CREDITS WHERE THEY'RE DUE

CLEAN DEVELOPMENT MECHANISM (CDM) ENERGY FROM WASTE: AN OVERVIEW OF AFRICA'S FIRST LANDFILL GAS TO ENERGY CDM PROJECTS

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OVERVIEW

"Build it, they will come"
Field of Dreams (1989)

The City of Durban (the eThekwini Municipality) spearheaded 'energy from waste' technology and the Clean Development Mechanism (CDM) market from as early as 2002 with the development of large landfill gas to electricity projects - in particular the landfill gas projects of the Mariannhill and Bisasar Road Landfills. Following protracted environmental authorisation processes where both landfill gas-fired internal combustion engine technology and the CDM concept were challenged, these projects were both CDM-registered and operationally commissioned in December 2006 and March 2009 respectively. ONLY ONE other landfill gas to energy project has since been commissioned (as well as CDM registered), this being the Alton Landfill Gas-to-Electricity project by ENER-G Systems. Whilst there are 3 other CDM registered landfill gas projects in SA, only two are operational and none produce energy. The Central Energy Fund (CEF) of South Africa has no fewer than 18 proposed landfill gas projects having submitted Project Idea Notes (PIN's) to the Designated National Authority (DNA), but none, in our opinion, are set to materialise.

The South African Clean Development Mechanism (CDM) market is growing at a fairly slow pace with some 140 projects now submitted to the country's Designated National Authority (DNA) yet only 17 projects (as at September 2010) are registered as CDM projects by the CDM Executive Board (EB) of the United Nations Framework Convention on Climate Change (UNFCCC). South Africa may be described as a *late-comer* to the CDM (Engineering News, 3 August 2007) but to the contrary, South Africa was one of the first entrants back in 2003. However, the CDM market has been significantly delayed by protracted environmental authorisation processes and detailed procurement legislation – in particular by the Municipal Finance Management Act 56 of 2003 (the MFMA, 2003). Indeed, the latter is a chief reason for the scarcity of Municipal CDM projects throughout the country. The Durban landfill gas CDM projects were on the very first list of what were 14 projects proposed to the UNFCCC in 2003 applying for methodology approval - in the pre–ACM0001 methodology days! In fact, the Landfill Gas CDM methodology of the UNFCCC was "Out of Africa" and is *Proudly South African*, however, owed to the mentioned protracted EIA processes, South Africa literally dropped off the CDM map until 2005. The first registered CDM project in South Africa was that of Kuyasa, a low income housing scheme which was registered in August 2005. The 2012 CDM-window-of-opportunity has rapidly closed and South African CDM's are beginning to miss the opportunity to offer energy-from-waste projects as environmentally responsible waste management action – as well as valuable action towards combating climate change and generating renewable energy. Moreover, the economically challenged waste management industry has certainly much to gain from CDM.

THE CDM PROTOTYPE – THE DURBAN LANDFILL GAS TO ELECTRICITY PROJECTS

The World Bank's Prototype Carbon Fund (PCF) is most appropriately the funding mechanism for South Africa's prototype CDM project i.e. The eThekwini Municipality's Mariannhill Landfill Gas to Electricity CDM Project. This project was conceptualised in early 2002 and was rapidly brought into a position of pre-CDM registration following completion of a baseline methodology, project design document (PDD), project monitoring plan and receipt of conditional host country approval. In fact, a *proudly South African* result was the development of the ***Approved baseline methodology AM0010*** that can be viewed on the UNFCCC's (United Nations Framework Convention on Climate Change's) website (UNFCCC; 2005), entitled: *"Landfill gas capture and electricity generation projects where landfill gas capture is not mandated by law;* ***Source: This methodology is based on the Durban Landfill Gas to Electricity Project in South Africa …"***

