Australian Government

Department of the Environment and Heritage
Australian Greenhouse Office

METHANE TO MARKETS PARTNERSHIP
LANDFILL GAS TECHNICAL SUBCOMMITTEE
COUNTRY SPECIFIC PROFILE

AUSTRALIA

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Methane to Markets – Landfill Gas Technical Subcommittee

Country Profile – Australia

This document has been prepared by the Australian Greenhouse Office, Department of the Environment and Heritage, with contributions from the Department of Industry, Tourism and Resources, the Department of Foreign Affairs and Trade, the Waste Management Association of Australia and Bioenergy Australia.

This Australian Country Profile is an "evolving" document and will be updated as new information becomes available.

Introduction

The Landfill Gas Subcommittee, at its first meeting in November 2004, agreed to develop an Action Plan to guide the activities of the Subcommittee over the next five years. To aid in developing this Plan, members agreed to complete country profiles, identifying their current situation with respect to landfill gas (LFG) activities, relevant policies and programmes, and opportunities from and barriers to the increased collection and use of LFG in their country. The following report is Australia's submission to the Subcommittee.

1. The Current Development Status of Australia's Landfills and LFG Projects

Australia's Waste Emissions

For 2003, Australia's net greenhouse gas emissions were estimated to be 550.048 megatonnes (Mt) carbon dioxide equivalent (CO_2-e).[1] Emissions from landfills totalled 8.141 Mt CO_2-e in 2003, accounting for 1.5% of national greenhouse gas emissions.[2] Emissions from waste disposal in landfills increased by 8.96% (0.67Mt) from 1990 to 2003. This trend was due to an increase in waste disposal per capita.

A small amount of methane generated from landfill sites is recovered, mainly for electricity generation. Rates of methane recovery from solid waste has improved substantially since 1993 increasing from a negligible amount in 1990, to 23.61% in 2003, as illustrated in Figure 1.

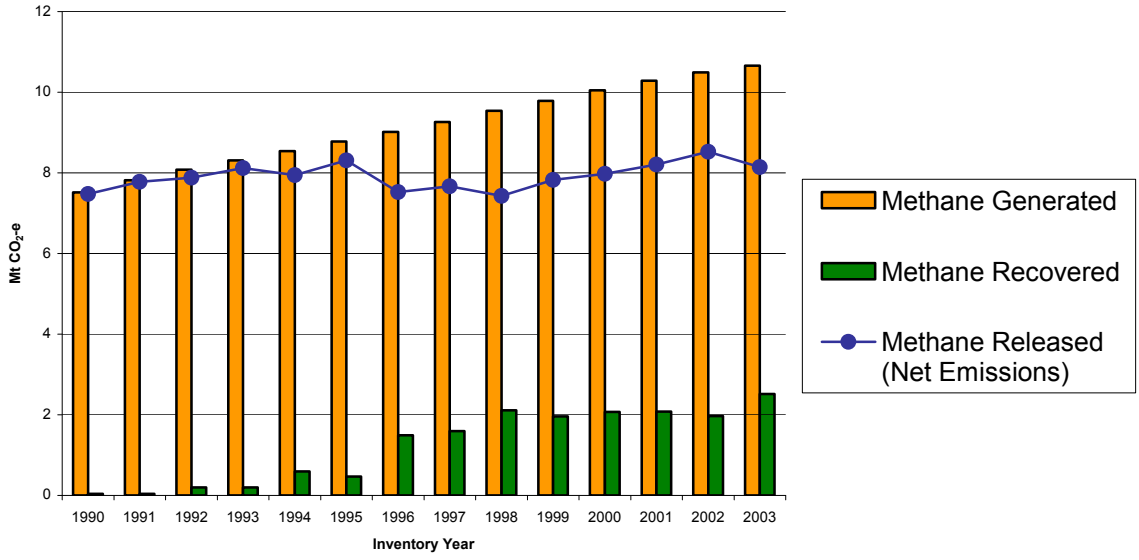

Figure 1: Methane emissions from solid waste disposal: 1990 - 2003

[1] Latest emissions data available *at time of drafting* was from Australia's 2003 National Greenhouse Gas Inventory (NGGI) released in May 2005. http://www.greenhouse.gov.au/inventory/2003/index.html

[2] Australia's 2003 NGGI identifies that emissions from the waste sector were 11.36 Mt CO_2-e – of this, 71.66% of waste sector emissions were from solid waste (emissions resulting from anaerobic decomposition of organic matter in landfills)

Many of Australia's landfill waste disposal sites do not incorporate measures for the collection and treatment of LFG. Many of these sites are old/former landfill sites, or do not contain significant amounts of putrescible solid waste to generate large amounts of methane. Presently a field scale trial is being conducted to investigate alternative approaches to LFG management that involves passive drainage and biofiltration of LFG at sites with insufficient methane to generate electricity at a commercial scale.[3]

Currently information on the total number and size of landfills capturing methane for electricity generation or flaring activities in Australia is limited (although a survey of such activities is expected to be available later this year – refer to section 4). Projections of LFG recovery rates for 2010 are developed (see table 1 below), based on a number of assumptions including suitability and efficiency of landfills for methane capture. These assumptions are being reviewed for inclusion in Australia's 2005 greenhouse gas projections for waste[4].

