

The Uraia Platform Inspiring Practices Catalogue

Landfill Gas-to-Energy Project Johannesburg, South Africa

PROJECT TITLE

Landfill Gas to Energy Clean Development Mechanism Project: harvesting and flaring landfill gas to produce green electricity, a SMART city initiative of Johannesburg, South Africa.



PROFILE OF THE CITY

The City of Johannesburg, in South Africa, has 3.8 million people and 787,000 dwellings.

PROJECT SUMMARY

Johannesburg, a city of 3.8 million people, has to handle more than 1.6 million tons of waste annually and to oversee eight landfill sites, which harm the environment and the surrounding communities. In addition, the City is facing serious difficulties regarding energy provision and particularly load-shedding issues. In this context, the City launched a landfill gas-to-energy project in 2007. The project uses gas turbines to drill out methane gas, caused by the degradation of bioorganic compounds at its landfill sites, and to generate renewable energy for the municipal grid, thus offsetting largely coal derived electricity. The project, which should be fully operational by the end of 2015, was developed through a Public-Private Partnership (PPP) with the British company EnerG Systems under a 20 years contract. To benefit from additional revenue, the City initiated a Clean Development Mechanism (CDM), which was completed in November 2012, and signed a Power Purchase Agreement (PPA) with the national electricity company, Eskom, to sell the energy produced in the landfill sites. Since 2011, wells to extract and flare the greenhouse gases as well as energy generators have been built in the five landfill sites selected for the project. Energy commercialization started at the beginning of 2015. The

expectation is to produce 19MW per year starting in 2016 from the five landfill sites, which should be enough to provide energy to 12,500 households. By the beginning of 2014, the project had managed to reduce pollution and noise for surrounding communities, had produced 137,888 Certified Emission Reductions (CER's) and destructed 18,288,457 Nm3 of landfill gas.

BACKGROUND INFORMATION ON WASTE MANAGEMENT AND ENERGY PRODUCTION ISSUES IN JOBURG

The City of Joburg, as of 2012, has been handling more than 1.6 million tons of waste annually and overseeing eight landfill sites. As a result the City is spending much on transportation costs, which also contributes to air pollution and Green House Gas (GHG) emissions from the trucks (emissions per capita in Joburg are 6.4 tons annually). Pikitup, a municipally-owned waste management entity created in 2001, covers an area of 1,625 km². Faced with the challenge of limited space for more landfill sites associated with GHG emissions; the City of Joburg has launched an integrated waste management operation which incorporates waste separation at source, garden dumping sites and composting plants. The city is looking into other technologies to deal with waste, as its landfill sites fill up. Possibilities are incineration and pyrolysis, or the composting of waste. Another important issue South African cities are facing is the difficult energy provision because of its dependence on coal. Therefore, the City of Johannesburg has been exploring possibilities of harvesting energy from existing landfills.



DETAILED DESCRIPTION OF THE PROJECT

Objectives

The goals of the City of Johannesburg Landfill Gas-to-Energy Clean Development Mechanism Project are:

1. **Extract and eliminate harmful greenhouse gases** emitted from decomposition of waste at the landfills that are currently polluting the environment and causing health and safety hazards as well as bad odors, especially to communities surrounding the landfill sites.
2. **Generate renewable energy**, improve the supply of energy and urban efficiency, and assist Eskom in the context of electricity shortage. The project aims at generating 19MW of electricity by 2016 from its five landfills via a smart technology that generates power from waste. The 19MW power to be generated from the five landfills is part of a medium term

plan to have the city generating approximately 300MW from alternative energy sources including solar energy.

3. To **allow for additional revenue streams** for the City through
 - The Clean Development Mechanism (CDM) process in compliance with the Kyoto Protocol requirements. This revenue is generated from the sale of Certified Emission Reduction certificates (CERs) –carbon credits- through the United Nations Framework Convention on Climate Change (UNFCCC).
 - The sale of the electricity produced to national and local energy supplier (Eskom and City Power).
4. To **ensure environmental compliance with national and state regulations** and meeting the City's long-term strategic goal of shifting to a low-carbon economy as detailed in the 'Joburg 2040: Growth and Development Strategy'.

How does the project work?

