

Australia Indonesia Kemitraan Project for Local Government Energy Efficiency



REEEP
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1.0 BACKGROUND ON KEMITRAAN PROJECT

The Kemitraan Australia/Indonesia - Sustainable Cities Program is a partnership between ICLEI and REEEP. The project executed in 2007/2008 sought to increase investment in greenhouse gas abatement to improve social and economic conditions, through effective partnerships combining the relationships built through ICLEI's Cities for Climate Protection Program with REEEP's experience in structuring financing for such initiatives.

The project was established on the premise that the ICLEI Cities for Climate Protection Program (CCP) that ran from 2000 to 2005 had built a strong network of contacts amongst ten cities within Indonesia with whom this programme had focused on climate change issues and how they could be addressed by local governments. Though this programme had clearly been effective, particularly in engaging cities in programmes to improve the efficiency of their street lighting operations, the network had been weakened after the termination of the CCP activities. In many cases those who had been involved in the earlier programme were no longer engaged in such work. This weakness became apparent when efforts were made to gather data to update the status of the projects initiated under the CCP programme.

Despite the loss of momentum after the formal CCP programme ended, efforts under this project demonstrated that there is a high level of interest in climate protection amongst Indonesia cities, as evidenced by their participation in workshops and the attempts to provide reliable data on the initiatives that are underway. It should be acknowledged that despite strong local and central government concern over such issues they are not always seen as key priorities given the pressure on the limited budgets that local government has to address the many issues facing rapidly expanding cities with limited infrastructure across all sectors.

What the current work did identify was that there are a number of areas where such a project could contribute support. These included:

- The expansion of programmes to expand / improve efficient street lighting
- The collection, handling and disposal of municipal waste and potential energy generation
- The identification of additional financial resources to fund these essential infrastructures
- Engagement of the private sector in the development and/or delivery of municipal infrastructure

This report updates the findings of the 2008 project and examines the opportunities in these areas for the Indonesian local government authorities from both technical and financial



perspectives. It is hoped that it will provide support to the local governments as they look to progress their efforts on climate change mitigation. It is also seen as a background document for the anticipated visit by Local Government officials to Australia in late 2009 and includes information on Australian companies that have the capacity to assist in implementing some of the opportunities identified.

As noted, two key project opportunities, street lighting and waste management, were identified in the Kemitraan report as suitable for further investigation. Besides providing a background to the current technical status of these two opportunities, the report made suggestions for possible commercial approaches to the projects and how the projects can be financed and these are addressed in the following notes.



2.0 STREET LIGHTING

2.1 Background

Public lighting of roads is a major source of greenhouse gas emissions for local government in many countries. There are many opportunities to improve the quality of the lighting while reducing both the costs and greenhouse emissions.

Public lighting provides an important service, supplying vehicle drivers and pedestrians with sufficient light to be able to identify hazards and move around safely at night. It also provides a number of other benefits such as amenity and aesthetic rendering of streetscapes. The issue of safety often makes public lighting an issue of great interest to local residents and businesses.

As an example, the annual cost of public lighting in Australia is about AU\$210 million, of which public lighting on minor roads makes up AU\$100 million. Public lighting of minor roads uses 486 Gigawatt-hours (GWh) of electricity and is responsible for 537,000 tonnes of CO₂ emissions. The 1.36 million public lights on minor roads in Australia annually use about the same amount of energy as 80,000 Australian homes. Local governments, which are being encouraged by the Australian and State Governments to reduce their greenhouse gas emissions, are paying particular attention to public lighting because it is the single largest source, typically accounting for 30 to 50 percent of their greenhouse gas emissions.¹

Local governments in Australia provide public lighting to meet the needs of their ratepayers and visitors, but the lighting itself is installed and maintained by electricity distribution businesses. Councils are customers of the distribution businesses, paying for the cost of the lighting equipment and for the energy consumed by lighting. Although the distribution businesses have traditionally taken most of the decisions about public lighting, local governments must ensure that the lighting is responsive to ratepayers' requirements for pedestrian and vehicle safety, amenity, and other services associated with public lighting. A primary interest of distribution businesses in the area of minor road lighting is to minimise their risk through use of proven technology and to minimise their maintenance requirements through use of reliable equipment. Reducing the energy consumed by public lighting is generally not a major driver for them.



¹ *Lighting the Way - A Local Government Guide to Energy Efficient Public Lighting on Minor Roads*. Australian Greenhouse Office in the Department of the Environment and Water Resources. February 2007

Councils can choose to own and maintain streetlights in their area, but no council in Australia is currently doing so. The main impediments, other than initial cost of installing or buying the infrastructure, are the need for specialised knowledge and skills and the potential burden of on-going maintenance.

On the technical side, there are a variety of system management techniques and increased efficiency equipment / lighting that can be employed.

The following table summarises the comparison between the reference 80 watt mercury vapour lamp and alternatives considered in the Australian market:

| Lamp type | 80 Watt Mercury Vapour (base lamp) | 42 Watt Amalgam Compact Fluorescent | 50 Watt High Pressure Sodium "Twin Arc" | T5 Triphosphor Fluorescent 14W |
|---|--|---|---|--|
| Power consumption, Watts | 80 | 42 | 55 | 14 each, mounted 2 together (total 28W) |
| Power consumption, Watts (inc ballast & control gear) | 96 | 46 | 65 | 30 |
| Light output when new, lumens | 3,800 | 3,200 | 3,600 | 1,350, total with two = 2,700 |
| Lumen depreciation, end of life, percent | 35% | 15% | 20% | 15% |
| Light output at end of life, lumens | 2,500 | 2,700 | 2,900 | 2,300 |
| Colour rendition index | 85 | 85 | 65 | 85 |
| Published life, hours (50% failure rate) | 20,000 | 10,000 | 40,000 | 20,000* |
| Notes on temperature performance | MV lamps perform well in all temperature conditions experienced in Victoria. | Amalgam CFL lamps perform well in all temperature conditions experienced in Victoria. | HPS lamps perform well in all temperature conditions experienced in Victoria. | Previously held that light output decreases with cold temperatures – a 20% decrease @ 0°C. Confirmation of new amalgam lamp allows good performance in all temperature conditions experienced in Victoria. |

2.2 Indonesian Background

Significant work was undertaken on street lighting opportunities during the 2000 to 2005 CCP Indonesia program. As part of the corporate emissions inventory compilation undertaken by cities involved in the program at that time, cities quantified the electricity consumption and consequent emissions arising from the provision of street lighting services to their communities. Several opportunities to improve the efficiency of existing and new street lighting were identified at that time, but during this project it proved difficult for cities to provide updated information on the status of those projects. However the information that has been gathered for the cities of Depok, Semarang, Yogyakarta and Denpasar indicates that there is still a opportunity for further improvements in street lighting energy



management but that there are challenges to be addressed before these projects can progress.

The opportunities in these cities fall into three areas:

- Improving the efficiency of existing street lighting;
- Ensuring that new street lighting is provided using efficient technologies;
- Ensuring that current energy supply deficits are met using low emission technologies.

The information that has been made available by the cities indicates that there is sufficient opportunity to warrant further investigation into projects in these cities. The feasibility of bundling street lighting energy efficiency projects for the purpose of attracting external investment should also be assessed.

Several cities that were represented at the Bogor workshop in July 2007 noted that the local electricity demand currently exceeds supply to a significant degree. This situation impacts on the communities' quality of life within the home and the ability of local authorities to provide adequate street lighting. It is important that efforts are made to ensure that future emissions arising from increased energy utilisation are kept to a minimum by ensuring that additional generation capacity is based on low-emission or renewable energy. While this is difficult to influence where supply is through the national grid, decentralised generation using renewable resources is something that local government could encourage. The monopoly position that PLN² holds as the sole generating authority complicates these opportunities and does not always provide a commercially attractive return to independent generators. However, there are growing opportunities for the returns from investment in additional generation capacity to be enhanced through accreditation under the Clean Development Mechanisms (CDM) process.

Specific Opportunities

As suggested above, a number of the cities involved in the earlier Sustainable Cities Project identified the poor technology currently used for street lighting as a major cause of inefficient energy use. The energy required for street lighting is also becoming increasingly expensive and placing strain on electricity generation infrastructure. Plans to extend street lighting, to improve safety on roads that are currently poorly lit, have been deferred due to the cost of the lighting itself and limited access to sufficient distribution capacity in outlying areas. While increased efficiency in the delivery of lighting will reduce the rate of growth in energy demand for these services, it is inevitable that the demand will continue to grow. A programme that maximises the efficiency of current installations and sets standards that

² See further under 2.6.3



ensure only the most energy efficient systems are installed as street lighting is developed in future is obviously the preferred situation.

When asked to consider what they saw as the projects with the most potential as part of the Kemitraan Australia/Indonesia – Sustainable Cities Project, the cities of Yogyakarta, Semarang and Depok and Denpasar all nominated street lighting projects as a priority.

Street lighting efficiency projects have previously commenced in most of these cities but have stalled due to a lack of finance. The projects that have been implemented in each city, using the city budget, have often not been completed due to the focus for spending moving to other priorities that are seen to deliver more immediate benefits.

The entire street lighting connected load in Indonesia is approximately 400 MW. It is estimated that there is potential for savings of 80 -160 MW, the amount that coincides with the increase in electricity demand during peak load. Data collection on street lighting's electricity consumption and subsequent emission was being done during the 2000 to 2005 Climate Change Program.

1. **Yogyakarta** – In 2001, Yogyakarta started a program to replace mercury vapour lighting and install metering so that the local communities benefiting from the street lighting contributed financially to the project. Between 2001 and 2006, approximately 7,625 main road lights were retrofitted but a further 5,000 still require work. Total cost to 2006 amounted to IDR26 billion (AU\$2.9 million). Remaining budget to complete all street lighting in the city is approximately IDR17billion (AU\$1.9 million).
2. **Denpasar** – In 2002 Denpasar commenced a street lighting program supported by the Bali Urban Infrastructure Project (BUIP). Based on the planning prepared by BUIP, Denpasar requires 20,000 street lights but currently has approximately 17,000. In order to achieve the planning targets, the city currently builds an additional 200 street lights each year which it funds with approximately IDR8 billion from the annual city budget. Access to approximately IDR120 billion of suitable finance could enable the city to implement the project rapidly and derive immediate road safety benefits.
3. **Semarang** – Also in 2002 Semarang started a program to install meters, improve the efficiency of existing street lighting and install additional lighting. The budget information provided by the city indicates that approximately IDR23.6 billion (\$A2.7million) was spent between 2002 and 2004 on the retrofit of 2,830 street lights, new lights and an extensive metering program to reduce the number of illegal connections. A lack of funding for further work has resulted in the city choosing to alternate areas of road lit at night, but the amount of funding required to complete the work was not made clear by the city.

4. **Depok** - During a July 2007 workshop held in Bogor as part of the Sustainable Cities Project, Depok also referred to a public roads street lighting replacement program, but were unable to provide any details or cost information. Depok was included primarily because it is in western Java, so there may be potential to include it in an aggregated project with nearby cities such as Jakarta or Bogor.

The similarity of the projects in Yogyakarta, Semarang, Depok and Denpasar suggests that there is scope for co-operation between the cities, leading to more effective implementation. The potential benefits of co-operation fall into three areas:

- **Skill sharing.** The initial project planning phase, including the assessment of technology options, can be very time consuming. Cities working together, or one city learning from a more experienced city, could lead to an expedited planning phase and so more rapid implementation.
- **Supplier base.** The size of any one city project may not be sufficient to attract interest from large infrastructure companies, particularly those that are based offshore. Cities working co-operatively will result in larger orders for both the technology and the installation process. This is likely to drive down the cost on a unit basis and attract more experienced companies.
- **Finance.** Certain financing options are appropriate for large projects but not smaller projects. To date, these cities have funded street lighting projects from capital budgets which has constrained the pace at which retrofits can take place. Debt financing may be an option for larger scale projects within one city, but is unlikely to be feasible for a project being implemented in more than one jurisdiction. This raises the potential for the involvement of an intermediary with the capacity to arrange debt financing or a bond issue specifically for the aggregated project.

These benefits of aggregation may be most effectively accessed through the use of an Energy Services Company (ESCO). Although there is potential for an ESCO to implement a street lighting efficiency project in a single city, the economies of scale that come from combining common elements of the projects may make an aggregated project more attractive. The potential involvement of an ESCO in an Indonesian street lighting project is discussed below, with particular emphasis on the way in which an ESCO undertaking this work could be financed.

2.3 The ESCO as a Delivery Mechanism

Suitable mechanisms are needed to support local governments as they seek to implement projects to address their street lighting needs. Within the energy efficiency industry in Asia



the presence of ESCOs is gaining growing acceptance³. A number of commercial operations are already established within Indonesia focused predominantly on servicing the industrial sector.

Fundamentally ESCOs are commercial entities whose focus is on the delivery of improved energy efficiency solutions to a cross section of clients. Their emergence has to some extent been premised on their capacity to not only offer technical solutions but also to provide an associated source of financing. This has been necessary in many markets where companies are reluctant to fund the capital investments that energy efficiency improvements generally entail. The ESCO may also provide the services to assess current energy usage (an energy audit) which forms the basis from which improvements are planned and measured.

ESCOs may be an integral part of a business venture (a utility or local government agency for example) or privately owned. The ownership of the specialist ESCO in turn influences not only how it is funded but also how the energy efficiency improvements are financed.

Where the ESCO is effectively owned by the industry to which it is providing services, funding may be through the organisation's general capital budget. A local government could for example set up a division to act as an internal energy efficiency auditor and solutions provider. Financing would then be a matter of allocation from within the government's budget. An ESCO may also be engaged to provide energy services with full responsibility for development (or upgrading of existing systems) and its medium or long term operation.

If a private ESCO were to be engaged its role would typically be structured in one of two ways:

- Performance contracting, where energy savings are guaranteed by the ESCO and the ESCO is paid from a share in the cost savings that the improvements provide. In this case the ESCO arranges funding and carries all the risk (technical and financial). The client sees a cost reduction from energy savings, outlays no capital expenditure for improvements and in due course takes over ownership of the more efficient systems.
- Third party financing (a design and build approach), where the ESCO implements a pre-agreed programme of energy efficiency improvements but financing is arranged by the facility owner who has access to the full value of the energy savings to service the borrowings. In this case the owner is exposed to more risk but in turn is compensated by receiving a higher level of cost savings.

