JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 – in effect as of: 15 June 2006)

CONTENTS

Annexes

SECTION A. General description of project

A.1. Title of the project:

"Landfill Gas recovery in the Czech Republic"

Document version number: 01

30. June 2006.

A.2. Description of the project:

Purpose of the project:

The project proposes to build and operate installations for extraction and subsequently flaring of methane gas or converting into electricity by gas engines at the landfill's sites in TKO Těmice (Moravia, Jihomoravský District), TKO Ronov nad Sázavou (Bohemia, Vysočina District) and EKOS Řevnice (Bohemia, Středočeský District).

Some basic information about the landfills follows:

Landfill site TKO Těmice

This directed landfill site TKO Těmice is lying in the Jihomoravský District, Moravia. It is situated at the Těmice not far from the City of Kyjov.

Landfill owner:	City of Kyjov
Owner of the property/ territory:	City of Kyjov
Runner of the landfill:	EKOR Kyjov, s.r.o.
Legal form:	Limited Liability Company
Yearly dumped refuse:	Approximately 50.000 tons
Start of Operation:	1995
Planned Closing:	In appr. 15 to 20 years
Type of waste:	Municipal Solid Waste (MSW)
Covering material:	Clay, from the area of the landfill
Ground water:	Level under bottom of the landfill

Operation of the landfill:

The landfill is divided into two parts, the first one is already recultivated, the second is currently in operation. The proposed capacity of all stages is approximately 1.500.000 m^3 of waste. The landfill site is completely secured against leachate's emissions, against infiltration of water and against outlets of light parts of waste and it corresponds with valid Czech Landfilling Standards. The landfill is situated at the clay bottom's layer and the body is laid on a slope by one side, mucked clay is used to pack the landfill. The landfill area will be completed with a separation unit and with some other technique, which will process or recycle waste. The operation and the technical equipment of this landfill fully correspond with Czech Law. An integrated permission according to IPPC Law was already given to the landfill site.

Landfill site TKO Ronov nad Sázavou

This directed landfill site TKO Ronov nad Sázavou is lying in the Vysočina District, Bohemia. It is situated at the Ronov nad Sázavou not far away from the City Přibyslav.

Landfill owner:	City of Přibyslav
Owner of the property/ territory:	City of Přibyslav
Runner of the landfill:	Město Přibyslav
Legal form:	Technical services of the City of Přibyslav
Yearly dumped refuse:	Approximately 35.000 tons totally Approximately 20.000 tons MSW (appr.66%)
Start of Operation:	1995
Planned Closing:	In appr. 15 to 20 years (2nd stage)
Type of waste:	Municipal Solid Waste (MSW) (including waste water treatment sludge) Construction waste, sweeping waste of the city, sand, soil
Area of the landfill:	1st stage: appr. 4 ha 2nd stage appr. 4 ha
Covering material:	Clay, from the area of the landfill
Ground water:	Level under bottom of the landfill

Operation of the landfill

This landfill was designed for depositing of "other wastes", but mostly solid municipal waste is disposed there. Currently waste is disposed into the 1st landfill's stage. So far (State: 15.12.2005) about 356.380 tons of waste, thereof 192.700 tons of municipal solid waste (MSW) are disposed on the landfill site. Approximately 2/3 of the total amount of the waste is municipal waste (including waste water treatment sludge) and 1/3 is described under other waste (construction waste, sweepings of the city, sand, soil for technical provision of landfill – ways, overlays of waste…).

The termination of the 1st landfill stage is expected during the year 2006. The 1st landfill stage will be recultivated step by step and will be equipped with an LFG recovery system, which is financed by selling of generated AAUs and ERUs under this project activity.

The 2nd stage of the landfill is in currently under preparation. The operator proposes to open it in these days. Together with the construction of the 2nd stage of the landfill the operator plans to build up a composting unit, a collection and sorting court and a reservoir for rainwater's accumulation.

Landfill site EKOS Řevnice

This directed landfill of municipal solid waste (MSW) is situated close to the City of Řevnice not far away from Czech capital Prague in Středočeský District, Bohemia.

Landfill owner:	EKOS Řevnice, s.r.o.
Owner of the property/ territory:	City of Řevnice
Runner of the landfill:	EKOS Řevnice, s.r.o.
Legal form:	Limited Liability Company
Yearly dumped refuse:	Approximately 30.000 tons
Start of Operation:	1990
Planned Closing:	Appr. 2025
Type of waste:	Municipal Solid Waste (MSW)
Covering material:	Clay, from the area of the landfill
Ground water:	Level under bottom of the landfill

Operation of the landfill

The landfill is operated by the company Ekos s.r.o. since 1998. The estimated annual amount of waste is approximately 30.000 tons. A new part with a lifetime till 2025 is already projected. It is a landfill of group S – other waste. The total projected capacity is 324.800 m^3 and the maximal height of waste must not exceed 15 m above the terrain.

- I. stage (2 boxes – in total 33.000 m^3; one is used for hazardous waste)
- II. stage (1 box – 39.000 m^3)
- III. stage (1 box – 97.000 m^3)
- proposed IV. stage (1 box – 80.000 m^3)
- proposed V. stage (1 box – 75.800 m^3)

The project will be financed through the sales of AAUs and ERUs generated from the collected and mitigated biogas and from selling the electricity, which is generated by the captured biogas.

The installed generators will combust the methane in the landfill gas to produce electricity for the export to the grid or landfill local sites use for gas collection purpose. Excess landfill gas, and all gas collected during periods when electricity is not produced, will be flared.

Revenues of feeding electricity into the grid have been taken into account for the proposed JI – project activity. But no emission reductions are claimed for displacing or avoiding energy from other sources.

The landfill gas utilisation equipment, which will be installed by an experienced company, will be a proven technology, including a piping and well network, blowers, flaring system and cogeneration and will represent the state of the art.

The project will result in greenhouse gas emission reductions by combusting of the recovered methane contained in the landfill gas. It is estimated that the project will generate 150.134 tons CO_{2eq} (AAUs and ERUs) within the commitment period.

The volume of landfill gas to be extracted at all three sites is calculated at approx. 400 - 450 Nm^3/hour on average during the Kyoto period.

Contribution of the project activity to sustainable development:

The long-term strategic objective of the project is to contribute to better waste management and to capture GHG-emissions from the landfill sites in TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice. In this way, emissions of other gases, such as H_2S, mercaptenes and other odorous compounds are reduced, which leads to a cleaner environment in the surroundings of the landfill. Even after closure of the landfill, escape of landfill gas to the atmosphere is not stopped. Only degasification of the landfill can improve the unwished local situation, guarantying:

- Abatement of methane emissions;
- Elimination of odorous gas emissions that affect the public health and quality of life. Bad odours can cause local health problems, negatively affect investment in the surrounding communities and lower property values and it's socio economic status;
- Reduction of explosion and fire risk.

The proposed project faces a number of market barriers of which the economic unattractiveness, lack of technical know-how, lack of availability of equipment is the most important. The implementation of this project will assist the Czech Republic in demonstrating the practice of landfill gas recovery.

Important elements are:

- Demonstrating the practice of landfill gas recovery in the Czech Republic;
- Demonstrating how trading in emission reductions via the Kyoto mechanisms could assist in making the practice of landfill gas recovery economically viable;
- Transferring the necessary technology and know-how to the Czech Republic, including:
  - making available the required equipment for the landfill degasification (at this moment there are few providers of landfill gas recovery equipment in the Czech Republic);
  - building of local know-how about the technology of LFG extraction through the involvement of Czech partners in the project;
  - additionally, building of local know-how about correct landfill site management after the closing time, i.e. covering systems, that contribute to reduction of the risk of waste slides at the site (covering of the landfill strongly accelerates the settlement of the waste);
  - carry over the technical knowledge about possibilities of the LFG gas utilisation methods, such as electrical power generation.
  - Providing of feedback to the Czech Government through close cooperation with the relevant departments and other interested stakeholders.

The Czech economy requires new investments from international sources. The landfill gas project brings money for new investments from foreign sources into the country. It is also envisaged that the project will create a better environment for other future investments of similar nature.

The project increases economic activities in the region. The construction of the landfill gas utilisation equipment will create new positions for both skilled and unskilled labour in the region. The purchase of materials and equipment from national sources will create better employment opportunities.

Landfills managed under environmental regulations such as degassing, which is an important tool for the sustained development of neighbouring communities, are of the utmost importance.

It can be concluded that the implementation of this JI project will assist the Czech Government in meeting the objectives of the EU Landfill Directive.

A.3. Project participants:

A list of the involved parties is indicated below.

Please list project participants and Parties involved in this section and provide contact information in annex 1. Information shall be provided in the following tabular format.		
Party involved *	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant(Yes/No)
Czech Republic (Host Country)	Terrasystems s.r.o.	No
Republic of Austria		No
* Please indicate if the Party involved is a host Party.		

The developer of the project "Landfill gas recovery in the Czech Republic" – landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice is the Terrasystems s.r.o. Terrasystems s.r.o. is in charge of the project design, project financing and investment, project implementation, project management and operation.

A.4. Technical description of the project:

A.4.1. Location of the project:

The project activities will take place at the landfill sites TKO Těmice (Jihomoravský District, Moravia), TKO Ronov nad Sázavou (Vysočina District, Bohemia) and EKOS Řevnice (Středočeský District, Bohemia) in the Czech Republic.

A.4.1.1. Host Party(ies):

The host country is the Czech Republic.

A.4.1.2. Region/State/Province etc.:

The landfill site TKO Těmice is located within Jihomoravský District, Moravia, the landfill site TKO Ronov nad Sázavou is located within Vysočina District, Bohemia and the landfill site EKOS Řevnice is located within Středočeský District, Bohemia.

A.4.1.3. City/Town/Community etc:

The landfill site TKO Těmice is located within Jihomoravský District, the Owner of the landfill site is the city of Kyjov and the owner of the property is the city of Kyjov too.

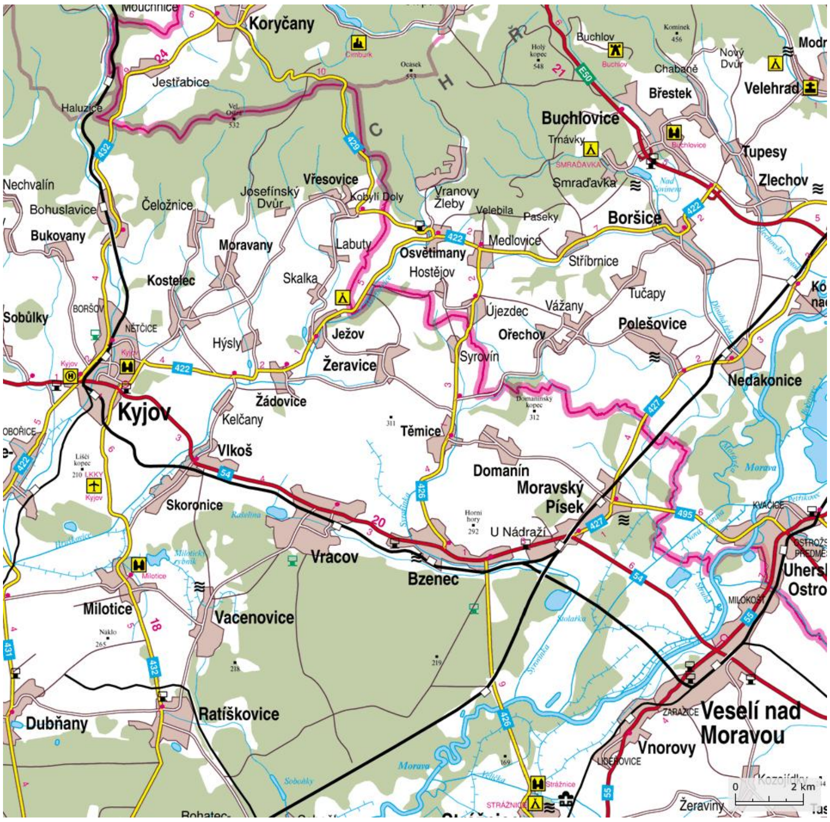
The landfill site TKO Ronov nad Sázavou is located within Vysočina District, the Owner of the landfill site is the city of Přibyslav and the owner of the property is the city of Přibyslav too.