Landfill gas capture rates are projected to increase to 2010, and are then assumed to level off. Table 1 outlines the assumptions from the most recent projections of greenhouse gas emissions from waste[5], surrounding the high, best and low methane capture rates for 2010. The table indicates that there are opportunities within Australia to increase the proportion of methane captured from landfill sites.

Table 1 Factors for estimating high, best and low emission estimates of LFG recovery in 2010

	High estimate	Best estimate	Low estimate
Minimum settlement size of landfill required to flare landfill gas[1]	100,000	50,000	25,000
Percentage of Australian population in settlements at or above the minimum size[2]	61%	65%	68%
Percentage of landfills at or above minimum size fitted with flaring[3]	60%	75%	90%
Methane capture efficeincy[4]	40%	55%	70%
Derived overall methane capture rate	14.6%	26.6%	43.0%

Notes:

1 *Larger settlements tend to have larger landfills with higher risks and better finances. These are more likely to be fitted with gas flaring systems.*

2 *There is an assumed relationship between population and waste production*

3 *Even in larger settlements, some landfills will not be suited to landfill gas recovery (e.g. solid inert landfills, smaller landfills on city outskirts)*

4 *The proportion of landfill gas collected depends on the efficiency of the system, the standard of the landfill and the time period the system is operational relative to the emission period*

[3] Trial of an Alternative Approach to the Management of Landfill Gas – for more information see: http://www.ghd.com.au/aptrixpublishing.nsf/AttachmentsByTitle/PP+AlternativeLandfillGas+PDF/$FILE/dever_landfillalternative.pdf

[4] Available at: http://www.greenhouse.gov.au/projections/pubs/waste2004.pdf

[5] Available at: http://www.greenhouse.gov.au/projections/pubs/waste2004.pdf

Australia's Current LFG Projects

Australia's first LFG project commenced in 1986. The 120 kW facility was operated by a local government waste disposal authority in Sydney, New South Wales, but is no longer in operation. There are now 402 renewable energy generators currently in operation in Australia, with a combined capacity of 9082 MW. Of these, 37 are LFG power generation projects (around 9 percent of total renewable energy generators), with a combined capacity of approximately 105 MW.

The main technology in use in LFG generators is reciprocating spark ignition and modified diesel engines, generally up to 1 MW each in size. Gas is captured via negative pressure wells, is scrubbed and dehumidified. Generators are generally driven by reciprocating engines and are invariably imported (Jenbacher, Caterpillar, Deutsch). The majority of LFG generators in Australia produce less than 5 MW per site.

Australian LFG is a relatively mature technology, generally not requiring specific targeted government assistance - although some government grants have been provided to LFG projects involving innovative new technology commercialisation. Most methane capture sites are in larger metropolitan landfills. The largest operational LFG installation at 13 MW capacity, is the Energy Developments Limited (EDL), Lucas Heights II Landfill Gas Plant[6] at Lucas Heights in New South Wales, 23 kilometres south west of Sydney. A larger LFG generator is under construction – a bioreactor located in a disused open-cut mine located at Woodlawn NSW (250 km south-west of Sydney). It will receive up to 500,000 tonnes of residual waste per annum, and the generation capacity will be 25 MW via gas turbines.[7]

In 2001/2002, LFG projects contributed 416 gigawatt hours (GWh) of electricity generation, representing AU $17 million in sales, out of a total of 16,763 GWh of generation from renewable sources.[8]

Australia's Strengths

Australia is very innovative when it comes to LFG development. Australian innovation has been strongest in LFG yield mapping, landfill monitoring and analysis (such as flow measurement, site conditions, groundwater sampling), gas extraction, and system integration from landfill to generator. A common difficulty in LFG yield prediction is the lack of data and extensive knowledge about the characteristics of a particular landfill site, including types of waste, and the length of time it has been contained in the landfill. In recent years, Australian research into the modelling of LFG yields has been carried out in laboratory investigations, and it is expected that, over time this data will be validated against data from actual larger-scale landfill sites.[9]

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[6] For more information see: http://www.bcse.org.au/default.asp?id=101&articleid=38
[7] For more information see: http://www.collex.com.au/innovations/bioreactor
[8] Australian Business Council for Sustainable Energy web site at: http://www.bcse.org.au/default.asp?id=257. NB: Figures only include actual electricity sold and excludes renewable energy generated and consumed on site (eg. cogeneration).
[9] For more information on research into LFG yield modeling, see: http://www.ens.gu.edu.au/ciep/CLEANP/CPbook/Chapt12.pdf pp. 625-632.