These ESCO approaches could be used (as appropriate) for the delivery of improved energy efficiency through local government operations although cities involved in the Sustainable

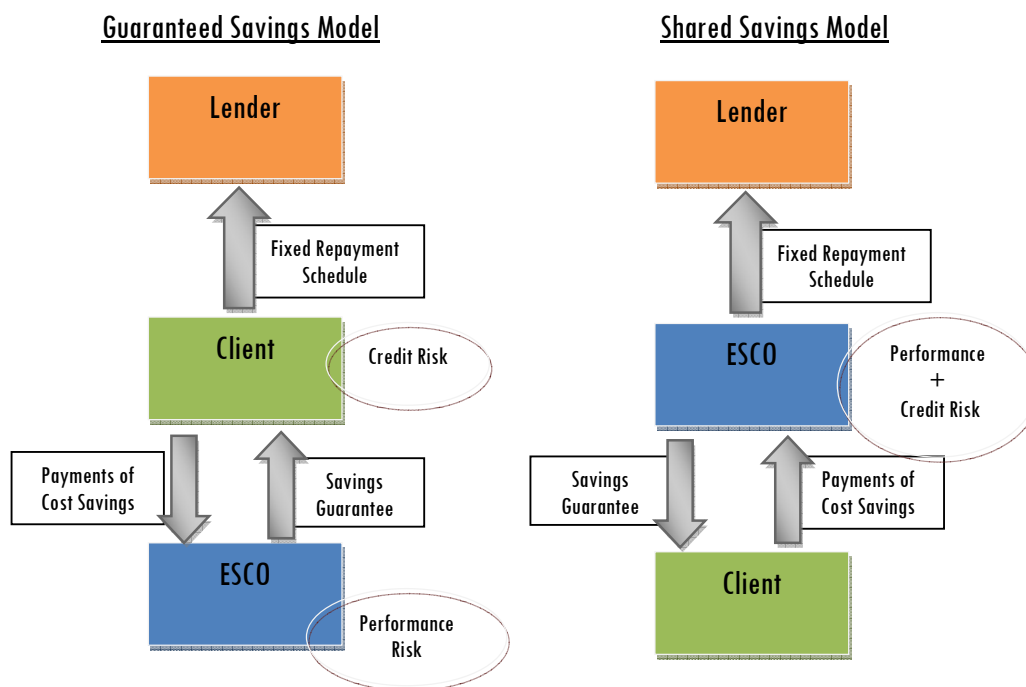
³ IMPROVING ENERGY EFFICIENCY IN INDUSTRY IN ASIA; A review of financial mechanisms as part of the Energy Efficiency Guide for Industry in Asia www.energyefficiencyasia.org United Nations Environment Programme Division of Technology, Industry and Economics June 2006

Cities Project did not discuss their potential use. Irrespective of the sourcing of financing, as discussed below a specialist ESCO can be engaged to undertake the work envisaged.

An energy audit usually marks the start of a project in the ESCO model. The current energy usage of the municipality (client) is first analysed and determined before establishing the improvements needed. A performance contract is then signed between the client and the ESCO, where the ESCO would guarantee a level of energy savings to the client. The ESCO would then receive a share of the actual cost savings as their payment.

The project would adopt either the shared-savings or guaranteed savings model as the basis for financing. Each savings model imposes a different set of risks on the ESCO and the client respectively. In reality, a more flexible model is used to ensure a more equitable spread of risk between the client and ESCO.

The diagram below demonstrates the two common forms of ESCO agreements:



2.4 Summary of India Energy Efficient Street Lamp Case Study ⁴

REEEP has been actively engaged in the Indian market and has directed its efforts across a range of projects with more recent activities including projects that cover:

⁴ Appendix B

- Financing for Bundled Small-scale Rural RE Ventures in India;
- Using Tamil Nadu Municipal EE Program to create and demonstrate a replicable financing model for the use of ESCOs;
- Removal of Financial and Institutional Barriers in Mainstreaming the Biomass Gasifier Systems for Thermal Applications in India; and
- Creating Scalable Financing Models for Sustainable Energy Services via Financial and Micro-finance Institutions.

Through its programme of project support, REEEP has assisted the promotion of the ESCO model in India, as noted above, and this has seen nearly US\$2 million invested in Energy Efficient (EE) street lighting projects in the second largest state in India, Madhya Pradesh. Econoler International, a Canadian ESCO, was involved in the implementation of the street lighting projects as part of a demand-side management (DSM) demonstration project to develop a commercially viable DSM concept that can be replicated across India.

2.5 Applying India's Experience

Since the successful completion of the first project in Madhya Pradesh, the use of the ESCO model has accelerated the implementation of EE street lighting across India. India's extensive experience in utilizing the ESCO model could provide insights and lessons into how the barriers faced by the Indonesian cities can be overcome.

2.5.1 Lack of Technical and O&M Expertise

When the Municipality of Semarang implemented their EE street lighting project, the municipality had to take responsibility for the entire implementation and had to deal with all the stakeholders involved. Dealing with the various stakeholders can be difficult for municipalities as they may lack resources and the technical know-how to implement successful projects.

Through the ESCO approach, municipalities in India avoided dealing with multiple stakeholders and contracted the entire implementation to a selected ESCO. The ESCO takes full responsibility for the analysis, design, installation, financing, verification, and training needed for the project. Leaving the implementation to an ESCO that has the required technical and O&M expertise reduces the risk of the project underperforming, allowing the municipalities to concentrate in their core activities.

Experience from India has also pointed out the importance of having a thorough and complete process to select a suitably qualified ESCO. This may present an initial challenge in Indonesia as experience of local companies in such activities is limited. The longer term benefits of establishing competent ESCOs is however of considerable value.



2.5.2 Challenges in Financing EE Street Lighting

As noted, implementation of EE street lighting in Indonesian cities has stalled due to the shifting of the city budget to other priorities that deliver more immediate benefits.

The use of the ESCO model has allowed the Indian Municipal Corporations to implement the EE street lighting projects at zero up-front cost through the shared-savings model. In exchange, the ESCO receives a larger share of the savings from the reduced electricity bill as payment during the contract period (typically 5 to 8 years).

This model would serve to remove the financial risks from the Indonesian cities, allowing them to commit their limited resources to projects that have a more immediate social impact.

It is also noted that some projects in India have arrangements that help ESCOs mitigate some of their credit risks. In a project by Elpro (ESCO) and Bangalore Development Authority (BDA), BDA made monthly payments to the ESCO through an ESCROW arrangement⁵ involving Karnataka State Financial Corporation (a statutory corporation). Having a mechanism to ensure that reduced energy costs are set aside to service the payment would help the ESCO to reduce the risk premium associated with their financing arrangement.

2.5.3 Involvement of PLN and the Government

In a World Bank report on Indonesia's demand side management program, it was pointed out that the DSM program in street lighting requires greater involvement from the Directorate General of Electricity and Energy Utilisation (DGEEU) and PLN⁶. Until now, PLN has only provided the installation of new meters. In contrast, the hugely successful Compact Fluorescent Lamps (CFL) replacement program in 2006/2007 has benefited from the strong involvement of these two agencies.

State Utilities and Governments stand to benefit from the decrease in non-profitable sales to street lighting and reduced subsidies. India's experience has highlighted that a successful project required the active involvement from the State Electricity Board (SEB) and the local government.

PLN local officials have expressed that the payment collection for street lighting has been a source of substantial loss. In several Indonesian cities, PLN would intentionally reduce power supply by turning on lights late and turning off lights early to reduce the amount of electricity that gets tapped off by unauthorised connections. The installation of a digital control system in the Bangalore project has allowed the accurate monitoring and control of the lightings from a central system. The system prevents sources of loss through energy

⁵ Payments are made into an independent third party account from which disbursements are made to individual parties on a pre-agreed basis.

⁶ World Bank (2006), Assistance to the Government of Indonesia's Demand-Side Management Program, Jan 2008, p. 25.

theft reporting and detection of faulty equipment. The potential of stemming the losses through such a system could provide PLN with the necessary incentives to play an active role in promoting EE street lighting projects across Indonesia.

2.5.4 Low Electricity Tariff

The electricity tariff in Indonesia is the lowest among ASEAN countries. As is often noted, a low electricity tariff reduces monetary incentives for electricity users to pursue energy efficiency improvements, including the development of EE street lighting projects. In India, the average electricity tariff for public lighting is at 4.4INR/kWh (US\$0.093/kWh). In contrast, the average rate charged by PLN is 34% lower (at US\$0.060/kWh). This significantly reduces the amount of cost savings; increasing the payback period for the ESCOs. The lower savings achievable and the longer payback period may reduce the attractiveness of the project and the ESCOs and municipalities would also have to mitigate the higher risk that arises from a longer contract.

Under the Clean Development Mechanism, Certified Emission Reduction (CERs) can be issued to a project that reduces greenhouse gas emissions in Indonesia. EE street lighting projects in Indonesia may aggregate together to increase their rate of return through the sale of such CERs. In India, Econoler International is in the process of bundling street lighting projects from 8 cities for CDM registration, and selling it to a multilateral financing institution. Aggregation of the Indonesian cities will be further discussed in section 3.4.

2.6 Characteristics of Financing EE Street Lighting Projects

The success of financing through the ESCO model is heavily dependent on the fair and equitable distribution of risks between the ESCO and the client. Projects would need proof of cash flow certainty to help them obtain financing at a cost that can keep the project commercially viable. This is especially important in markets like Indonesia, where the ESCOs are still relatively young and do not have a strong balance sheet to borrow against.

There are a number of financing mechanisms that can be used to ensure greater certainty in the cash flows, and help ESCOs or the local governments obtain financing at a viable rate:

1. **Guarantees for ESCO** – Local government with a stronger balance sheet may provide letter of guarantees to a financial institution on the loan that they are taking to help them reduce the associated credit risk.
2. **ESCROW accounts** – The cost savings payments can be made to an ESCROW account where the lender can have access to the payments to reduce the default risk associated with the ESCOs.
3. **Arrangement for payments to be made through utility bills (PLN)** – Arrangements can be made with PLN to collect payments through the monthly utility bills to the local government. This reduces the default risks as defaulting would result in the cutting of power supply to the entire street lighting network.

2.7 Summary on the Use of an ESCO Approach for Street Lighting

This report has highlighted the learning points available from the development of EE street lighting in India. There are noted differences between the street lighting situation in India and Indonesia so it is acknowledged that the precise implementation of the street lighting project in each city needs to be developed in consultation with the cities and the stakeholders involved.

In light of the valuable lessons highlighted and status of local ESCOs in Indonesia, it is recommended that:

1. An awareness and capacity building program be developed in conjunction with municipalities, PLN and an experienced off-shore ESCO. The program will target interested financial institutions, local ESCOs and other interested parties to build up market activities.
2. A city be selected to participate in a demonstration project to help develop financing, and an implementation mechanism that is oriented to the Indonesian market for replication across other cities.
3. Local government must be willing to share the risks with ESCOs to improve the rate at which affordable financing can be obtained.
4. As the revenue savings comes from measured energy savings, a robust and transparent monitoring and verification plan must be in place to win the trust of all stakeholders. Monitoring and verification protocols should be independently audited to ensure this.

2.8 Other Financing Options

If the ESCO approach outlined above is not adopted, there are a variety of options available to finance projects in cities, but the nature of energy efficiency projects can make some of them problematic. Two particular features of energy efficiency projects cause difficulties when a traditional finance option is used:

- High initial capital cost;
- A return expressed in terms of reduced expenses.

The features need to be considered when assessing which of the following options is suitable.

2.8.1 Direct Financing for City Projects

The financing option chosen by Yogyakarta and Semarang for street lighting efficiency upgrades was to fund the projects from the capital works budget of the city. Denpasar is also intending to complete the project in their city using their own funds.

Direct financing by cities presents challenges. Many energy efficiency projects, including street lighting retrofits, require a significant outlay which diverts funding from other priorities. In a developing country such as Indonesia there are many other potential uses for funds that will have a more immediate impact on the social well-being of the community.

The return on an energy efficiency project is a reduction in expenses rather than monetary income. Cities typically have a certain proportion of the annual budget allocated for capital works and another proportion for recurrent expenses, such as energy costs. Frequently these two budgets will be under the control of different departments in the local government. The result of this is that an energy efficiency project is paid for by one departmental budget but it benefits the budget of another department. It is not common practice, in Australian local governments at least, for the reduced energy expense to be returned to the capital budget although there are instances of revolving energy funds being established for that purpose.

One benefit of a city choosing to finance energy efficiency projects from the capital works budget is that ownership of any consequent emission reduction is clear. As a non-Annex 1 country, Indonesia can access the Clean Development Mechanism and potentially sell any Certified Emission Reductions (CERs) that may be granted to such projects.

While CERs may contribute to an increased rate of return from a project, the amount of the additional revenue stream can be uncertain, if the CERs are sold on the secondary market, due to price fluctuations. A more certain income stream is available by selling the reductions to a third party in the early stages of project development, but this will undoubtedly be at a discount to the open market price.

2.8.2 Direct Financing for Aggregated Projects

It is unlikely that a city would be willing, or even have the legal capacity, to use its capital works budget to contribute to a project being implemented in multiple cities. Other financing options are more suitable for aggregated projects.

2.8.3 Debt Financing for City Projects

A city seeking debt financing for an energy efficiency project will need to demonstrate that the risk of the investment has been minimised and that the projected return from the project is sufficient to service interest payments plus the repayment of the principal amount. This can be challenging given that the return from the project is in the form of reduced expenses, if there is no mechanism established by the city to ensure that the reduced energy costs are set aside to service the debt.

The majority of banks will view a potential investment from a purely commercial perspective and so analyse the risk in terms of:



- Political elements – whether the city has a history of default due to a change in government;
- Technology – whether the proposed project will use well established infrastructure, potentially leading to more innovative projects being avoided;
- Project management – whether the city itself and the companies involved in delivering the project have a good record of completing similar projects.

An analysis of the project using these elements will determine the risk premium charged for a loan, which reflects the financial institution's required return in excess of the rate available for an essentially risk free investment in government bonds. A city is likely to seek non-recourse financing⁷ for an energy efficiency project to avoid any claim on city assets other than the project itself, which further increases the risk to the financial institution. If a commercial loan was available for such a project, it would be likely to attract such a high interest rate that project would not be economic.

There are, however, sources of non-commercial debt that could be available to a city government. Multilateral development banks, such as the Asian Development Bank, and The Global Environment Facility, through the World Bank, have made funds available for energy efficiency projects in a number of countries. Access to these funds is however through a loan programme between central government and the banks and generally is distributed via a domestic banking facility. The on lending of these funds provides an avenue that may not be immediately available through existing banking arrangements. It is however important to recognise that establishing such a facility with multilateral (or bilateral) support requires the Indonesian government's support and as such they must consider it a priority for borrowing over and above other projects. It would also be unlikely to be considered unless it was of significant scale. This could of course encourage initiatives to aggregate the opportunities for energy efficiency at a local government level.

A further option for funding projects in Indonesia is the Islamic Development Bank. It was established to foster the economic development and social progress of member countries and Muslim communities individually as well as jointly in accordance with the principles of Shari'ah, i.e. Islamic Law. Indonesia is a member country and the regional office in the Malaysian capital Kuala Lumpur serves Indonesia. The Bank is understood to have financed several projects in the electricity generation, distribution and transmission sector.

2.8.4 Debt Financing for Aggregated Projects

A larger scale project implemented across several cities has some advantages over smaller scale projects, in terms of reducing the risk of debt financing. A larger project is likely to attract infrastructure companies with more project management experience and also help

⁷ Financing that is secured only against income from the project. No independent guarantee or security is provided. Also referred to as "project finance".

to drive down the cost of the technology needed. It will also spread the political risk by making several cities ultimately responsible for the debt.

In order to use debt financing for a project implemented across multiple cities, it would be necessary to use a financial intermediary between the cities and the financial institution. The use of such special purpose companies is well established as a mechanism to deliver projects involving a consortium of parties. In this case the special purpose company would be jointly owned, and guaranteed by, the cities involved and its purpose would be to raise debt funding for the project. As noted earlier, this special purpose vehicle could engage an ESCO on behalf of all the cities involved or could in itself be an ESCO that carried out the work directly.

As discussed above, for aggregated projects an ESCO should be able to lower its costs through the increased volume of energy efficient products required. In addition, a larger project should also attract larger ESCOs that are better positioned to assist the special purpose company access debt and provide a more professional approach in their project management.

