Palmerston North City Council
Biogas to Energy Project

Phil Burt – Palmerston North City Council

Part of “Sustainability” Strategy

- Over-arching strategy/Brand
- Long term
- Linked to sustainability goals
- Specific targets

Renewable Energy Target

- Council had a target to generate 100% of electricity needs (2.5MW) by 2012.
- Target generation was:
  - Landfill gas
  - Biomass
  - (Mini) Hydro
  - Solar and Wind
- There is an existing 1MW LFG and 120kW Mini-hydro
- Biogas will replace LFG as it is depleted in next 15 to 20 years

Land Fill Gas 2 Project

- Original plan was to locate new generator alongside the existing LFG unit.
- Decision was made during the process to utilise the Biogas from the digesters instead
- Shortlisted 3 suppliers Energen Solutions, Clark Energy and ENTEC Services
- Involved reference checks and site visits to evaluate their technology.

Engine Selection

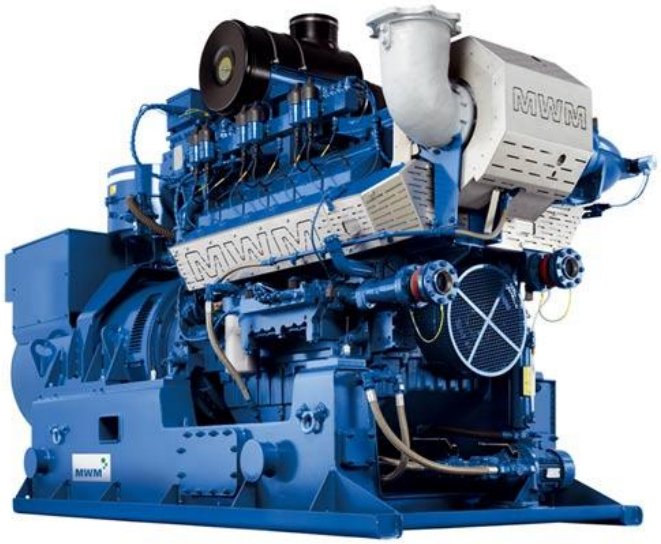
Two options were assessed

- Council purchases the 2nd CHP plant or;
- Council enters a partnership type arrangement
- Based on PNCC supplies sufficient gas
- Generator operator owns & maintains unit, sells electricity & heat to PNCC (at discount)
- Share of cash flows (and costs) from additional carbon credits & energy sales
- Extensive financial modelling was undertaken with the assistance of PriceWaterhouseCoopers

Outcome

- Ownership of a 750kW generator resulted in the most financially favourable outcome for PNCC

ENGINE SELECTED WAS A MWM TCG2016 V16 GENERATOR



Engine was supplied by ENERGEN Solutions of Brisbane Australia

Suppliers of the earlier unit

Have extensive experience with stand alone generation in Australia particularly in the mining and oil & gas industries

Biogas Production - Anaerobic Digestion

- In Anaerobic digestion the organic material is converted to biogas by microbial activity
- Gas can be flared or used for digester heating
- Existing facility is upgraded with improved mixing and efficiency
- Target to generate 180 m3/hr methane from 2 tanks within 3 years. The biogas has around 60% methane
- Move from 2 to 1 tank for City effluent

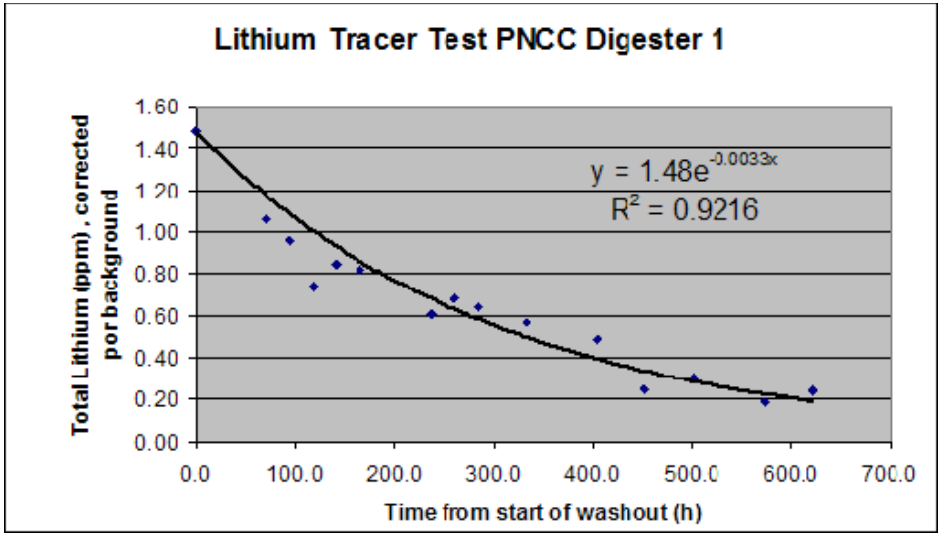
Increasing Biogas Production

- Realised that there was insufficient gas from the current digester operations.
- SPiiRE (then called Waste Solutions) were engaged to assess the current performance of the AD's.
- Initial work suggested the baseline biogas potential could be increased to 500kW from existing feed stocks.
- With additional feed stocks biogas production could be increased to supply up to 750Kw of electrical production.