A range of technologies is being demonstrated in Australia, including gasification, and use of digester cells to speed the decomposition process (see case study 1). Several landfill sites are looking at water recirculation to enhance gas generation. In addition to direct LFG capture and use facilities, a number of innovative new projects that generate electricity from waste materials (including wood, sewage, sugar cane, crop waste, forestry waste, food waste and organic material) *before* they reach landfills, are being developed.

EDL[10] is one of the largest LFG to electricity companies in the world and has pioneered many innovations in gas field development and generator design. EDL has pioneered the multi-site system where a number of landfills in close proximity are connected by underground gas lines to a single power station. They have developed sophisticated computer models to show the gas generation over time using actual production bore well data. EDL has developed over 50 LFG facilities in Australia, the United Kingdom, the United States, France and Taiwan.

Another innovative Australian company developing LFG projects is Landfill Management Services Pty Ltd (LMS)11. LMS' Gas Division incorporates all facets of gas projects from evaluations, desktop modelling, design, engineering, manufacture of purpose built gas field components, installation and management. Of note, LMS has developed Clean Burn Enclosed Flares, which have been independently audited for the production and verification of Emission Reductions Units and carbon credit trading.

Waste and industrial services company Collex, has also been involved in advancing bioreactor technology for use in landfills, and has installed bioreactor facilities at two Australian sites: Woodlawn 250 km south-west of Sydney, and Ti Tree Bioenergy near Ipswich in south-east Queensland. The Woodlawn Bioreactor is located in a disused 25 million cubic metre open cut mine on the Southern Tablelands of New South Wales. Woodlawn will receive up to 400,000 tonnes of residual waste per annum from Sydney and produce around 20MW of green electricity.[12]

Drivers for Increasing LFG Capture and Use in Australia

It is expected that LFG capture levels throughout Australian States and Territories will increase, with a high [see p.2] estimate of 41% on current levels,[13] between now and 2020. It has been assumed that, although small increases in the amounts of methane captured may occur as business as usual operations, the majority of the increase will be the result of government initiatives. Drivers for increasing landfill methane capture and use include environmental benefits such as minimising leachate and odour control, and greenhouse gas mitigation, and the government incentives and regulatory requirements that aim to address these factors. Regulators are increasingly recognising greenhouse as an additional reason for landfill gas control. It is assumed that some of the recent

[10] For more information on EDL and its products and projects, see: http://www.edl.com.au/
[11] For more information on LMS see: http://www.lms.com.au , and case study 2, below.
[12] For more information on Collex's Bioreactor technology, see: http://www.collex.com.au/innovations/bioreactor
[13] Independent research commissioned by the Australian Greenhouse Office, Department of the Environment and Heritage, 2001.

increase in landfill gas recovery has been driven by site liability and OHS concerns, but that greenhouse issues will become progressively more important in the future.

The Australian Government's major policy driver for increasing the uptake of renewable energy projects, including utilising energy from LFG, is the Mandatory Renewable Energy Target, which is discussed further in the next section.

A major determinant of the economic viability of LFG projects is their competitiveness vis-a-vis other energy sources in the market. LFG conversion to electricity (using a gas engine) costs around AU $55 to $90 per megawatt hours (MWh), compared to AU $30 to $60 per MWh for coal and natural gas. Some of the Australian Government's policies and programmes affect these price relativities, and can improve the competitiveness of LFG projects. These programmes are discussed in the next section.

2. National Programmes and Initiatives that will Impact LFG Project Development in Australia

Australia's three levels of government (Federal, State/Territory and Local – see Figure 2 for schematic representation) each have responsibility that impacts on the production of energy from methane sourced from landfills. Local governments manage landfills and on-ground infrastructure development. Each local government has its own means of minimising sorting and storing of waste. State governments each have a range of different means to regulate emissions and standards, set guidelines and some provide financial incentives to meet a range of environmental parameters including greenhouse.

The Australian (federal) Government has an important role in the promotion of renewable energy through a range of policy and regulatory measures, and programmes, however waste management and electricity generation and distribution are generally not direct federal responsibilities.