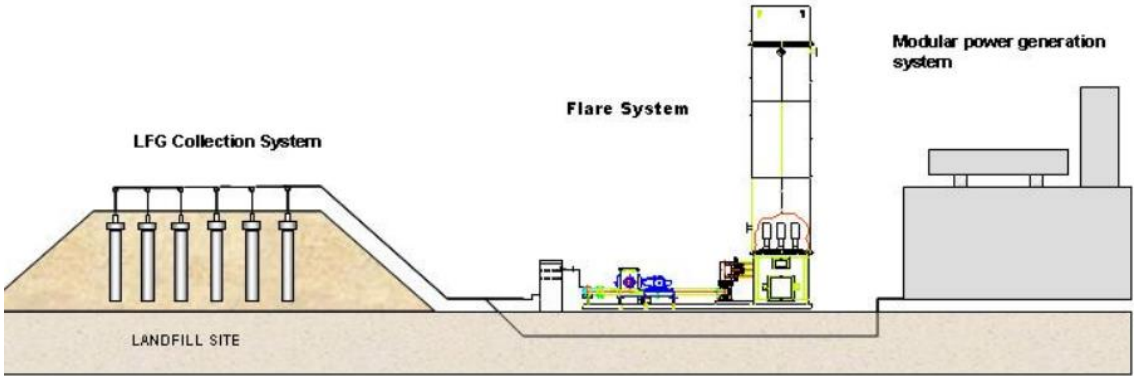
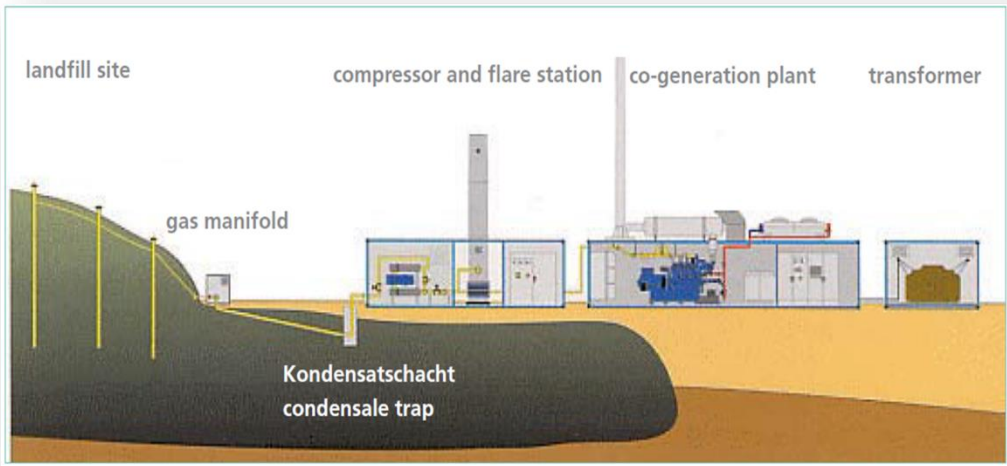
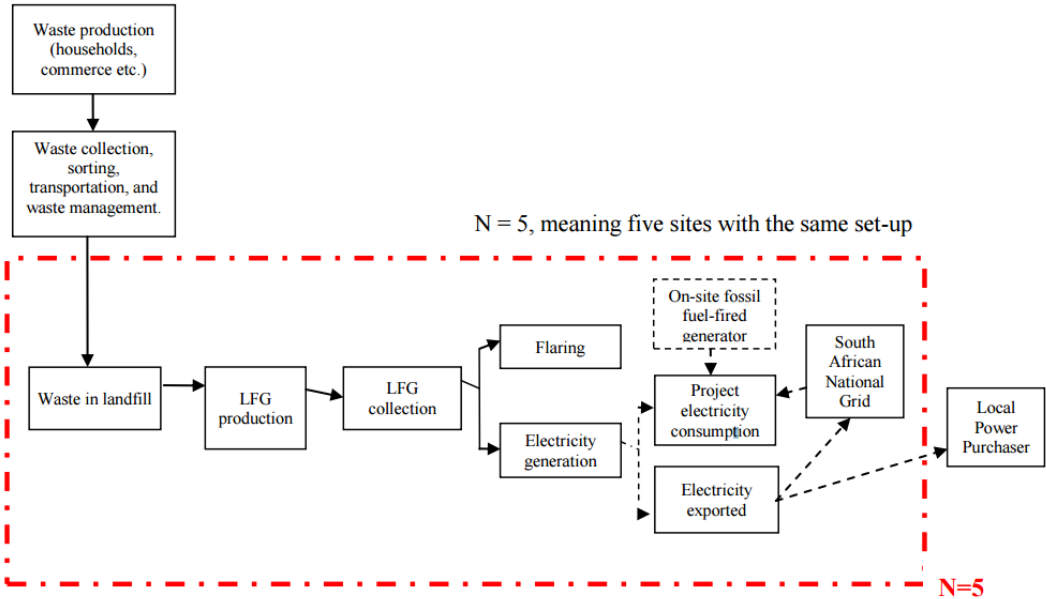
Landfill gases. Landfill gases (LFGs) are unknown to most citizens, but the odors coming from landfills, which are caused by these gases, are an apparent sign of their presence. Landfill gases are created when organic waste decomposes. Most landfill gas is composed of roughly 50% methane, 50% carbon dioxide and a very small amount of other organic compounds, some of which are hazardous. Both methane and carbon dioxide are greenhouse gases. Methane is 21 times more harmful to the environment than carbon dioxide. This means reducing LFGs is important to help reduce greenhouse gases. In addition, methane is highly combustible, making it a fire hazard. Keeping these gases under control is part of the operational issues faced by all landfills.

The situation prior to the project. Up until now, the City intervened in the landfills through the following actions: First, the site is covered with waterproofing, to protect the ground water. Then, as rubbish goes into the landfill, it is covered with 150mm of earth, to reduce the smell and cut down on vermin and flies. Water running off the landfill is channeled away and evaporated. The landfill is also sprayed with disinfectant water so it does not pollute the air.

The project activities. One way of managing landfill gases is transforming them into clean energy. The Project has two complementary activities: (1) Methane collection and destruction (through flaring) and/or utilization of LFG (through combustion in electricity generation units), in order to convert its methane content into CO₂ and thus reducing its greenhouse gas effect. (2) Electricity displacement: the generation and supply of electricity to the grid of the local and national power purchaser, thus displacing a certain amount of fossil fuels that are used for electricity generation for the national grid.