The landfill site EKOS Řevnice is located within Středočeský District, the Owner of the landfill site is the EKOS Řevnice, s.r.o. and the owner of the property is the city of Řevnice.

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project (maximum one page):

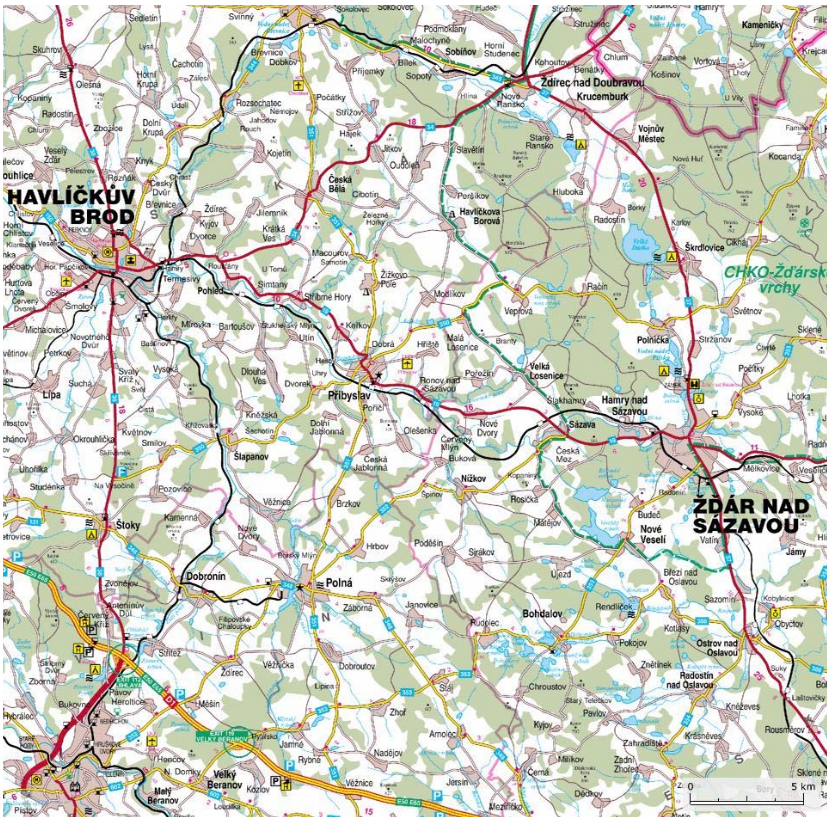
Landfill site TKO Těmice

The directed landfill site of municipal solid waste Těmice is situated close to cities Bzenec, Kyjov and Veselí nad Moravou. The landfill site is operated by the company Ekor s.r.o. since 1995. On the landfill Těmice, municipal solid waste is disposed from Kyjov city and the neighbouring areas. The landfill site is located on the territory of the Těmice community.



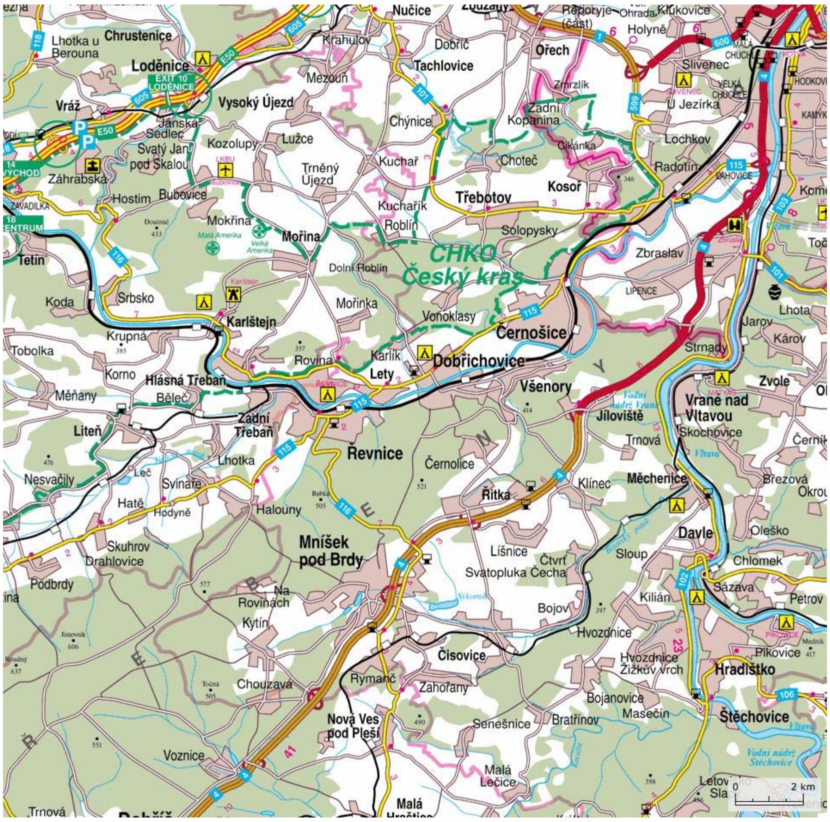
Landfill site TKO Ronov nad Sázavou

The directed landfill site is operated by the city of Přibyslav. It is located in the Vysočina district between the cities Havlíčkův Brod and Žďár nad Sázavou. The landfill site is located a few kilometres outside of the city. The address of the landfill site is: Bechyňovo náměstí 1, 582 22 Přibyslav.



EKOS Řevnice, s.r.o.

This directed landfill site of municipal solid waste is situated close to the city Řevnice not far away from Prague. The landfill site is operated by the company Ekos, s.r.o since 1998.



A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

The technology that will be used to capture and utilize (flaring and energy production) the methane currently generated at the landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice consists of an active LFG collection system, the most effective means of LFG collection. Generators will combust the methane in the landfill gas to produce electricity for export to the grid or landfill local sites use for gas collection purpose. Excess landfill gas, and all gas collected during periods when electricity is not produced, will be flared subsequently.

The technology proposed for the extraction and utilisation of biogas can be regarded as standard technology. It is the most up-to-date technology that is fully in compliance with EU-legislation.

The basic operation principle is the application of vacuum in the waste mass to extract the gas. The main components of the active collection system to be installed are the ***gas extraction wells*** and ***collection piping***, ***the gas pumping equipment*** represented by mechanical blowers, which create a suction pressure in the system necessary for extraction of the LFG, **the** ***gas treatment unit*** including the condensate and flare systems, the ***monitoring and control system*** and the ***gas utilisation uni***t (production of electricity).

- ***The LFG extraction wells*** and collection piping will be installed around the perimeter and in the centre of the landfill. Gas extraction wells will be connected to a master pipe that will carry the LFG to the blower facility. The gas collection system includes a network of vertical gas extraction wells de-watering units and HDPE pipelines.
- ***The LFG pumping equipment*** will include pipeline header system and blowers. A pipeline header system conveys the flow of collected LFG from the well system to the blower facility. The blowers to be installed will be single-stage centrifugal type. The blowers will be used for transportation of the landfill gas from the landfill to the gas engines, under correct suction and pre-pressure. Capacity and pressure will be adjusted through frequency controlled electro motors. Moreover, the blowers will be equipped with all the necessary safety equipment, including a noise reducing housing.

  On the pressure side of the degassing installation, all kinds of gas analyzing and gas measuring instruments will be present. These instruments are very important for safety, process and operating purposes.

- ***Gas treatment unit***: The landfill gas will be cooled down when transported from the landfill site, resulting in a production of condensate. This has to be drained to condensate shafts, to be placed nearby the gas pipes. Once in the degassing installations, the landfill gas will be cooled again to remove moisture. This is a very important step in the gas treatment process, since the condensate, which contains silicium components, could block the gas pipes and also damage gas engines, due to the silicium. After this step, the gas will be heated again through a second heat exchanger, or economizer, to a temperature of around 25 °C, far enough from the dew point of 4 °C to avoid further condensation.

  Considering demoisturing is fundamental for the energy generation, as per the reasons mentioned above, a demister will be installed for extra safety reasons. The demistor is a stainless steel high density filter, which separates liquid particles (small amounts of condensate) from the landfill gas. This liquid has to be drained off to a condensate shaft as well.

  A closed flare will be installed to burn the LFG in a controlled environment to destroy methane and other harmful constituents and discharging them safely to the atmosphere. LFG will be flared in a ‘low emission’ with high temperature flare (>1000^{o}C).

- ***The monitoring and control system*** will be used to measure actual LFG flow and composition to avoid the intrusion of ambient air into the extraction wells and thereby optimize the extraction of gas.

  The projected plant is operated by an electrical control system equipped with a monitoring system for methane, oxygen, flow, pressure and temperature.

  The control activities for this system consist of periodic adjusting of the gas wells by means of measuring equipment. The gas flow, the methane content and the oxygen content are very important parameters. **For the implementation of these activities local operators must be trained.** Using the telephone helpdesk of supplier the trained operators can always ask for technical support. Experts of the supplier execute the maintenance every half year.

  The maintenance consists of the control of subsiding and/or distortion of the gas wells and the pipeline system. Local companies execute convalescence of these activities.

- After described treatment, analyzing and measurement, the landfill gas will be transported as a fuel to the ***gas engines***. These will drive electrical generators in order to generate electrical power. An occasional surplus of the landfill gas will be burned off by the flares installed.

  Besides the electrical connections and back supply systems to the public grid must be erected.

Typical biogas extraction unit.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

Greenhouse gas (GHG) emissions from the "business as usual case" currently employed by the municipal landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice will be reduced through the collection of the landfill gas and the subsequent destruction of the methane in a closed flare or in gas engines, as described in Section A.4.2.

The current practice at the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice is to allow the uncontrolled release of LFG into the atmosphere. The landfill site TKO Temice is already equipped with a small 150 kW cogeneration unit. This cogeneration unit is just using a part of the generated landfill gas of the site. Therefore an adjustment factor (AF) is taken into account for this landfill site.

The LFG generated at the landfill sites consists approximately of 50% methane and 50% carbon dioxide, both known GHG's with Global Warming Potentials (GWP) values of 21 and 1, respectively. However, the carbon dioxide portion of landfill gas is considered to be biogenic in origin and part of the natural carbon cycle, and thus not considered as an anthropogenic source of greenhouse gas.

The assigned amount units (AAUs) and emission reduction units (ERUs) to be achieved with the proposed project activity will be directly measured according to the Monitoring Plan described in Section D of this document.

The estimated AAUs and ERUs for the proposed project activity are 150.134 tons CO_{2eq} over the period from 2007 to 2012 (see Section E).

The Czech Ministry of the Environment has approved the Landfill Directive (EULFD) in 2001. The Czech Republic got transitional period for implementing Article 14b (concerning existing landfill sites) until 2012 in order to take a definite decision on whether operations may continue on the basis on Directive 1999/31/EC. After year 2012 every operating landfills, which are accepting biologically decomposable waste, shall comply with the requirements of the Directive and if not, the landfill shall be closed down according to closure and after-care procedures.

