Biogas

A Producer's Perspective

TRANSPACIFIC INDUSTRIES GROUP LTD

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> 18 November 2010

Transpacific Industries Group

- Australasian company with a key focus on integrated total waste management
  - Collection, Transport, Processing, Recycling and Disposal
  - Equipment manufacturing (waste), Industrial services and Commercial vehicle distribution
  - Variety of waste streams and operations
- Acquired Waste Management in New Zealand July 2007

Transpacific Industries Group

- Largest operator in both Australia & New Zealand
- Operations incorporate:
  - Substantial truck fleet (600 trucks in New Zealand)
  - Ownership and operational involvement in numerous landfills
- Potential to both produce and utilise biomethane in significant quantities

Redvale Landfill

- Most significant and largest Transpacific landfilling operation (annual volume)
- Class A Landfill, opened 1992
- 69 ha footprint, 20 million m^3 airspace, >$85 million
- Currently receives waste from the upper north Island

Redvale Landfill

- Consented to 2023 (closure)
- Favourable site geology
- Fully engineered liner, cap, leachate management and gas extraction systems
- Waste receives daily, intermediate or final cover

Redvale Landfill

- Leachate management and gas extraction systems important in optimising gas production and recovery
- Active gas extraction system with vacuum blowers acting on a network of pipes and gas wells
- Innovative ‘bottle-brush’ gas well design – constructed as waste is placed
- Estimated 93% capture efficiency

Landfill Biogas

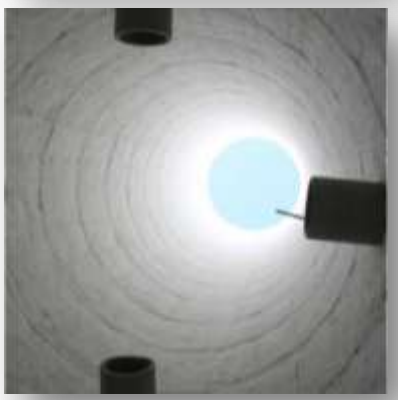
- Typical composition (Redvale)

Methane	CH_4	56%
Carbon Dioxide	CO_2	37%
Nitrogen	N_2	5%
Oxygen	O_2	1%
NMOCs		1%
Hydrogen Sulphide	H_2S	300ppm
Other Contaminants		trace

- Oxygen and nitrogen present due to air ingress. Occurrence is inevitable with optimised gas extraction (target 1% O_2)

Landfill Biogas

- Gas extraction operational priorities:
  - Minimise odour
  - Manage fire, explosion and asphyxiation risk
  - Reduce greenhouse gas impact
- Gas extraction becoming widespread
- Standard destruction method is to flare gas
  - Inexpensive & Simple
  - Addresses odour, GHG and contaminants
- Energy utilisation objectives considered secondary



Electricity Generation

- Beneficial utilisation through generation of electricity exported to the grid
- Specialised GE Jenbacher reciprocating engines, 1 MW_e
- 9 containerised units installed, 3 more arriving 2011. Current 9.5 MW output sufficient to power 10,900 homes[1] (12.7 MW with additional generator sets)
- Gas also fed to a local greenhouse for heating

[1] Ministry of Economic Development Energy Data File – Based on 7.66 GWh annual residential consumption

Electricity Generation

- Minimal treatment of raw landfill gas before engines
- High operating and maintenance requirements
  - Siloxanes form a build-up on combustion surfaces
  - Halogenated organics degrade engine oil
  - Regular internal cleaning and oil changes required
- Electricity spot market is highly variable
  - Generation regularly uneconomic and gas must be flared

Biogas Pilot

- Intended to promote biogas opportunities in New Zealand through a demonstration project
- Massive collaborative effort from contributing parties
  - NIWA – Compressor
  - Greenlane – Manuka Biogas Upgrading unit
  - Transpacific – Site and Landfill Biogas
  - Dieselgas – Dual Fuel Collection Truck
- Successfully produced fuel grade biomethane from landfill biogas and used this to run a dual fuel collection truck

Biogas Pilot

- Greenlane biogas upgrading
  - Manuka unit installed
  - Pressurised water adsorbtion process removes carbon dioxide and pollutants
  - Output of decontaminated, dry, high methane gas
  - Effluent gas of carbon dioxide enriched air
  - Contaminants captured in carbon filter
- DieselGas dual fuel technology
  - Minor modifications to a diesel engine
  - Pilot amount of diesel for ignition
  - Biomethane gas provides balance of combustion energy
  - Substitution up to 80% expected in operation