The technical process. Methane is passed through a combination of vertical and horizontal pipes to a flare system where it is burnt and released as carbon dioxide, which is less harmful to the atmosphere. The process of extracting landfill gas begins with the drilling for gas wells, using horizontal extraction pipes that are laid and connected to the manifold boxes. From there, the gas goes through to the flare systems, where it is mixed with oxygen content for cleaning purposes. Then the gas is combusted for release as clean carbon dioxide. The final step of the process is to install generators through which the gas will be channeled as fuel for electricity generation. The renewable electricity will be "exported" by connecting the generators to the municipal distribution grid, with Eskom's (the National electricity supplier) or City Power's (Johannesburg's electricity supplier) distribution infrastructure. The use of methane-rich gas to generate renewable energy is now a global trend and is considered a commercially viable, cost-effective technique.

Figure B.3.1 - Flow diagram of Project set-up





Drilling wells

Laying pipes

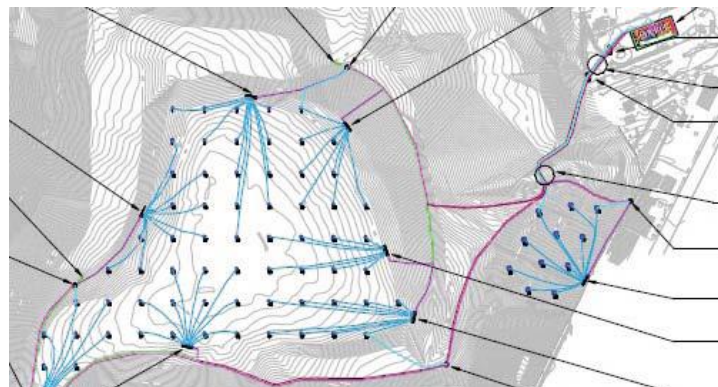
Connecting pipes

Feeding the flare

Scope of the project. Due diligence into the City of Johannesburg’s landfills indicated that only five of the initial eight targets for the project were viable, as some would have generated less than 1MW. The five landfills selected to receive the installation of active LFG capturing systems are: Robinson Deep, Marie Louise, Linbro Park, Goutkoppies, and Ennerdale. Four of the five were active, with Linbro Park closed due to lack of space. The total system will cover 26ha when complete in all five landfill sites (Robinson Deep represents 10ha). According to Dave Harris, general manager for landfill at Pikitup, there is enough gas to keep the project running for 15 to 20 years. However, the rate of gas production is influenced by several factors, including the age and composition of the waste, and the temperature and moisture content of each site.

Project implementation. Since initial viability studies showed that Robinson Deep Landfill had the greatest quantity of methane gases, the decision was made to begin at the site. Robinson Deep is one of the oldest landfill sites of the city (it was built in 1930), takes about 124 acres of land, stand 80 meters high, and had a lifespan of only seven years. As records prior to Pikitup’s engagement in 2001 were not available, what lay beneath the immediate surface was unknown. In addition, Robinson Deep is still an active site, with more than 300 trucks delivering waste daily, which poses operational challenges as trucks and equipment can damage pipes. Initial methane mapping was conducted to determine the greatest potential wells of methane gas. As shown in the diagram, the initial pipes were laid out into various places in the landfill according to the operational conditions and other requirements as specified by the service provider.

The implementation of the project started in Robinson Deep landfill site in February 2011, with the construction of 68 wells and pipelines and the beginning of flaring or burning of methane gases in May 2011. The installation of four generators began in October 2014, and they were operational by early 2015. Each one of them costs about R10 million (USD 760 000) and will generate 1MW per year. This landfill currently produces around 1,400m³ per day which is destroyed by means of a flare. When operating at full capacity, the capped landfill will produce around 3,000 m³ per day. This amount of landfill gas can be converted to 5 MW of renewable electricity when in the second phase the generators are installed providing renewable electricity for around 4,000 to 5,000 households. When operating at full capacity, the reduction of greenhouse gasses is equivalent to approximately 149,000 tons of CO₂-equivalents per annum.



At the Marie Louise landfill site, 28 gas extraction pipes were built and flaring began in February 2012. Construction for the three remaining sites (Goudkoppies, Ennerdale and Linbro Park) commenced in 2014. Commercial operation started for all five landfill sites in the first semester of 2015.

The total investment for the five sites will be R276 million (USD 21 million). The project has a life expectancy of 20 years. Once the five landfill sites will be operating, they will constitute the largest landfill gas-to-energy program in the country, producing an estimated 19MW of power, sufficient to supply 12 500 households per year.

DETAILED DESCRIPTION OF THE PPP PROCESS

Conception phase 2001- 2006:

The City of Johannesburg started making efforts to launch a landfill gas project in 2001, but faced financial constraints and lacked expertise. In 2005, the City identified the 5 landfills to benefit from the project. In 2006, the City's Environmental, Infrastructure and Services Department (EISD) chose to finance and manage the landfill gas-to-energy project through a Public-Private Partnership (PPP) and started a process of seeking out a private partner that would be awarded a long-term contract to design, develop and implement the system.