The Czech Republic undertook a national environmental planning, but, as is the case with implementation, a source of problems with obtaining the financial investment needed is obvious. The development of the environmental program requires very substantial investments, and given the financial resources the Czech Republic has available, these will by far not be enough.

Thus the emission reductions would probably not occur in the absence of the project activity due the above mentioned financial barriers (the lack of economic benefits to develop this type of projects) and national circumstances such as the current legislation.

Because of the transition period till 2012 to fully implement the EU landfill directive, no operator of landfills, which are in operation right now, would invest in the building up of landfill gas recovery and utilisation equipment.

Therefore it is clear that without the income from the sale of AAUs and ERUs, the project activity (an advanced active degassing system combined with electricity generation) would not be carried out because finances for the necessary investments are hardly available for landfill operators and municipals in the Czech Republic.

Based on the previous considerations, for all the current landfill sites the BAU scenario as mentioned above (full release of the LFG to the atmosphere through the surface without any treatment on the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice and recovery and utilisation of a small amount of the produced LFG at the landfill site TKO Těmice) is the most likely scenario at least till 2012.

A.4.3.1. Estimated amount of emission reductions over the crediting period:

By direct flaring and/or combustion of LFG in gas engines, the proposed project is expected to generate 133.173 tons of emission reduction units (ERUs) expressed as tons of CO_{2eq} over the crediting period from 2008 to 2012. For the year 2007 it is expected to generate 16.961 tons of CO_{2eq} as Assigned Amount Units (AAUs).

The annual expected amount of emission reductions generated over the crediting period is indicated below:

Table 1: Annual estimation of emission reductions in tons of CO_{2eq} at landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice:

Please indicate the length of the crediting period and the length of the period within which ERUs are to be earned and provide estimates of total as well as annual emission reductions. Information shall be provided using the following tabular format.

	Years
Length of the period within which ERUs are to be earned	5
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2equivalent
Year 2008 (ERUs)	23.445
Year 2009 (ERUs)	25.167
Year 2010 (ERUs)	26.757
Year 2011 (ERUs)	28.224
Year 2012 (ERUs)	29.580
Total estimated emission reductions over the period within which ERUs are to be earned (tonnes of CO_2equivalent)	**133.173**
Total estimated emission reductions over the crediting period (tonnes of CO_2equivalent)	**133.173**
Annual average of estimated emission reductions over the crediting period/period within which ERUs are to be earned (tonnes of CO_2equivalent)	**26.635**

A.5. Project Approval by the Parties involved:

The Czech Republic fully supports the JI - project "Landfill Gas recovery in the Czech Republic – landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice" and has endorsed the project as a Joint Implementation (JI) project.

The Letter of No Objection can be found in the Appendix 4 of the PDD: Letter of No Objection; Date: July 22, 2005 Ref. No.: 715/960/05 signed by Tomáš Chmelík, Director of the Climate Change Department of the Ministry of Environment of the Czech Republic. The Czech Republic has registered the aforementioned JI project under the number 078/JI/2005.

The Republic of Austria also fully supports the current project. The KPC (Komunalkredit Public Consulting), which is working on behalf of the Ministry of Environment, intends to sign an ERPA with the Terrasystems s.r.o. to purchase Assigned Amount Units (AAUs) and Emission Reduction Units (ERUs) from this project.

Obtaining a letter of Approval from the government of the Czech Republic is envisaged for autumn 2006.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

Title and reference of the approved baseline methodology applied to the project:

The approved baseline methodology applied to this project is the approved ACM0001 – Consolidated Baseline Methodology for Landfill Gas Project Activities.

Justification of the choice of the methodology and why it is applicable to the project:

ACM0001 was developed as a consolidated document that incorporates all previously-approved methodologies applicable to landfill gas project activities where the baseline scenario is the partial or total atmospheric release of landfill gas to the atmosphere and the project activities include situations such as:

a) The captured gas is flared; or

b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources1; or

c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable". If capacity of electricity generated is less than 15MW, and/or thermal energy displaced is less than 54 TJ (15GWh), small-scale methodologies can be used.

This baseline methodology shall be used in conjunction with the approved monitoring methodology ACM0001 ("Consolidated monitoring methodology for landfill gas project activities").

For the proposed project activity, the baseline scenario is the partial total respectively atmospheric release of the gas, it is falling under the above mentioned point b) and thus the **ACM0001** is applicable to the project activity.

The AAUs and ERUs exchange mechanism provided under JI is considered as a real and concrete incentive in the decision to proceed with the project activity and the project activity will not be initiated without JI.

Description of how the methodology is applied in the context of the project:

According to the adopted methodology **ACM0001**, "the methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared or combusted…"

In the proposed project activity, the actual methane destroyed will be obtained from direct measurements of key parameters that in turn will allow calculating the emission reductions.

Following the chosen methodology **ACM0001**, the emission reductions achieved by the project activity during a given year "*y*" (ER_y) will be calculated as the difference between the amount of methane actually destroyed during the year ($MD_{project,y}$) and the amount of methane that would have been destroyed during the year in the absence of the project activity ($MD_{reg,y}$), times the approved Global

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWP_{CH4}$$

where:

ER_y	emission reductions [ton CO_{2eq}/year]
$MD_{project,y}$	is the methane destroyed by flaring [ton CH_4/year]
$MD_{reg,y}$	is the methane that would have been destroyed during the year in the absence of the project activity
GWP	is the Global Warming Potential value for methane 21 [ton CO_{2eq}/ton CH_4]

$MD_{reg,y}$ (TKO Ronov nad Sázavou and EKOS Řevnice):

$MD_{reg,y}$ is zero [ton CH_4/year], because there are currently no legal requirements to capture LFG on landfill sites in the Czech Republic till the need of implementation of the Landfill Directive in 2012.

$MD_{reg,y}$ (TKO Těmice):

According to the statements of TEDOM, this is the supplier of the cogeneration unit on the landfill site Těmice, the capacity of the gas engine is 120 kW. Taking into account an operation duration of approximately 8000 hours per year, the produced electricity is 960 MWh/year.

The heating value of LFG, which contains 50% CH_4 is 18 MJ/Nm³. The generator has an output efficiency (η) of approximately 33%. Thus the produced energy out of 1 Nm³ LFG can be calculated with 1,65 kWh/Nm³ (18 [MJ/Nm³] * 0,33 / 3,6 = 1,65 kWh/Nm³). As follows, the production of 960.000 kWh needs an amount of LFG of 960.000/1,65 = 581.820 Nm³ LFG.

Using the equation $MD_{electricity,y} = LFG_{combusted} \times w_{CH4,y} \times D_{CH4} \times GWP_{CH4}$ this amount of LFG is equal to 4.380 tons CO_{2eq} (581.820 x 0,5 x 0,717 x 21 / 1000).

This fixed quantity of emissions was taken into account for the adjustment factor (AF).

The methane destroyed by the project activity $MD_{project,y}$ during a year is determined by monitoring the quantity of methane actually flared:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity}$$

$$MD_{flared,y} = LFG_{flared,y} \times w_{CH4,y} \times D_{CH4} \times FE$$

$$MD_{electricity y} = LFG_{electricity} \times w_{CH4,y} \times D_{CH4}$$

where:

$MD_{flared,y}$	is the quantity of methane destroyed by flaring [ton CH_4/year]
$MD_{electricity y}$	is the quantity of methane destroyed by generation of electricity [ton CH_4/year]
$LFG_{flared,y}$	is the quantity of landfill gas flared during the year (see section D.1.2.1. ID2)
$LFG_{electricity}$	is the quantity of landfill gas fed into the electricity generator (see section D.1.2.1. ID3)
$w_{CH4,y}$	is the methane fraction of the landfill gas (see section D.1.2.1. ID7)
D_{CH4}	is the methane density (see section D.1.2.1. ID6)
FE	is the flare efficiency (see section D.1.2.1. ID8)

No leakage effects need to be accounted under this methodology!

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

Greenhouse gas emissions from the chosen municipal landfills will be reduced below those that would have occurred in the absence of the JI project activity through the collection of the landfill gas and the subsequent destruction of the methane in closed flares or gas engines, as technically described in Section A.2.

The emission reductions (ERs) to be achieved with the proposed project activity will be directly measured and then calculated according to the Monitoring Plan described in Section D of this document. Emission reductions (ERs) will be claimed for combusting the collected LFG in gas engine generators to use power on the sites and sell the excess power to the local grid, and for flaring any excess gas in controlled flaring systems

The **ACM0001** methodology requires the use of the *"Tool for the demonstration and assessment of additionality (version 2)"* to demonstrate and assess additionality, which is a step-wise approach that includes:

- Identification of alternatives to the project activity;
- Investment analysis to determine that the proposed project activity is not the most economically or financially attractive (in the absence of the JI incentive);
- Barriers analysis;
- Common practice analysis and
- Impact of registration of the proposed project activity as a JI project activity.

The "Tool for the demonstration and assessment of additionality" (UNFCCC, 28 November 2005) is applied as follows.

Step 0: **Preliminary screening based on the starting date of the project activity**

This step is not applicable since the project participants do not wish to have the crediting period starting prior to the validation of their project activity by an independent entity (IE).

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity:

The table below presents an analysis of different alternatives to the project activity along with a discussion of probable outcome.

Alternatives of proposed project activity	**Probability of scenario**
Alternative 1: No capture of LFG from the landfill site (continuation of the current situation – BAU scenario)	**Most probable**: this is the current situation at least at the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice and is considered as the baseline scenario. There are no regulations requiring the capture and destruction of landfill gas at the site. No economic benefits would be obtained from LFG capture and flare and no legal bounds are established either.
Alternative 2: LFG collection system without producing energy (outside JI)	**Very low probability**: the high costs for the construction and operation for the LFG recovery plant are difficult to afford without financial assistance. There are no additional revenues (e.g. electricity generation) out of this project activity. Thus, it is highly unlikely without significantly increasing waste management fees. Currently, an increase in waste management fees is politically difficult. Besides, till 2012 there are no legal requirements for LFG capture and flaring in the Czech Republic.
Alternative 3: LFG collection system and electricity generation (project activity) (outside JI)	**Low probability**: high investment costs for construction and operation for the LFG recovery and power plant make this alternative unlikely.

The project activity not carried out as a JI project is not viable since the investments to extract methane and generate energy are high in comparison to the revenues out of selling of the electricity to the grid.

Thus there is no incentive for investors or operators of landfill sites to produce energy out of the captured LFG, and current landfill's managements in TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice would continue.

As a result, the project activity is the only viable alternative to address the reduction of greenhouse gas emissions at these sites.

Sub-step 1b: Enforcement of applicable laws and regulations:

The Czech Ministry of the Environment has approved the Landfill Directive (EULFD) in 2001. The Czech Republic got transitional period for implementing Article 14b (concerning existing landfill sites) until 2012 in order to take a definite decision on whether operations may continue on the basis on Directive 1999/31/EC. After year 2012 every operating landfill shall comply with the requirements of the Directive and if not, the landfill shall be closed down according to closure and after-care procedures.

Thus, right now each of the above mentioned alternatives complies with the applicable laws and regulations in the Czech Republic. In terms of the project activity, just passive collection of LFG is mandatory at landfill sites TKO Ronov nad Sázavou and EKOS Řevnice. The recovery of a part of LFG and the subsequently combustion in the 120 kW gas engine will continue in TKO Těmice. As such, these sites are currently in compliance with all local environmental regulations with respect to air emissions.