2.8.5 Bonds

Bonds are essentially debt that is intended to be bought and sold on a secondary market. The bond market is relatively well-established in Indonesia and offers potential as a financing mechanism for energy efficiency projects in the country. However as discussed in a later section, there are no recorded bonds issues by local governments.

Most of the US\$87.5 billion of bonds currently on issue in Indonesia has been issued by the central government, with only US\$8.4 billion of the total being corporate bonds⁸. Of particular interest to the financing of street lighting energy efficiency projects is that several infrastructure companies regularly issue bonds for the purpose of financing road construction as does PLN Persero, the national vertically-integrated electricity company, for the funding of generation assets.

The use of corporate bonds for infrastructure development has been encouraged by the national government since 1990. Before then, large infrastructure projects were financed by the government through a combination of the state budget and overseas soft loans. Projects were developed and operated by fully state-owned business enterprises such as PT Jasa Marga (Persero).

In 1990, the government stipulated that large projects should no longer be funded solely by the state budget and allowed state-owned business enterprises to issue bonds. These businesses have been progressively privatised and now issue bonds independently of government.

⁸ Asian Development Bank (ADB) (2008), *Asian Bond Monitor*, April 2008, p. 6.

CASE STUDY: BOND ISSUES BY INFRASTRUCTURE COMPANIES

PT Jasa Marga (Persero). Largest toll road construction and operation company, with 78% of Indonesia's total toll road length. Operates roads in Java (including Jakarta, Bogor, Bandung, Semarang, Surabaya, Paliman and Kanci) and Sumatra (including Medan and Belawan). Has been a public state owned enterprise since November 12 2007, when 30% of the company was floated on the Jakarta Stock Exchange. Jasa Marga currently has four listed bond issues, of between IDR 150 billion and IDR 1,000 billion.

PT Perusahaan Listrik Negara (PLN) (Persero). The national electricity generator, distributor and retailing company. PLN Persero uses predominantly coal, gas and oil/diesel for generation, with the rest being hydro and geothermal. It services over 33 million customers across all sectors of the economy. The company currently has five conventional bond issues, of between IDR 865 billion and IDR 1,335 billion and two Ijarah bond issues of IDR 200 billion and IDR 300 billion (see Section Bond financing for city projects).

Source: PT Pemeringkat Efek Indonesia (PT Pefindo) (2008). *Rating Announcement as of March 31, 2008*. Accessed May 8, 2008 at <http://new.pefindo.com>.

This experience of bond issues for transport infrastructure development in Indonesia is important if it is to be considered as a financing mechanism for street lighting projects.

2.8.6 Bond Financing for City Projects

Projects of the scale required for a single city probably do not warrant the issue of conventional bonds, either by the city government or a special purpose company established by the government. Although accurate budget information was difficult to obtain from cities in the Sustainable Cities Project, it appears that funding of approximately IDR 120 billion is required to complete the planned project in Denpasar which is the largest project of those in the four cities reviewed.

An alternative to conventional bonds that could be considered for certain cities are bonds that comply with Shari'ah. Shari'ah bonds that are intended to be publicly traded must still be registered with Badan Pengawas Pasar Modal (BAPEPAM) (Capital Market Advisory Agency), which is the supervisory body for capital markets. However, Shari'ah bonds need not be traded publicly and are, in many respects, more suitable for relatively small amounts of finance.

A 2002 study by Indonesia's central bank, Bank Indonesia, highlighted the potential for the development of Shari'ah financial products, particularly in those provinces with over 90% Muslim populations in which Yogyakarta, Semarang and Depok all lie⁹.

⁹ Bank Indonesia (2002), *The Blueprint of Islamic Banking Development in Indonesia*.

2.8.7 Islamic Financing Options for City Projects

Ijarah bonds are based on a contract in which one party purchases and leases out equipment required by another party for a rental fee. The following characteristics of *Ijarah* bonds make them suitable to consider as a financing mechanism for street lighting energy efficiency projects:

- They are securities representing the ownership of defined assets, which are tied to a lease contract;
- The expected net return need not be completely fixed or determined in advance, which allows for unforeseen expenses due to maintenance or insurance;
- They are completely negotiable and able to be traded in secondary markets;
- The bondholders bear full responsibility for what happens to their property. They are also required to maintain it in such a manner that the lessee may derive as much benefit as possible¹⁰.

Ijarah bonds could be issued by the city to the citizens in the area in which the street lighting project is implemented. The local community would then collectively own the assets and lease them back to the city.

PLN Persero has issued two series of *Ijarah* bonds to fund electricity infrastructure, of IDR 200 billion and IDR 300 billion. The utility has transferred to the holders of these bonds benefits obtained from certain transformers and the bondholders have agreed to provide PLN Persero a power of attorney to enter into agreements with users of the transformers to the benefit of bondholders.¹¹

2.8.8 Bond Financing for Aggregated Projects

The smallest of the bond issues by the toll road company PT Jasa Marga (Persero), noted in 4.4.3, is of the magnitude required to complete the street lighting projects in cities that reported information as part of the Sustainable Cities Project. Bond issues in Indonesia are short-term compared to many others issued internationally, typically of three to five years duration, but are regularly rolled-over to another issue. This is necessary in cases where the bond issue is for a shorter period of time than it takes for the project to return the initial investment, as is the case with street lighting energy efficiency as demonstrated in the Green Light Graz project.

A special purpose company would be required to ensure that there was a single enterprise responsible for the issue and the periodic payment of coupons. The exact mechanism by which this could be achieved would need to be investigated fully with BAPEPAM (Capital Market Advisory Agency), which supervises capital markets.

¹⁰ Al-Amine, M. (2001), *Islamic Bonds Market: Possibilities and Challenges*, International Journal of Islamic Financial Services, Vol. 3 No. 1.

¹¹ PLN Persero (2007). *Consolidated Financial Statements for the three-month periods ended March 31, 2007 and 2006 (unaudited)*.

Assistance with the design of an appropriate structure may be available from Bahar & Partners, Attorneys at Law, in Jakarta. The company specialises in project financing and has advised on a number bond issues by infrastructure companies for both toll road construction and energy generation.

2.8.9 Islamic Financing Options for Aggregated Projects

Two forms of Islamic bond finance are worthy of consideration for aggregated projects – mudharabah (muqaradah) bonds and musharakah bonds.

Mudharabah bonds involve an agreement between two parties according to which one party provides the capital for another party to use, on the condition that the profit is shared between them according to an agreed ratio. These bonds are suitable for a variety of development projects because the return is related to the profitability of a project rather than being set as an agreed interest rate. In this way mudharabah bonds are similar to revenue bonds in conventional finance¹².

There are six mudharabah bond issues currently listed in Indonesia, for between IDR45 billion and IDR200 billion each (KSEI, 2008). Issuing companies include two banks, plantation companies, civil engineers and the Indonesian Satellite Corporation.

Musharakah bonds are similar to mudharabah bonds, except that the finance is from a group of subscribers instead of one party only. Musharakah bonds have been used to finance transportation infrastructure in Turkey and have been very popular securities in the Istanbul market (Al-Amine, 2001). There do not appear to be any current issues of musharakah bonds being actively traded in Indonesia.

As a street lighting project financing mechanism, musharakah bonds could be issued by a special purpose company to the public. Those living in the area in which the project was to be implemented would have an incentive to subscribe to the issue, as they would benefit from the project, but subscription would be open to any member of the public. Musharakah bonds can be traded on a secondary market, on the same profit-sharing terms that they were originally issued.

2.8.10 ESCO involvement

A relevant feature of mudharabah bonds is that the agreement is between two parties only so, in the context of an aggregated street lighting efficiency project, a bond issue could be made by an ESCO to a special purpose company that is co-owned by the cities involved in the project. This finance would then be used for project implementation with the profit being shared between the two parties according to an agreed ratio.

¹² Al-Amine, M. (2001), *Islamic Bonds Market: Possibilities and Challenges*, International Journal of Islamic Financial Services, Vol. 3 No. 1.

As with *Ijarah* bonds, the use of an ESCO in combination with the issue of musharakah bonds unnecessarily complicates the project financing structure due to the agreement being between a group of subscribers and the bond issuer. A private ESCO is likely to consider it more efficient to deal with one party as the financier than many bondholders. As noted above, drawing funds from a group of subscribers is more appropriate for the city government itself, which has an existing relationship with the community it governs.

2.9 Summary of Financing Options for Efficient Street Lighting

There are many potential avenues of finance for street lighting efficiency projects that have been canvassed in this report. The precise design of contractual relationships used to deliver projects should, of course, be developed in consultation with the cities concerned but this report has outlined a number of options that could be further investigated with those cities.

In light of the findings presented in this paper, it is recommended that:

- Further ‘investment grade’ detail on potential projects¹³ is sought from the four cities already identified and other cities that could benefit from more efficient street lighting.
- Low emissions intensity energy supply options are pursued, in conjunction with energy efficiency, in all cities that require additional street lighting.
- Cities that wish to directly finance projects in their cities are made familiar with the concept of ‘revolving energy funds’, which would increase the rate of project implementation.
- Advice be sought from Islamic finance experts, particularly at the ADB, in order to refine the options presented in this paper.
- Cities on Java be brought together with PLN Persero to discuss Islamic finance options and the potential use of ESCOs.

¹³ Under the original CCP project a software facility was provided to gather data. However this facility is no longer available and data collection has not been maintained.



3.0 WASTE MANAGEMENT

3.1 Background

Within the waste to management industry there are a number of common approaches to disposal / management, the simplest of which is a landfill, where waste is gathered and then placed in a specially constructed facility. As waste is added to the landfill, layers of soil are then spread across it on a daily basis. This acts to contain odour and also assist in the long term consolidation of the landfill overall.

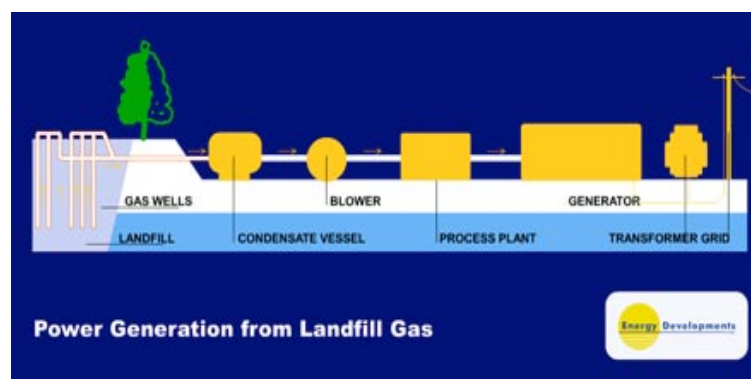


Flaring of landfill gas

The design and construction of such facilities is a well established practice. Their key design elements are to contain all waste within a managed boundary; to ensure that leachate (contaminated water that soaks through the landfill) is effectively controlled and disposed of; to separate incoming waste streams to minimise the non organic content of the landfill (and maximise the opportunities for recycling); and to control the natural emissions of gas (largely methane) from the decomposing organic waste within the landfill.

Over recent years the capture and utilisation of landfill gases has received increasing attention. The approach is one in which shallow wells are drilled into the landfill to capture the methane at depth and then this gas is either flared or where practical, used to drive stationary gas engine / generator sets which provide a small but useful source of electric power. Landfill gas is eventually exhausted (after 15 to 20 years depending on the scale of the landfill) and plant is typically designed so that it can be removed in due course and installed on an alternative site.

The diagram below shows a schematic arrangement for a landfill gas operation (Energy Developments – Australia).





The photo below shows a typical installation to generate power from land fill gas at the West Nowra Landfill in Australia; an on-site 1-Megawatt generating plant.



3.2 Waste Management in Indonesia

Municipal Waste Management (MWM) contributes to the overall health and environment conditions of urban cities. 60% of the garbage in Indonesia ends up in final disposal sites where the wastes are stacked in an open dump. Within Indonesian cities, the average waste management collection coverage is partial, estimated to be between 40% - 50%. The uncollected waste is disposed off (or burned off) in an unregulated manner that results in environmental problems. Insufficient management of the landfills in Indonesia has led to environmental problems, including the infiltration of leachate (the liquid produced in a landfill from the decomposition of waste within the landfill) into the water supply.

The central government has acknowledged this, and has passed a law on waste management in 2008¹⁴. The law is the first ever national policy that provides a comprehensive strategy towards waste management in Indonesia. It provides greater legal clarity and certainty, and has defined the role and responsibility for government authorities, local government and community for waste management. The law has mandated the closure of all open-dumping landfills within five years of the Law's introduction, and that garbage should be processed. This law gives a clear signal of the government's commitment towards the improvement of the waste management system in Indonesia.

¹⁴ Law No.18 of 2008, Indonesia



The introduction of the National policy paves way for a more sustainable solution towards waste management. The new strategy centres on the reduction of waste at its sources and recycling of resources. The implementation of this strategy requires a huge shift from environmentally unsound practices and habits to those that are more sustainable. This presents a huge opportunity for local government, businesses, and the community to build upon and improve waste management in Indonesia.

3.2.1 Private Sector Involvement for Waste Management

It is estimated that Indonesia produces some 10 million tonnes of municipal waste annually. The organic component of the waste could potentially yield 400 million m³ of methane. The reduction of methane gas through sustainable management of municipal waste – could possibly provide 80MW of continuous power generation and US\$10million annually in carbon credit revenue¹⁵.

The opportunity to earn additional revenue from the sale of CERs has definitely improved the interest and development of a market for MWM projects. There are a number of landfill gas-flaring projects across Indonesia that have been motivated by the potential of CER revenue. However, landfill projects involving the waste to energy model have not taken off due to a number of market issues and barriers. Some of the issues and barriers surrounding MWM are addressed and discussed in the following notes.

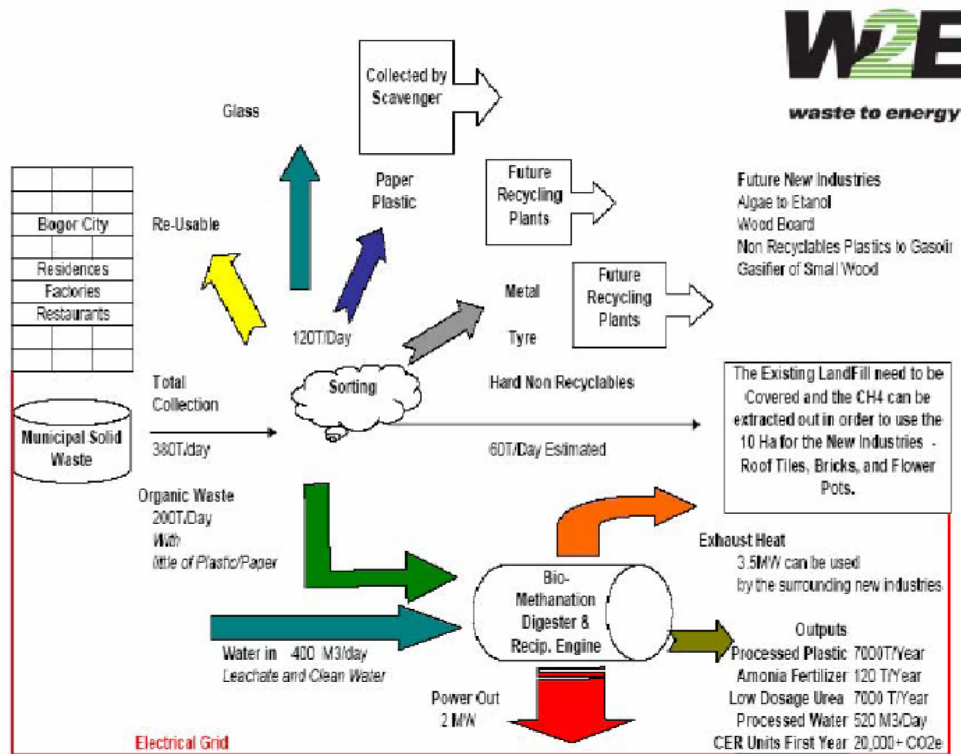
Flaring reduces emission of methane into the atmosphere (a greenhouse gas more than 20 times as potent as CO₂) but wastes the energy potentially available as heat or electricity.