The reasons that led the City of Joburg to develop this project through a Public-Private Partnership (PPP) are:

- A PPP provides external funding for big infrastructure projects. The expected development cost of the project was 10 Billion South African Rands (USD 765 million), which was unaffordable for the City on its own.
- The PPP brings the expertise that the municipality lacks; it is a tool for facilitating and enhancing quality public service delivery by using the capacity and skills of private sector entities to assist with service delivery, and by being a catalyst for efficient, effective and value-for-money solutions.
- The PPP allows dividing responsibilities and risks among each partner according to their capabilities. In this specific project, the negotiation allowed for the City to be the owner of the facilities, and for the private sector to build and operate but not take the demand risk as its role was to transform the gases into energy but not to provide it to the population.
- A PPP helps the City face challenges with users. Most cities in developing countries have some kind of experience or challenges around community ownership regarding the services that are delivered to the public and/or private sector, such as theft and vandalism of municipal water, electricity, waste management infrastructure, land and other state assets; unlicensed trading with state assets by illegal businesses; culture of non-payment for municipal services whether basic or advanced; tempering with municipal infrastructure in order to avoid paying for service usage.
- Driving the implementation of Smart City initiatives through a PPP approach will ensure that all parties are constructively involved in the development of solutions that will support the business and domestic customers in a mutually beneficial way.
- The institutional and legislative South African framework is friendly to the implementation of PPPs. The South African government has implemented a series of policies, and legislative and institutional reforms to create an enabling environment for Public-Private Partnerships for municipal management; among others, a Strategic Framework that was endorsed by the South African Cabinet in 1999. Later, the principles of PPPs were adopted by many government institutions including City Power which is a utility company of the City of Johannesburg. In addition, the City of Johannesburg is active in providing technical assistance to its entities through project feasibility, procurement and management;

promoting an enabling environment for PPPs by facilitating certainty in the regulatory framework; developing best practices guidelines, providing training, disseminating reliable information; and driving black economic empowerment in PPPs.

According to former Project Manager Palesa Mathibeli, *“We would rather take a risk-averse process and have a private party come in to develop and invest in the project at no cost to the City.”* It is clear to the City of Johannesburg that a smart city solution can only be rapidly advanced through the use of PPP, whether in principle or legally, due to the large scale of the project and the need to get community or customer buy in.

Stages of the PPP process for the landfill gas to energy project:

- Project Inception - Project initiation through a Mayoral Committee & Council approval
- Request for Expression of Interest – Receive RFIs from public
- Feasibility Study - Conducted and complete in line with PPP
- Treasury Views and Recommendations (TVRI) - National Treasury & Municipal Finance issued the project with TVRI
- Consultation and Council Decision - Public Consultation conclusion
- In Principle’ Council approval was obtained in
- Appointment of a Senior Project Manager for this project
- Terms of Reference for the Request for Qualification (RFQ) finalized
- Treasury Views and Recommendations (TVR IIA)
- Issuing a Request for Qualifications (RFQ)



Preparation and negotiation phase 2007-2009:

Tender process and choice of the private partner. The tender process brought several potential service providers, but EnerG Systems had put in place similar systems in various places around the world, including South Africa, and had the necessary capability, expertise and acumen with LFG extraction projects. EnerG Systems Consortium was awarded the tender in 2007 but the contract was only signed with the City in 2009 because the private party presented the City with an inadequate draft contract that needed intense negotiation. The negotiations with the service provider were difficult and protracted and each clause had to be agreed upon. The contract was signed in 2009 to construct and operate the landfill gas-to-energy project over 20 years. The agreement also gave EnerG Systems exclusive rights to mine gas and generate electricity at the five sites.

Studies and Analysis. Before launching the project, a feasibility study on the landfills was conducted between 2007 and 2009. WSP Environmental South Africa was appointed by Ener-G

Systems to carry out the environmental scoping, Environmental Impact Assessment (EIA), and draft Environmental Management Plan (EMP), for the development of the Joburg Landfill Gas to Energy Project into a CDM Project. Environmental impact assessments on each of the landfill sites have been completed and the City received Waste Licenses under the Waste Management Act to implement the projects on each of the sites in 2010.

External expertise. In order to strengthen its negotiation skills and expertise for the PPP implementation in general and LFG projects in specific, the municipality employed in 2008 an outside legal firm with expertise on LFG project negotiations, the North American company Lee International. For about a year, the consultants provided financial, legal, and environmental experts to advice on each aspect of the project and contract. In addition to international experts, the Project Manager was able to call on the National Treasury, which at the time had an expert assisting with municipal projects. This individual assisted in negotiations when the service provider came back to ask for changes to the contract. When the private party was appointed, it presented the City with a draft contract, which it assured the City had been signed by another municipality. Advice from the Treasury assisted Johannesburg in determining that the contract was one-sided and did not benefit the municipality. It took one year to renegotiate the contract and sign a new, comprehensive one.