The Durban landfill gas to electricity CDM projects have an ultimate combined design capacity of 10MW of *green power*. The Bisasar Road Landfill will generate 6~8MW of sustained power for some 10 to 12 years whilst the Mariannhill landfill could ultimately offer up to some 2MW of renewable energy power. The Durban project adopts proven technology of feeding the landfill gas into purpose-built spark-ignition engines each with a 500 KW to 1MW electricity generation capacity. The electricity is fed directly into Durban's grid. Colloquially speaking, the eThekwini Municipality has not "reinvented the wheel" with their implementation of the current best environmental and economic

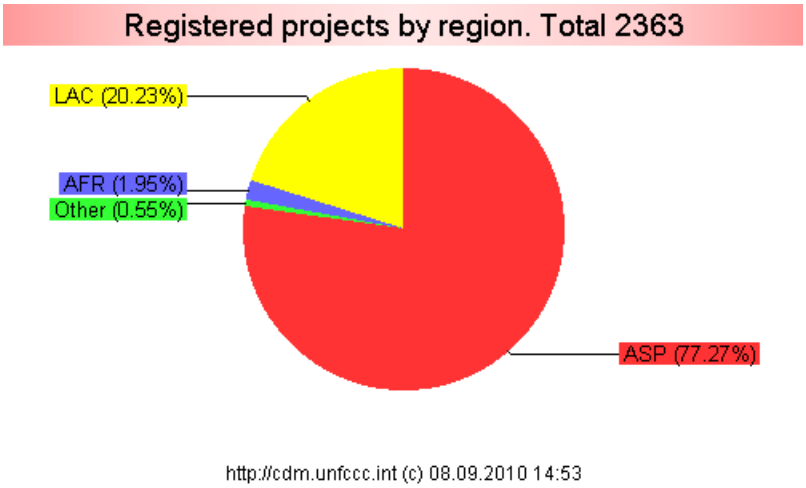
practice of treating landfill gas, ensuring that modern *tried-and-tested* technology was procured. The project procurement sought equipment that offered the most effective environmental as well as economical package to the life of the project deal of some 12 to 14 years. Landfill gas generators can vary greatly from brand to brand in terms of performance, durability and running costs. Moreover, the extent of emissions from the engines is crucial. The assessment research of Gillett, Gregory and Blowes (2002) reflects that certain generators may have high "gas-leaks" in their systems and offer unreliable regulation of exhaust emissions. It was essential that eThekwini procured the right equipment for the green power job! Also, flares were specified as closed high temperature type flares. Currently, overall power generation capacity of the project is at 7,5MW (1MW at Mariannhill and 6,5MW at Bisasar Road) and offers SA a leading example of an operational project of its type.

Figure 1: The Mariannhill 1MW (left) and Bisasar Road 6,5MW (right) landfill gas to electricity CDM projects which were CDM-registered and commissioned in 2006 and 2009 respectively.

GROWING CDM PROJECTS

"The coming into force of the Kyoto Protocol is a major stride forwards in the fight against global climate change and global warming", said Mr Marthinus van Schalkwyk, the Minister of Environmental Affrairs and Tourism (Press, Feb 2005). This may indeed be true, but the strides being taken to realise emission reductions soon, through Kyoto's flexible mechanism of the CDM are being taken by other countries and not necessarily by South Africa nor any other African Country. However, a future prospective was elucidated at the COP 12 and COP/MOP 2 (Conference/Meeting of Parties) in Kenya. Attending country representative ministers highlighted their awareness of the potentially devastating impacts of climate change on livelihoods in Africa, the continent's adaptation challenges, and the lack of capacity to share in CDM projects. Ministers looked forward to active participation during the African COP that was held in Nairobi in November 2006. Whilst there was a surge of 'project developers' entering into Africa from 2006/7 seeking viable CDM projects, the 2008 *credit crunch*, unfortunately, put pay to very few projects materialising. In a reviving economy it is apparent that from 2010 a CDM revival will hopefully occur and project development funding will be realised for Africa.