3.2.2 Bogor City Project

Located on West Java, Kota Bogor (Bogor City) has a population of 800,000, and is surrounded by the Regency of Bogor. Waste disposal is conducted at the landfill site of TPA Galuga, Poor site management at TPA Galuga has resulted in the infiltration of leachate to the surrounding areas, affecting the communities living around it.

In 2007, W2E Holdings PTE (Singapore) LTD, a waste management company that specialises in waste to energy (WTE) projects, started the background development of a waste to energy plant on a new landfill site near Kota Bogor. The facility would be designed to handle 380 tonnes of waste a day. The municipal waste would be treated to produce biogas that will generate electricity and heat for sale. It was estimated that 25,000 tonnes of CO₂ equivalent of Carbon Emission Reductions (CERs) would be generated before 2012. The facility would also earn revenue from the sale of recyclables, and the production of organic fertilisers from the digester. Progress has been slow and a number of the issues faced by the project are described below.

¹⁵ John Morton, World Bank



Proposed Structure of Bogor Waste Management Operation

3.2.3 Bali Waste Management, Disposal and Energy Generation¹⁶

Sustainable Infrastructure Bali, a Denpasar based consultancy, was engaged to prepare a detailed overview of the way in which waste is being managed in Bali, in particular in south Bali. Their task was to review the private sector engagement in waste activities. This study (which is annexed to this report) provides a candid insight into an approach to waste management which is perhaps reflective of much that has occurred in this field in Indonesia.

In the background to the report it is stated that “This problem (solid waste collection and disposal in South Bali) is neither new nor easily solved. Numerous studies have been undertaken over the years” and it then lists 8 significant studies undertaken since 1992 through UNDP, local universities, ADB supported programmes and various technical assistance studies for local government. The key points that emerged from the present study include:

- Some 80% of the solid waste that reaches landfill sites is putrescible / green waste after ad hoc recycling of metallic material, wood, plastics, paper, rubber, textiles and glass.

¹⁶ See Appendix C



- A number of public and private institutions share responsibility for waste management in Bali – they range from national, provincial, district/city, sub-district to community level institutions. “The prevailing (institutional) framework is multi-tiered and largely dysfunctional”.
- The local regulatory framework for waste management is limited and most district governments rely on standards that were prepared by the former Cipta Karya¹⁷.
- Much of the funding for solid waste management projects still comes from loan funding from international development banks and bilateral organisations.
- There is a (mis)conception at local government level that waste represents an easy income if collection and control of recyclable materials can be achieved. Much of the ad hoc recycling removes the higher value waste leaving only the lower value marginal material.
- The four Kabupatens that occupy some 30% of Bali’s land area and contain 53% of the population have agreed to cooperate to address solid waste management on a collective basis. This is a significant step and is allowing planners and developers to look at an optimised system for disposal.
- The collaborative approach has led to the NOEI¹⁸ project that is now focused on using high rate anaerobic cells to capture methane and provide for power generation and compost production.
- The NOEI project has already undergone an ownership change (which is providing much needed capital to move the project ahead) and there have been changes to the technology to be employed. There is some concern that the technologies being considered are “pioneering” and may introduce a number of challenges over and above those of sourcing a sustainable waste stream.
- There is a need for work to be done to rehabilitate the existing landfill at Suwung, where the NOEI project is based, as it is expected to be at capacity within the next two years. This work and the success of the NOEI project are critical to managing Bali’s short to medium term waste disposal.

A number of issues have driven this development.

Bali’s strong tourism industry and the demands that this puts on local infrastructure is one element. It was becoming clear that the existing landfills were soon to reach capacity. In 2001, the City of Denpasar and the Regencies Badung, Gianyar and Tabanan established an agency called SARBAGITA to administer Municipal Solid Waste (MSW) within these areas.

¹⁷ Cipta Karya was the Department of Human Settlements within the Ministry of Public Works who oversaw the design and construction of most solid waste management infrastructure.

¹⁸ PT Navigat Organic Energy Indonesia

In 2002 the Bali Province through Public Works (PO) proposed a public-private partnership to open and operate a new landfill site in the Regency Tabanan. However, due to pressure from the public this project was shelved. Open dumping of MSW still continues within the district administrated by SARBAGITA. The obvious choice was then to better utilise the location of the existing landfill site at Suwung. SARBAGITA issued an invitation for development of this site which led to P T NOEI's engagement. It is interesting to note that NOEI had previously presented their gasification, landfill gas and anaerobic digestion (GALFAD) MSW management concept to Jakarta, Bandung and Surabaya governments. The main reason for the first project start-up being in Bali is that the southern part of Bali already had a dedicated agency (SARBAGITA) managing MSW and this was seen as making the situation much more efficient in Bali than in the other cities visited by NOEI.

In preparing these notes a further report was prepared by Sustainable Infrastructure Bali to update the progress and situation at the waste management in South Bali. The report reviewed and updated the status of private sector's engagement in waste activities.

A few key points emerged from the update:

- The NOEI¹⁹ project has failed to meet the predicted outputs of power generation. They have only averaged 500kW of continuous power generation. The digestive cells are being filled with unsorted municipal waste now, making it impossible for them to reach the target of generating 2 MW by July 2009.
- NOEI has been unable to demonstrate sufficient technical experience to effectively implement their preferred technology. There is reasonable doubt on their ability to carry out the pyrolysis project, as the application of pyrolysis on municipal organic waste itself is pioneering and has only been applied in one plant worldwide.
- There is a sizeable demand for compost from an adjacent real estate development for the next 7 years. A composting facility could possibly run in conjunction with the digester, and serve as a contingency to NOEI's plan. However, the lack of understanding between the developer and NOEI has hindered the development of a mutually beneficial proposal.
- Jimbaran Lestari, a privately owned waste collection company that recycles, composts, and disposes residue waste, has been making good progress in expanding their operation. They have expanded their composting facility. They are expanding into household waste collection, and has secured the contract to manage the household waste at Jimbaran Municipality.

3.2.4 Landfill Gas-Flaring

One Indonesian private company, P T Gikoko, is aggressively addressing the opportunities that these landfills can offer by developing gas flaring systems which in the main part are

¹⁹ PT Navigat Organic Energy Indonesia



being financed through the carbon credits (CDM) that this procedure generates. Where flaring is not possible, the focus is on composting.

Currently they are developing four significant projects and three of these have been approved by the UNFCCC CDM procedures. In addition to these projects the company has Memoranda of Understanding (MOUs) in place for 9 additional sites.

Their model is based on the pre-sale of carbon credits (currently through the World Bank PCF) and using an advance payment to construct the gas flaring unit (which they manufacture themselves in Indonesia). As part of the public-private partnership they establish with the local government it is agreed that 10% of the carbon revenue stream goes to the local government to allow re-investment into waste management with 7% directed to community development programmes.

Observations made by this group include:

- The Ministry of Environment is drafting a waste management regulation and the Public Works Department is encouraging municipal and local governments to cooperate to construct new integrated regional landfills and to covert open dumps into controlled / engineered sanitary landfills.
- They have had MOUs in place with local governments for nine landfills but progress is limited until an appropriate (additional) source of finance can be identified.
- The landfills typically take about 60 to 80 tonnes of waste per day.
- Given the smaller size of many of the projects, future development could be accelerated with programmatic CDM which would also encourage composting operations.
- There is limited appreciation amongst local government of the importance of tipping fees and a reluctance to set these at a level which would encourage the development of well designed and managed landfills. This point is echoed by other private sector groups who have offered integrated MSW systems to cities within Indonesia.

3.3 Drawing Lessons from the Projects

The problems faced by the private sector in Kota Bogor and Bali are common across Indonesia. The experiences of these two cities would provide other cities with an indicative model of how some issues or barriers can be handled.



3.3.1 Dealing with a Poor Framework

In the study by Sustainable Infrastructure Bali in November 2007²⁰, it was pointed out that “the (institutional) framework for waste management in South Bali is multi-tiered and dysfunctional”²¹. There are multiple agencies (both public and private) from different levels of government that shares the responsibility for waste management.

The Kota Bogor project faced similar problems. The landfill is in the jurisdiction of Kota Kabupaten, while the land lease belonged to the government of Kota Bogor. Negotiation had to be carried with the two cities to obtain the necessary approval from both governments to implement the project at Bogor.

SARBAGITA of Bali is an agency set up to counter this problem. In 2001, SARBAGITA was established in South Bali to administrate MSW in and within the City of Denpasar and the Regencies Badung, Gianyar and Tabanan. The regional agency reports directly to the office of the Mayor of Denpasar and to the offices of the Regents in the three Regencies Badung, Gianyar and Tabanan. The agency SARBAGITA works also in close cooperation with the Provincial Planning Authority (BAPPEDA). The presence of SARBAGITA as a single coordinating agency was the primary reason behind the selection of South Bali by NOEI to develop their project.

Indonesian provinces could replicate the SARBAGITA model. Regencies and cities can come together to form a dedicated agency to plan and implement waste management. This model provides the provincial government with a suitable framework to execute the strategy²² laid out by the Waste Management Law in 2008.

3.3.2 Technical Capacity

The updates on NOEI’s progress at the waste to energy facility have proved that there is still a gap in the capacity and capabilities of private companies. Within Indonesia, there is still a lack of expertise for solid waste management. Projects are still heavily dependent on foreign technical expertise to implement the projects. Therefore, projects should not include pioneering technologies but stick to time-tested ones to ensure success in Indonesia.

It is therefore important for private companies that are seeking to operate in this sector to have relevant technology capabilities.

²⁰ Private Sector Engagement in Waste Opportunities in Bali, ICLEI Oceania Secretariat

²¹ Indonesia Kemitraan Project for Local Government Energy Efficiency, p.14

²² Provincial government has the responsibility to facilitate cooperation and partnership between regions. They will coordinate, guide and supervise the performance of the cities and districts; and resolve disputes between local governments.

3.3.3 Financing

Traditionally, the financing of waste management projects has been limited to direct financing from the local government budget. The budget is usually supplemented by some financial assistance from multilateral institution like ADB, IBRD or JBIC. The new Waste Management Law of 2008 has not indicated any other new sources of financing that will be available for waste management in Indonesia.

Financing through traditional borrowings such as “project finance” is difficult in this market as the project income stream is unstable. In a typical landfill project, stable income generation is heavily dependent on the access to a waste stream of consistent composition, which is difficult to guarantee.

One Indonesian company, PT Gikoko, has been addressing opportunities in this sector through the construction and operation of gas-flaring projects. They have successfully financed the projects through a program management approach instead of individual project financing. Gikoko arranged the Emission Reduction Purchase Agreements (ERPA) with NCDMF through World Bank. Under the agreements, Gikoko will receive advance payments for the CERs that it generate in one project, and uses it to finance the construction of another planned project.

The carbon market provides a window of opportunity for private companies and local governments to access funding that might otherwise be unavailable for infrastructure development.

3.3.4 Tipping Fees and Government Budget

The concept of tipping fee is still not widely recognised by the local governments. Even at places where tipping fees are accepted, the ability to pay a commercially viable rate is still low. For instance, when Jakarta called for tender to expand the Bantar Gebang dump, it received bids with a tipping fee of between Rp 100,000 and Rp 300,000 for per ton of waste. In contrast, the administration was only prepared to pay a maximum of Rp 103,000. This shows the disparity in the commercially viable rate determined by the private sector and the one that the government pays. Local government will have to address this disparity to make the operation of sanitary landfills and waste to energy projects viable for the private sector.

At present, local governments receive about Rp 10,000 – Rp 15,000 per month per household for the provision of waste management services. The fees are too low to properly compensate the local government for the cost of collection and disposal, which often led to improper disposal and poor collection rate. Increasing the waste management fees from households, where feasible, would be a way to relieve the strains resulting from a lack of investments from governments.

In Bekasi and Pontianak, the agreement between the local government and PT Gikoko will see 10% of the carbon revenue going to the local government for re-investment in waste



management, and an additional 7% would be directed to Gikoko-initiated community development projects. This model could provide the local governments with an additional source of financing to improve the effectiveness of the waste management systems in cities and districts.

3.4 Summary and Recommendation

Although financial responsibility for urban government has been decentralised, no clear regulations exist at local levels for much of the essential infrastructure that needs to be developed and/or expanded to meet ever increasing demands on municipal services. It appears that there are not many proactive urban authorities encouraging private sector engagement in these services, perhaps influenced by the fact that there is still access to loans from international FI's (through central government borrowing) and support through a number of bilateral programmes. While it appears that local government authorities recognise the issues that surround the effective collection and disposal of waste it seems that in general their view is somewhat simplistic and development hampered by the fact that there are many uncontrolled landfills throughout Indonesia.

The project approaches outlined above show the opportunities that exist where a strong private sector interest is present but also demonstrate the issues that are hindering fully effective waste management and reinforce some of the generic points highlighted earlier.

There is no question that there must be improvements in the infrastructure at a regional and local level; many of these will have direct climate change mitigation impacts; those studied under this programme (street lighting / transport / waste) can all influence energy consumption and/or generation. There is an acknowledgement of the benefits that these improvements can offer in terms of local environment and general living standards but budgets for such work appear limited.

While the current project sought to encourage the local government (mainly through the city mayors' offices) to engage the private sector in assisting the development of improved infrastructure, it appears that it will be equally important for any future efforts to engage both the public and private sectors at all steps of the process.

The example of what has happened in Bali demonstrates what can be achieved where a coordinated effort is made amongst local authorities to collectively address MSW issues.

One of the first (purpose built) integrated landfill developments is currently underway in Aceh with support from GTZ and UNDP with multi-donor support, but this is seen as an exception to normal practices. UNDP with JBIC backing is reported to be working to address animal waste, particularly that from small dairy holdings.

To encourage private sector involvement in providing infrastructure for the MSW market in Indonesia there are a number of points that need to be addressed (many of which have been covered earlier in these notes):



- There needs to be a single local government group responsible for waste collection, handling and disposal.
- There need to be sensible and enforceable regulations in place covering all aspects of MSW.
- The fact that tipping fees are an integral part of any effectively designed and managed MSW operation needs to be accepted by local government and enforced.
- The ad hoc scavenging of higher value recyclable material is an important income source for the poor who inhabit the areas surrounding many landfills. Their interests need to be recognised and can be met more effectively if developments allow them to be engaged in a structured labour force.
- Uncontrolled landfills are not suitable for significant gas collection and flaring or power production.
- Integrated purpose-built landfill facilities with adequate leachate control are essential if waste disposal is to be sustainably managed and effluents controlled effectively.
- With a well structure MSW industry there is potential to earn significant income through the carbon markets which may in turn offer a source of early finance for what are seen as higher risk projects.
- The MSW business is complex but there are many groups who can offer sound services at competitive prices if the issues above are addressed.
- The carbon market provides a window of opportunity to access funding that might otherwise not be available for local infrastructure development and any measures to help enable this development should recognise the importance of this source of finance and the benefits it could provide.
- Those in the private sector who have an interest in the Indonesian market need to be pro-active in seeking out the opportunities and will need to be willing to bring technology and financing with them. An understanding of the carbon market and access to resources through this would appear to be an appealing approach in the near term.