Legal framework. The gases and their management are not complicated, but the legislation, the requirements of the Kyoto Protocol 2002, other legislative requirements and legal processes make the “landfill gas to energy clean development mechanism project” very complex. Compliance with national and state legislation is key to guarantee the success of the project and the city’s project managers and team members had to engage in intensive due diligence to put in place the legislative and financial requirements to get the project off the ground. Several different agreements, legislative issues, tenders and other legal documents have bearing on the success of LFG gas projects. An understanding of how each of these will impact timelines, outcomes, costs and results is critical, and can either enable a project team or clarify challenges. Current Project Manager Simphiwe Mbuli of the City’s Environment and Infrastructure Services Department (EISD) has identified several pieces of legislation, document requirements and agreements that had bearing on the project:

- (i) Environmental Impact Assessments (EIA) were conducted in 2008 on each landfill site.
- (ii) Consent Use to implement the LFG projects at each site was received in 2010.
- (iii) Power Purchase Agreement was signed between the Department Of Environmental Affairs (DOE - Ministry), the municipality and the service provider as an Independent Power Producer (PPP) in 2013.
- (iv) A Wheeling Agreement and a Connection Application were signed between the company, City Power and Eskom in 2014 to allow the use of national infrastructure and connect distribution networks to the power production in the landfill sites.
- (v) At the end of 2012, after a process of two and a half years, the municipality received the authorization to sell CERs according to the Clean Development Mechanism process of the UNFCCC and the Kyoto Protocol of 2002.



Implementation phase 2009 – present:

FINANCIAL INFORMATION

<i>Global Budget</i>	<i>10 Billion South African Rands (USD 764 million)</i>
<i>Short Term Funding</i>	<i>200 Million to 2 Billion (Planning and Design or Small Scale Rollout or POC) (USD15 million to USD 153 million)</i>
<i>Long Term Funding</i>	<i>10 Billion (Large Scale Rollout) (USD 764 million)</i>

PPP projects of this nature require LFG experience and expertise, which is expensive. While the service provider contract allows for a private contractor to take on the actual capital and maintenance costs, the municipality must still pay for the consultants and experts to assist with the agreements and legal requirements. The City of Johannesburg has invested more than R200-million (USD15 million) in developing the landfill gas-to-energy project. The PPP was designed in order for the project to fit in the municipal budget and a specific risk management framework was established. Operating costs are estimated at 10% of capital cost per year and security alone is 3% of the contract value, and these need to feature in future budgets and financial projections for the project.

The project was set to generate additional revenue for the City of Johannesburg through: 1. selling carbon-credits on the international market and 2. selling the power to Eskom (national electricity supplier).

1. Credit-Carbon selling process:

In 2009, the City of Johannesburg initiated the process of applying for registration as Clean Development Mechanism (CDM) projects under the United Nations Framework Convention on Climate Change (UNFCCC) to reduce greenhouse gas emissions and registration was achieved in December 2012. Gathering of VERs began on 29 May 2012.

In 2002, the South African government signed its accession to the Kyoto Protocol on World Climate Change, a legally binding commitment by developed countries to reduce greenhouse gas emissions and for the implementation of supportive CDM projects in developing countries. The adoption of the UNFCCC convention, which leads to member countries adopting the Kyoto Protocol for the commitment period 2008 – 2012, was a major step in tackling the problem of global warming. The protocol created a mechanism where developed and developing countries can transact using carbon credits as currency to be compliant under the UNFCCC obligations. When a developing country initiates a CDM project, the credits for reducing carbon emissions are first known as Value Emission Reductions (VERs). The flaring of methane at landfills is an example of a CDM project. The project must undergo an intensive process to be registered as a CDM project, from which time the VERs, which have accumulated from start-up, become CERs, or Certified Emission Reductions, which are commonly known as carbon credits. Carbon credits may be purchased on the open market. They are a source of revenue for developing countries, while at the same time serving as ways to offset the carbon requirements for developed countries under the Kyoto Protocol.

Since the project covered several years, the viability of selling carbon credits alone as a revenue source was not enough to make the financing bankable. In addition, with the Kyoto Protocol expiring in 2012, the cost of carbon credits began to decline, and banks required additional revenue sources. While a carbon credit price of €11 was secured and an overseas buyer for the credits was in place, this was also contingent on the registration of the project with the UNFCCC, which was due to be completed only by the end of 2012. The City began to hold

the service provider to the agreed-upon timelines to execute the project. Since 2012, the project has produced 137,888 Certified Emission Reductions (CER's).

2. Sale of power produced on landfill sites

Constructions at the different landfill sites followed three phases: 1. Installation of the gas extraction and collection systems, and installation and commissioning of the gas flares within equipment compounds located at the landfill sites. 2. Installation of gas engines that will be used to generate electricity using the landfill gas as fuel. 3. Electricity generation. One of the riskiest aspects of LFG projects is the funding and income streams. While the service provider is responsible for raising the funding, without external capital the service provider might have difficulty in fully executing the contract. Hence, the bank that EnerG Systems was working with (Nedbank) required that the City and EnerG Systems signed a Power Purchasing Agreement (PPA) for the sale of the power extracted from the landfill sites, before releasing financing to develop the third phase of the project. As such, the City and EnerG Systems started looking for a buyer to the energy produced in the landfill sites and applied to a REBID tender under the National Department of Energy's (DOE) Independent Power Producers (IPP) Procurement Program¹, in May 2012. In October 2013, the department of Energy approved the project and agreed to sign a Power Purchase Agreement (PPA) with Eskom for a 19 MW contribution as part of the Renewable Energy Independent Power Producers program. An independent power producer is an entity that is not a public electric utility that owns and operates facilities to generate power for sale to an electricity utility, central government buyer and end users. The stakeholders agreed that the electricity would be sold to Eskom for 94c/kWh. The income from the sale of power to Eskom will amount to R800-million a year (USD 61 millions). A portion of this will be paid to the city as a royalty, which will largely be used to maintain the sites.