Moreover, and according to the Monitoring Plan **ACM0001**, relevant regulations for LFG extraction or combustion (even if these laws and regulations have objectives other than GHG reductions) will be monitored yearly. If any changes impact Alternative 1, the Adjustment Factor will be changed to represent the portion of LFG that must be collected and flared to be in compliance.

Step 2: Investment analysis

Sub-step 2.a: Determine appropriate analysis method

Given that the main potential financial returns derived from the collection of landfill gas is the sale of electricity, the feasibility of this project is, thus, dependent on factors related to the energy sector. It is necessary to conduct a financial analysis to determine whether the project is economically attractive course of action. As suggested in the tool for the demonstration and assessment of additionality, Project IRR and NPV are used to analyze the financial attractiveness of the project.

Sub-step 2.b: Option III benchmark analysis is chosen.

Investments are usually analyzed through the internal rate of return (IRR) to the equity invested in project initiatives. In the case of our project activity, this is the main chosen financial indicator. Additional to the IRR the Net Present Values (NPV) were calculated under an estimated interest rate of 10 % as well.

This indicator is to be compared with government bond rates, since such bond rates are considered risk-free investments. Government bond rates for the Czech republic are lying between an interest rate of 3,5 and 4 %. Daily interest rates of Czech Government bonds can be taken from the homepage: http://www.patria.cz.

Sub-step 2.c: Calculation and comparison of financial indicators.

According to the statements of the Czech ministry the feed in tariff for green energy is 2.360 CzK/MWh (=84,43 €/MWh). The normal feed in tariff for energy produced out of fossil fuels is given with 1.500 CzK/MWh (=53,67 €/MWh). With selling prices of 8,5 €/ton CO_{2eq} and 15 €/ton CO_{2eq} respectively, the calculations of the IRR and NPV are shown as follow:

Feed in tariffs for the selling of electricity	**without credits**	**with credits AAU and ERU price 8,5 €/ton CO_{2eq}**	**with credits AAU and ERU price 15 €/ton CO_{2eq}**
	IRR (for 2012)	IRR (for 2012)	IRR (for 2012)
1.500 CzK/MWh (=53,67 €/MWh)	**-18,3%**	**-3,7%**	**4%**
2.360 CzK/MWh (=84,43 €/MWh)	**-6,1%**	**3,8%**	**9,6%**
	without credits	with credits	with credits
Interest rate = 10 %	NPV (for 2012)	NPV (for 2012)	NPV (for 2012)
1.500 CzK/MWh (=53,67 €/MWh)	**-1.878.447 €**	**-1.029.698 €**	**-476.776 €**
2.360 CzK/MWh (=84,43 €/MWh)	**-1.284.044 €**	**-522.334 €**	**-30.974 €**
No electricity production		**with credits AAU and ERU price 19 €/ton CO_{2eq}**	
Interest rate = 10 %		NPV (for 2012)	IRR (for 2012)
		-222.791 €	**5,0%**

The financial analysis conducted for the project activity shows, that the Internal Rate of Return (IRR) of the project activity without carbon finance is negative, even if the electricity is sold under the higher green energy feed in tariffs. It also shows that without the production of electricity (just flaring of the landfill gas) the project activity only becomes an economically viable project with a price of appr. 19 €/ton CO_{2eq}. It is unrealistic that such a high price can be claimed from a potential buyer like the Republic of Austria.

Because of the rather small amount of produced AAUs and ERUs of approximately just 150.134 tons of CO_{2eq} for the whole period, a selling price of 8,5 €/ton CO_{2eq} is needed to bring the project to an IRR of approximately 4 % in the year 2012, taking into account the feed in tariffs of green energy.

If only the normal tariff for electricity selling out of fossil fuels can be claimed, for the project activity a selling price of 15 € / ton CO_{2eq} is necessary to reach an positive IRR of 3,8 % in the year 2012.

With the selling of the emission credits (AAUs and ERUs) the project activity is reaching an IRR of approximately 4% under the above mentioned circumstances. Under a selling price of 8,5 €/ton of CO_{2eq} which is quite realistic and claiming the green energy feed in tariffs the IRR for the current project activity is a with an interest rate of 3,8 % just a little bit higher than an average of 3,5 % of Government bond rates of the Czech Republic. Thus, only the claiming of emission credits can make the project activity economically viable.

The results show that, even under the best possible conditions (selling the electricity under green energy tariff) the current project activity “Landfill gas recovery in the Czech Republic” is still not an economically course of action **without the carbon credits generated from JI**.

Sub-step 2.d: Sensitivity analysis.

The conducted sensitivity analysis led to the table in *Sub-step 2c*. The scenarios and project details were analyzed to examine, whether or not the conclusions regarding the financial attractiveness of the project are well founded.

It can be concluded, that the project activity is very sensitive to the amount of emission reduction units, because of the small amount of claimed credits. Taking into account, that very conservative assumptions were made for the recovery rate, it can be assumed that even more emission reductions can be generated, which makes the project economically more viable.

Step 3: Barrier Analysis

Since the proposed project activity is not financially attractive without carbon credits, Step 4 follows.

Step 4: Common practice analysis

Sub-step 4a: Analyse other activities similar to the proposed project activity

There are no similar projects like "Landfill Gas Recovery in the Czech Republic", which are being carried out in the Czech Republic at the current date. There are so far 24 landfill gas recovery projects registered at the Ministry of Environment of the Czech Republic. But so far none of the registered projects were realized.

The transition period for the total implementation of the EU landfill directive 1999/31/EC ends with 2012. After year 2012 every operating landfill shall comply with the requirements of the Directive (active landfill gas recovery mandatory) and if not, the landfill shall be closed down according to closure and after-care procedures.

Therefore, currently landfill gas capture is not considered as common practice in this country. There is just little local technology available and there are just few experts in the field to apply knowledge in actual projects.

Sub-step 4b: Discuss any similar options that are occurring

Considering there are no similar activities widely observed and commonly carried out, it is not necessary to perform an analysis at this point.

Step 5: Impact of accepting the project activity as JI project

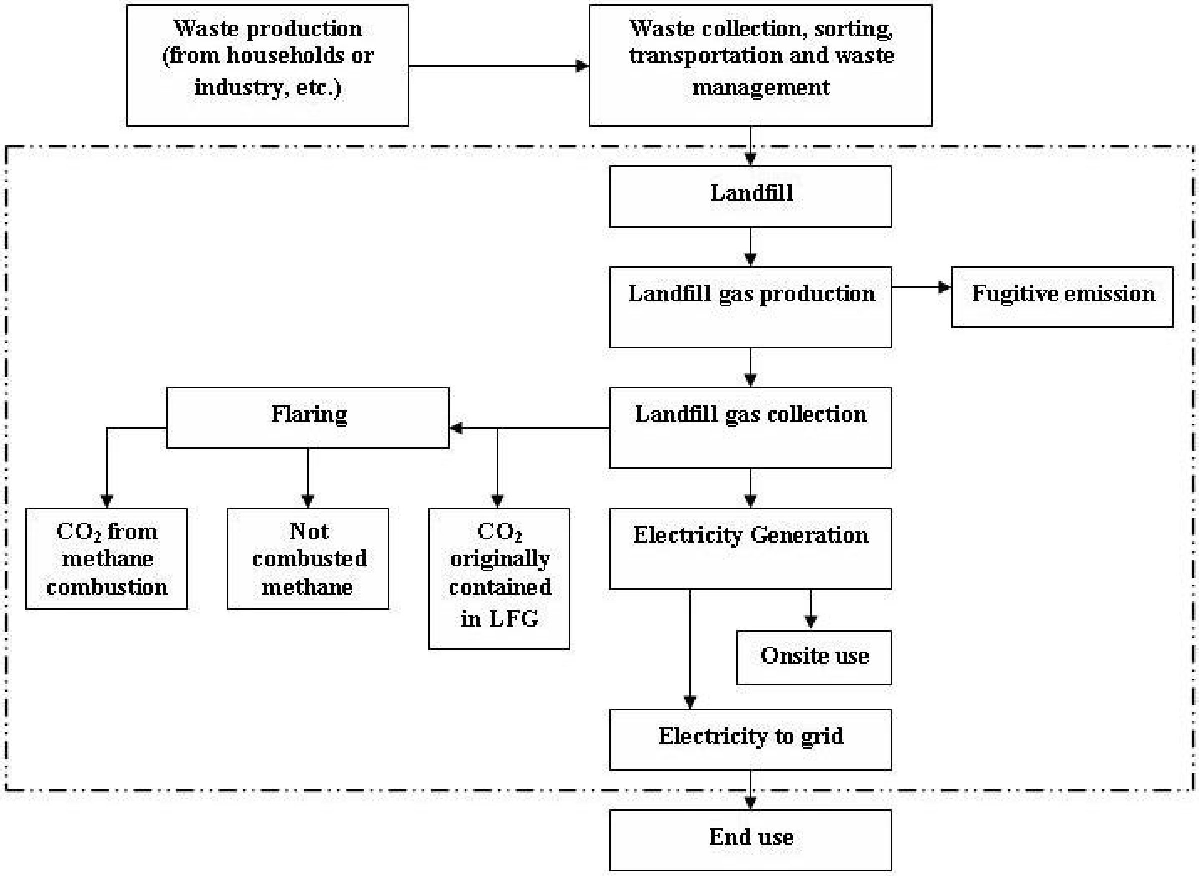
The proposed activity will reduce greenhouse gas emissions, thereby generating assigned amount units (AAUs) and emission reduction units (ERUs). The income generated from the AAU and ERU sales will make it possible to eliminate the barriers preventing the implementation of this project. By participating in the carbon market through JI, the project becomes economically viable.

The project will also deliver local community benefits related to the creation of new jobs during the construction, operation and maintenance stages of the LFG recovery plant and to the possibility of using the captured LFG as renewable energy resource in future economic enterprises.

Besides, the replication of the project activities in other towns around the country will trigger environmental awareness related to waste management, renewable energy resources and climate change in the involved communities.

B.3. Description of how the definition of the project boundary is applied to the project:

The following figure shows the basic operations involved in the MSW management on the landfill sites in "TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice" including the proposed project activity. The dashed line defines the project boundary.



According to the approved consolidated baseline methodology **ACM0001** under the title Project Boundary, CO_2 emissions from the combustion of the methane shall not be accounted for as well as the emissions of CO_2 originally contained in LFG.

B.4. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Date of Completion: The baseline study was completed on 31/06/2006. Detailed baseline information is included as Annex 2 of this document.

Name of Entities Determining the Baseline: The baseline was determined by the Tanzer Consulting GmbH. Contact information is presented below:

Tanzer Consulting GmbH

Zip code + city postal address:	Kirchengasse 43/11, 1070 Vienna
Country:	Austria
Contact person:	Mr. Christian Praher
Telephone number:	+43/1/994 99 69 - 29
Fax number:	+43/1/994 99 69 - 40
Email:	christian.praher@tanzerconsulting.com
URL:	www.tanzerconsulting.com

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The construction of the LFG equipment at the landfill site TKO Ronov nad Sázavou is envisaged to take place from August to November 2006. The construction of the LFG equipment at the landfill site EKOS Řevnice is envisaged to take place from June to September 2007. All the landfill gas extraction and flaring and utilisation systems will be operative in summer 2007.