4.0 FINANCIAL OPPORTUNITIES AND MECHANISMS TO SUPPORT LOCAL GOVERNMENT

Drawing on the information gathered, it is clear there are a number of issues which influence the effective development of municipal infrastructure in Indonesia and hence may hamper local government capacity to put large resources into those projects that could have most influence in addressing climate change impacts in the near term.

4.1 Decentralisation

In 1999 the Indonesian national government moved to transfer the responsibility for the delivery of services to local government. This process was not without its difficulties some of which were addressed by subsequent regulations intended to reduce bureaucracy and streamline operations in all areas.

From discussion held during the July workshop and the course of this programme it was apparent that while there is a general recognition amongst local authorities that climate change issues are of importance there is tension between addressing these and focusing on what are often more pressing immediate issues. There is still a tendency to look to central government for guidance, particularly where policy and regulation are involved. It is also recognised that environmental management in general has suffered through the decentralisation process in that there has been no clear plan to transfer responsibility from national to local government, though efforts are underway to remedy this situation.

4.2 Funding

With decentralisation the responsibility for raising all operational funds was passed to local government and Law 25/1999 allows local government to raise funds from:

- local revenue or income (regional taxes, user charges, revenue from local state-owned companies and revenue from local asset management);
- central-local balance fund (taxes on land and building construction, revenue from taxes on land and construction rights, revenue from natural resources, general allocation fund and specific allocation fund);
- local borrowings; and
- other legal revenue in the region.

Central government funding for regional governments has been increased since FY2001 to help implement local autonomy. However, not many regions have sufficient local revenue

sources, either because of insufficient natural resources and low intensity of economic activity, or because of the inability to increase local taxes and user charges, which is associated with scarcity of base data and system information about tax and user charges, weakness of local tax and user charge management and limited capability of government officers. Therefore the financial needs of local autonomy greatly affect the ability of local government to sustain development²³.

Most regional government borrowing in Indonesia has been conducted via central government mechanisms. While the terms and conditions of central lending have been highly favourable to regional borrowers, repayment of debt has been very poor. The empirical evidence suggests that local governments have borrowed well within their fiscal capacities to repay and that repayment problems are largely a function of unwillingness to repay debts and of central government acquiescence. Regional borrowing must significantly increase in the years ahead in order to meet growing demand for infrastructure services and lending to regions will have to become more market-based. Reducing systemic credit risk and improving the creditworthiness of regional borrowers are prerequisites to increased and sustained market-based lending²⁴.

This situation also explains to some extent why there are no bond issues by local government recorded to date, despite the fact that these are an approved source of fund raising. While there are mixed views about the opportunities to raise local government bonds, there has been an admission by central government (BAPEPAM²⁵) that local bond issues are hampered by poor financial administration, inadequate regional accounting systems, limited competency within the regional institutions that will process bond issue and poor financial reporting. With ADB support (and AusAid Technical Assistance supporting capacity building) a Capital Market Development programme is underway that amongst other issues addresses the central bond market, its activities and supervision. New laws and regulations are being established as part of this process.²⁶ This suggests that the opportunity for local government bond issues is still some time away. However, as indicated in the discussions on street lighting above, there may also be opportunities to use less traditional bond applications.

²³ Local Government Finance and Bond Markets – Carunia Mulya Firdausy, Center for Economic Research, Indonesian Institute of Sciences, Jakarta.

²⁴ Local Government Borrowing and Repayment in Indonesia: Does Fiscal Capacity Matter? **Blane D. Lewis** Research Triangle Institute International, Research Triangle Park, NC, USA

²⁵ Capital Market and Financial Institution Supervisory Board (BAPEPAM-LK)

²⁶ <http://www.indoexchange.com/services/regulation/rule/rule8.htm> provides coverage of current laws and regulations within the Indonesian finance sector.

4.3 Local Government Resources for Infrastructure Development

Given this general picture of local government finance which suggests limited resources but with budgets managed in a fiscally responsible way, it is clearly important that the regional and local governments look to maximise the opportunities that a balanced participation by the private sector could offer in infrastructure development. It is however important to recognise that the investment environment in Indonesia in general and at a local level continues to attract much scrutiny because of issues of transparency, the ability to negotiate and maintain commercially viable terms and conditions for investment, project approval and implementation and the underlying political issues that seek to ensure that the poor are not disadvantaged by cost and price increases that improved infrastructure may generate if (reasonable) user charges are enforced.

As described below, under the ICLEI/ REEEP study attention was focused on identifying approaches with local government that would reinforce work that they are already undertaking on street lighting (energy efficiency opportunities), waste collection and disposal and transportation that would encourage climate mitigation measures. In particular the aim was to identify where the private sector could be engaged in an active role covering development, financing and operations and management.

4.4 General Financing

Given the situation that decentralisation has created for local government finances, it is felt that infrastructure finance, where the private sector is involved, will be seen as the responsibility of the private sector partners. The local government will provide in-kind, regulatory and administrative support but is unlikely to be an active investor in such operations. Clearly some private sector entities will have their own access to bilateral (tied) funds though there will no doubt be requirements to get local (and central?) government sign-off where such financing is to be used.

Financing through more traditional borrowings such as “project finance” is difficult in this market. Such funding is dependent on a secure future income stream. In the waste industry this is a particular issue in that long term agreements on access to waste streams (of consistent composition) are difficult to secure. In addition, while an acceptable level of payment from PLN that would make power generation a viable option would typically be supported by a 10-year power purchase agreement, security of fuel access remains a problem. Landfill gas power generation does however have the advantage that, if the power sales agreement pricing is reasonable, income from electricity sales coupled with a parallel stream from carbon credits often can provide a relatively short payback period. In addition the generation units are typically modest in size and transportable to another site if waste deliveries and/or gas production decline significantly.

While the ESCO offers an attractive option for energy efficiency improvements it is widely recognised that funding for ESCOs (and the implicit capital investments required) is not easy to obtain. Typically, and especially in an emerging EE market where there is limited experience with ESCOs and their funding, ESCOs are smaller companies with limited collateral. Seeking financing through local banks who generally seek substantial collateral therefore presents a challenge. While the local government may be attracted by a performance contract concept, it may be necessary to use some form of hybrid financing so that the funder is satisfied that debt servicing will be possible whatever the outcome of the EE improvements. Lessons from experience in India have been included in these notes to highlight some of the opportunities that an ESCO approach can however offer once established.

4.5 Private Sector Engagement

The opportunity for the private sector to collaborate with bilateral funders is clearly one that would be well received by local government. This is particularly true where it is inevitable that regulations may not be well established and political support at a local level will be necessary to help establish these and provide mediation between often inexperienced local government agencies and the private sector (whether national or foreign).

Perhaps ironically, one of the key drivers for private sector interest in both the Bali projects and the landfill gas developments is the opportunity for credits through the CDM process. Given the nature of local government financing, the limited exposure that domestic banks (particularly those outside Jakarta) have to funding environmental / small energy projects, sourcing finance in the local market is a challenge. Carbon finance is not straightforward but, as in the case of the landfill cases projects described above, where an international agency such as the World Bank can be engaged it brings with it a wide range of experience and a willingness to enter into relatively high risk investments where it believes there is a strong opportunity that they will yield (tradable) carbon credits. There are many players in the carbon market and more recently the ADB has established a very encouraging carbon facility that will offer early stage financing secured against future carbon credit income streams. While there are others in this market they are often less enthusiastic about smaller scale projects (limited volume of carbon credits) and as noted above programmatic CDM will be an important advance – under this a collection of smaller projects can be aggregated for financing and issue of credits.

The signing of an agreement between the World Bank and P T Gikoko in Indonesia is an example of what is being achieved. The World Bank, acting as a trustee of the Netherlands Clean Development Mechanism, will help provide the social benefit component. Under the agreement for Bekasi city, the World Bank will purchase 250,000 tons of CO₂-equivalent of Certified Emissions Reductions (CER) each year, for the next 15 years. In the global carbon market, one CER is equal to one ton of CO₂ and is priced between US\$5 to \$10. Note that this project is based on gas flaring alone without any power generation. It is not easy to



define a typical project cost but the Bekasi project will develop a facility which serves a population of some 2 million and the investment to establish a gas flaring facility alone is understood to be of the order of US\$800,000 in capital costs with annual charges of some US\$50,000.

While energy efficiency improvements (such as street lighting) can also generate carbon benefits, the typically smaller projects size and hence level of savings, can be made more attractive by the aggregation of projects. This approach is under consideration by the UNFCCC as it is recognised as a key element in making energy efficiency an attractive investment. Examples in India do demonstrate the effectiveness of the CDM process in such projects.





5.0 CONCLUSION

The report seeks to highlight the opportunities that exist for action at a Local Government level in Indonesia to address the implementation of efficient street lighting programmes and to encourage private sector participation in the waste sector, with potential waste to energy developments. It also attempts to identify potential sources of finance whether projects are implemented directly by cities, in public private partnerships or by the commercial sector alone.

The approach taken has been to provide a frank and realistic assessment of the issues that are faced in implementing energy efficiency and engaging effective waste disposal solutions at a city level. Any criticisms will hopefully be seen as constructive. As the markets evolve it is inevitable that national and local policies and regulations will need to develop to allow the implementation of projects that were not foreseen when they were first being implemented.

All cities face the challenge of addressing increasing environmental pressures on their physical and fiscal resources. While household income levels may restrict the ability for costs / charges for municipal facilities and services to be met by individual city dwellers, solutions must be found to source the essential financing for the infrastructure that all cities need to meet the pressure of increasing population while protecting their environment.

Experience suggests that a combination of public and private entities and financing will be required to stimulate the development of key infrastructure. To encourage private sector participation requires not just inductive commercial conditions but may also require assistance in attracting and training local capacity to be able to participate in such programmes. The REEEP ESCO programme outlined in this report is one that could be drawn on as an example of an effective approach to engage local capacity in a novel ESCO model to deliver much needed street lighting facilities.

Many cities within Australia have faced (and still do) some of the challenges that Indonesian cities are working to address. Part of the team undertaking this project were representatives from such cities. Their experience and that of a range of Australian companies is available to assist in taking the concepts outlined here to the next stage.

The information provided in this report is also seen as background material for an anticipated visit to Australia of Local Government officials from Indonesia and their Australian counterparts and companies engaged in the sectors with whom they may meet.



6.0 AUSTRALIAN COMPANIES

As noted above, there are a range of Australian companies who are engaged in waste to energy and energy efficiency activities and some are listed in the Appendices.

Appendix D lists a range of Australian companies who are engaged in waste to energy and Appendix E, those engaged in energy efficiency activities.



APPENDIX A: CITY LIGHTING DATA

CITY: Denpasar

| | |
|-------------------------|---|
| PROJECT: | Street light installation and replacement program |
| RESPONSIBLE DEPARTMENT: | Cleanlines Units, Sub-units of Park & Landscape, Section Streetlighting of Denpasar Municipality |
| RELEVANT REGULATION: | Mayors Decree No. 6 Year 2002 regarding tax of street lighting, Denpasar Municipality |
| BUDGET REQUIRED: | Approximately IDR 120 billion (A\$13.4m), based on the current annual budget of IDR 8 billion (A\$0.94m) to fund new lights and retrofits |

| | LIGHT TYPE | MAIN ROADS | OTHER LIGHTS | ENERGY USE | GHG EMISSIONS |
|-----------|------------|------------------------------|--------------|------------|---------------------------|
| CURRENT | Mercury | 3,000 x 250W 3,800 x 125W | | 10,900 MWh | 8,200 t CO ₂ e |
| | Sodium | 10,200 x 125W | | | |
| | Tungsten | | | | |
| POTENTIAL | Mercury | 3,800 x 70W | | 10,000 MWh | 7,600 t CO ₂ e |
| | Sodium | 16,200 x 125W | | | |
| | Tungsten | | | | |

SUMMARY OF PROJECT:

- Many lights have already been replaced with the assistance of the Bali Urban Infrastructure Project
- Remaining phase is to replace the remaining 3,000 250W mercury lights with 125W sodium lights and install the additional 3,000 lights that the city needs.
- A small decrease in energy use (900 MWh) and an emission reduction of 600 tonnes CO₂e can be realised, while still providing additional street lighting.
- Meter panels are also required so that local communities can be charged for street lighting, which contributes to the project's financial savings.



CITY: Yogyakarta

PROJECT: Street lights management

RESPONSIBLE DEPARTMENT: Human Settlements Unit, Highway Department, Yogyakarta Municipality

RELEVANT REGULATION: Local Government Regulation No. 3 of 2002 regarding tax of street lighting, Yogyakarta Municipality

BUDGET REQUIRED: Approximately IDR 17 billion (A\$1.9m), based on cost of project so far of IDR 26 billion (A\$2.9m)

| | LIGHT TYPE | MAIN ROADS | OTHER LIGHTS | ENERGY USE | GHG EMISSIONS |
|-----------|------------|--------------|--------------|------------|---------------------------|
| CURRENT | Mercury | 7,625 x 250W | 5,325 x 125W | 8,700 MWh | 6,600 t CO ₂ e |
| | Sodium | | | | |
| | Tungsten | | 3,000 x 100W | | |
| POTENTIAL | Mercury | | 10,325 x 70W | 7,900 MWh | 6,000 t CO ₂ e |
| | Sodium | 7,625 x 250W | | | |
| | Tungsten | | 3,000 x 100W | | |

SUMMARY OF PROJECT:

- Until the end of 2006, 7,625 main road lights had been installed, there are a further 5,000 lights needed.
- Under the current plan, the project will be implemented gradually until 2011.
- Although the information provided by the city was confusing, it appears that the current main road lights are to be replaced with 250W sodium and all new lights are to be 70W mercury.
- The 5,325 125W mercury housing complex lights will also be replaced with 70W mercury lights.
- Should this be the case, an additional 5,000 lights will be installed, the overall consumption will decline by 800 MWh, saving 600t CO₂e.



CITY: Semarang

PROJECT: Street lighting

RESPONSIBLE DEPARTMENT: Park and Cemetery Department, Semarang Municipality

RELEVANT REGULATION: Local Government Regulation No 4 of 2003 which amended Local Regulation No 12 of 2001 - Street Lighting Tax

BUDGET REQUIRED: Unknown

| | LIGHT TYPE | MAIN ROADS | OTHER LIGHTS | ENERGY USE | GHG EMISSIONS |
|-----------|------------|-------------------------------|--------------|------------|----------------------------|
| CURRENT | Mercury | | | 13,500 MWh | 10,300 t CO ₂ e |
| | Sodium | 10,877 x 250W 2,830 x 125W | | | |
| | Tungsten | | | | |
| POTENTIAL | Mercury | | | 7,500 MWh | 5,700 t CO ₂ e |
| | Sodium | 13,707 x 125W | | | |
| | Tungsten | | | | |

SUMMARY OF PROJECT:

- Data from this city needs to be confirmed.
- The focus of the program since 2002 has been on the provision of additional street lighting, with only 2,830 250 W lights apparently being replaced with 125 W lights while an additional 2,264 250 W lights have been installed.
- There may be the potential to replace all 250 W lights with 125 W lights, as is planned in Denpasar.
- Semarang reports that it is in need of additional lighting and generation infrastructure to support it.
- If existing lighting was replaced, additional energy required would be offset by the energy savings of approximately 6,000 MWh.
- An emission reduction of approximately 4,600 t CO₂e could also be achieved.