GOVERNANCE OF THE PROJECT

The City of Johannesburg implemented a tight management process. The Municipality:

- Established a **Steering Committee** comprised of: the Gauteng provincial Finance and Environment department, the City of Johannesburg Legal & Compliance, and Finance departments, City Power, the City's Environment, Infrastructure and Services Department (EISD), Vela VKE, and Pikitup, along with service provider EnerG Systems. It meets quarterly to oversee the project and detailed minutes are captured for follow-up. They present the Mayoral Committee with regular updates, which ensured senior management was kept abreast of activities.
- Established a **Technical Team** composed of members from EISD, Pikitup's Landfill Operations Team and EnerG systems. They meet monthly to follow up on timelines, check on progress and identify any issues to address.
- Appointed a **Senior Project Manager** who tightly managed team deliverables and communication with detailed meeting minutes.

The City of Johannesburg mentioned that a **multi-disciplinary transaction advisory (TA)** might be advisable for such PPPs, since the LFG project was the first of its kind and there was no internal expertise at that time.

Project Steerco Member	Role and Responsibility
Pikitup	Began investigating in 2001 the possibility of developing a LFG project. Kick-started the project with discussions in 2005.
EISD	EISD Executive Director decided to seek service provider for

¹<http://www.ipprenewables.co.za/>

	LFG project in 2006.
City of Joburg	Awarded the tender to the private party in 2007. Registered the five landfill CDMs with UNFCCC to allow the sale of carbon credits.
EnerG Systems	Brought the expertise on gas extraction from landfills, and the capital and funding to purchase the equipment for the wells, gas extraction, gas flaring and the future linkages to the electrical grid.
Gauteng Province Department of Environment	Ensured the environmental impact oversight. New Environmental Waste Act comes into effect, resulting in application having to go through new process for submission. Conducted in 2008 the Environmental Impact Assessment (EIA). The authorization was awarded in 2010.
City Power	In 2013 the city signed the Power Purchasing Agreement (PPA) with Eskom and Wheeling Agreement with City Power to allow gas to be piped to their electrical grid.
Gauteng Province Department of Finance	Responsible for the PPP Financial Oversight

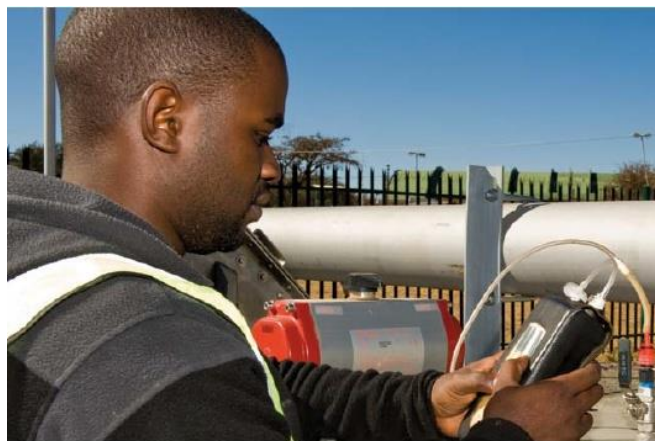
RESULTS

This very innovative project, first and biggest in South Africa, has seen several key accomplishments, including:

- **The construction on the landfill sites (gas wells, pipes, energy generators).** For example, the Robinson Deep landfill, composed of 68 gas wells and four energy generators, has produced 137,888 Certified Emission Reductions (CER's) and destructed 18,288 457 Nm³ of landfill gas, in the atmosphere. The total potential energy generated from the project was 19MW, comparable to electricity usage by about 12,500 middle-income households.
- The Power Purchasing Agreement (PPA) that City Power signed with Eskom to sell the energy produced in the landfill sites will **contribute as a load shedding mitigation initiative** as it will benefit the City through the following channels: Reduction of waste going to landfill (500,000 tons diverted); Renewable energy (potential 35 – 60 MW); Revenue from sale of by-products (bioenergy, heat and recyclables).
- **Application with the UNFCCC for registration of the CDM project for carbon credits under the Kyoto Protocol.** The gas extraction is being accumulated as credits that can be sold on the open market since it was registered in November 2012. This allows the City to accumulate a balance sheet of future revenue. Up to February 2014, a total 19 042 CER's were amassed corresponding 3 157 656 Nm³ of landfill gas was destructed since May 2012.
- **Additional revenue to the City.** The income from the sale of power to Eskom will amount to R800-million a year (USD 61 million).
- There has been measurable **reduction in landfill odors and methane gas concentration** as measured by the University of Witwatersrand team from the Department of Geography, Archaeology and Environmental Sciences.
- **Compliance has been improved with regard to the National Environmental Management:** Waste Act, Provincial Waste Management strategies and municipal

Development of Integrated Waste; and the Waste Management Plan strategies for Integrated Development Plans.