C.2. Expected operational lifetime of the project:

20 years

C.3. Length of the crediting period:

Length of the period within assigned amount units (AAUs) are to be earned:

1 year (1st January 2007 – 31st December 2007)

Length of the period within emission reduction units (ERUs) are to be earned:

5 years (1st January 2008 – 31st December 2012)

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The Monitoring Plan (MP) for the Project "Landfill Gas Recovery in the Czech Republic – landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice" was developed according to the approved consolidated monitoring methodology **ACM0001**: ***"Consolidated monitoring methodology for landfill gas project activities".***

Justification of the choice of the methodology and why it is applicable to the project:

ACM0001 was developed as a consolidated document that incorporates all previously-approved methodologies applicable to landfill gas activities where the baseline scenario is the partial or total atmospheric release of landfill gas. The current JI project activity (the collection of the landfill gas and the subsequent destruction of the methane in closed flares or gas engines) is falling under this methodology.

The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform and the electricity generating energy units, to determine the quantities. The Monitoring Plan for the proposed project activity provides for direct measurement of the quantity and quality of LFG flared. The main variables that need to be determined are the quantity of methane actually captured ($MD_{project,y}$) and the quantity of methane flared ($MD_{flared,y}$) and the quantity of methane used to generate electricity ($MD_{electricity,y}$).

To determine these variables, the following parameters will be monitored:

- The amount of landfill gas generated (in m³, using a continuous flow meter), where the total quantity ($LFG_{total,y}$) as well as the quantities fed to the flare ($LFG_{flare,y}$) and to the generation unit ($LFG_{electricitye,y}$) will be measured continuously. The continuous methane analyzer should be the preferred option because the methane content of landfill gas captured can vary by more than 20% during a single day due to gas capture network conditions (dilution with air at wellheads, leakage on pipes, etc.)

- The fraction of methane in the landfill gas ($w_{CH4,y}$) will be measured with periodical measurements, at a 95% confidence level, using a calibrated portable gas analyzer and taking a statistically valid number of samples.

- Temperature (T) and pressure (p) of the landfill gas will be measured to determine the density of methane in the landfill gas.

- The flare efficiency (***FE***), measured as the fraction of time, in which the gas is combusted in the flare multiplied by the efficiency of the combustion process. This combustion efficiency is initially assumed at 99% and will be periodically verified through laboratory analysis to determine the methane content in the flare emissions.

- The quantities of electricity or any other fuels required to operate the landfill gas project, including the pumping equipment for the collection system.

- Relevant regulations for LFG project activities will be monitored. Changes to regulation will be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{reg,y}$).

Please, refer to the tables in section D 1.2 (Option 2) for detailed data measurement and recording frequency.

D.1.1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

The section was left blank on purpose. **Option 2 was selected**. (N/A)

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

The section was left blank on purpose. **Option 2 was selected**. (N/A)

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

The section was left blank on purpose. **Option 2 was selected**. (N/A)

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

The section was left blank on purpose. **Option 2 was selected**. (N/A)

D. 1.2. Option 2: Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

D.1.2.1. Data to be collected in order to monitor emissions from the project, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.2)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
ID 1. $LFG_{total,y}$	Total amount of LFG captured	On-Line LFG flow meter	m^3	m	Continuously	100%	Daily: electronic Monthly: paper	Data will be aggregated monthly and yearly! Measured by a flow meter!
ID 2. $LFG_{flare,y}$	Amount of LFG flared	On-Line LFG flow meter	m^3	m	Continuously	100%	Daily: electronic Monthly: paper	Data will be aggregated monthly and yearly! Measured by a flow meter!
ID 3. $LFG_{electricity,y}$	Amount of LFG combusted in the power plant	On-Line LFG flow meter	m^3	m	Continuously	100%	Daily: electronic Monthly: paper	Data will be aggregated monthly and yearly! Measured by a flow meter!
ID 4. T	Temperature of the LFG	Temperature sensor	^oC	m	Continuously	100%	Daily: electronic Monthly:	Data will be aggregated monthly and yearly! Data will be used to calculate the

							paper	methane density!
ID 5. p	Pressure of the LFG	Pressure sensor	Pa	m	Continuously	100%	Daily: electronic Monthly: paper	Data will be aggregated monthly and yearly! Data will be used to calculate the methane density!
ID 6. D_{CH4}	Methane density of the LFG	Calculation	ton CH_4/m^3CH_4	c	Daily	100%	Daily: electronic Monthly: paper	Data will be used to calculate the methane destroyed!
ID 7. $w_{CH4,y}$	Methane fraction in the landfill gas	On-Line LFG analyzer	m^3CH_4 $/m^3LFG$	m	Continuously	100%	Daily: electronic Monthly: Paper	Data will be aggregated monthly and yearly! Measured by continuous gas quality analyser!
ID 8. FE	combustion efficiency determined by the methane content in the exhaust gas (1) / flare availability determined by operation hours (2)	(1) Samples (2) Timer	%	m/c	(1) quarterly; (2) continuously	100%	Daily: electronic Monthly: Paper	Data will be aggregated monthly and yearly! (1) Periodic measurement of methane content of flare exhaust gas (2) Continuous measurement of operation time of flare (with temperature)
ID 9.	Total amount of electricity and/or other energy carriers used	Electricity meter	MWh	m	Continuously	100%	Electronic/ paper	Measured to determine CO_2 emissions from use of electricity or other energy carriers to operate the project activity

	in the project for gas pumping							
ID 10.	CO_2 emission intensity of the electricity and/or other energy carriers in ID9	Calculated	tCO_2 / MWh	c	Annually	100%	Daily: electronic Monthly: paper	Required to determine CO_2 emissions from use of electricity for the project activity!
ID 11.	Legislation and regulatory requirements relating to LFG projects	Local regulatory framework	Test	n/a	Annually	100%	Periodically	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,\ y}$!

Additionally, all data will be archived during the crediting period and for two years after.

D.1.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not applicable. In this project and according to ACM0001, project emissions will not be monitored nor measured, instead emission reductions will be directly measured, as explained in section D.1.4.

D.1.3. Treatment of leakage in the monitoring plan:

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

No leakage effects need to be accounted under methodology ACM0001.

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

No leakage effects need to be accounted under methodology ACM0001.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Following the chosen methodology **ACM0001**, the emission reductions achieved by the project activity during a given year "*y*" (ER_y) will be calculated as the difference between the amount of methane actually destroyed during the year ($MD_{project,y}$) and the amount of methane that would have been destroyed during the year in the absence of the project activity ($MD_{reg,y}$), times the approved Global Warming Potential value for methane (GWP_{CH4}), plus the net quantity of electricity displaced during the year (EG_y) multiplied by the CO_2 emissions intensity of the electricity displaced ($CEF_{electricity,y}$), plus the quantity of thermal energy displaced during the year (ET_y) multiplied by the CO_2 emissions intensity of the thermal energy displaced ($CEF_{thermal,y}$).

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWP_{CH4} + EG_y \times CEF_{electricity,y} + ET_y \times CEF_{thermal,y}$$

where:

ER_y	emission reductions [ton CO_{2eq}/year]
$MD_{project,y}$	is the methane destroyed by flaring [ton CH_4/year]
$MD_{reg,y}$	is the amount of methane, that would have been destroyed during the year in the absence of the project activity [ton CH_4/year] $MD_{reg} = MD_{project} * AF$, where for the proposed project activity AF is **zero** for the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice, because there are currently no legal requirements to capture LFG on the landfills in the Czech Republic until 2012. In the case of the landfill site TKO Těmice $MD_{reg,y}$ is given as a quantity. As calculated under section B1 $MD_{reg,y}$ = 4.380 tonsCO_{2eq}.
GWP	is the Global Warming Potential value for methane 21 [ton CO_{2eq}/ton CH_4]
EG_y	is net quantity of electricity displaced during a given period t, measured in MWh;
$CEF_{electricity,y}$	is the CO_2 emissions intensity of the electricity displaced, measured in tonsCO_{2eq}/MWh;
ET_y	is the quantity of thermal energy displaced, measured in TeraJoules (TJ);
$CEF_{thermal,y}$	is the CO_2 emissions intensity of the thermal energy displaced, measured in tonsCO_{2eq}/TJ.

It is noted that while the terms for electricity and thermal energy have been included to be consistent with the overall formulation stated in ACM0001, energy displacement is not a component of the proposed project activity. As a result, the above equation reduces to the following form for the project activity:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4}$$

For the proposed project activity, $MD_{electricity}$ (EG_y x $CEF_{electricity,y}$) = $MD_{thermal}$ (ET_y x $CEF_{thermal,y}$) = 0, as there is no energy displacement component of the project. $MD_{reg,y}$ = 0 because of AF = 0 for the landfill sites TKO Ronov nad Sázavou and EKOS and $MD_{reg,y}$ = 4.380 tonsCO_{2eq} for the landfill site Těmice. As a result, the total actual quantity of methane captured and destroyed at the landfill sites TKO Ronov nad Sázavou and EKOS will be metered *ex post* once the project activity is operational, and:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity} - E_{pr.act}$$

and

$$MD_{flared,y} = LFG_{flared,y} \times w_{CH4,y} \times D_{CH4} \times FE$$

$$MD_{electricityy} = LFG_{electricity} \times w_{CH4,y} \times D_{CH4}$$

where:

$MD_{flared,y}$ is the quantity of methane destroyed by flaring [ton CH_4/year]
$MD_{electricity}$ is the quantity of methane destroyed by generation of electricity [ton CH_4/year]
$LFG_{flared,y}$ is the quantity of landfill gas flared during the year (see section D.1.2.1. ID2)
$LFG_{electricity}$ is the quantity of landfill gas fed into the electricity generator (see section D.1.2.1. ID3)
$w_{CH4,y}$ is the methane fraction of the landfill gas (see section D.1.2.1. ID7)
D_{CH4} is the methane density (see section D.1.2.1. ID6)
FE is the flare efficiency (see section D.1.2.1. ID8)

As a result, the total actual quantity of methane captured and destroyed at the landfill sites Těmic will be metered *ex post* once the project activity is operational, and:

$$MD_{project,y} - MD_{reg,y} = MD_{flared,y} + MD_{electricity} - E_{project.activityt} - MD_{reg,y}$$

and

$$MD_{flared,y} = LFG_{flared,y} \times w_{CH4,y} \times D_{CH4} \times FE$$

$$MD_{electricityy} = LFG_{electricity} \times w_{CH4,y} \times D_{CH4}$$

The volumetric flows of methane ($LFG_{flared,y}$) to the flare ,as well as the methane content in the landfill gas ($w_{CH4,y}$) are continuously measured. The density of the methane can be calculated from the equation

$$D_{CH4}(T, p) = D_{CH4}(T_0,p_0) \times (p_1 - p_0) / (T_1 - T_0),$$

where $D_{CH4}(T_0, p_0) = 0.0007168\ t_{CH4}/m^3_{CH4}$ *(Density of methane at normal temperature and pressure* $T_0 = 273.15$ *K,* $p_0 = 101300$ *Pa)*

The Flare efficiency FE is measured as the fraction of time the flare is functioning (burning the gas) multiplied by the efficiency of the flaring process.

$FE = T_{flare} \times (1-\eta_{flare})$, *where*
T_{flare} = *Flare operating time in %*
η_{flare} = *Measured flare combustion efficiency as of amount of* CH_4 *left in the flare gas from the amount going into the flare in %.*

Finally, the emissions caused by the consumed electricity consumed by the landfill equipment will be calculated as:

$E_{project\ acivity} = EG_y \times CEF_{electricity}$, where
EG_y **(ID9)** = *the electricity consumption measured in MWh*
$CEF_{electricity}$ **(ID10)** = CO_2 *emission intensity of the electricity consumed in* tCO_2/MWh

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

After the consultation with the Czech Ministry of Environment, Department of Climate Changes, Mr. Zámyslický it is clear, that we should monitor just activities concerning installation and operating the gas recovery system, which will be applied by project activity. Monitoring of other environmental impacts is not required.