Investigations into Digester Performance

- Previous mixing was achieved by sludge recirculation through a heat exchanger 24hrs/day
- Gas blowers operated for 8hrs/day through a central eductor tube and pearth lances
- Hydraulic Residence Time test (HRT) was proposed using Lithium tracer
- Mixing time and HRT tests were performed on Digester 1 with the assumption that both digesters would behave identically.

Investigations cont



- Tracer washout rate was consistent with an average hydraulic residence time (HRT) of 13.2 days at an average combined daily fresh feed flow of 112 m3/day to both digesters.
- Based on 2 x 1360 m3 digester volume, the expected digester HRT should have been 24.2 days
- Test showed an available effectively mixed working volume of only 55 % of the design volume (13.2 days/24.2 days) or 750 m3 per digester (assuming identical digesters)

STEPS TO INCREASING GAS PRODUCTION

Once the cause of the low performance was determined investigations were undertaken to determine most appropriate methods to increase gas production.

Strategies arrived at included;

- Clean out of both digesters to restore complete working volume
- Improved hydraulic mixing through an external ring main and 5 injectors
- Implementation of Booster technology on both digesters
- Additional high strength/fatty wastes such as DAF, grease trap and piggery waste

Hydraulic Mixing Improvements

External Mixing System on Digester 2

Close up of SS injector

Video Demonstrating Rotational movement

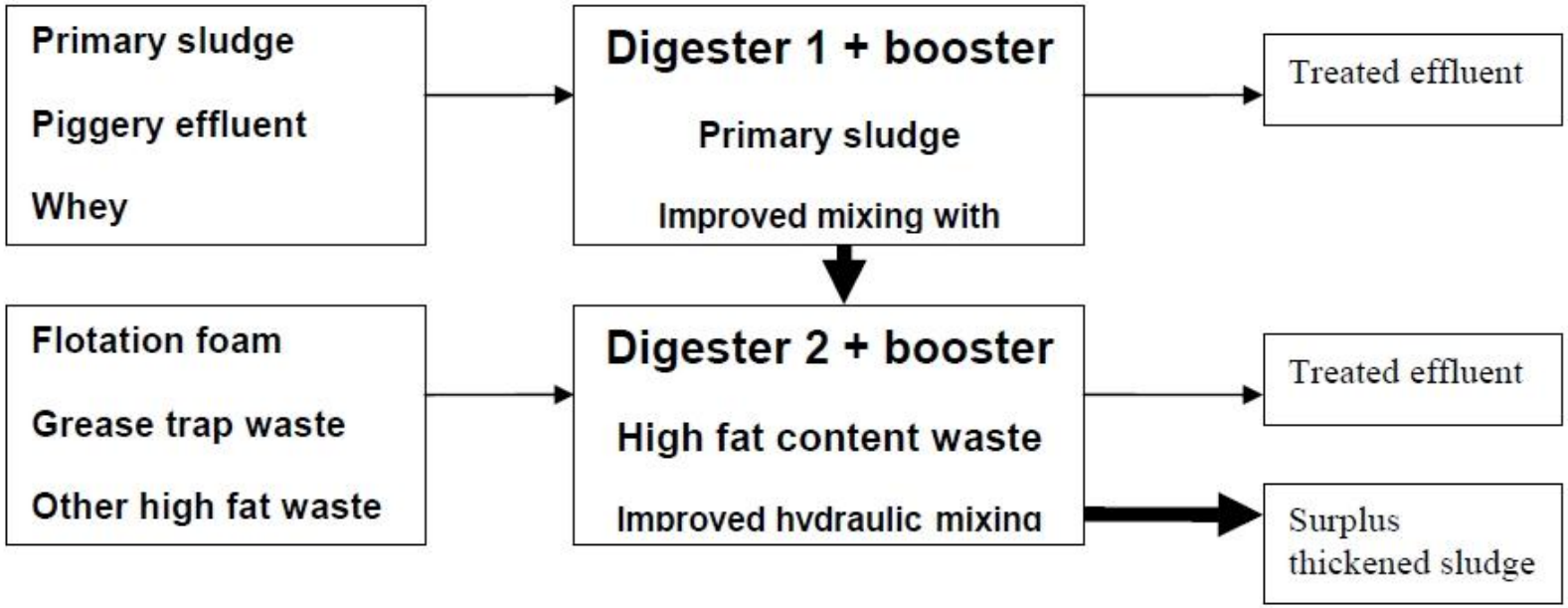
BOOSTER STEP TO IMPROVE PERFORMANCE

- Purchased an ANDRITZ PDR 900L thickener for use in the booster step.
- Consists of a rotating gravity drum thickener to thicken sludges to 8% before return to the digester

Tomal Automated batch plant

- Booster works by returning biologically active sludge to the digesters and countering digester washout from the higher loading rates used.

Conceptual Design of New Waste Deliveries



Liquid Waste Facility to Introduce High Strength Feeds

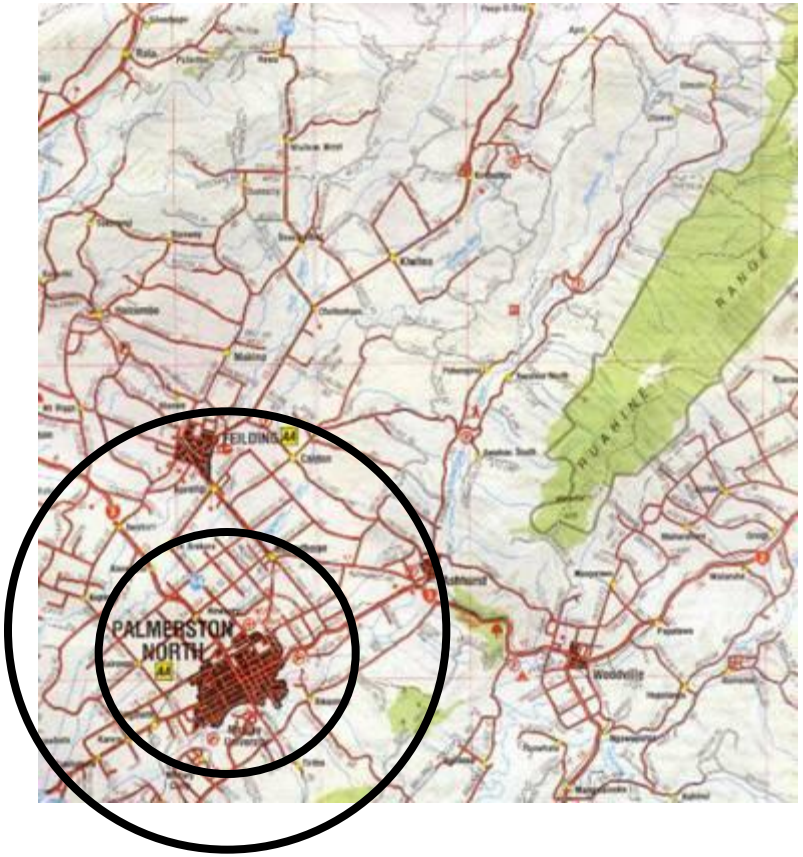
- Consisting of two 30000L tanks
- Proprietary mixing system supplied by PumpSystems of Christchurch (Rotamix System)

Sourcing High Strength Wastes

- Driven by requirement of additional gas for new generator.
- Based on existing Anaerobic Digesters which are being modified.
- Use mixed sources of biomass including food waste
- Opportunities for additional waste sources

Looking for organic material in initially in 10km, 20km, 30km and 50km radius

- Costs are driven by:
  - Distance
  - Volume
  - Consistency
  - Strength
  - Potential Contamination
  - Other alternatives
  - Sunk capital investment