- The PPP has offered the City of Johannesburg to **build social cohesion and breach the divide regarding the culture of non-payment and the high rate of vandalism and theft** of the City's infrastructure due to low employment rate and high illiteracy rate. Reduction of crime related to state asset misuse, theft or fraud due to community participation and surveillance. The communities become beneficiaries of the solution. The project aims at establishing a sense of ownership from the citizens through Jozi@Work programme and Cooperatives that directly benefits the members of society where projects are delivered and executed. All projects are now subjected to Jozi@Work which requires the allocation of 5% of the capital project budget to the cooperatives or local businesses where the service is deployed. This creates job opportunities and sustainability through partnerships between the communities, government and service providers. It also increases the sense of ownership and encourages the culture of payment.
- Finally, the Project attempts to **increase employment opportunities** in the areas where the Project is located, by providing short and long-term employment opportunities for local people. Local contractors and laborers will be required for construction, and long-term staff will be contracted to operate and maintain the system. With this purpose, EnerG System: established an EnerG Educational Community trust which is financed with the revenues of the project; committed to spend 1% of the revenue from the project will be spent on socioeconomic development in the local community; committed to a local content spend of 42%; defined targets of Employment Equity according to which 84% of employees must be South African; 65% of total employees and 50% of skilled employees must be Black People; and 22% of employees must be local). According to the City of Joburg, the project has contributed to creating approximately 400 waste recovery officers and 80 technicians.



LIMITATIONS AND DIFFICULTIES

The City of Joburg identified the following difficulties when developing and implementing the landfill gas to energy CDM project:

- **The PPP process is complex, expensive and very time-consuming.** It took a long time to design and implement the project. While the dialogue for this project started as early as 2004, the actual construction of the equipment took place in 2011 and it became fully operational in 2015. The norm in the landfill gas industry for service provider partnerships around the world is five to eight years. The entire process of conversion of LFG to energy and carbon credits is a complex, expensive project that has a multitude of work-streams

happening simultaneously over a number of years. Many work-streams and 'go – no go' decisions are based on steps along the way. It is critical that these activities are synchronized and mapped out, and for that synchronization to form part of the project. Since PPPs are an innovative funding mechanism to fund infrastructure requiring a substantial capital investment they are severely regulated and feasibility studies must be conducted before it is possible to move on to procurement and project management. This leads to a time-consuming process. In fact, although the project was initiated in March 2008, the feasibility study was only completed in July 2010. The project formally entered the procurement stage in 2011, and the next step in the process was issuing of a request for qualifications. The process took more than four years, which is a long period of time if compared to one year for a municipally funded project. Also, projected timelines are normally not met which has severe impacts on the budget.

- **Reluctance to innovation** in the field of waste management is very common, and it often comes from municipal services.
- **The City of Joburg lacked technical capacities and skills.** A project of this magnitude cannot be undertaken by one entity alone, so the City had to collaborate with several other actors, including the National Treasury and the Industrial Development Corporation that joined the City's Environmental Infrastructure and Services Department (EISD) to contribute with their expertise. This introduces new team dynamics and has a considerable impact on the project.
- **Development of matching skills to the service provider, and skills transfer as per contracts were not guaranteed.** One element that has not happened in this project is the matching of skills development at Pikitup to the service provider. Municipal agents comment that: "The people managing our landfills should be qualified engineers, as land filling is engineering. At Pikitup there are two engineers on the disposal side and they are far stretched. Capacity and skills are a critical issue. If the service provider were to get out of the city right now, we would not know where to start." And this is a risky place for a municipality to place itself, as the time and cost for the project to reach this stage are very high. The project will continue for another 15 to 20 years and needs to ensure skills transfer. Transfer needs to happen not only at City level, but also from the service provider to its Broad-Based Black Economic Empowerment (BBBEE) partners, which is not currently seen to be happening. In addition, the compliance manual that was written specifically for the project by the outside legal consultants needs to be fully implemented to capture the full earnings and ensure that compliance requirements are being upheld.
- Over time, the **changing regulatory and legislative framework and shifting energy dynamics** become critical variables, which affect the viability of LFG projects. According to Mr. Cornish from the private provider EnerG Systems, the development of the partnership has been made possible through the pioneering work undertaken jointly with the City of Johannesburg, which cleared what had hitherto been deal-breaking hurdles to power generation projects based on landfill gas. These related mainly to contracting constraints contained in the Municipal Public Finance Management Act, which prevent a municipality from entering into contracts with a duration of longer than three years. A model was eventually found ensuring that the project could be developed at no cost to the municipality, while offering an ongoing revenue stream to the city. In addition, the National Treasury and the Department of Energy made important changes to the power purchase agreement, which took account of the unique ramp-up, peak and decline production profile of a landfill gas power project and did not limit output to its initial production at start-up.

ELEMENTS FOR TRANSFERABILITY

The City of Johannesburg has identified key elements that guaranteed the success of the Landfill Gas to Energy project and the main lessons learned from this experience. They are as follows:

