



Natural Systems Limited

BioGenCool™

Biogas Energy System
for Dairy Farms



July 2008



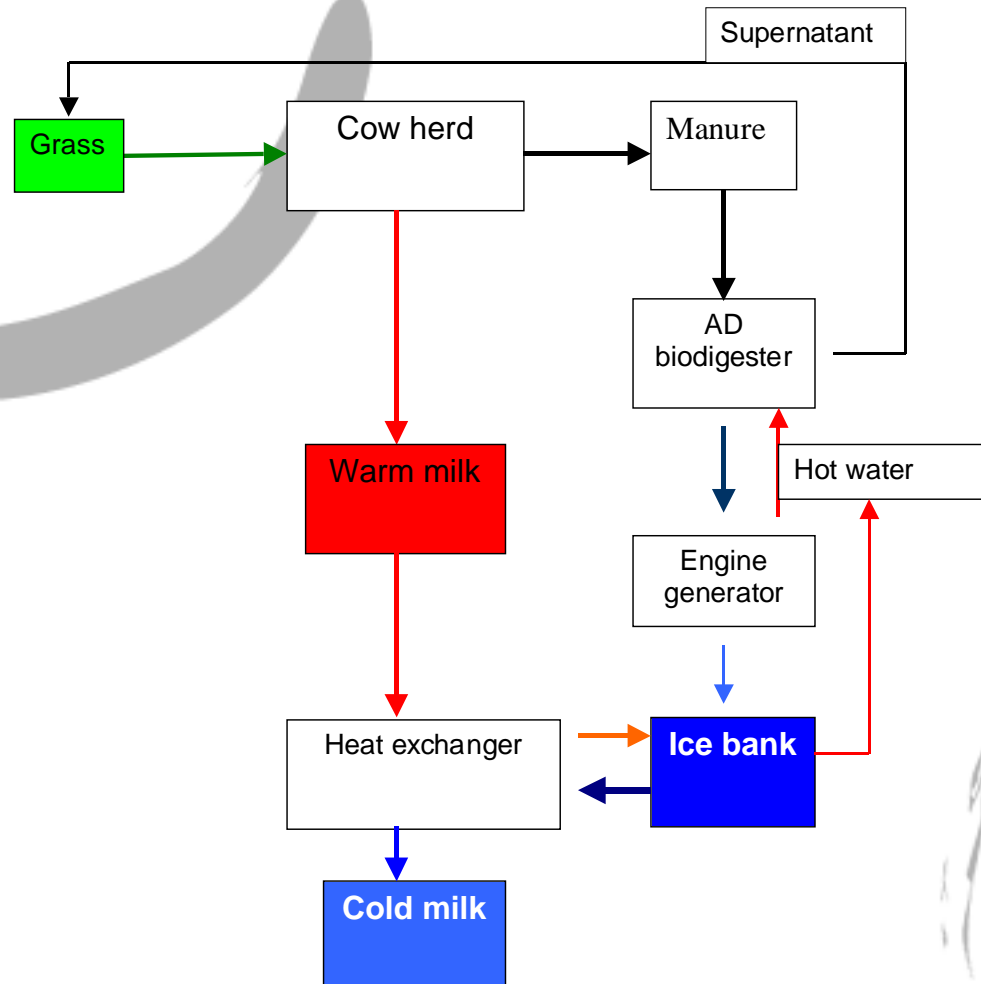
Content

- Introduce Natural Systems Limited (NSL)
- The BioGenCool™ System
- Design and Performance
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Who are Natural Systems Limited?

- NSL is a start up 'green' micro generation company, established in 2004 and is based in Christchurch, New Zealand. Shareholder funded
- Our first technology combines Energy Production with farm Waste Management and Greenhouse gas emissions abatement.
- Patented technology – BioGenCool™ (2003 IET Innovation Award for Sustainability, London)
- Farm Energy Audits are part of the design process
- Commercial Demonstration unit on Landcorp farm, with assisting grant.

The System



Digester

- Continuous stirred-tank reactor design (WSL)
- Timber stave construction, fabric liner, polystyrene insulation, inflating Butynol roof (TTEL)
- Operates at 35C using heat from genset
- Periodic hydraulic mixing
- Batch fed after milking events
- Digestate outflow for fertilisation of pastures
- Excess gas safety relief
- 65% methane biogas fed to generator