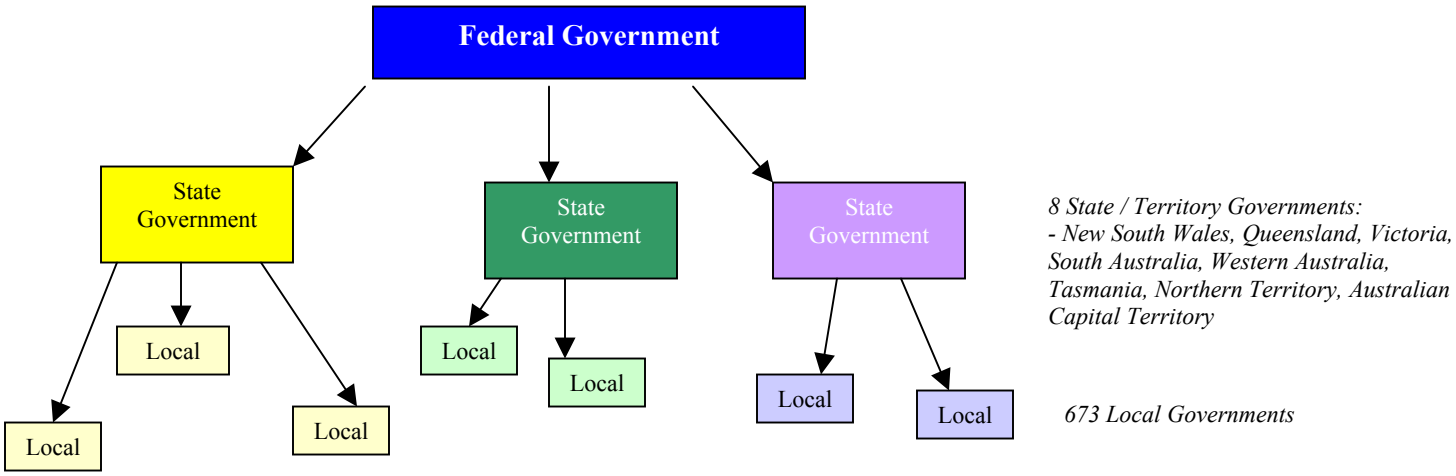

Figure 2: Australia's 3-tiered Government Structure

Federal Government Policy and Programmes

Australian government policy and programmes relevant to the use of LFG include renewable energy incentive programmes, greenhouse gas abatement programmes, grants for technology commercialisation, and alternative fuels, and the Mandatory Renewable Energy Target (MRET). Some of these are outlined below. It is important to note that LFG in Australia is generally considered as part of the broader renewable energy industry. In this respect, many of the policies and funding programmes that may be relevant to LFG also have a wider scope.

Energy White Paper [14]

In June 2004 the Australian Government released a white paper on energy policy, *Securing Australia's Energy Future*. The policy included a longer-term climate change strategy, and introduced a number of new programmes aimed at supporting technology development which may be applicable for renewable energy.

Mandatory Renewable Energy Target [15]

The MRET mandates an increase in the contribution of renewable energy to Australia's grid-based electricity supply mix to achieve a target of an additional 9,500 GWh per annum by 2010. This measure is expected to generate at least AU $2 billion in renewable energy investment in Australia and is a significant driver for the industry's growth. LFG is an eligible renewable energy source under MRET.

Wholesale electricity purchasers will be proportionally liable for purchasing the designated percentage of renewable energy (increasing interim targets exist for 2001 – 2010 and remains level until 2010), based on their overall electricity purchases for a year. Penalties of AU $40 per MWh are imposed on liable parties who fail to meet their purchase obligation.

The renewable energy target, specified in annual regulations, is the process for determining the actual number of renewable energy certificates which must be surrendered each year to discharge a liability. Eligible generation assets earn certificates on the basis of their renewable generation. Each renewable energy certificate (REC) is equal to 1 MWh of renewable generation. RECs can be traded among liable generators or third parties – trading prices have been in the vicinity of AU $35 - $40.

In effect, MRET means that renewable generators can sell their electricity, and also sell their RECs, thus effectively doubling the income from the level of investment that may not be possible from the sale of the electricity alone. Since the scheme's commencement in 2001, RECs from LFG projects accounted for between 5 and 10 percent of RECs created across all eligible renewable energy generators.[16]

[14] For a copy of the paper, see: http://www.pmc.gov.au/initiatives/energy.cfm
[15] For more details on MRET see: http://www.greenhouse.gov.au/markets/mret/index.html
[16] The Office of the Renewable Energy Regulator maintains a registry of RECs registered under MRET. This information is updated daily, and is available at: http://www.rec-registry.com/public/home.summary

Renewable Energy Action Agenda[17]
The Australian Renewable Energy Action Agenda strategically analysed the renewable energy industry's competitive position, identified opportunities and impediments to the industry's growth, and developed a set of actions to achieve a sustainable and internationally competitive Australian renewable energy industry. The Action Agenda focuses on the renewable energy industry as a whole, and does not specifically address LFG issues independently. It focuses on community commitment, market development and growing industry capacity towards the goal of a sustainable renewable energy industry. It discusses incentives and the role of government and industry.

Renewable Energy Technology Roadmap[18]
The Australian Renewable Energy Technology Roadmap, aims to help the renewable energy industry achieve the vision identified in the Action Agenda. It aims to do this by focusing the industry on customers' needs and identifying the technologies required to meet those needs. The Roadmap suggests a long-term research and development plan that defines the industry's collective future and establishes clear pathways forward. It focuses on the renewable energy industry as a whole, and on the key renewable energy technologies and products, including biomass, cogeneration and remote area power supply. The Roadmap identifies the need for both continuous, incremental improvements to existing technologies, and radical advances in new technologies to enable the industry to respond to future challenges.