To date (as at September 2010) of the 2363 registered CDM projects internationally, there is only 46 registered CDM projects from the African continent and 17 in South Africa. Of all registered CDM projects internationally, 476 (some 20%) are of the 'Waste Handling and Disposal' sector. Figure 2 below shows the project distribution illustrating the low volume of projects in Africa. To offer project development comparisons, in 2005 Malaysia had no registered CDM projects and were seeking advice from South Africa. Today, Malaysia has 81 CDM projects with an annual Certified Emission Reductions generation of some 5,1 million CER's compared to South Africa's 2,96 million CER's per annum.



[RE1]

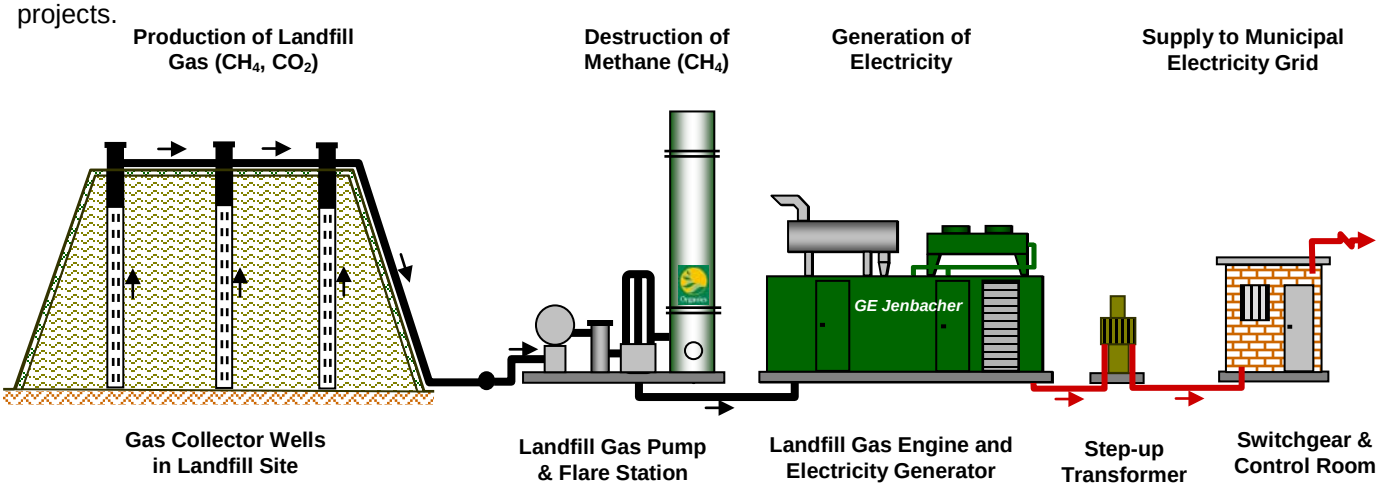
Region	Number of registered CDM projects
NAI-Africa (AFR)	46
NAI-Asia and the Pacific (ASP)	1826
NAI-Eastern Europe (Other)	13
NAI-Latin America and the Caribbean (LAC)	478

Figure 2: Project Type Share of Registered CDM Projects Worldwide (as at September 2010)

THE ESTABLISHED SCIENCE OF LANDFILL GAS TO ENERGY

Landfill gas extraction engineering isn't an exact science and *'suck-it-and-see'* methods are widely applied exposing risks to a landfill-gas-to-energy type CDM project. The science of landfill gas and its recovery from landfill sites is widely known and established internationally. The Sardinia Landfill Symposia since 1987, for example, have documented much work (Cristensen, Cossu and Stegman; Biogas, 1996) on the subject through to present day. The mass transfer process of waste in landfills, which undergoes biological, chemical and physical transformation, gives rise to the formation of landfill gas. The presence, formation and composition of landfill gas have been the subject of widespread detailed study in the last four decades. Early literature on landfill gas was derived arguably from the milestone works of Farquhar and Rovers (1973), Ham and Bookter (1982) and Stegmann (1982). Ham and Bookter (1982) studied landfill gas back in 1966, by initiating a project to study landfill gas and liquid emissions from landfill test cells over a monitoring period of 6~7 years. It is by now widely known that the main components of landfill gas are methane (CH_4) and carbon dioxide (CO_2). Further to this, it is widely accepted that the high concentration of methane occurring in landfill gas, typically up to 60% by volume (Christensen et al, 1996), presents an explosion risk yet a viable source of power.