- **Choose the right service provider and build a strong partnership.** The private partner, which will bring expertise and funding to the project, must be chosen based on past experiences and track records.
- **Be sure to comply with national and provincial legislative framework and be able to adapt to modifications.** The municipality must have a clear understanding of how existing legislation will affect the project's timelines, outcomes, costs and results. In addition, the municipality must anticipate regulatory and legislative changes. While this is a difficult call, it is important to anticipate that there will be some changes in regulations and legislation when a project extends over a period longer than five years. In addition, carbon credits mechanisms and other measures may change, which can have significant impacts on the project. It might be of value to assign one member of the team to follow regulatory and legislative changes.
- **Build a strong governance model and tight management process with multidisciplinary and multi-stakeholders teams with clear mandates.** Be sure to work with all the departments of the city. Good coordination is required between departments such as waste and electricity for the execution of this project. The project's steering committee and technical teams, especially during the earlier stages, were crucial in launching the project. Having members across various City departments provided critical input and resulted in time-saving.
- **Ensure a regular and transparent dialogue between all stakeholders.** In the specific case of the LFG to energy project of Joburg, which involved many actors with different interests, intense negotiations, dialogue and transparency regarding the selling price of the energy was key to ensure the success of the project. One of the key learning of the project is that it is necessary to consult different concerned departments within the Municipality to ensure the quality of the project. For ex. in this case, City Power, had not been contacted prior to setting the tariffs. When EnerG Systems initially put in its bid for electricity, one of the stumbling blocks was their initial price of 60 cents per kWh, which was well above City Power's charge of 38 cents per kWh. According to Simphiwe Mbuli, "City Power said legislatively they could not transfer a higher amount to their customers," so the negotiations continued. However, with the REBID program coming online at a prescribed 90 cents per kWh, the revenue streams are looking far more positive. With the advent of Load Shedding, City Power had to look at this offer with more interest. When sales of electricity into the electrical grid are part of the income stream, early dialogue for the execution of this needs to be an important step in the work-stream to determine viability. The team got lucky with the REBID processes, in that the tariffs were raised in excess of the expected pricing, but this might not always be the case. In addition, with the annual energy pricing increases in Johannesburg, in the next few years traditional tariffs may have caught up with renewable energy tariffs. It would assist the process to apply the best science and information against future expected tariffs, even if there is a cost associated upfront to access the studies.
- **Develop strong skills for project management.** The landfill gas to energy project involves a high level of complexity, which is why the municipality must be sure to acquire the necessary capacities, in particular in legal and financial terms. To do so, the City of

Johannesburg hired a private consultancy and worked closely with the National Treasury. Another important source of capacity building is the service provider involved in the partnership that must guarantee the skills transfer as per contracts. Make sure there is a strong localization of the project and skills transfer through mentorship, on-the-job-training and formal classroom training.

- **Have a strong contract with adequate timelines.** When the timelines were drawn out by the banking approvals, the service provider was held to default dates that were built into the contract. It was felt that a strong contract, even if it took a year to negotiate, was crucial in ensuring that the project stayed on track.
- **Build strong partnerships with a variety of actors.** To implement the landfill gas-to-energy project, the City of Joburg collaborated with a variety of local, national and international actors (National Treasury, consulting firms, etc.). One specific actor that brought an important contribution to the project and particularly in the monitoring activities was the Geography, Archaeology and Environmental Sciences department of the local University of Witwatersrand.
- **Ensure that the project has local impact.** Big infrastructure projects managed through a PPP must ensure that the service provider will contribute to local development. This usually means that the project benefits surrounding communities and works closely with local actors such as small and medium enterprises and civil society organizations. The City of Joburg obliged EnerG Systems to provide employment opportunities for local people to construct, operate and maintain the system.
- **Anticipate and carefully plan beforehand: ex-ante evaluations and feasibility studies:** build timelines and budgets to anticipate agreements and tenders. Project Managers in Johannesburg had to deal with the then-mayor of the City, Amos Masondo, calling the LFG program a “mystery project”, as it was initially introduced in 2007 and took another five years to implement. When a municipality is drafting a contract for a long-term PPP of a big infrastructure project, such as the landfill gas-to-energy project, it must carefully plan beforehand and build timelines that provide both a best-case and worst-case scenario, and anticipate the financial implications of both scenarios. In fact, when it comes to such a time-consuming and expensive project, it is fundamental to manage expectations by anticipating unexpected changes, as every delay might bring extra costs. For the landfill gas-to-energy project of Joburg operating costs are estimated at 10% of capital cost per year and security alone is 3% of the contract value, and these need to feature in future budgets and financial projections for the project. Even though the PPP was designed in order for the project to reduce costs for the municipality, the City had to invest more than R200-million (USD15 million). This includes the price of the consultants and experts that assisted with the agreements and legal requirements and that are often not taken into consideration in project budgets (in this specific case, the cost of the consultants were not foreseen in the initial budget of the project). Moreover, the delays in themselves are not free: time and energy that could otherwise be spent on other revenue-generating projects are opportunity costs for the City as a whole. In the same way, the legal processes should be best exploited for efficiency in order to reduce impact on the project timelines.
- **Make sure that the LFG to energy project is part of integrated waste and energy management policies.** In Joburg, other programs complete the LFG project. Pikitup lead an integrated waste management operation that helps reduce the waste going to the landfill sites saving space and limiting methane generation. It includes: a waste separation at source project (in 2012 it represented 15.000 tons of recyclable waste diverted from the

landfill sites and managed by cooperatives and SMEs); and the creation of garden dumping sites for the disposal of light garden waste. On the energy side, in order to face the city's issue of little production and strong consumption, City Power has launched a load shedding mitigation initiative in April 2015. Through this project, the municipality will install 65.000 smart meters throughout the city that will allow identifying households exceeding energy consumption, and will be able to contact residents through sms to advertise on the necessity of switching off appliances.

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“The landfill gas project relates to new, innovative technologies which allow us the ability to develop green projects out of what is generally considered waste/nuisance: landfills, and new income streams through the sale of carbon credits, and generating new energy and selling that electricity through the grid.”

Neville Smith, Disposal Executive, Pikitup Johannesburg