APPENDIX B: CASE STUDY OF INDIAN STREET LIGHTING PROJECT

India Street Lamp Energy Efficiency Project

Purpose:

Support the implementation of an innovative financing mechanism in order to reduce the consumption of the street lighting network in the cities of Madhya Pradesh, India, by 30 to 40%.

Financiers:

1. REEEP initial and scaling up funding of \$1.57 million and £145,000 respectively
2. Co-funding from Asian Electronics Ltd
3. Econoler International
4. Indian Municipalities

Time Frame:

Initial stage – from 2005 – 2006, Scaling up to different cities – from 2007 - ongoing

Main Strategy for the Initial Stage²⁷:

1. Prepare baseline data for use in the tendering purpose for ESCO projects;
2. Develop tender documents for the benefits of the Municipal Corporation;
3. Launch the tender;
4. Select the winning ESCO to implement the project and negotiate the contract between the ESCO, Municipal Corporation and MPSEB;
5. Supervise the project implementation and insuring the fair application of the performance contracting concept by all parties;
6. Search for a carbon buyer and supporting the trade of the CERs.

²⁷ <http://www.reeep.org/index.php?assetType=project&assetId=72>



Main Strategy for Scaling Up²⁸:

1. Create a steering committee to implement the concept dissemination activities in India.
2. Prepare and disseminate the required standard documents based on the previous project including a conceptual document for internal approval in municipalities; technical, legal, financial, and other documents for City councils for bidding procedures; Request for Proposals (RFP); and Monitoring and Verification (M&V) plan and payment mechanism.
3. Seek support from local organisations.
4. Organise and deliver dissemination and capacity presentations in different states on the concept, and provide all the needed documents (in Hindi and English) to interested participants.
5. Support municipalities in utilizing the concept within their process.

Learning points²⁹:

1. Capacity building at the city level is important to realizing more city level energy initiatives;
2. Regional and city level sustainable energy initiatives provide a good starting point to have maximum impact;
3. Revenues from carbon finance have the potential to improve the business prospects of ESCOs.

Project highlight for 5 MCs

| Items | Units | Amritsar | Bathinda | Jalandhar | Ludhiana | Patiala | Total for 5 MCs |
|--|-------------------------|-----------|-----------|------------|------------|-----------|------------------|
| Baseline Data | | | | | | | |
| Number of lights points | Units | 44 000 | 11 200 | 48 500 | 77 000 | 21 300 | 202 000 |
| Connected Load | kW | 3 295 | 792 | 5 304 | 8 787 | 1 685 | |
| Annual Electricity Consumption | kWh/year | 9 621 400 | 2 312 640 | 15 487 680 | 25 658 040 | 4 861 800 | 57 941 560 |
| Post-Implementation Results | | | | | | | |
| Load Reduction | kW | 1 153 | 277 | 1 856 | 3 075 | 583 | |
| Expected Energy savings | kWh/year | 3 367 490 | 809 424 | 5 420 688 | 8 980 314 | 1 701 630 | 20 279 546 |
| Money Savings (@ 4.4 INR/kWh) | Lakh INR/year | 148 | 36 | 239 | 395 | 75 | 892 |
| Investment by ESCOs | INR Crores | 8 | 2 | 13 | 22 | 4 | 49 |
| Payback Period | Years | 5 | 5 | 5 | 5 | 5 | |
| Shares of savings to MCs | | | | | | | |
| During Payback Period (lakh) | 20% | 30 | 7 | 48 | 79 | 15 | 179 |
| After Payback Period (lakh) | 100% | 148 | 36 | 239 | 395 | 75 | 893 |
| CDM | | | | | | | |
| Annual Emission Reduction (0.81 tCO ₂ /MWh) | tCO ₂ e/year | 2 728 | 656 | 4 391 | 7 274 | 1 378 | 16 426 |
| Cumulative for 10 years | tCO ₂ e | 27 277 | 6 556 | 43 908 | 72 741 | 13 783 | 164 264 |
| Expected net revenue (@US\$ 15/tCO ₂) | INR Crores | 1.6 | 0.4 | 2.6 | 4.4 | 0.8 | 10 |
| CDM net revenue/investment | % | 20% | 20% | 20% | 20% | 20% | 20% |
| Shares between MCs and ESCO | | | | | | | to be negotiated |

²⁸ <http://www.reeep.org/showProject/655.10601504/scaling-up-a-proven-mechanism-to-implement-energy-efficiency-street-lighting-projects-in-india.htm>

²⁹ <http://webapps01.un.org/dsd/caseStudy/public/displayDetailsAction.do?code=453>



APPENDIX C: BALI WASTE PROJECTS AND UPDATE AS OF JUNE 2009

Update Report on
**Private Sector Engagement in Waste
Opportunities in Bali**
Prepared for REEEP
By
Sustainable Infrastructure Bali

June 2009





INTRODUCTION

This brief up date study has been prepared for REEEP to review the opportunities previously presented in November 2007.

The aim of the previous study is to clearly define the prevailing situation with regard to solid and liquid waste disposal and identify development opportunities or initiatives that may exist. Opportunities that are likely to have a positive impact with respect to climate change issues are preferred. Particular attention was also paid to projects or opportunities where there is a strong possibility of private sector engagement.

SOLID WASTE IN SOUTH BALI

NOEI Project

PT Navigat Organic Energy Indonesia (NOEI) project is located within TPA Suwung. In November 2007 they were 22 months into a 5-year development plan to win energy from the incoming municipal waste. At that stage NOEI had recently changed hands and was owned by the Manunggal Energi Group. This is unchanged.

The NOEI project was originally based upon a high rate slurry digestion system. However, no CDM methodology was secured for that style of anaerobic digestion and NOEI resorted to more conventional waste decomposition in rotating cells (similar to a conventional municipal landfill with shortened retention times). CDM registration was secured for the Project Design Document (PDD) on 20 May 2007. This process is based on the expectation that the putrescible waste with continuous leachate circulation will substantially decompose in 3.5 months (say 105 days) in these large cells.

In addition to this NOEI intend to develop a high rate Pyrolysis/gasification plant which will involve waste drying, shredding, gasification (driving off energy rich volatiles @ 850°C) and direct firing of these volatiles to produce steam for power production. This element of work will be completed as part Phase III and Phase IV.

The plant has been designed for 1,000 tonnes a day capacity and the original energy production targets for each phase and process are shown in Table 1 below:



Table 1

Energy production targets from the NOEI Project

| Phase | Date | Cumulative tonnes of organic waste /day | MW | Source |
|-------|---------------|--|-----|-----------|
| I | March 2008 | 320 | 1.0 | Biogas |
| II | August 2008 | 800 | 1.0 | Biogas |
| III | August 2009 | 800 | 2.0 | Biogas |
| III | August 2009 | 800 | 2.8 | Pyrolysis |
| IV | December 2010 | 1,000 | 2.8 | Pyrolysis |
| Total | | 1,000 | 9.6 | Combined |

In December 2008 NOEI started to supply PLN with power generated from the temporary landfill – this is conventional technology mining the existing landfill mass. At this time it is reported that they average about 500 kW of continuous power generation and this fluctuates with local rainfall. This is 50% of the predicted output.

In November 2007 it was believed that the design of the high rate system was flawed. This opinion has not changed and as off June 2009 little progress has been made. The large above ground cells (58 m x 20 m x 12 m) which were under construction in May 2007 have been completed and are currently being filled with unsorted municipal refuse to test their structural integrity. On 15 July 2009 they plan to start generating 2 MW for PLN. This is not possible. The unsorted waste mass will not generate the sort of methane levels required and will only be partially decomposed by that time. It is believed that unsorted waste has been used because the sorting facility is unable to be commissioned.

NOEI have been unable to demonstrate any real grasp of the required technology and its probable this project will fail. There is no reason to believe the pyrolysis project is any better off. This in itself presents an opportunity to any company with a genuine understanding of the required technology.

Opportunities in Solid Waste related services

Opportunities in Solid Waste services are still focused on TPA Suwung. The development landscape was enhanced by the proximity of the adjacent real estate project. Unfortunately that project has stalled in the current economic climate but the project owners are financially solid and the project will proceed when prevailing economic conditions improve. It is essential for them that TPA Suwung is cleaned up and a comprehensive waste handling facility established. It is very unlikely that NOEI will be able to do this.

Opportunities reported November 2007 were as follows:

- Rehabilitating the existing waste mass at Suwung (estimated to be 1,440,00m3).





- Establishing a compost facility for bulk sales to the adjacent development.
- Taking over NOEI and the anaerobic digestion process
- JV assistance to Jimbaran Lestari (not directly associated with TPA Suwung)

These opportunities are briefly discussed in section 2.2.1 – 2.2.4 below with the inclusion of an additional section on Temesi Composting as 2.2.5:

Rehabilitating the existing waste mass

The existing waste at Suwung is estimated to be around 1,440,000 m³. It is up to 12 m deep, with an average depth of around 6m, and is spread over a 24 hectare site. The waste mass has never been effectively separated from the adjacent mangroves and the edge of dump forms a 'shoreline' with the waters of Benoa Bay that is around 1km in length. The leachate from the mass has been mixing with the tidal/estuarine waters of Benoa Bay for many years.

NOEI have been mining methane from the new waste but significantly more work is required to rehabilitate the entire site. When the economic situation improves it is likely that the real estate development group, BTID will be receptive to the costs of capping the existing dump but would, in all likelihood, seek support to rehabilitate the total dump mass. It is estimated that the cost of rehabilitating the waste mass would be in the order of 2 -3 times the cost of capping the same mass.

Composting facility

The adjacent real estate development has a need for significant quantity of soil conditioner or mixed green-waste compost. It has been calculated that they could absorb up to 1,650,000 m³ over the next 7 years. Given the waste volumes predicted this development could absorb the entire green waste/ putrescible organics waste stream for over 4 years.

It is surprising that this opportunity has not been pursued. BTID have planted thousands of pioneer species on the island with a view to developing a humus mass naturally. This could take many years. It is probable that neither party truly understand how to develop this opportunity.

Taking over NOEI

The fact that PT Navigat Organic Energy Indonesia is still operating in Bali and other parts of Indonesia suggests they are in fact well funded. However, the technical challenges raised above appear to be well founded and it is believed that PT Manunggal Energi Group would

probably be interested in exiting the project. It is possible that the current infrastructure could be secured for a fraction of the capital value.

Jimbaran Lestari.

Jimbaran Lestari is a privately owned waste collection company that recycles, composts, and disposes of residue waste. It was established in Jimbaran, Bali in 1995 with the help of a local environmental NGO (Wisnu Foundation), in response to the illegal dumping by the hotel industry. In November 2007 Lestari was processing waste from over 27 international and regional hotels as well as a dozen small businesses.

Lestari have taken on expatriate technical support and are making good progress. They now have in excess of 30 large commercial clients, have expanded their MRF-composting facility, and now produce on average 30 tons of compost/month

They have also secured the contract for the Jimbaran Municipality to manage the waste of the district of 25,000 people. (5,000 households) and they have expanded their fleet of vehicles to over 25 collection vehicles.

The collapse of the recycling market due to global economic slowdown as well as imported recycled waste entering Indonesian markets is challenging.

Temesi Composting

A community-based project in Ubud called the Gianyar Waste Recovery Project is endeavouring to develop an economically viable solution for waste treatment in the Regency of Gianyar with its 500,000 inhabitants, which can be replicated in the region.

It is their aim to fund the project out of greenhouse gas reductions under the Kyoto protocol's Clean Development Mechanism. The aim is a processing capacity of 20,000 tonnes of waste per year. In 2008, the Gianyar Waste Recovery Project was first among 13 projects selected from 353 proposals as a 'Showcase Project'. This award by the ROAP/APEED of the UN Environment Programme included a US\$30,000 grant to be used for further technology transfer.

The project has a US\$ 140,000 pilot plant for waste recovery with a capacity of 4 tonnes per day. The second phase of the project is to move from 4 tonnes to 60 tonnes per day. The added capacity will allow processing all waste collected from the 500,000 inhabitants and tourists of the Regency of Gianyar, to which Ubud belongs.



SEWAGE DISPOSAL IN SOUTH BALI

Opportunities in Sewage related services

Opportunities in Sewage development were previously reported as follows:

- Improved treatment services to Commercial & Industrial users
- Improved the sludge disposal services
- Sanitation to the ultra-poor
- Improving the DSDP sewage treatment plant

It is now believed that only 'Improved Treatment Services to Commercial & Industrial Users' justifies any sort of consideration and that must be weighed against the prevailing economic climate.

The industrial and commercial sector is still poorly served from a technical perspective and there are opportunities in turn-key waste treatment offering easy to operate, effective waste water treatment solutions. However the regulatory and enforcement environment is still weak and until that changes meaningful opportunities will be few and far between.

Improved sludge disposal services

It is clear that the demand for sludge disposal exceeds the proposed 100 m³/day plant and the demand is expected to be in the order of 350 m³/day. It is probable that 2 or 3 additional 100 m³/day sludge handling facilities strategically located in South Bali would be an appropriate solution.

However, current fee regimes and links to local Government Sanitation services would suggest that meaningful development would be challenging.

Sanitation to the ultra-poor

It has been shown that a tiny % of the population (estimated to 2% or ~40,000 people) have no access to proper sanitation. This small group are generally ultra poor and simply cannot afford to build latrines or have no fixed abode and as such have no access to sanitation. This group have a disproportionately high impact on the local public health of South Bali. As a group their general health is poor and casual contamination from this group carries a high risk of pathogen transfer.





In 2002 it was proposed that some 1,400 latrines be strategically located around South Bali. It was estimated these could be built for as little as AU\$500 each. This is likely to be an aid funded project that will not be considered further at this time.

Improving the DSDP Sewage Treatment Plant

The current reticulation system should be extended and the capacity of the sewage treatment plant increased. DSDP have plans to both extend the reticulation network (2025) and increase the capacity of the plant from 51,000 m³/day to 94,000 m³/day. (2010).

Although the DSDP facility is an energy hungry aeration plant that utilises a large number of float mounted mechanical aerators to treat the incoming sewage it is unlikely that the DSDP would be able to respond favourably to third party proposal to improve the process for financial benefit. This project will not be considered further at this time.



SELECTED ARTICLES ON BALI'S WASTE

Bali starts clean, garbage-fired electricity generation project

Luh De Suriyani, Contributor, Denpasar | Fri, 09/05/2008 11:33 AM | Bali

A garbage-fueled power plant at a dumpsite on Jl. Bypass Ngurah Rai has begun supplying electricity to state-owned electricity company PT PLN.

The plant, called the Sarbagita integrated garbage processing installation project, is located at the Suwung garbage dump, about 10 kilometers from downtown Denpasar.

Its launch date was delayed for four years for reasons unknown.

The project, launched early last month, is expected to produce 2 megawatts (MW) of electricity this year, increasing to 9.6 MW by 2010.

"We hope all systems will begin functioning in early November," Budi Mulyanto, project manager of PT Navigat Organic Energi Indonesia (NOEI), a joint venture with General Electric, which manages the project, said Thursday.

PT NOEI applies an integrated garbage processing technique, including gasification, landfill use, and anaerobic digestion, he added.