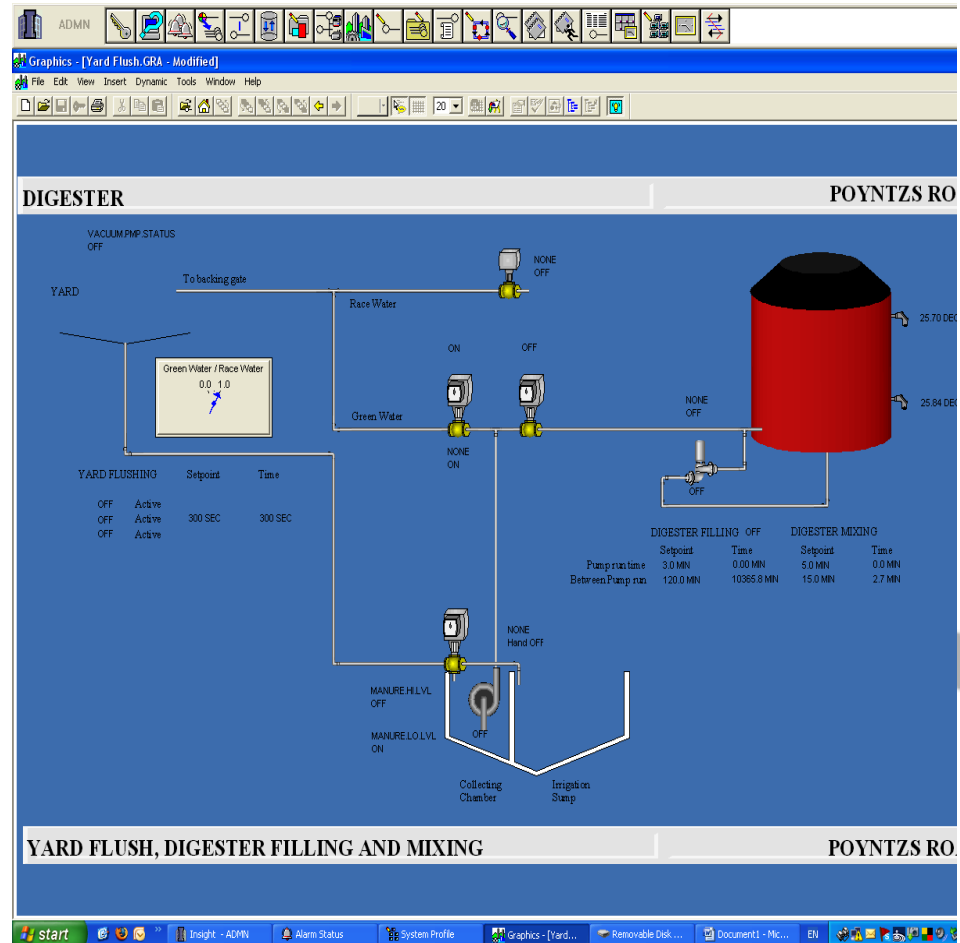
Genset

- Deutz diesel engine with heat recovery
- Brushless synchronous 3-phase alternator
- Auto-synchronising on 100% diesel
- Auto change-over to dual-fuel (15% pilot diesel)
- Import/ export Time Of Use metering
- Peak shaving export during the Winter (off season)
- Island mode standby generation



Controls and Grid Interface

- Siemens controller and on-site computer
- Ethernet communications TCP/IP
- Freely programmable
- Graphical interface; user friendly
- Long-term data storage and reporting software
- Remote access
- Generation from other sources e.g. wind & PV, can be added using the Distributed Generation platform



Ice bank

- Power from biogas generator to ice slurry machine – waste heat to dairy
- Store of ice slurry used via heat exchanger to snap chill milk direct from dairy before it enters vat.
- Milk enters vat at 4C
- Very efficient use of the power
- Cooler milk is not valued by NZ dairy companies. All are happy with the status quo involving higher vat storage temperatures
- Apparent contrast with EU and Australia



Environmental Benefits

- Renewable energy
- Reduced water usage
- Reduced nitrate level in digestate
- Reduction in GHG emissions
- Reduced pathogens

The Business Case

- For a system to be economic it needs a sufficient quantity of effluent
- Based on current costs, and ascribed values, needs circa 4000 'cow concrete hours' per day, a figure that will reduce with benefits of scale, and better appreciation of values.
- This volume of effluent is available from most farms using supplementary feeds via feed pads.
- All (??) farms with feed pads store effluent in open ponds, which emit methane, and are a few years away from a CO2 liability – which will / should assist with the business case

Typical Feed Pad



Typical Feed Pad Effluent Storage –emitting methane



Value Proposition, 850 head herd spending 2.5 hrs / day on Feed Pad, 270 days/yr

	BENEFIT	ESTIMATED VALUE \$k p.a.	COMMENT
1	Power production	28.000	From Biogas Generation (@ 15c/kWh)
2	Heat	3.000	("up to" value - If any left over from heating digester)
3	Energy Savings	1.000	From various reductions e.g. water pumping,
4		4.000	effluent pumping
5	Water savings	4.500	"up to" value
6	Early Return of Pasture	13.000	Cows graze immediately after irrigation. 40Ha 6 times per year, 2 week break, silage 12c/kg OR 1% increase in revenues, circa \$25.000
7	Fertilizer value / reduced solids content	10.000	Greater realization of fertilizer value from easier more irrigation. \$11/cow/timeond.y or f.p
8	Reduced Solids Content	9.000	Labour saving on irrigation maintenance \$15/hr
9	Eliminate risk of ONE consent breach	1.000	
10	Standby power	6.800	loss of one milking worth of milk solids (if cannot be removed ASAP by tanker)
14	Reduced N2O Emission		Not known
15	Reduced Methane	8.000	Based on NIWA model and \$20 per tonne CO2
	TOTAL VALUE	88.300	
	Operating Costs	14.6	Diesel & 0.5hrs/day mntnce for 260 days \$20/hr
	NET VALUE	73.700	OR \$370k if larger value ascribed to item 5 above

Return on Investment

Benefits:	15Y NPV	IRR
1-5	\$166k	11%
1-11	\$684k	41%
1-11,15	\$790k	49%

- Calculations done at zero cost of capital
- At current one off costs, and power costs, marginal for the 850 herd with 2.5 hrs on feed pad.
- Becomes economic as other values are recognized

The Future For Farm Based Systems

- Uncertain,- on a scale of high tech cottage industry to vibrant business
- No support or incentive from Government
- Some recognition from Regional Authorities
- No support from dairy companies
- Future is dependant on combination of:
 - Take up of feed pads and intensification - happening
 - Venture capital
 - Cost reduction – through scale and system refinement
 - Progressive dairy farmers
 - Regulation

For More Information

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