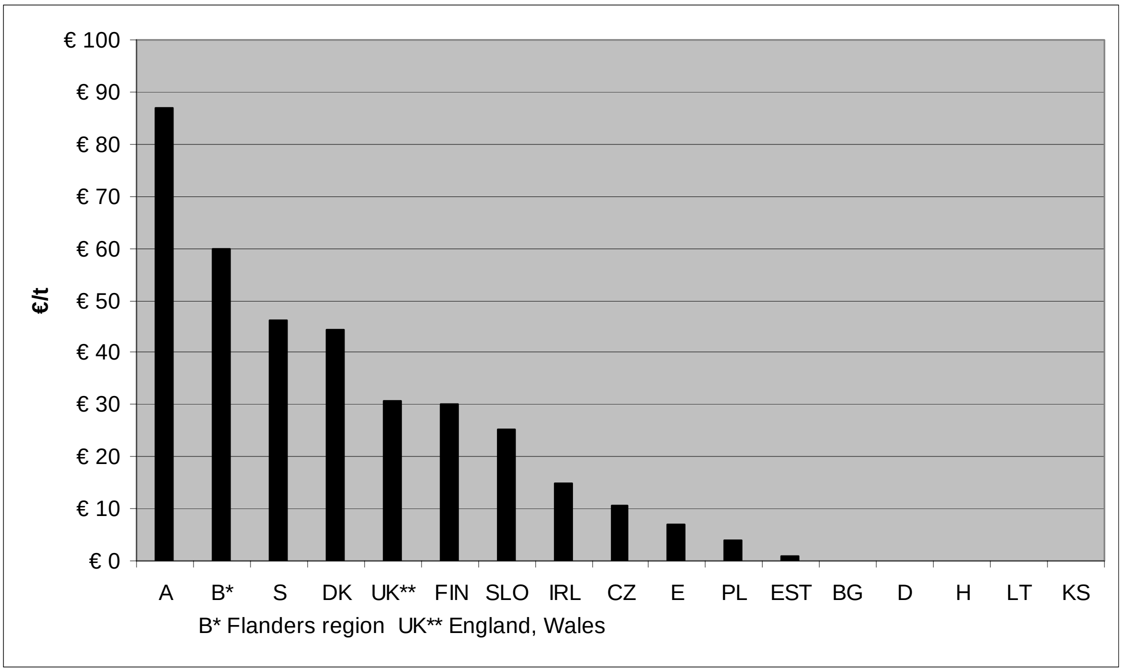


Fig. 11: *Landfill levies* (in €/t) for MSW reported to the author in 2006 by 16 national administrations in charge for solid waste management

4 CALCULATING LANDFILL COSTS FOR KOSOVO

A spreadsheet calculation has been prepared to evaluate the expected costs for landfills managed by KLMC. These cost estimates will be compared to the current tariff in Kosovo of 8,60 €/tonne. Table 4 presents data using in the cost determinations, Table 5 presents costs.

Amounts are based on weighbridge data (out of 2006, for one site – Pristina – the daily average of the first recorded fortnight was taken) provided by KLMC.

Data on investments, equipment and staff were provided by KLMC during various visits (refer to Chapter 2.5 on page 11) according to the table below.

Name of site	Rolling stock (compactor etc.)	Weighbridge	´All above ground construction´ (i.e. all remaining investments)	N° of staff
Assumed lifetime	8 years	15 years	20 years	
Pristina landfill	434.555 €	89.112 € [8]	3.036.333 €	14 - 15 [9]
Prizren landfill	434.555 €	29.112 €	3.241.003 €	10 - 11
Gjilani landfill	434.555 €	29.112 €	2.530.000 €	11 - 12
Podujeva landfill	168.805 €	29.112 €	837.083 €	7
Ferizaj transfer station	233.000 €	29.112 €	289.000 €	4

Table 4: Data on waste disposal structures managed by KLMC

The single cost items and the Consultant’s methodology is described as follows:

1. *Investment replacement costs:*
   This item accounts for an annual amount to be put aside (e.g. in a bank account where an interest return of 5 % was assumed) thus accumulating a budget which represents the present investment after this investment has reached its technical lifetime. The term “depreciation” is often used for this cost item (not in line with at least the German terminology where depreciation describes a loss of value in book keeping terms).
   It is not known to the author of this study if investment replacement costs are to be applied in the present case (i.e. if such replacement budget is really accumulated).