Landfill gas control started in the USA in the late 1960's and early 1970's, where large landfills had been developed (Christensen, Cossu and Stegmann, 1996). The first plant to extract and utilise landfill gas was commissioned in Europe in Germany in the mid 1970's, incorporating a great deal of experience gained in the USA. The first utilisation of landfill gas in South Africa was arguably the Robinson Deep landfill gas scheme in the 1980's where a goldmine gold ore extraction process utilised the landfill gas. The next landfill gas extraction projects in South Africa were then spear-headed in the early 1990's by DSW (Durban Solid Waste, City of Durban – now the Department of Cleansing and Solid Waste of the eThekwini Municipality) and have been sustained till present day. Methane presents a carbon gas emission that is twenty-one times more potent than carbon dioxide in terms of its global warming potential as a recognised greenhouse gas (GHG) (UNFCCC; 2005). This factor of 21 (to be amended to 23) is often referred to as the financial "Methane Kick" of a Landfill Gas based project as it is multiplied by the tons of methane emissions to provide equivalent carbon dioxide emissions (CO_2eq). This project "kick" provides CDM project viability with landfill sites and is a prime reason why landfill gas utilisation projects have been referred to as the "Low Hanging Fruit" CDM projects.



Schematic Layout of Landfill Gas-to-Electricity Project
(Source: Strachan, S.Jewaskiewitz et al, Resource; Feb 2007)

CONCLUSIONS

Climate change is real and is caused by the increase in the atmospheric concentration of *so-called* greenhouse gases (GHG's). The human contribution to climate change or *anthropogenic climate change* by the disposal of wastes in landfill sites is significant, for example in the case of Durban (South Africa), some 25% of the City's greenhouse gas emissions may be attributed to landfill sites. However, the high methane volume component of landfill gas offers a current resource of *green power* to South Africa. It is planned that the country's renewable energy target will be supplemented by some 6% of landfill gas. Typically, the utilization of landfill gas is not economically viable as the cost of electrical power is still comparatively 'cheap' (albeit that the authors avoid the argument of "how cheap" is the "environmental cost"). The injection of the carbon finance, derived from a CDM project undertaking, is required to allow landfill gas utilization projects in South Africa to be viable. However, it is essential to realize, particularly by the general public, that CDM landfill gas CDM projects where energy recovery is demanded, is not highly profitable.

The South African presidency ratified the Kyoto Protocol that was adopted on 11th December 1997 and was subsequently established as a legitimate host country for the commissioning of CDM projects with the launching of SA's Designated National Authority (DNA) on 1st December 2004. Russia's signing of the Protocol on 16th February 2005 finally brought the commitments of the signing parties of Kyoto into full effect. The lack of CDM projects in South Africa and on the African continent under the UNFCCC's "Waste Handling and Disposal" portfolio is alarming and certainly the waste management industry should make better effect of the opportunities presented by the development of CDM projects.

The Municipal Finance Management Act (MFMA No. 56, 2003) and its associated Supply Change Management Policy that is adopted by a municipality, presents significantly tight legal constraints on the development of CDM projects and in particular the sale of carbon credits. Whilst the local government sector holds arguably the highest potential for leading the way with the development of CDM projects, the authors of this paper believe that public awareness on renewable energy, climate change combating and CDM projects should not be left solely to the project proponent. It would be advantageous to the development of CDM projects for there to be an increase in demand pressure from a National level where renewable energy and alternative energy (alternative to coal fired energy) initiatives are strongly supported. Undoubtedly, the authors also feel, that the developmental success of any CDM project is largely attributed to the passion and drive of the allocated project management – or colloquially termed the "project champion".

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