D.2. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table D.1.2.1 ID.1-3	Low	Flowmeter will be subject to regular maintenance according to the technical specifications from the manufacturers to ensure accuracy and good performance.
Table D.1.2.1 ID.4-5	Low	Temperature and pressure sensors will be subject to regular maintenance according to the technical specifications from the manufacturers to ensure accuracy and good performance.
Table D.1.2.1 ID.7	Low	Gas analysers (LFG quality) will be subject to regular maintenance and calibration procedures according to the technical specifications from the manufacturers to ensure accuracy and good performance.
Table D.1.2.1 ID.8	Medium	Regular maintenance will ensure optimal operations of the flare. Flare efficiency will be checked quarterly to verify deviation from the estimated value.
Table D.1.2.1 ID.8	Low	Timer device will be subject to regular maintenance to ensure accuracy.
Table D.1.2.1 ID.9	Low	Calibration of equipment as per manufacturer specifications to ensure validity of data measured.
Table D.1.2.1 ID.10	Low	Not applicable.

D.3.	Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

All continuously measured parameters (LFG flow, temperature, pressure, CH_4 concentration and flare operating hours) will be recorded electronically via a data logger, which will have the capability to aggregate and print the collected data at the frequencies as specified above.

Before commencement of the O&M phase, a training and quality control program will be enacted to ensure that good management practices are ensured and implemented by all project operating personnel in terms of record-keeping, equipment calibration, overall maintenance, and procedures for corrective action. An operations manual will be developed for the operating personnel. The procedures for filling data and calculations to be performed by the LFG management operator will be included in a daily log to be placed in the main control room.

D.4.	Name of person(s)/entity(ies) establishing the monitoring plan:

Name of Entities Establishing the Monitoring plan: The Monitoring plan was determined by the Tanzer Consulting GmbH. The details of the Monitoring plan are provided in Annex 3 contact information is presented below:

Tanzer Consulting GmbH

Zip code + city postal address:	Kirchengasse 43/11, 1070 Vienna
Country:	Austria
Contact person:	Mr. Christian Praher
Telephone number:	+43/1/994 99 69 - 29
Fax number:	+43/1/994 99 69 - 40
Email:	christian.praher@tanzerconsulting.com
URL:	www.tanzerconsulting.com

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

The anthropogenic emissions that would occur within the boundary of the project when the project activities (LFG capture and destruction) are in operation can be described as follow:

1. methane emissions due the non-captured LFG *(1-RE)*
2. methane emissions in the flare due to the flare efficiency *(1-FE)*
3. CO_2 emissions in the flare due to the CO_2 contained in the captured LFG that remain unchanged during the combustion process
4. CO_2 emissions in the flare due to the combustion of methane
5. CO_2 emissions resulting from electricity used by LFG pumping equipment

The sources of emissions (3. and 4.) are part of the natural CO_2 biological cycle and considered neutral to the atmosphere; therefore these CO_2 emissions are not considered in this project.

The methane emissions due to the not captured LFG (1.) and can be estimated from the following equation:

$$PE_{y1} = CH_{4,y} \times D_{CH4} \times (1-RE) \times GWP_{CH4}$$

PE_{y1} (in tons CO_{2eq}/year)

The methane emissions in the flare due to the flare efficiency (2.) can be estimated from the following equation:

$$PE_{y2} = CH_{4,y} \times D_{CH4} \times RE \times (1-FE) \times GWP_{CH4}$$

PE_{y2} (in tons CO_{2eq}/year)

Sum of above mentioned CH_4 - Emissions

Both sources of anthropogenic GHG are defined as the project emissions *(PEy)* and can be estimated from de following equation:

$$PE_y = CH_{4,y} \times D_{CH4} \times (1-RE) \times GWP_{CH4} + CH_{4,y} \times D_{CH4} \times RE \times (1-FE) \times GWP_{CH4} = PE_{y1} + PE_{y2}$$

PE_y	estimated project emissions from non captured and due to non combusted methane (in tons CO_{2eq})
$CH_{4,y}$	is the total methane generated at the landfill (in m^3 of CH_4) and is obtained by using the FOD model explained in section D 3.7 (Appendix 2),
D_{CH4}	is the methane density (kg/m^3 of CH_4);
RE	is the recovery rate of the LFG;
FE	is the flare efficiency (combustion of the methane) and
GWP_{CH4}	is the global warming factor of methane (GWP = 21).

Tables 2a, 2b and 2c (below) present the total waste tonnage (MSW, inert wastes, soils…..) accepted at landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice and the methane emission estimates based on the FOD model described below in section E.4. It is noted that the values presented in Tables 2a, 2b and 2c represent modelled quantities of methane generation for the stated time period.

The actual amount of GHGs reduced will be calculated based on the actual quantities of LFG collected and flared or combusted.

Table 2a: Methane Emissions Estimate for landfill site TKO Těmice

Waste Quantity		***Emissions***	***AF***	***Baseline Emissions***
Year	**(tons)**	**tons CH_4/year**	**tons CH_4/year**	**tons CH_4/year**
1995	4.402			
1996	24.206			
1997	27.353			
1998	34.921			
1999	31.182			
2000	37.492			
2001	37.083			
2002	42.284			
2003	56.304			
2004	54.309			
2005	Appr. 50.000			
2006	Appr. 50.000			
2007	Appr. 50.000	1.222	208,6	**1.013**
2008	Appr. 50.000	1.329	208,6	**1.121**
2009	Appr. 50.000	1.428	208,6	**1.220**
2010	Appr. 50.000	1.520	208,6	**1.311**
2011	Appr. 50.000	1.604	208,6	**1.396**
2012	Appr. 50.000	1.682	208,6	**1.473**
2013				
2014				
2015				
2016				
2017				
2018				
2019				
2020				
Sum		**8.785**	**1.251**	**7.534**

Table 2b: Methane Emissions Estimate for landfill site TKO Ronov nad Sázavou

Waste Quantity		*Emissions*
Year	**(tons)**	**tons CH_4/year**
1995	19.000	
1996	27.645	
1997	31.750	
1998	28.035	
1999	29.714	
2000	30.945	
2001	32.210	
2002	45.808	
2003	36.000	
2004	34.000	
2005	Appr. 35.000	
2006	Appr. 35.000	
2007	Appr. 35.000	982
2008	Appr. 35.000	1.036
2009	Appr. 35.000	1.086
2010	Appr. 35.000	1.131
2011	Appr. 35.000	1.174
2012	Appr. 35.000	1.213
2013		
2014		
2015		
2016		
2017		
2018		
2019		
2020		
Sum		**6.621**

Table 2c: Methane Emissions Estimate for landfill site EKOS Řevnice

Waste Quantity		*Emissions*
Year	**(tons)**	**tons CH_4/year**
1995		
1996		
1997		
1998	20.742	
1999	15.239	
2000	15.232	
2001	13.318	
2002	84.100	

2003	108.641	
2004	104.251	
2005	43.187	
2006	Appr. 40.000	
2007	Appr. 40.000	**99**
2008	Appr. 40.000	**603**
2009	Appr. 40.000	**659**
2010	Appr. 40.000	**710**
2011	Appr. 40.000	**757**
2012	Appr. 40.000	**800**
2013		
2014		
2015		
2016		
2017		
2018		
2019		
2020		
Sum		**3.628**

The total methane emissions in the absence of the project activity during the crediting period (2007 – 2012) are calculated for the landfill site TKO Těmice as 7.534 tons of methane (CH_4) (AF factor was taken into account), for the landfill site TKO Ronov nad Sázavou as 6.621 tons of methane (CH_4) and for landfill site EKOS Řevnice as 3.628 tons of methane (CH_4). The figures above are calculated under assumption that generated LFG is composed of 50% methane.

The landfill gas collection and flaring systems will capture only a portion of the generated landfill gas. Therefore methane emissions due the non-captured LFG (*1-RE*) (1.) are occurring.

According to the wish of the applicant a very conservative estimate of 30% LFG collection was applied to the estimated amount (see section E.4.) of produced LFG for the landfill site Těmice. A conservative estimate of 50% LFG collection was applied for the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice.

3a, 3b and 3c illustrate the quantities of methane captured and not captured (depends on the recovery rate (RE)) by the project activity during the crediting period.

Table 3a: Estimated quantities of methane captured and non captured by the LFG collection system at the landfill site TKO Těmice

Year	*Percentage of Methane Captured* (RE)	*Amount of Methane Captured by Project Activity* (tons CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tons CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)
2007	30%	304	709	14.893
2008	30%	336	784	16.473
2009	30%	366	854	17.930
2010	30%	393	918	19.275
2011	30%	419	977	20.516
2012	30%	442	1031	21.660
Sum		**2.260**	**5.274**	**110.747**

Table 3b: Estimated quantities of methane captured and non captured by the LFG collection system at the landfill site TKO Ronov nad Sázavou

Year	*Percentage of Methane Captured* (RE)	*Amount of Methane Captured by Project Activity* (tons CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tons CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)
2007	50%	491	491	10.310
2008	50%	518	518	10.876
2009	50%	543	543	11.398
2010	50%	566	566	11.879
2011	50%	587	587	12.323
2012	50%	606	606	12.733
Sum		**3.310**	**3.310**	**69.519**

Table 3c: Estimated quantities of methane captured and non captured by the LFG collection system at the landfill site EKOS Řevnice

Year	*Percentage of Methane Captured* (RE)	*Amount of Methane Captured by Project Activity* (tons CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tons CH_4/year)	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)
2007	50%	50	50	1.040
2008	50%	302	302	6.334
2009	50%	329	329	6.916
2010	50%	355	355	7.452
2011	50%	378	378	7.947
2012	50%	400	400	8.404
Sum		**1.814**	**1.814**	**38.093**

The total methane captured by the project activity during the crediting period is estimated as 2.260 + 3.310 + 1.814 = 7.384 tons of methane (CH_4) for the landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice. This amount is equal to 155.064 tons of CO_{2eq}.

The flare efficiency (FE) (methane emissions in the flare due to the flare efficiency (1-FE) (2.)) is assumed to be approximately 99 %. As required, uncombusted methane will be measured and accounted for according to the requirements set forth in methodology ACM0001. In case of combusting landfill gas (LFG) in gas engines a flare efficiency must not be considered. Since *ex ante* the amount of LFG, which is flared is not known, it was estimated that all of the LFG will be flared. This represents a very conservative estimation. Project activity emissions from uncombusted methane are summarized in 4a, 4b and 4c.