The Roadmap identifies a range of opportunities for converting waste organic matter by anaerobic decomposition processes, from agriculture, landfill, human and wood waste into forms of energy for transport and stationary energy production. It does not separate LFG from other forms of bioenergy derived from anaerobic processes but discusses all forms of bioenergy collectively. Consideration is given to all aspects of sorting, controlling, cleaning and maximising gas extraction, use of self-adapting control systems capable of handling diverse and variable input fuels. It also addresses improvements to heat loss, fuel delivery at pressure, hot gas clean-up and direct injection improvements to waste-to-energy systems to improve generator efficiency, the production of soil conditioners, and the extraction of recyclables. Approaches to removing barriers to bioenergy generation are also outlined.

Funding Programmes

Major Australian government funding programmes relevant to LFG which have resulted in the commercialisation of innovative LFG and methane projects include:

- The $50 million Renewable Energy Commercialisation Programme (RECP)[19], which provides funding for renewable energy commercialisation, including a component for industry development;

- The $205 million Renewable Remote Power Generation Programme (RRPGP)[20], which funds special purpose grants to State and Territory governments to provide

[17] A full version of the Action Agenda is available at: http://www.industry.gov.au
[18] A full version of the Technology Roadmap is available at: http://www.industry.gov.au
[19] http://www.greenhouse.gov.au/renewable/recp/

rebates for the installation of renewable energy equipment where it will reduce the use of diesel fuel for electricity generation; and

- The $20 million Renewable Energy Equity Fund (REEF)[21], which provides venture capital for small innovative renewable energy companies; it has funded a number of non-LFG innovative bioenergy projects.

Further information on Australian Government programmes and strategies to encourage renewable energy in Australia can be found at the Australian Greenhouse Office and Department of Industry, Tourism and Resources web sites.[22]

A new 7 year $100 million funding programme, the *Renewable Energy Development Initiative* (REDI)[23] was announced in June 2004 as part of the Australian Government white paper, *Securing Australia's Energy Future*. REDI will be a competitive grants program designed to give strategically important smaller scale renewable projects a "leg up" to commercialisation. REDI will provide support along the entire renewable energy innovation spectrum, helping projects move from proof-of-concept to commercialisation and then on to business collaborations.

In addition to these funding programmes, the Australian Government manages the Greenhouse Friendly Programme[24], an initiative designed to help business and industry balance the greenhouse gas emissions produced during the life of a product or service with verified emission reductions. As at September 2004, five of the seven accredited abatement projects, which provide emissions reductions to certified Greenhouse Friendly products and services, were LFG projects. (See Case Study 2 for an example).

Case Study 2 – Greenhouse Friendly Project

Landfill Management Services Pty Ltd is operating a methane collection and flaring project at Carup Landfill in Western Australia, to offset emissions from BP Ultimate & BP Global Choice Commercial Fuel. The flaring of the landfill gas is intended as a temporary measure only. When a sufficient flow of gas is achieved (estimated to be around June 2005), it will be diverted for use in generating electricity for domestic and commercial use. This project is expected to offset around 10 000 tonnes of greenhouse gas emissions in 2002 with offsets expected to increase over time up to about 40 000 tonnes of carbon dioxide equivalents per annum.

Companies choose to sign on to Greenhouse Friendly to show their commitment to reducing greenhouse gas emissions, and in doing so, gain a marketing advantage over their competitors. Accredited companies display the Greenhouse Friendly certification

[20] http://www.greenhouse.gov.au/renewable/rrpgp/index.html
[21] http://www.greenhouse.gov.au/renewable/reef/index.html
[22] http://www.industry.gov.au/content/sitemap.cfm?objectid=48A4770B-20E0-68D8-ED49F83F135CFC1E
[23] http://www.ausindustry.gov.au/content/content.cfm?ObjectID=655D266E-78B7-44B6-BC3148BFBE5B7B57
[24] Further information about Greenhouse Friendly, including detailed case studies of LFG projects are available at: http://www.greenhouse.gov.au/greenhousefriendly/index.html

mark, demonstrating that the business (manufacturer or service provider) has fully offset greenhouse gas emissions produced during the life of their product.

State / Territory Government Policy

Local and State governments have the greatest influence on the establishment and management of LFG developments. Landfills are generally regulated by State Environmental Protection Authorities (State government agencies) and are often required to install appropriate LFG management technologies to reduce odour and explosion risks. Liability and OHS concerns can also prompt a landfill manager to install a landfill gas recovery system.