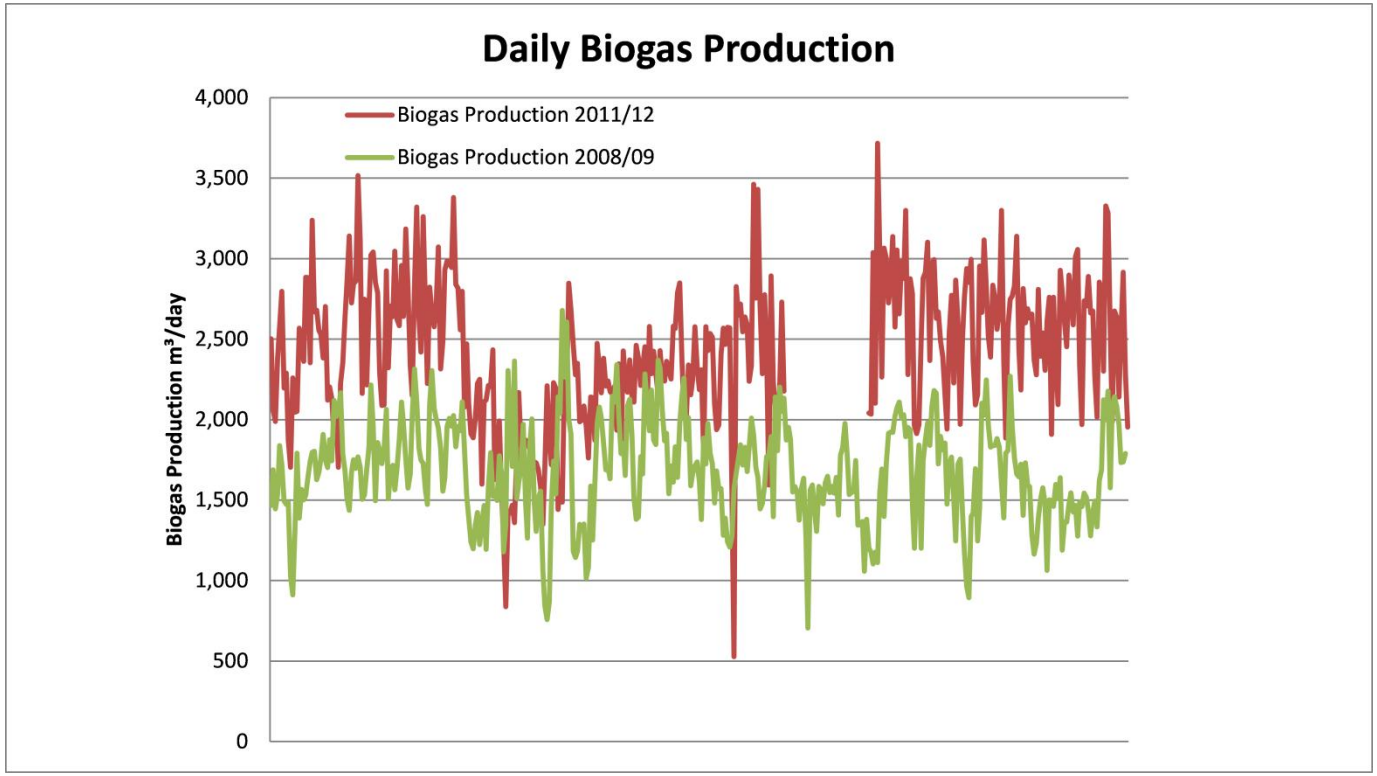
Sourcing Organic Material (cont)

List of used waste materials:

Supplier	Flowrate (wet wt)				TS %	VS (% of TS)	VS (t/day)
Venison Packers (paunch only - not usable)							
Land Meat NZ (paunch only - not usable)							
CMP (too small daily volume to be significant)							
PN TTS Grease trap waste (Paul Ward) sample analysed by WS	50	m3/wk	7.14	t/d	7	80	0.40
Additional Grease trap waste (Wellington Paul Ward) will be thickened	350	3/month	11.48	t/d	7	80	0.64
PNCC primary sludge (digester #1)	770	m3/wk	110.00	t/d	4	80	3.52
Speirs Food (cabbage, lettuce offcuts etc.)	950	t/yr	2.60	t/d	14.6	92	0.35
Fonterra DAF waste (70 % FOG in VS as specified by PNCC)	105	t/wk	15.00	t/d	15.0	92	2.07
piggeries (happy hog fresh manure)	100	m^3/wk	14.3	t/d	5.0	85.4	0.61
other hypothetical piggeries	100	m^3/wk	14.3	t/d	5.0	85.4	0.61
Fonterra whey (digester #1)	150	m^3/wk	21.4	t/d	6.4	90	1.23
Fonterra whey (digester #2)	70	m^3/wk	10.0	t/d	6.4	90	0.58
Total			**206**	t/d			**10.0**