Table 4a: Emissions Resulting from Uncombusted Methane in the Project Activity at the landfill site TKO Těmice

Year	*Destruction Efficiency of Enclosed Flare*	*Amount of Uncombusted Methane* (tons CH_4/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)
2007	99%	3,0	64
2008	99%	3,4	71
2009	99%	3,7	77
2010	99%	3,9	83
2011	99%	4,2	88
2012	99%	4,4	93
2007-2012		**22,6**	**475**

Table 4b: Emissions Resulting from Uncombusted Methane in the Project Activity at the landfill site TKO Ronov nad Sázavou

Year	*Destruction Efficiency of Enclosed Flare*	*Amount of Uncombusted Methane* (tons CH_4/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)
2007	99%	4,9	103
2008	99%	5,2	109
2009	99%	5,4	114
2010	99%	5,7	119
2011	99%	5,9	123
2012	99%	6,1	127
2007-2012		**33,1**	**695**

Table 4c: Emissions Resulting from Uncombusted Methane in the Project Activity at the landfill site EKOS Řevnice

Year	*Destruction Efficiency of Enclosed Flare*	*Amount of Uncombusted Methane* (tons CH_4/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)
2007	99%	0,5	10
2008	99%	3,0	63
2009	99%	3,3	69
2010	99%	3,5	75
2011	99%	3,8	79
2012	99%	4,0	84
2007-2012		**18,1**	**381**

One source of the project activity emissions is uncombusted methane. As a result, the total emissions attributed to this source of project emissions are estimated as (475 + 695 + 381) 1.551 tons CO_{2eq} for landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice over the duration of the crediting period.

CO_2 emissions resulting from electricity used by LFG pumping equipment (5.) were estimated based on an overestimated electricity consumption of 876 MWh/year (100kW, 8760 h) and the emission factors for JI projects generating electricity, taken out of the Operational Guidelines for PDDs of JI projects of the Dutch ERUPT 4 program. See table below. (*Source: ERUPT 4: Guidelines – Volume 1 Table B1:2008).* The calculations yields project emissions, which can be taken from the table below.

Table 5: Emission factors and estimated project emissions from LFG pumping equipment for the project activity landfill sites

Emission factor for the Czech Republic for JI projects generating electricity		Estimated emissions from the project activity on site
Year	$kgCO_2$/MWh	$tonsCO_2$/year
2007	679	595
2008	665	583
2009	652	571
2010	638	559
2011	625	548
2012	611	535
2007-2012		**3.390**

The tables 6a, 6b and 6c show the summary of all the Project emissions (E1) mentioned above:

Table 6a: Summary of the project emissions (E1) at the landfill site TKO Těmice

Year	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)	*Estimated emissions from the project activity on site* (tons CO_{2eq}/year)	*Sum of all the project emissions in* (tons CO_{2eq}/year)
2007	14.893	64	198	15.155
2008	16.473	71	194	16.738
2009	17.930	77	190	18.197
2010	19.275	83	186	19.544
2011	20.516	88	183	20.786
2012	21.660	93	178	21.931
Sum	**110.747**	**475**	**1.130**	**112.352**

Table 6b: Summary of the project emissions (E1) at the landfill site TKO Ronov nad Sázavou

Year	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)	*Estimated emissions from the project activity on site* (tons CO_{2eq}/year)	*Sum of all the project emissions in* (tons CO_{2eq}/year)
2007	10.310	103	198	10.611
2008	10.876	109	194	11.179
2009	11.398	114	190	11.702
2010	11.879	119	186	12.184
2011	12.323	123	183	12.629
2012	12.733	127	178	13.039
Sum	**69.519**	**695**	**1.130**	**71.344**

Table 6c: Summary of the project emissions (E1) at the landfill site EKOS Řevnice

Year	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)	*Estimated emissions from the project activity on site* (tons CO_{2eq}/year)	*Sum of all the project emissions in* (tons CO_{2eq}/year)
2007	1.040	10	198	1.249
2008	6.334	63	194	6.592
2009	6.916	69	190	7.175
2010	7.452	75	186	7.713
2011	7.947	79	183	8.209
2012	8.404	84	178	8.666
Sum	**38.093**	**381**	**1.130**	**39.604**

Table 6d: Summary of the project emissions (E1) total

Year	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)	*Estimated emissions from the project activity on site* (tons CO_{2eq}/year)	*Sum of all the project emissions in* (tons CO_{2eq}/year)
2007	26.243	177	595	27.015
2008	33.683	243	583	34.508
2009	36.244	260	571	37.075
2010	38.606	276	559	39.441
2011	40.786	291	548	41.624
2012	42.796	304	535	43.636
Sum	**218.358**	**1.551**	**3.390**	**223.299**

E.2. Estimated leakage:

No leakage effects need to be accounted under methodology ACM0001 (E.2 = 0).

E.3. The sum of E.1. and E.2.:

Table 7 presents the total project activity emissions, attributable to non captured methane emissions, uncombusted methane release and emissions associated with electrical consumption during the crediting period. As mentioned above E.2 = 0. Therefore table 7 is equivalent to table 6d in section E.1.

Table 7: Total Project Activity Emissions

Year	*Amount of Methane Not Captured by Project Activity* (tons CO_{2eq}/year)	*Amount of Uncombusted Methane in* (tons CO_{2eq}/year)	*Estimated emissions from the project activity on site* (tons CO_{2eq}/year)	*Sum of all the project emissions in* (tons CO_{2eq}/year)
2007	26.243	177	595	27.015
2008	33.683	243	583	34.508
2009	36.244	260	571	37.075
2010	38.606	276	559	39.441
2011	40.786	291	548	41.624
2012	42.796	304	535	43.636
Sum	**218.358**	**1.551**	**3.390**	**223.299**

E.4. Estimated baseline emissions:

In order to calculate the baseline emissions, an estimation of the potential landfill gas production has been performed. Van der Wiel Stortgas BV has developed a model to calculate landfill gas production. The quantity of methane projected to be generated during a given year is estimated using as a basis the First Order Decay model for landfill gas generation. The general formula of degradation used in this model depends on several parameters including age of waste, mass, waste composition (concentration in organic carbon) and waste temperature.

The model is driven by the input of the following key parameters:

(1) Total tonnage of disposed waste
(2) Organic carbon content means the total quantity of organic carbon contained in waste and is measured in kg/ton. The organic carbon content depends on the composition of waste.
By using bibliographical data and measurements in laboratory column tests or in instrumented cells, the organic carbon content value can be evaluated for municipal solid waste on 150 kg/ton wet component.
(3) Methane generation decay rate is specified as an exponential rate of decomposition of the landfill refuse. Its value determines the amount of methane, that is released in a given disposal area during a specified time.

- Methane content in the landfill gas is 50%
- Molecular weight CH_4: 16.03
- Gas density of CH_4 : 0.717 kg/ Nm^3.

(4) Temperature in the refuse is expressed in °C. Temperature has an impact on the biodegradable carbon converted to landfill gas. The average landfill temperatures generally observed is appr. 35°C.

(5) Parameters, that have been applied by calculations:
- Parameter of gasification speed: 0.035
- Calorific value of the landfill gas: 5 kW
- Gas density of CO_2 : 1.99 kg/ m^3
- Heating value of landfill gas: 18 MJ/m^3

(6) Extraction efficiency
The recoverable landfill gas depends on the effectiveness of the extraction system. The rate of landfill gas recovy generally ranges between 50 and 90% of the total production. For this calculation a very conservative extraction efficiency of 30 % for the landfill site TKO Těmice and 50 % for the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice was considered, according to the wish of the applicant.

(7) Assessment and uncertainties
The main uncertainty in the proposed project is the prediction of future emission levels, LFG production levels and LFG extraction efficiency, which are depending on a large number of practical and operational factors. However, the baseline emissions are in this case determined by measuring the real amount of extracted LFG, so this uncertainty does not affect the choice of the baseline scenario.

The quantity of methane projected to be generated during a given year is estimated using as a basis the First Order Decay model for landfill gas generation:

GHG = Collectable gas quantity m^3/h x Hours per year x Methane content x Spec. mass x 21

GHG = GHG emissions [ton CO_{2eq}/yr]
21= GWP of methane [ton CO_{2eq}/ton methane]

The general formula of degradation used in this model depends on several parameters including age of waste, mass, waste composition (concentration in organic carbon) and waste temperature. At the moment the flaring of the biogas does not occur at the project landfills.

The actual quantity of methane emitted to the atmosphere is therefore equivalent with the quantity to be captured and flared and subsequently combusted in gas engines at the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice. For the landfill site Těmice an adjustment factor of 4.380 tons CO_{2eq} was taken into account because of the existing cogeneration unit.

- Decayable carbon in refuse 150 kg/ton
- Lag phase of methane production 0.7 year
- Half value for decomposing or organics 3.0-15.0 year
- Average landfill temperature 35 ^oC
- Landfill gas collection efficiency 30 % and 50 % respectively(Recovery rate)
- Methane content in landfill gas 50 %
- Molecular weight CH_4 16.03 --
- Gas density of CH_4 at STN 0.72 kg/ m^3
- Gas density of CO_2 at STN 1.99 kg/ m^3
- Heating value of landfill gas 18 MJ/m^3

Based on the model projections of the total emissions illustrated above, for the landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice, the total methane emissions in the baseline scenario (no collection or destruction of methane at the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice and collection of 4.380 tons CO_{2eq} for the operation of the cogeneration unit at the landfill site TKO Těmice) for 2007 to 2012 are 373.433 tons of CO_{2eq}.

Table 8: Estimated emissions due to the baseline scenario (full release of LFG to the atmosphere)

Year	*Estimated baseline emissions in* (tons CH_4/year)	*Estimated baseline emissions in* (tons CO_{2eq}/year)
2007	2.094	43.976
2008	2.760	57.953
2009	2.964	62.241
2010	3.152	66.199
2011	3.326	69.849
2012	3.486	73.216
Sum	**17.783**	**373.433**

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

The total emission reduction of the project activity at the landfill sites TKO Těmice, TKO Ronov nad Sázavou and EKOS Řevnice, is the difference between E.4 and E.3 and results in an estimated emission reduction of 150.134 tons of CO_{2eq} between 2007 and 2012.

E.6. Table providing values obtained when applying formulae above:

Table 9 summarizes the net emission reduction associated with the project activity.

Table 9: Total Project Activity Emissions:

Year	*Sum of all the project emissions in* (tons CO_{2eq}/year)	*Estimated baseline emissions in* (tons CO_{2eq}/year)	*Estimation of leakage in* (tons of CO_{2eq})	*Estimation of Net Emission Reductions* (tons of CO_{2eq})
2007	27.015	43.976	0	16.961
2008	34.508	57.953	0	23.445
2009	37.075	62.241	0	25.167
2010	39.441	66.199	0	26.757
2011	41.624	69.849	0	28.224
2012	43.636	73.216	0	29.580
Total (tons of CO_{2eq}**)**	**223.299**	**373.433**	**0**	**150.134**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

In the baseline situation, Landfill gas is generated as a result of decomposition of municipal waste under anaerobic conditions. It is mainly composed of carbon dioxide and methane. Carbon dioxide and methane are greenhouse gases, which do not cause harmful effects to the local environment, but rather affect global warming and economic value of the area where the landfill is implemented.

In the baseline situation, emissions of methane from the landfill are associated with the following negative impacts:

- Undesirable odour especially for the human establishments surrounding the landfill area.
- Safety and health risks to landfills staff due to generation of methane concentration above safe limits as well as explosions and fires at the landfill site.
- Potential for landfill fires and the associated release of incomplete combustion products.

A very small percentage of volatile organic compounds (VOCs) is also found in the landfill gas, contributing to the undesirable odour. VOCs emissions are photochemically reactive, and result in the formation of tropospheric ozone. The latter might cause adverse effects to the respiratory system such as breathing difficulty and aggravated Asthma, and damages to crops and plants. VOCs are also known for their toxicity and carcinogenic effect from chronic exposure. However, since volatile organic compounds comprise very small percentage of the landfill gas, impact on air quality is expected to be minimal.

Overall, the project activity leads to positive environmental impacts, which contribute to the sustainable development of the area and no significant negative impacts are expected.