2. *Repair and Maintenance:*
   A yearly percentage of the relevant investment item is accounted for the cost to

[8] 2 pumps for groundwater control (estimated investment: 60.000 €) have been added into this cost group

[9] One KLMC worker operating the groundwater control station; all other staff provided by subcontractor.

repair and maintain it (0,5 % of ´all above ground construction´ plus weighbridges, and between 5 and 8 % – depending on the waste amount handled at the single site – of the initial rolling stock value).

3. *Energy*
   Assumed daily work times of fuel consumers by site were combined with usual specific fuel consumption data (all based on a fuel price of 0,95 €/l). Fuel consumption was estimated by in this study at the higher end, *however it represents the most important cost position* (31% of total cost, 62% of operational costs i.e. repair & maintenance, energy & staff) *to be verified at first*. Electricity cost for pumping groundwater at Pristina was assumed with 0,10 €/kWh.

4. *Staff*
   Divided in operational staff and guards, combined with a locally reported range of labour costs.

5. *Ongoing investments*
   Estimates have been made by site on the capital items essential to preserve the disposal structure for the mid to long term (i.e. 1-3 years).

6. *Aftercare measures*
   No allowance has been made for aftercare costs.

7. *Overhead & management fee*
   A percentage applied on above cost items N° 2 – 6 accounting for all non site-related efforts performed by KLMC.

All KLMC operated structures			Landfill input		136.000 t/y including		5%
4 landfills with 7,7 Mio. m3 total volume					assumed increase for 2007		
11,8 Mio. € total investment				1,5 €/m3	Consultant´s estimates		
					per year	per t	rel.
1) Investment replacement costs					€ 490.000	3,6 €/t	27%
2) Repair & Maintenance					€ 160.000	1,2 €/t	9%
3) Energy					€ 550.000	4,1 €/t	31%
4) Staff	47 total				€ 180.000	1,3 €/t	10%
5) Ongoing investments necessary to preserve the structure from being lost					€ 250.000	1,8 €/t	14%
6) Aftercare measures					€ 0	0,0 €/t	0%
7) Total site-related landfill cost (lines 1 to 6)					€ 1.630.000	12,0 €/t	90%
8) Overhead & management fee	15%	for ~ 7 staff, office, cars, PR, not on 1) investments of course			€ 170.000	1,3 €/t	10%
9) Total cost	split up to single elements… by t/a	by m3 (total)	by invest	by cost	€ 1.800.000	13,2 €/t	100%
Prishtina Landfill	42%	39%	30%	35%	€ 640.000	11,2 €/t	
Prizren Landfill	18%	34%	31%	24%	€ 430.000	17,1 €/t	
Gjilani Landfill	33%	16%	25%	22%	€ 400.000	8,9 €/t	
Podujeva Landfill	7%	12%	9%	8%	€ 140.000	15,7 €/t	
Transfer station Ferizaj	-	-	5%	11%	€ 190.000	9,6 €/t	

Table 5: Cost assessment of waste disposal structures managed by KLMC

5 CONCLUSIONS

Table 5 indicates that based upon the Consultant's assumptions **a tariff covering investment replacements as well as some ongoing investments would be about 13,20 €/tonne, based upon the amounts disposed of in 2006 plus an assumed increase of 5 %.**

However, it should be noted that the investment costs for replacements and on-going investment are not accounted for in the current tariff. There is also considerable debate about depreciating or accounting for assets provided from grant from donor organisations[10]. It is unlikely that the situation presented in Table 5 would prevail. Assets that are essentially free (provided by grants from donor organisations) would not be depreciated as if they had been financed. Nor would an investment fund be established to pay for future landfill development. Removing these two cost factors reduces the costs from 13,20 €/t to 7,80 €/t. This revised estimated is directly comparable to costs from Macedonia of 5,65 €/t. Much of this difference could be accounted for by different site plant and diesel usage.

Operating costs (i.e. repair & maintenance, energy and staff) are about 6,60 €/t or almost 900.000 €/yr. Note: the contract value in 2006 of all private operators (who should perform these operational tasks i.e. providing staff, energy and basic repair and maintenance for the equipment belonging to KLMC) was about 650.000 € (4,80 €/t).

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[10] This issue will be reviewed shortly by the WWRO support project and covered in a tariff policy document.

The European Agency for Reconstruction is responsible for the management of the main EU assistance programmes in the Republic of Serbia, Kosovo, and the Republic of Montenegro.