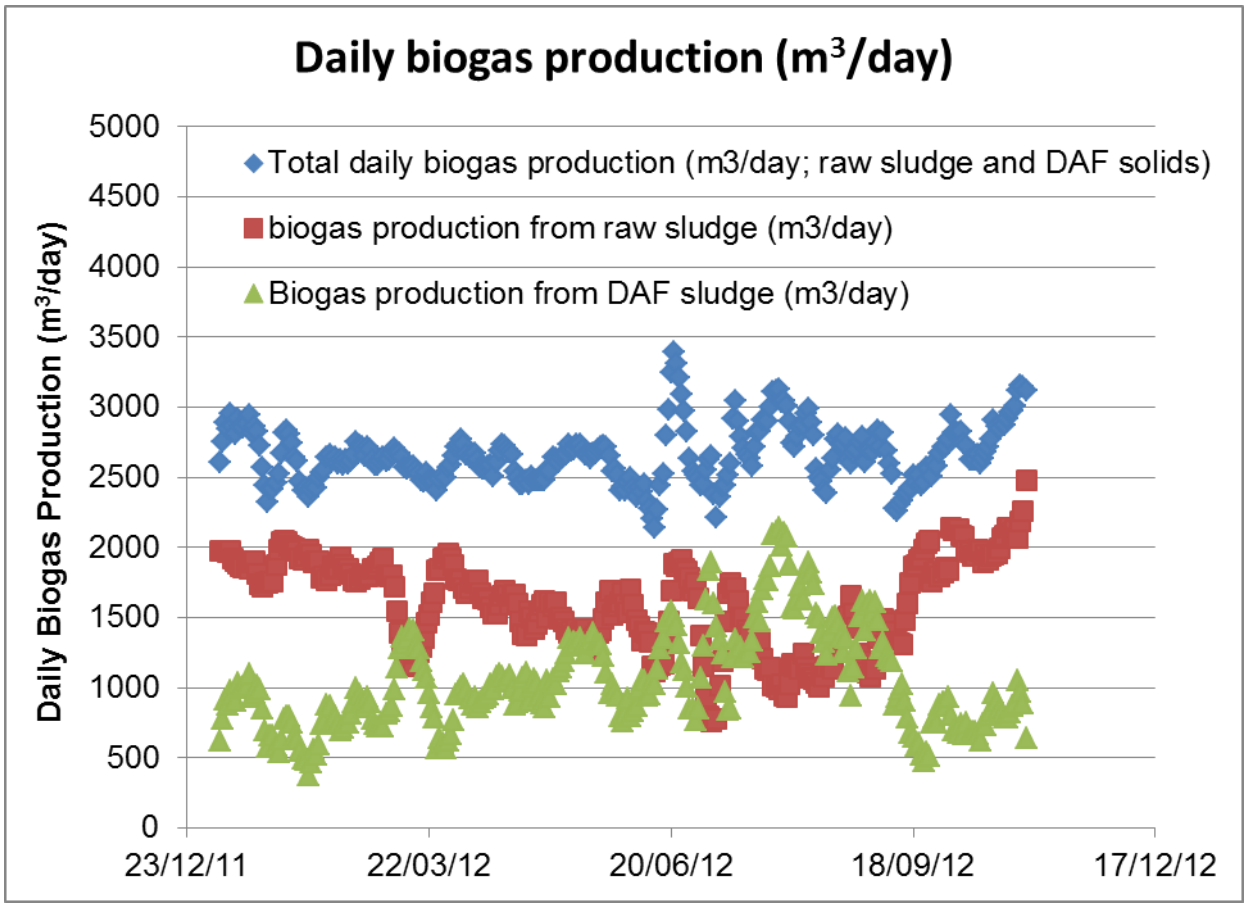
- Piggery waste initially seen as a high value waste for introduction into digesters
- Practice has shown that this is very difficult to source
- Currently receiving wastes from Fonterra Longburn (DAF), Fonterra Ice Cream Plant (DAF) and Grease Trap Wastes

Upgraded Digester gas Production



Daily Biogas Comparison 08/09 v 11/12

Upgraded Digester gas Production



Pitfalls And Unanticipated Consequences

Delays in Commissioning

- Delays in Commissioning Booster restricted total volumes of new waste that could be accepted.
- Had contract to accept waste but unable to take it all in the digesters
- Highlighted the need for alternative disposal route for waste

Digester Lid Internal Corrosion

- Project highlighted the many unknowns in retrofitting existing infrastructure.
- Additional costs for replacement of failing undersized infrastructure needs to be understood before commencing project.

Examples of Gas Pipe issues

Corroded pipe fittings

Undersized gas pipes & broken fittings

Undersized flow meter

Digester Issues

- Issues with toxic compounds in the waste stream
- Have been 3 instances of digesters getting sick
- Reinforced requirement for robust Trade Waste systems

Conclusions

- The Digester Improvements & new Generation facility have been successfully implemented
- PNCC has successfully moved to operating two high rate digesters and increased biogas production
- Total project cost not just new infrastructure but also cost of renewals/replacements brought forward resulting from project.
- Process taken longer than anticipated and not without issues