Recycling targets are increasing, with more waste set to be reused, recycled, and reprocessed before final disposal. Some Australian states and territories have proposed zero waste to landfill targets. The Australian Capital Territory has a Zero Waste policy and New South Wales aims to reduce landfills by 60 percent. This will reduce the potential for methane capture from landfill in the longer-term, however, the waste degradation process occurs slowly and methane emissions continue long after waste is placed in landfill. Estimates in any year include a large component of emissions resulting from waste disposal over the preceding 25 years. This means that recent changes in waste management practices may not have a significant immediate impact on reported methane emission levels from landfill.

In addition to waste management policies, State and local government greenhouse and emissions management programmes affect LFG projects.

The most populated State, New South Wales, for example, has a Greenhouse Gas Abatement Scheme[25], which requires electricity retailers and other large suppliers to reduce state per capita greenhouse gas emissions from the electricity sector. The Scheme imposes enforceable annual reduction targets (between 2003 and 2012) on participants, including electricity retailers, customers taking supply directly from the National Electricity Market, and some generators meeting specific supply requirements. The New South Wales Government has set a statewide benchmark of reducing greenhouse gas emissions to 7.27 tonnes of carbon dioxide equivalent per capita by 2007. This target is 5% below the equivalent NSW per capita emissions in 1989-90.[26] Scheme participants are liable to meet their share of the state's electricity sector benchmark by reducing their emissions of greenhouse gases to the pre-set benchmark levels, or paying a penalty of AUD $10.50 per tonne of emissions above their targets.

To reduce the costs of compliance, persons carrying out activities in Australia that abate greenhouse gases can generate abatement certificates. These certificates may be sold to participants who do not meet their benchmarks, who then surrender these off-setting certificates to reduce the emissions attributable to them. LFG operations are eligible to seek accreditation to create abatement certificates under the Scheme, and currently there

[25] For information on the scheme see: http://www.greenhousegas.nsw.gov.au
[26] NSW Greenhouse Gas Abatement Scheme – Operation of the Scheme and Compliance during 2003: Report to Minister. (June 2004) www.ipart.nsw.gov.au

are 26 LFG accredited generating facilities. Combined, these 26 LFG facilities create approximately 2.5 million New South Wales Greenhouse Abatement Certificates (NGACs) per annum. In 2003, approximately one-third of the 6.6 million NGACs created were from LFG projects.

A further programme is Green Power[27], a national accreditation programme that sets stringent environmental and reporting standards for renewable energy products offered by electricity suppliers to households and businesses across Australia. Green Power was formed through the collaborative efforts of State and Territory government agencies to provide support for the establishment and governance of a national voluntary renewable energy accreditation scheme. The programme enables residential and commercial energy consumers to choose government accredited renewable energy products as a means to help reduce greenhouse gas emissions associated with electricity generation. As at 30 June 2004, there were 100,959 domestic customers and 5,021 commercial customers nationwide. Of the 250 approved renewable energy generators under the Green Power programme, 33 are LFG facilities.

While the Green Power programme, MRET and NGACs share the similar objectives of reducing greenhouse gas emissions from the electricity generation sector, and drive investment in renewable energy, the schemes utilise different mechanisms to deliver this objective – Green Power relies on consumers *voluntarily* paying a premium for their electricity to be sourced from renewable generators, whereas MRET and NGACs are based on legislated requirements on the suppliers.

Government – Industry Collaboration

A number of government-to-industry forums have been established to underpin the development of a commercially viable and internationally competitive renewable energy industry in Australia. The Australian Government works closely with the renewable energy industry and provides financial support for technology based industry associations to assist the removal of barriers to implementation of RE technologies. Technology roadmaps for major technologies are being considered (including a roadmap for bioenergy) by the industry associations, in conjunction with government, to address specific technology development and implementation in Australia.

The LFG industry is generally represented by Bioenergy Australia[28], the peak industry body dealing with development of biomass for energy, liquid fuels, and other value-added bio-based products. Bioenergy Australia provides support to the industry, mainly through the provision of information and general assistance. Australian Government departments and agencies are founding members of Bioenergy Australia, and provide ongoing financial and other support to this government-industry alliance.

The Waste Management Association of Australia (WMAA)[29] also provides a forum for government and industry to share information, and fosters and facilitates education, training and research relevant to waste management. The WMAA has established a

[27] Further information about Green Power is available at: http://www.greenpower.com.au/GPAbout.shtml
[28] For more information on Bioenergy Australia see: http://www.bioenergyaustralia.org/
[29] For more information on WMAA see: http://www.wmaa.asn.au/tech/landfill.html

technical committee on landfills. The committee's objective is to endorse Australian best practice; establish a reference group to provide technical advice, and a forum for information exchange. The WMAA plans to hold Australia's first conference dedicated specifically to landfill, later this year.

Involvement in International Fora

Australia is actively involved in a number of international fora to promote the uptake of renewable energy and increase exports, including international bilateral meetings and the Asia Pacific Economic Cooperation (APEC). Industry and government also collaborate through the Australian Renewable Energy Export Network, to increase Australia's success in exporting renewable energy technologies and services abroad. Australia is a member of the Renewable Energy and Energy Efficiency Partnership (REEEP), a global partnership that structures policy initiatives for clean energy markets and facilitates financing for energy projects.