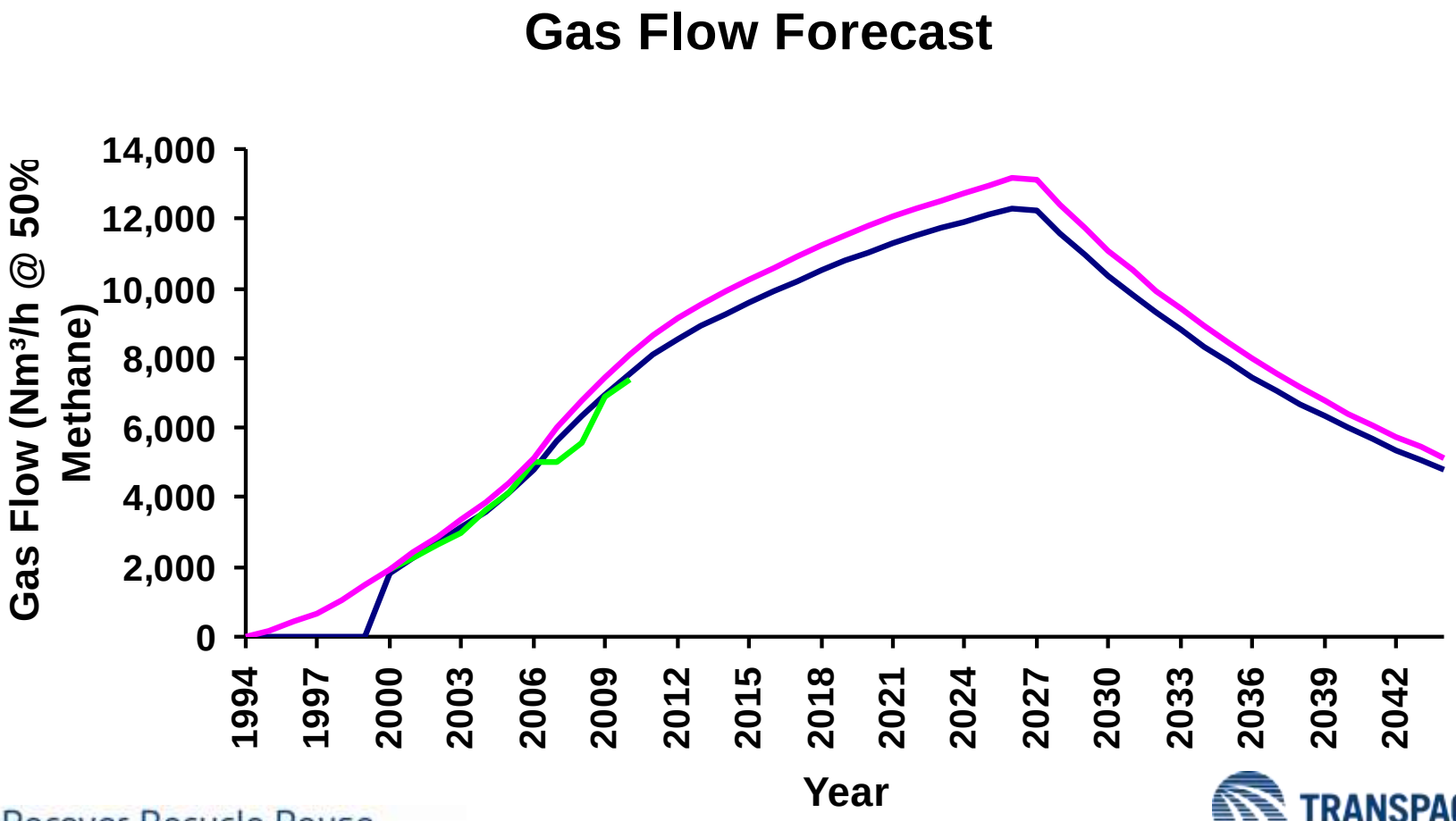
Biogas Technology

- Improved beneficial utilisation of landfill gas
  - Direct offset of fossil fuels
- Avoids variable electricity spot market
  - Reduced liklihood gas being flared
- Reduced maintenance requirements
- Alleviates site air discharge consent challenges
- Carbon dioxide stream could be used by local greenhouses (or other industry)

Dual Fuel Technology

- Minor modifications to diesel engines
  - Minimises reinvestment replacing fleet vehicles/engines
- Ability to revert to diesel operation if gas runs out
  - Removes critical dependency on limited refuelling infrastructure (minimising investment requirements)
- Internal protection against oil price rises going forward
- Suits short, closed loop routes of our vehicles
- Reduced pollution and greenhouse gas emissions

Energy Resource



Energy Resource

- 50 year viable gas output
- Current - 2010
  - 4,000 Nm^3/h methane,1.4 PJ per year
- Projected peak – 2025
  - 6,250 Nm^3/h methane, 2.1 PJ per year
  - 9^{th} largest gas field in New Zealand[2]
  - Potential 54 million LDE per year
- Transpacific nationwide usage - 11.8 million litres

[2] Ministry of Economic Development Energy Data File – Placement based on 2009 gas field outputs

Biogas Production – Full Scale

- Capital intensive – maximum scale required
- Significant obstacles to be addressed
  - Abandonment of generation
  - Instantaneous market for large amounts of gas required
  - Logistics of distribution
- Injection into the natural gas grid an option
- Pipeline gas standards an issue
  - 0.1% oxygen
  - Wobbe index (dilution by inert balance gasses)

Biogas Production – Full Scale

- Oxygen and nitrogen not removed by Greenlane process
- Limited (proven) technology available for their removal from biogas
- Hope to trial inert removal technologies in the next phase of the pilot project
- Oxygen standard has been relaxed in several countries to promote biogas

Fuel Utilisation– Full Scale

- Must be viable for transport operators
- Conflict of investment in
  - Biogas production
  - Vehicle conversions
  - Refuelling infrastructure
- Trade pricing of grid natural gas can act as a reference for feasibility investigations

Fuel Utilisation– Full Scale

- Conversions initially centred on natural gas would help establish the biogas transport fuel market

- Again, numerous challenges:
  - Extensive application engineering specific to engines for required dual fuel kits (expensive and time consuming)
  - Natural gas engines remain expensive (plus bottles)
  - Tare weight of bottles reduces payload
  - Shortage of refuelling infrastructure at present limits application to vehicles with relatively short, closed routes

Thank you for your time

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