The risk from collecting, pumping and treatment of landfill gas can be properly controlled. Controls from such operations include equipment safety precautions (such as alarms, safety valves, and automatic shutdown), daily inspection, and fire fighting extinguishers.

In the project activity, flaring of the collected biogas and combusting the landfill gas in gas engines, respectively will destroy methane and thus will mitigate the above mentioned negative impacts.

Methane is a greenhouse gas, known for its contribution to global warming. The proposed project main activity is combusting the landfill gas to convert methane to carbon dioxide. Therefore, the project will result in positive environmental impacts, where it will lead to decrease the amount of greenhouse gases released to the atmosphere.

The LFG system might also lead to some minor CO, NO_x and VOCs emissions. However, thanks to the sophisticated combustion and to the high burning temperature (over 1000°C), it will ensure an almost total destruction of the gases. In that way, emission of CO, NO_x and VOCs and other compounds present in the biogas such as ammonia will be minimal, and much lower anyway to what it would have been occurred in the absence of the project activity.

Overall, the minimum required 10 m-height chimney will ensure for all emitted gases to be properly evacuated and dissolved into the atmosphere, with very limited impacts in the surrounding local environment and population.

Further, the driving force for subsurface migration of landfill gas and landfill gas components is minimized, protecting adjacent buildings and water bodies.

There is minimal visual impact from the flaring systems and the gas engines. Noise and vibration will be limited to the localized sites.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

With reference to a letter of the Czech Ministry of Environment, workplace Brno from 15th March 2006, projected activity "degassing of landfill sites and construction of a landfill gas pumping station" is not subject of Environment Impact Assessment Process according to the respective country regulation (Act No. 100/2001 Coll., On Environment Impact Assessment).

The concerned JI Project represents activities, which were already covered by environmental impact assessment processes for the operating of the landfill sites (according the Act No 100/2001 Coll.) (landfill sites Těmice and Ronov nad Sázavou) and 244/1992 Coll. (landfill site Řevnice), which means that for installation and operation of landfill gas recovery systems were already issued affirmative opinions during those processes.

Consequently, the operators of the landfill sites have to fulfil measures and requirements resulting from a finished EIA. Obligation followed from this JI Project is to give the operators of the landfill sites output data from the monitoring of the degassing systems. The current project activity has to fulfil the requirements set through the conducted EIA processes.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

During the preparation of the project documents presentations a workshop will be organised by the Project Management Team.

Participants will be representatives of the Project Management Team from the position of Project's developers, concerned municipalities from the position of local authorities (City of Kyjov, City of Přibyslav and City of Řevnice), Ministry of Environment, Department of Climate Change from the position of the Central Executive Authority in the area of JI/CDM Projects and Private Sector from the position of the operators of Landfill sites.

The workshop (including a presentation of the project) will take place on one of the concerned landfill sites in autumn 2006 before construction works will begin. The participants mentioned below will be invited directly by letter.

It is envisaged to invite journalists of local newspapers as well. By publication of a description of the project activity in local newspapers the interested inhabitant should be well informed.

This workshop should be a platform for all stakeholders to comment on the project and to suggest improvements, modifications etc.

The issue of Stakeholder Process was also discussed with a representative of the Czech Ministry of Environment, Department of Climate Changes, Mr. Zámyslický. According to the information of Mr. Zámyslický there are no criteria, issued by the Ministry of Environment how to organize this meeting and who to invite.

Therefore, the Stakeholders process conducted by the Project developer Terrasystems s.r.o. is acceptable for Czech executive authority and local authorities.

The following tables illustrate the list of participants in the meeting:

Municipality: City of Kyjov	
Ing. Šárka Hauserová, s.hauserova@mukyjov.cz, tel.: 518 697 550	Head of Environment Department

Municipality: City of Přibyslav	
Ing. Jiří Musil, musilj@pribyslav.cz, tel.: 569 430 825	Head of Department of Constructions and Ecology

Municipality: City of Řevnice	
Miroslav Cvanciger, starosta@revnice.cz, tel.: +420257720150, mob.:+420603854843	City Manager

Terrasystems s.r.o.	
RNDr. Alena Galková, agalkova@slovanet.sk	Chair man

Van Der Wiel, stortgas B.V.	
Wytze Hoeksma, w.hoeksma@vanderwiel.nl	

Tanzer Consulting GmbH	
DI. Alexander Simader alexander.simader@tanzerconsulting.com	Chair man
DI. Christian Praher christian.praher@tanzerconsulting.com	
Ing. Tomáš Chorazy, tomas.chorazy@tanzeconsulting.com	

Ministry of Environment	
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Summary of the comments received:

A questionnaire will be distributed to participants of the workshop for feedback, with questions relating to how the project activity would relate to sustainable development in the Czech Republic, technology transfer, and improvement in the socio-economic situation of the local region.

Report on how due account was taken of any comments received:

The comments, which will be received relating to further information of the project technology, will be addressed and the following options will be contemplated:

- A pamphlet describing the project technology will be produced and distributed to interested stakeholders.
- An information package containing drawings and specifications detailing the project technology will be produced and kept at the Sites and be available for public information.

Progress with respect to increasing the awareness of the project technology will be monitored and strategies re-evaluated as necessary.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

The baseline scenario for the project activity is the uncontrolled release of landfill gas (LFG) to the atmosphere at the landfill sites TKO Ronov nad Sázavou and EKOS Řevnice and the collection of 4.380 tons CO_{2eq} / year for the operation of the cogeneration unit at the landfill site TKO Těmice. The total estimated emissions of landfill gas to the atmosphere in the baseline scenario are estimated as **373.433** tons of CO_{2eq} during the crediting period from 2007 to 2012. There are presently no further measures in place to reduce carbon dioxide emissions and there are no current or pending regulations that would require the specified site to reduce emissions until 2012.

After year 2012 every operating landfill, which is accepting biologically decomposable waste, shall comply with the requirements of the EU Landfill Directive 1999/31/EC and if not, the landfill shall be closed down according to closure and after-care procedures.

Annex 3

MONITORING PLAN

1.0 Introduction and Objectives

The two primary purposes of a landfill gas monitoring plan are:

- To collect the necessary system data required for the determination and validation of emissions reduction units (ERUs) and of assigned amount units (AAU); and
- To demonstrate successful compliance with established operating and performance criteria for the system, and to verify that the ERUs and AAUs have been generated.

The operational data that is collected for the system will be used to support the periodic report that will be required for the auditing and validation of ERUs and AAUs. The monitoring plan discussed herein is designed to meet or better the UNFCCC requirements.

The routine system monitoring program required for the determination and validation of ERUs and AAUs is discussed in Section 2, while the additional system data that is collected to ensure the safe, correct, and efficient operation of the landfill gas management system is discussed in Section 3.

Coupled with an operations and maintenance manual that is generally developed for a system, expected performance guidelines in accordance with the data collection procedures described below will be provided with trigger levels that would be indicative of a need for any follow-up assessment and possible remedial response measures.

2.0 Monitoring Work Program

The landfill gas monitoring program is a relatively simple, straight forward program designed to collect system operating data required to safely operate the system and for the verification of ERUs and AAUs. This data is collected in real time, and will provide a continuous record that is easy to monitor, review, and validate.

The following sections will outline and discuss the following key elements of the program:

- Flow measurement;
- Gas quality measurements;
- Data records; and
- Data assessment and reporting.

2.1 Flow Measurement

The flow of landfill gas collected by the system and subsequently flared or utilized is measured via a flow measuring device suitable for measuring the velocity and volumetric flow of a gas. Two such common examples are an annubar or an orifice plate. The flow measurements are taken within the piping itself, and the flow sensors are connected to a

transmitter that is capable of collecting and sending continuous data to a recording device such as a datalogger.
The flow sensors are calibrated according to a specified temperature, pressure and composition of the gas, thus the flow actually measured must be corrected to according to actual temperature, pressure, and composition, thus density, of the gas measured. The equipment selected will allow dynamic compensation for these parameters, normalized to a standard temperature, pressure, and gas composition. For reporting purposes, the flows are generally required to be normalized to 0°C and 1 atm at standard gas composition of 50% methane and carbon dioxide each by volume.

Specific calibration procedures are dependent on the actual equipment selected, however calibration of the sensors is required on a regular basis to ensure the quality and validity of the data. The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used, however equipment is available that will provide a minimum accuracy of +/- 2% by volume. Again dependent on the equipment selected, the measured flow is aggregated approximately once per second.

All data is that is collected will be recorded for the permanent record. Both electronic and hard copies of the data will be maintained for auditing purposes, and for use in the calculation of ERUs and AAUs.

2.2 Gas Quality

The two parameters that are most pertinent to the validation of ERUs and AAUs, as well as the safe and efficient operation of the system are the concentration of methane and oxygen in the gas stream. These two parameters are measured via a common sample line that is run to the main collection system piping, and measured in real time by two separate sensors, one each for methane and oxygen.

Although compensation for temperature and pressure is not required for the methane and oxygen sensors, the sensors are designed to operate within specified temperature and pressure conditions. Again, specific calibration procedures are dependent on the actual equipment selected, however calibration of the sensors is required on a regular basis to ensure the quality and validity of the data. Regular calibration of the equipment is especially important, as the accuracy of the methane and oxygen sensors is greatest within the expected range of the gas stream to be measured. Equipment is readily available that will provide an accuracy of +/- 1% by volume. Dependent on the equipment selected compositions are aggregated approximately once per second.

2.3 Data Records

Data collected from each of the parameter sensors is transmitted directly to an electronic database from which the ERU quantity calculations may be carried out, and a hard copy backup of the data may be printed. Backup of the data electronically may be conducted on a daily basis, and hard copy data may be printed weekly or monthly. As a back up would be produced separate from the main recording system, no more than one day of data at a time would ever be lost due to a system malfunction. Calibration records will be kept for all instrumentation.

2.4 Data Assessment and Reporting

Assessment of the flow and composition data described above coupled with the operating hours of the flare and flare destruction efficiency are used to determine the quantity of ERUs and AAUs generated. The destruction efficiency of the flare is a function of the internal combustion temperature and resident holding time, which are generally measured by the flare system controller, and recorded for auditing purposes. Extensive technical documentation is available that documents the destructive efficiency of the enclosed drum flares that will be used, subject to the flow rate and combustion temperature verification. Destruction efficiency will also be assessed periodically through measurement of uncombusted methane emissions.

As discussed in Section 2.1, flow data is normalized to standard temperature, pressure, and composition for reporting purposes. The data will be compiled and assessed to produce the required quantification and validation. The annual monitoring report will contain the data required for the validation of the ERUs and AAUs, and additionally may contain operational data from the collection system and flaring system described below to illustrate that the system is well maintained and operating at peak efficiency. Records of regular maintenance performed will also be a component of the annual report.

3.0 Related Monitoring

Additional operational monitoring of the landfill gas collection wellfield is conducted in order to optimize the system and ensure that it is operating both correctly and efficiently. Periodic adjustments to the extraction wells will be required to optimize the collection system effectiveness. Such collection field adjustments are undertaken made based upon a review of the well performance history considered within the context of the overall field operation in order to maximize the collection of methane balanced against the minimization of any oxygen in the system which could introduce unsafe operating conditions. Monitoring at each extraction well will consist of the following parameters: valve position, individual well flow, individual well vacuum, and composition of the gas collected, i.e., methane, carbon dioxide, and oxygen, using a portable measuring device.

At such time as a landfill gas facility is designed and commissioned, a specific monitoring plan tailored to the actual utilization technology selected will be developed for this system.