In its initial steps, the plant will process garbage from 68 dump trucks each day, equal to about 600 cubic meters of waste, Budi said. At full capacity, the plant is expected to process about 12,000 tons of garbage a day from Denpasar municipality and Badung, Gianyar and Tabanan regencies.

As of Thursday, a landfill cell had been constructed, with informal trash collectors seen separating non-organic waste, such as plastic, paper and metal.

"We still need trash collectors to separate waste before it's processed. We will be employing those who used to collect trash informally," he added.

As he explained, most of the garbage at the Suwung dumpsite was piled in the open air, an inefficient system, as it relies on limited separation performed by informal collectors. The result was pollution of the surrounding areas, he added.

Construction of the plant constitutes Bali's first foray into the clean development program, designed to reduce global warming, Budi added.

According to the program, discussed at the UN Framework on Climate Change (UNFCCC) in Nusa Dua last year, developing countries will receive financial benefits for their efforts to reduce gas emissions, with reduced emissions "purchased" by developed countries.

As methane gas from garbage is considered the greatest environmental threat, waste processing has been given priority in the effort to reduce global warming.

Made Suarnatha, director of the Wisnu Foundation, an environmental NGO in Bali, hoped the clean development program would also provide local communities with a sense of justice.

"Besides helping reduce the effects of climate change, we have to struggle on behalf of a kind of 'climate justice', for the sake of improving living conditions in local communities," he said.

For climate justice to be achieved, separation of household garbage has to be intensified, he added.





"I will offer a material recovery facility system in which residents will separate the garbage in order to resell certain components of the waste, while the remainder will be transported to the garbage dump," Suarnatha said.

Jimbaran Lestari turns piles of trash into piles of cash

Wasti Atmodjo, Contributor, Denpasar | Sat, 09/06/2008 11:26 AM | Bali

A private company, PT Jimbaran Lestari, proves that waste management and processing can be a profitable business in Bali.

The company, which pioneered large-scale commercial waste management and processing on the island, was established in 1994.

In its early stages, it received generous assistance from the Wisnu Foundation, a leading local environmental NGO.

"At that time, we campaigned hard to promote responsible and sustainable waste management. The campaign specifically targeted the island's growing tourism industry," Wisnu's Chairman Made Suarnatha recalled.

Tourism produced a huge amount of waste, but most of it had not been managed in a responsible manner.

Wisnu's activists found and documented several hotels and restaurants that dumped their garbage at public sites without processing them first.

"Our campaign ran along the line, 'Treat waste as an asset not a liability', but we needed private enterprise to make that a reality since Wisnu is a non-profit organisation. During that campaign, PT Jimbaran Lestari expressed its readiness to be our partner," he added.

In the initial stages of the partnership, PT Jimbaran Lestari constructed the proper waste management and processing facilities while Wisnu lobbied numerous hotels in the Nusa Dua and Jimbaran areas to participate in a mutually beneficial relationship with the company.

Today, PT Jimbaran Lestari offers a comprehensive waste management and processing service to a growing number of clients. Its services include composting, recycling and waste separation and selection.

Co-owned by Nyoman Sutarman and his wife Made Seni, it now operates a main processing plant on a two-hectare plot right in the middle of a housing area in Jimbaran.

Unlike ordinary garbage sites, which are characterised by their pungent odors and large fly population, this plant is clean and relatively free from obnoxious smells. It is no wonder that its surrounding neighbors have never registered a complaint regarding the plant's presence.

"We have a strict policy on transporting garbage in and out of the plant. This has succeeded in keeping bad odors at a minimum level," the company's program manager Stephen D Wattimena said recently.

First of all, the garbage must be inside sealed plastic containers during transport. Also, when transporting garbage, the trucks are always fully covered with thick sheets of tarpaulins. The tarpaulins prevent the containers from accidentally falling out of the trucks.





"Therefore, it only smells bad in the loading and unloading stages and we have tried to minimise this time by training our employees to complete these stages as quickly as possible," he said.

Inside, the front of the plant looks like any ordinary office, with its glass door, smiling receptionists in the lobby and air-conditioned working spaces and meeting rooms.

The real work is conducted in the spacious area behind the plant's administrative offices.

The unloading area is separated into several stalls, which bare the names of popular tourist establishments in Bali, such as the Conrad, Bulgari and Hard Rock hotels.

Once the garbage is unloaded, the workers immediately set about the laborious work of separating the organic waste from the inorganic. If they find an intact eating utensil, such as a fork or a spoon, then it will be placed in a special container.

"We will return those objects to the respective hotels or restaurants. Its part of our contract with the clients. We will send back to them any object that, in our opinion, is not garbage," Wattimena stressed.

Inorganic wastes are then packaged and sent to various factories in East Java for further recycling while the organic wastes are transported to the composting facility at the far corner of the plant.

"Once the composting process is over, we will send the compost to the hotels where the organic waste originally came from," he added.

This scheme gives the hotels and restaurants the opportunity to fertilise their gardens using compost from their own organic garbage.

"In this context, we help the hotels and restaurants process their organic waste for further use. Ten kilograms of waste will produce seven kilograms of high quality compost," he said.

The company's composts are in high demand, but it has limited production capacity. Currently it is only able to meet its clients' demands.

PT Jimbaran Lestari serves up to 30 hotels and restaurants in Jimbaran, Nusa Dua, Kuta, Sanur and Denpasar. It also caters to dozens of pig farmers.

"Each day our plant produces up to 2,500 liters of organic liquids. The farmers feed these liquids to their livestock which we sell to them at the very reasonable price of Rp 5,500 (58 US cents) per 25 liters," he said.

The waste management company has grown into a large-scale business that operates a fleet of eight trucks and is staffed with 40 workers. It has also started another initiative: Community-based waste management in Jimbaran village.

"For us, garbage is not garbage -- garbage is money," he underlined.



Bali to produce power from organic garbage

Irawaty Wardany, The Jakarta Post, Denpasar | Wed, 25/06/2008 10:32 AM | Bali

Bali will be the first province in the country to produce electricity using organic garbage, with zero waste.

PT Navigat Organic Energy Indonesia, an British-based power company is developing an installation in Suwung final waste site in Denpasar, using 10 hectares of land granted by the provincial administration.

"We are developing a waste-driven power plant that we call Integrated Waste Management (IPST) Sarbagita, an acronym for Denpasar, Badung, Gianyar and Tabanan," Navigat Organic Energy president director Soeyoto told The Jakarta Post on Tuesday.

Those four regencies have agreed to provide all necessary facilities, including garbage supply, he said.

"We will need 800 tons of garbage a day, from four regencies (Denpasar, Badung, Gianyar and Tabanan) to be used as raw-material for the power plant," Soeyoto said.

The plant, with a total investment of 20 million Euros (more than US\$31 million), would use Galfad technology (gasification, landfill gas and anaerobic digestion) from the United Kingdom to create electricity.

"After we receive waste from the four regencies, we will separate the organic from inorganic waste," he said.

The wet organic waste, he said, would be crushed, dried and later be transformed into compost and would undergo a process called anaerobic digestion, to produce gas.

While the dry organic waste, he said, would go through pyrolyses and gasification processes.

Gasification is the process of converting biomass into combustible gases using a thermal process. This process will produce synthetic gas which can be converted into electricity after undergoing a process in a boiler machine.

"The whole process will yield zero waste," he said, adding that the project would be conducted in phases.

"In the first phase, we will produce two megawatts of power this October," he said.

The second phase in June 2009, they would double the production into four megawatts and 9.6 megawatts in 2010, he said, adding that his company had made a deal with the state-owned PT PLN to supply electricity to Bali.

"We signed an agreement with PLN in Nusa Penida yesterday," he said.

Soeyoto said Similar technology was already being used in other countries but they had not put it together into an integrated system like the one in Bali.

Separately, PLN Bali distribution office head Sudirman said that he expected the waste-driven power project would help PLN save money.





1 Mn. Cubic Meters of Trash and Only One Place to Go Denpasar Officials Reveal How They Handle a Massive Amount of Garbage and Trash.

(from Bali Discovery Tours see <http://www.balidiscovery.com>)

(5/30/2009) *Kompas.com* reports that each month some 75,000 cubic meters of trash and waste materials – a figure approaching 1 million cubic meters in a year – are generated by the people living in Bali's capital of Denpasar and surrounding areas.

The Head of Bali Hygiene and Parks Service, I Ketut Wisada, told the press, "the production of useless waste – similar to other major cities in Indonesia – totals 2,500 cubic meters each day in Denpasar, generated from households and commercial companies in the city."

According to Wisada, the production of trash has increased dramatically in the past 2 years from a previous average of 2,000 tons a day. This increase is attributed to a growing population base and the larger component of disposable trash generated by businesses and households.







Wisada said Denpasar sends all its trash and garbage waste to the rubbish tip (TPA) located in the Suwung area, adjacent to the port of Benoa.

Performing the job of rubbish removal and management of the TPA involves a total of 1,753 workers. A further armada of 38 dump trucks perform a minimum of 4 round trips each day to carry waste materials to Suwung. Or, in other words, city garbage workers make a minimum of 150 trips each day in their never-ending effort to accumulate unwanted rubbish to the massive garbage tip in the City's southern region.




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APPENDIX D: AUSTRALIAN COMPANIES IN WASTE TO ENERGY

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| <p>AGL</p>  | <p>AGL has a diverse power generation portfolio including base, peaking and intermediate electricity production plants. These are spread across traditional energy sources (gas and coal) as well as renewable sources (such as hydro, wind, landfill gas and biogas). AGL owns and operates several renewable landfill gas and biogas (sewage) generation facilities across Australia. http://www.agl.com.au/about/companyoverview/Pages/default.aspx</p> |
| <p>Diamond Energy</p>  | <p>DIAMOND ENERGY is a specialist company that is experienced in developing and delivering accredited renewable electricity generation, cogeneration/tri-generation and interruptible load projects. Through a strategic investment and a joint venture with Lend Lease Ventures Pty Ltd (a fully owned subsidiary of Lend Lease Corporation), Diamond Energy is also participating in a number of projects across the Australian Lend Lease project portfolio, with the mandate to provide low and/or nil carbon energy solutions. Projects include biogas, agricultural and wood waste, wind, wave, through to natural gas cogeneration / tri-generation and interruptible load. http://www.diamond-energy.com/about-us.html</p> |
| <p>Earth Power</p>  | <p>EarthPower is Australia's first regional food waste to energy facility in Sydney. EarthPower accepts source segregated food wastes from the industrial, commercial and domestic sectors and converts them to green energy and nutrient rich fertilisers using state of the art technology. http://www.earthpower.com.au/index.asp</p> |
| <p>Energy Developments Ltd</p>  | <p>Energy Developments is an Australian based renewable and remote-area energy supplier with international operations. The Company's headquarters are located in Queensland, Australia with operations in Australia, the United States, Europe and the United Kingdom. Energy Developments is involved in project development, finance, design, construction, operation and maintenance of international small scale power-generating and energy delivery projects. The Company owns and operates 74 power stations and has total installed generation capacity of 552MW (as at 30 June 2008). Energy Developments has four core business areas:</p> <ul style="list-style-type: none"> ▪ Landfill Gas (LFG) power generation; ▪ Coal Mine Methane (CMM) power generation; ▪ Remote-area power generation; ▪ Liquefied Natural Gas (LNG) and Compressed Natural Gas (CNG) power generation and associated energy solutions. <p>http://www.energydevelopments.com.au</p> |





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| <p>Energy Impact</p>  | <p>Energyimpact is committed to the development of renewable energy projects in Australia, with technical, commercial and energy trading elements to design, build and maintain renewable energy products such as biomass generation sites, solar energy and wind energy. Energyimpact can develop sites from conception to completion with confidence and speed, and with financial backing and long term vision.</p> <p>Proven ability in six operational landfill sites throughout Australia:</p> <ul style="list-style-type: none"> ▪ Established track record in running gas turbines and steam equipment ▪ Long term experience in managing green incentive schemes ▪ Long term experience in trading energy ▪ Commitment to sustainable energy sources ▪ Technical expertise in mechanical, chemical, civil and electrical engineering ▪ Assessment of technical viability of projects ▪ Development and financial expertise to assemble viable packages <p>http://www.energyimpact.com.au/renewable_energy/index.html</p> |
| <p>Landfill Gas & Power</p>  | <p>Landfill Gas and Power Pty Ltd (LGP) is a private company owned by ACE Holdings. Since its inception in 1993, Landfill Gas and Power Pty Ltd (LGP) has established itself as a market leader in the development and management of efficient waste-to-energy technologies. This West Australian company generates huge savings for its clients – and the environment – as it extracts landfill gas and converts it into a safe, clean and reliable renewable energy source, also referred to as environmentally friendly electricity.</p> <p>LGP extracts landfill gas (methane) and converts it into a safe, clean and reliable, renewable energy source. It manages the gas emissions from six landfill sites and also operates four waste-to-energy Power Stations, which are located adjacent to these landfill sites.</p> <p>http://www.landfillgas.com.au/</p> |
| <p>Landfill Management Services</p>  | <p>LMS is a specialist landfill gas and power generation company. In 1982 the company principals pioneered the collection and conversion of landfill gas to energy in Australia. Having invested extensive resources in the on-going development of intellectual property for landfill gas management and power generation, LMS technologies are now utilised throughout the world.</p> <p>LMS is managed by a qualified team with experience in landfill gas, bio gas, coal gas, power generation, energy trading, emission trading, power purchase agreements, and the commercialisation of new technologies. The management team has extensive project development experience encompassing significant landfill gas and energy infrastructure projects throughout Australia, Malaysia, China, Korea, North America, United Kingdom and Europe.</p> <p>http://www.lms.com.au</p> |



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| <p>Stratcon Australia Pty Ltd</p> <p>Stratcon Singapore Pte Ltd</p>  | <p>Renewable Energy</p> <ul style="list-style-type: none"> • Conversion of liquid and solid digestible wastes from a range of sources (cassava processing, palm oil processing, organic fraction of municipal solid waste, piggeries, cattle yards and fish processing) to biogas which can be converted to power and heat energy which displaces grid power and fuel oil whilst earning Carbon Emission Certificates (CERs) under the Clean Development Mechanism of the Kyoto Protocol. • Conversion of solid biomass (from rice husk, timber scraps and other homogeneous cellulose sources) to syngas to displace diesel fuel for power generation. <p>Energy Efficiency</p> <ul style="list-style-type: none"> • Upgrading of existing air-conditioning systems with catalyst to provide lower pumping energy and higher heat transfer. IceCOLD has achieved approximately 15-20% savings on energy use for the same heat load. • Power Management Systems to more efficiently share phase loading for high current applications and allocate loads. • Complete review of existing energy use and advisory on reduction in energy foot print and provision of ESCO services. <p>The Sustainable Built Environment</p> <ul style="list-style-type: none"> • Development of any type of built asset with review of the use of energy, water and materials. • Review of the designed foot print for gas, liquid and solid inputs and emissions. • Use of various techniques to minimise the impact of heat, fire and solar radiation. • Provision of quantifiable outcomes to show impact of asset modifications. <p>Research and Development</p> <ul style="list-style-type: none"> • Commercialisation of process to fire sludges to produce bio-continuous media. • Conversion of Palm Oil Solids Wastes into usable products including fertilisers, composts, animal feeds, algae and fish. <p>Biofuels</p> <ul style="list-style-type: none"> • Distillation of various feed stocks into bio-ethanol (1st Generation biofuels). • Conversion of fish fats to biodiesel (1st Generation biofuels). • Conversion of algae into biodiesel (1st Generation biofuels). <p>http://www.stratcon.net http://www.enviwan.com</p> |
| <p>Transpacific Energy TransPacific Energy, Inc.</p> | <p>TransPacific Energy (TPE) is a high-tech corporation that designs, builds, owns, operates, sells and installs proprietary, modular Organic Rankine Cycle (“ORC”) utilising multiple refrigerant mixtures to maximise heat recovery and convert waste heat directly (75F to 900F) from industrial processes, solar and geothermal converting it into electrical energy.</p> <p>TPE technology can also be utilised as alternative to cooling towers and use heat released to generate electricity.</p> <p>http://www.transpacenergy.com/</p> |
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| <p>Veolia Environmental Services</p>  | <p>Veolia Environmental Services is the Waste Management and Industrial Services arm of the VE Group with Key Services as listed:</p> <ul style="list-style-type: none"> • Liquid and Solid Waste Management • Recycling and Resource Recovery • Industrial Services including Facilities Management • Municipal and Council Waste Collections <p>http://www.veoliaes.com.au/</p> |
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| <p>Verve Energy (Biomass)</p>  | <p>Verve Energy has five major power stations - Muja, Collie, Kwinana, Cockburn and Pinjar north of Perth. We also have wind farms at Albany and Esperance, and biomass and solar facilities. Verve Energy was created in April 2006 when Western Power separated into four businesses as part of the State Government energy market reforms.</p> <p>http://www.verveenergy.com.au/index.html</p> |