Australia participates in the International Energy Agency Implementing Agreement on Bioenergy, through Bioenergy Australia. One of IEA's 40 Implementing Agreements, IEA Bioenergy[30] aims to develop cost-effective and sustainable opportunities to increase the use of biomass (including LFG) with the potential to meet 50% of global energy demand this century.

Australia also has a number of bilateral climate change partnerships (with the United States, China, New Zealand, the European Union, and Japan) and bilateral energy partnerships (with the United States, China, Japan, Korea, Taiwan, Indonesia, the Philippines, India and Mexico), which may provide opportunities to pursue joint LFG projects in the future.[31]

3. National Opportunities and Potential for Implementing LFG Projects

Opportunities for Capturing LFG Methane

Key opportunities in Australia relate mainly to new landfills, given that the LFG resource from most existing landfills are either being exploited, or uneconomic.

There are opportunities to develop and implement more effective methods to cap landfills to reduce leakage, as Bioenergy Australia estimates that the best landfills in Australia might leak approximately 50% of the methane. Australia would be interested in collaborating with other Parties who may be able to assist in solving this issue. There are investigations being undertaken on ways to better capture and store methane in landfill by use of better modelling, better designed landfill facilities, and specific anaerobic digestion cells. Maximising methane generation by better controlling what material enters landfill and reducing contamination is also a priority. Australia is interested in participating in improvements in methane capture from existing landfills to better reduce

[30] http://www.ieabioenergy.com/IEABioenergy.php
[31] For more information on Australia's greenhouse-related partnerships, see: http://www.greenhouse.gov.au/international/partnerships/index.html

influx of oxygen, better seal landfills via carbon dioxide blankets and less permeable materials, improve monitoring of landfill dynamics and trial a range of extraction techniques.

Opportunities for Using LFG Methane

There are opportunities to introduce advanced forms of generation technologies, in order to reduce costs associated with LFG capture and use. This will contribute to more economical electricity generation, placing LFG in a more competitive position with conventional sources of electricity, such as fossil fuels. Work is being done to investigate improvements in efficiency in gas extraction, energy conversion, generation, and energy export arrangements, including recognition of the benefits of distributed generation, grid stabilisation, and opportunities for obtaining the best energy prices at peak loads on the national electricity market.

In terms of research, Australia's *Renewable Energy Technology Roadmap* has identified the use of LFG for vehicles as a mid-term opportunity to be explored over the next 4-10 years.[32]

4. Models, References and Other Tools that Australia can Share with other Subcommittee Partners

Australia has developed a range of models, references and tools to assist the renewable energy industry, and many of these are relevant to LFG.

- The Australian Government has developed a map of all Australian renewable energy generators (including LFG). This map contains locations of Australian renewable power stations greater than 3kW installed capacity with information about fuel type, technology used, size (kW), ownership, latitude, longitude and data source. The site also contains an excel spreadsheet of all operating renewable energy generators including LFG, which may be sorted by fuel source, size, location, ownership and technology used.
  See: http://www.agso.gov.au/renewable/

  - A similar interactive map is available through the web site of the Office of the Renewable Energy Regulator, the statutory authority established to oversee the implementation of MRET. This map includes information of accredited renewable energy power generators, for the purpose of the scheme.
    See: http://www.ga.gov.au/map/orer/

- The Australian Business Council for Sustainable Energy has developed a Renewable Energy Power Plant Register, which includes renewable power generation projects ranging from 100 kW to more than 2000 MW in capacity, as well as particularly significant projects of a smaller size. The Register also includes a list of renewable energy projects (including one 1.7MW LFG project)

[32] Renewable Energy Technology Roadmap (p.35), available at:
http://www.industry.gov.au/assets/documents/itrinternet/RETRSplitVersion2ch4-lesspage.pdf

that were under construction as of 31 December 2003.
See: http://www.bcse.org.au/default.asp?id=172

- The Australian Government funded the publication 'Waste to Energy: A Guide for Local Authorities', soon to be available on http://www.bcse.org.au, which provides local governments (who have responsibility for landfill and waste management) with information on opportunities, costs, technologies and potential for generating energy from waste in their jurisdictions. This guide will include information on LFG opportunities.

- The Waste Management Association of Australia (WMAA) has an Energy from Waste Division which is relevant to LFG projects in Australia. With sponsorship from the Australian Government, they have produced a 'Sustainability Guide for Energy from Waste Projects', and an Industry Code of Practice for waste proponents and practitioners. The Guide discussed issues associated with energy from waste projects including LFG generation.
See: http://www.wmaa.asn.au/efw/home.html

- The WMAA is currently conducting a national landfill survey that will identify how many sites are flaring LFG and how many are using it to power on-site facilities, and off-site electricity generation. The results are expected to be available later this year.