APPENDIX E: AUSTRALIAN COMPANIES IN THE FIELD OF ENERGY EFFICIENCY

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| <p>Auzion Pty Ltd</p>  | <p>Auzion’s vision is to create sustainable communities by investing into technology that has long-term environmental and economic benefit. Operating out of the University of Sunshine Coast's Innovation Centre we are well connected to leading expertise in environmental research.</p> <p>Auzion have leaders and innovators in the solar energy and sustainability management industry, and provide a range of products and services to meet the requirements of today’s consumer based society. Balancing energy consumption, comfort levels and the health of our planet is becoming a challenge, and Auzion aims to provide Australians with the vision and practical products and services to realistically make a difference.</p> <p>http://www.auzion.com/</p> |
| <p>Centre for Sustainable Energy Systems (ANU)</p>  | <p>CSES is a large research group of staff and PhD students developing breakthrough technologies in the areas of photovoltaics, solar thermal power and solar energy systems.</p> <p>Another role of CSES is to liaise with industry partners to assist in the commercialisation of new technologies emerging.</p> <p>http://solar.anu.edu.au/cses.php</p> |
| <p>Conergy</p>  | <p>Conergy manufactures and distributes components and systems for generating solar electricity, solar hot water and wind power for domestic, commercial, small community and industrial applications. We are your trusted renewable energy partner.</p> <p>Conergy Australia is a subsidiary of Germany's Conergy AG – one of the largest suppliers and system integrators of solar power in Europe and beyond since 1998.</p> <p>http://www.conergy.com.au/DesktopDefault.aspx</p> |
| <p>Cool nrg International</p>  | <p>Cool nrg was founded in 2007 in response to the global climate crisis. Cool nrg designs, develops and delivers innovative energy efficiency action. Ground-breaking campaigns reach millions of consumers worldwide. Cool nrg campaigns save energy and money by bringing energy efficiency action direct to consumers in developed markets. They help to combat both climate change and fuel poverty.</p> <p>CDM-DEE – Cool nrg’s Clean Development Mechanism - Domestic Energy Efficiency (CDM-DEE) programmes through the UN’s Kyoto Protocol – bring energy and financial savings to citizens and governments in the developing world. They tackle the twin global threats of climate change and extreme poverty.</p> <p>http://www.coolnrg.com/index.html</p> |







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| <p>CSR Ltd</p>  | <p>CSR Limited (CSR) is one of Australia’s leading manufacturing companies with operations throughout Australia as well as in Asia and New Zealand. Through its three principal businesses, CSR is a leading supplier of building products and sugar and holds an effective 25% interest in the Tomago aluminium smelter. CSR is also developing a number of former industrial sites for future land sales. Each of the CSR group’s businesses has leading or established positions in its target markets. Originally founded in 1855 as a sugar company, CSR is one of Australia’s oldest companies, with a proven record of consistent returns and strong cash flow.</p> <p>Within Building Products, CSR is a leading supplier to the construction industry - supported by a nationwide distribution network. CSR manufactures and supplies a wide range of building products including Gyprock™ plasterboard, Cemintel™ fibre cement, PGH™ bricks, Monier™ rooftiles and Bradford™ insulation with 35 wholly owned or majority owned manufacturing plants in Australia and operations in New Zealand and Asia. CSR has also recently announced a new name in glass, Viridian™.</p> <p>http://www.csr.com.au/Corporate/default.asp</p> |
| <p>CVC Sustainable Investment</p>  | <p>Climate change, resource shortages, pollution, and the effects of increased urbanisation are increasing concerns both in Australia and globally. As a result, business, government, and the community are driving the use of more efficient and environmentally sustainable technologies and business practices to fuel future economic growth and reverse existing environmental damage.</p> <p>CVC Sustainable Investments is dedicated to investing in expansionary companies operating in this market - businesses dedicated to addressing environmental problems, developing or utilising clean technologies or whose operations cause little or no environmental damage.</p> <p>Their objective is to create a diversified investment portfolio that generates strong returns on invested capital while delivering meaningful and measurable environmental benefits.</p> <p>http://www.cvc.com.au/cvcsi/index.php</p> |
| <p>Energy Strategies</p>  | <p>Energy Strategies is a nationally recognised leader in providing analysis and advice on the sustainability of energy systems at all levels from the global down to individual projects and buildings. We have been centrally involved in the formulation of national energy policy since establishment (initially as Energy and Economic Analysis Pty Ltd) in 1982.</p> <p>The company has been involved in the convergent study of the environment and energy systems for nearly twenty years, analysing the links between them and providing advice on the development and implementation of government and corporate policies, and post-implementation evaluation of policies and programs.</p> <p>Growing out of our broader experience in the environmental impacts of energy systems, we have been closely involved in analysing greenhouse gas emissions and shaping policy responses to</p> |






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| | <p>greenhouse concerns since 1989. Energy Strategies is internationally recognised for its expertise in methodologies for compiling greenhouse gas emissions inventories. http://www.enerstrat.com.au/</p> |
| <p>Fletcher Insulation</p>  | <p>Fletcher Insulation is Australia's leading insulation company supplying our favourite insulation brands through well established distribution channels. Fletcher Insulation has a strong pedigree dating over half a century.</p> <p>Fletcher Insulation have invested heavily in Green manufacturing processes with plants now utilising a cleaner, greener furnace to produce molten glass for the manufacture of glasswool insulation. The INTECH melters were developed in house and are much more energy efficient than the gas fired furnace they replaced. Unlike their predecessors, these melters do not emit any carbon dioxide or nitrous oxide and the bulk of the emissions from the stack is steam.</p> <p>Other environmental initiatives Fletcher Insulation has embraced include using approximately 70% recycled glass in its process. This is glass that would have otherwise gone to landfill.</p> <p>Special filters on the furnace stack reduce airborne particles by 98% and these collected particles are then reused in the furnace feed. This further reduced the pollution in the environment.</p> <p>http://www.insulation.com.au/</p> |
| <p>Global Sustainable Energy Solutions</p>  | <p>Global Sustainable Energy Solutions (GSES) is a consortium of Renewable Energy System Engineers, Designers and Installers. GSES utilises the experience of established businesses to develop sustainable energy solutions which meet the needs of individuals and communities throughout the world. These solutions are supplied through the provision of training, consultancy services, project management, and formation of joint venture enterprises within the host country. GSES supports renewable energy businesses to grow and develop, and at the same time help develop the infrastructure in-country to facilitate the growth and development of a renewable energy industry. GSES is also involved in training people and furthering the renewable energy industry within Australia, through being part of various committees and groups, and also providing training to a variety of people.</p> <p>http://www.gses.com.au/</p> |
| <p>Green Smart Electrical Pty Ltd</p>  | <p>GreenSmart Electrical is committed to the highest quality service for our customers with the latest information and advice regarding energy efficient solutions for home, schools and business. With over 20 years of experience, we specialise in design and installation of Grid Connect Solar power and hot water systems to suit your needs.</p> <p>GreenSmart Electrical offers advice regarding rebates for installation, energy efficient lighting, monitoring the cost of electricity usage in your home, viable reduction of greenhouse gas emissions and tips on how to reduce your power bills.</p> <p>http://www.greensmartelectrical.com.au/</p> |






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| <p>Low Energy Supplies and Services</p>  | <p>Low Energy Supplies and Services Pty Ltd (LESS) is an Australian company that delivers energy and water savings to generate real financial and environmental benefits. LESS is a leading innovator in creating and delivering energy efficiency and demand management programs in Australia.</p> <p>Their expertise is in the large-scale distribution of domestic energy and water efficient products either direct to householders or through public and private sector clients.</p> <p>Founded in 2001, LESS has been directly responsible for almost two million tonnes of carbon abatement and water savings of over four gigalitres per annum.</p> <p>Since their foundation we have provided energy-saving light bulbs and showerheads to over 200,000 homes in NSW in partnership with over 50 metropolitan and regional councils, metropolitan and regional water companies as well as energy utilities, NGOs and charities and businesses.</p> <p>http://www.lowenergy.com.au/</p> |
| <p>Measurement Engineering Australia Pty Ltd</p>  | <p>MEA designs and manufactures environmental monitoring systems including:</p> <ul style="list-style-type: none"> • Automatic Weather Stations which measure climate conditions for use in agriculture, research, education, wind energy surveys, mining, pollution management and environmental policing. • Soil Moisture Monitoring Systems which provide critical irrigation and crop management information to agriculture. • Water Quality and Flow Systems which provide key information for the management of water distribution systems, river systems and waste water. • Custom Designed Systems <p>In addition to the standard product line, MEA designs and manufactures project specific, customised, measurement systems.</p> <p>http://www.mea.com.au/</p> |
| <p>Nickel Renewable Energy</p>  | <p>Nickel Renewable Energy installs renewable energy technology throughout the North Coast of NSW and South East Queensland. They want to enhance our community's sustainability and wellbeing. Their Vision is to power our region with clean renewable energy.</p> <p>http://www.nickelenergy.com.au/</p> |
| <p>PB Power</p>  | <p>Parsons Brinckerhoff (PB) is one of the world's leading planning, environment and infrastructure firms. In Australia and New Zealand their work spans nation-building projects in transport, power, renewable energy, urban development, water, and resources and industry. PB's comprehensive services include strategic consulting, environmental studies, design, construction management, and project and program management PB Australia-Pacific is an integral part of PB's 13,000-strong global team working in 150 offices across six continents.</p> <p>http://www.pb.com.au/</p> |



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| <p>Power Up Solar Pty Ltd</p>  | <p>PowerUp Solar is dedicated to providing environmental solutions to the community which will promote sustainable living. We believe that through public awareness promoted by educational material, positive outcomes for the environment can be achieved. In order to achieve this goal, PowerUp Solar will provide \$1,500 educational package to all schools that take up the \$50,000 grant through the National Solar Schools Plan by the 30th September, 2008. PowerUp Solar brings with it 20 years experience in solar and electrical mechanics that will ensure all installs are completed to a high standard, backed by a national guarantee. In order to ensure a seamless experience, all facets of the solar installation are designed in-house and assembled by our team of BCSE accredited members. http://www.powerupsolar.com.au/about.html</p> |
| <p>Quantum Energy Technologies Pty Ltd</p>  | <p>Quantum is Australia's leading manufacturer of advanced renewable solar energy hot water, pool and building heating products. The Quantum story is based on innovation and the quest to harness renewable energy to produce sustainable hot water. The University of Melbourne with extensive research pioneered the development of heat pump technology for the production of hot water in the mid 70's. The technology has been progressively developed, and Quantum now produces hot water heaters, pool heaters as well as residential, commercial and industrial building heaters. With over 30 years of on-going product development of a proven technology, Quantum is able to confidently provide worry free operation and product reliability. Quantum hot water heat pumps will deliver customers financial and environmental benefits for many years to come. http://www.quantumenergy.com.au/</p> |
| <p>Robert Bosch (Aust) Pty Ltd</p>  | <p>The Bosch Group is a leading global supplier of technology and services. In the areas of automotive and industrial technology, consumer goods, and building technology, some 280,000 associates generated sales of EUR 45.1 billion in fiscal 2008. The Bosch Group comprises Robert Bosch GmbH and its more than 300 subsidiaries and regional companies in over 60 countries. Bosch Australia and New Zealand activities' encompass all three business sectors listed below.</p> <ol style="list-style-type: none"> 1. The Household Appliance Division in Australia forms part of the BSH group (Bosch and Siemens Hausgeraete GmbH) and is one of the most successful international brands in whitegoods. 2. Bosch water heaters are among the most economical appliances on the market today, boasting high energy efficiency ratings. Due to their excellence in energy efficiency, Bosch water heaters provide considerable savings on running costs today and help preserve the environment for tomorrow. 3. Bosch' strong corporate environmental policy ensures energy efficient appliances which have won numerous Galaxy Awards for environmental excellence. <p>http://www.bosch.com.au/</p> |



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| <p>Siemens Limited </p> | <p>Siemens has been creating and applying innovative technology solutions in Australia and New Zealand for more than 135 years. Today, increasing urbanisation, changing demographics, globalisation and climate change present many challenges and opportunities. Our portfolio offers global solutions for water, energy, environment, healthcare, productivity, mobility, safety and security. http://w1.siemens.com/answers/aunz/en/</p> |
| <p>Soanar Ecotech </p> | <p>Soanar EcoTech is a division of Soanar, an Australian Company Headquartered in Melbourne with over 45 years of experience. Soanar EcoTech distributes a broad range of Renewable Energy technologies and related products. The range of products includes:</p> <ul style="list-style-type: none"> • Components - Solar Cells, Modules, Panels, Kits, Wind Generators • Batteries and Other Storage Technologies • Charges and Charge Controllers • Inverters, Regulators and System Controllers • Lighting Products • Balance of System - Meters, Leads, Cable, Connectors, Junction Boxes, Accessories <p>What sets Soanar EcoTech apart from other distributors is our local, dedicated and experienced team’s ongoing commitment to servicing our customers and supply partners alike. For over 45years Soanar has been supplying Technology Solutions to some of Australia’s and New Zealand’s largest manufacturing industries including:</p> <ul style="list-style-type: none"> •Automotive •Communication •Security •Industrial Control and Automation •Medical <p>With the establishment of Soanar EcoTech we now have a division 100% focused on providing innovative, cost effective solutions that make a positive difference to our environment. Soanar EcoTech’s range of products can be used in residential, commercial, industrial and public utility sectors. http://www.soanarecotech.com/</p> |
| <p>S.T.S Services Pty Ltd </p> | <p>STS Services has been installing renewable energy systems and consulting on sustainability for nearly 20 years. STS Services is committed to sustainable living: offering an affordable, premium yet integrated design and installation service. STS aims to bridge the gap between building infrastructure, technology, energy systems and natural resources. STS Services provides a range of distinctive services: Sustainable design; technological solutions and integrated community solutions. http://www.stsservices.com.au/index.html</p> |