- The Australian Government, in 1997, commissioned the development of a workbook to provide a step-by-step approach to estimating potential methane generation, intended to enable waste managers to undertake a preliminary analysis of the potential for methane recovery and energy generation from solid waste.
See: http://www.greenhouse.gov.au/challenge/methane/mwbquickref.html#2

5. Australia's Objectives and Support Needs to Facilitate Implementing New LFG Projects

Australia's objectives for developing LFG projects are based on two general aims: reducing greenhouse gas emissions from the electricity generation sector, and driving investment in renewable energy. Both of these objectives can be met through practical and concrete actions to deploy existing technologies leading to LFG capture and utilisation. The increased use of LFG as an energy source has the additional benefit of diversifying Australia's energy supply.

As outlined above, Australia's current waste management policies are aimed at reducing the total amount of putrescible waste that goes to landfill, in some instances to zero. As such, a further objective is to develop opportunities in international markets for Australian companies specialising in LFG.

There are a number of technological and economic barriers to the implementation and uptake of increased LFG capture and use in Australia. We are looking forward to working with M2M Partners to:

- Identify opportunities for the Australian renewable energy industry to participate in LFG projects in other countries, thereby transferring expertise and technology built up through years of practical experience in Australia.

- Improve economies of scale and reduce operating costs to make LFG projects more competitive with conventional energy generation. Achieving lower prices is a key objective of the Australian renewable energy industry through targeted innovation, achieving economies of scale and managing raw material and processing costs.

- Develop more effective technologies and practices for capturing LFG. Improved practices for capping landfills to contain methane, which is generally problematic because of poor cover material, would increase the amount of LFG available for use in existing projects and reduce leakage to the atmosphere, and may make future projects more economically attractive.

- Attract additional foreign investment in LFG projects. Foreign direct investment would enhance Australia's renewable energy industry by stimulating growth and development, financing capital needs, boosting jobs, and enabling technology transfer.

6. Recommendations for Specific LFG Subcommittee Objectives to be Accomplished over the Five-year Timeframe

Australia's overarching objective for the LFG Subcommittee is to increase the number of tangible, measurable LFG projects implemented, with significant greenhouse gas reductions. To this end, Australia's recommends the following to be considered for incorporation into the Subcommittee's five-year Action Plan:

- Improving the cost-competitiveness of LFG: One of the major barriers to the uptake of LFG as an electricity source is its lack of competitiveness to conventional sources of electricity generation, in particular coal. The Partnership provides a constructive forum to develop practical collaboration between member countries, which complements parties' differing skills and expertise. The Subcommittee may consider establishing a working group to examine the issue of financial barriers, and approaches to overcoming these.

- Improving access to technology: Technological advancements, and improving access to existing technologies enables countries to combine resources, reduce unnecessary duplication of effort, and learn from other's experiences in developing and implementing relevant LFG technologies. Subcommittee members may benefit from direct exposure to other parties research and

technologies, as well as from opening potential export markets for industry. The Subcommittee may consider encouraging technology partnerships between member countries, aimed at improving technologies relevant to LFG capture and use.

- Awareness raising: Improving the quality of information, and access to information, about the environmental and economic benefits of using LFG may drive investment in the sector, thereby improving economies of scale, and in turn reducing costs associated with implementation and operation. Initial target audiences would include government officials and policy-makers at relevant levels of government, industry representatives, landfill proponents, investment institutions and donor agencies. The Subcommittee may consider developing mechanisms for partner countries and participating companies to share information and experiences on practical awareness raising activities, through informal dialogue (e-mail and document sharing), formal discussions at Subcommittee meetings, and workshops involving interested participants.

- Analysis of regulatory mechanisms: A number of public policy measures could be considered to improve the status of LFG technologies in the marketplace. While Subcommittee member countries will have differing national regulatory structures, and different levels of landfill infrastructure, interested parties could benefit from analysis and information sharing, to help develop suitable regulatory mechanisms to maximise the use of recovered methane from landfills.

7. Key Resources in Australia

See section 4 above, and footnote references throughout.

8. Conclusions and Observations

Although LFG capture and utilisation is a relatively mature technology in Australia, only a small number of companies are involved. Generally, LFG capture and use is considered as part of the broader waste management industry, which incorporates strategies for waste minimisation and reuse, as well as methane capture and utilisation.

There is opportunity around Australia to increase the number of LFG developments in the short term, due to increasing pressure from government and the community to reduce greenhouse gas emissions, and a desire to improve environmental performance generally. At the same time however, as various low and zero waste strategies are implemented around Australia, it is anticipated that opportunities for LFG project development over the longer term will be reduced. It is therefore likely that companies wishing to continue developing LFG projects will look offshore for opportunities. It may be worthwhile for the Landfill Gas Subcommittee to consider broadening the scope of the LFG component of M2M to include methane captured from municipal waste and green waste that is intentionally diverted from landfill.