



BIOGAS AS A VEHICLE FUEL AND INJECTION INTO NATURAL GAS GRIDS





Presentation Outline

- Greenlane Biogas Overview
- Biogas Upgrading Explained
- Biogas Upgrading Via Water Scrubbing Explained
- Biomethane for Grid Injection & Vehicle Fuel
- Greenlane R&D plus Collaborative project at Redvale Energy Park



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Greenlane Biogas an Overview



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Greenlane Biogas

- Greenlane Biogas Ltd is part of the Flotech Group of companies
- Flotech was established in New Zealand in 1986
- Greenlane Biogas Ltd is the global leader in water scrubbing technology with around 40+ sites worldwide.
- The Flotech group have offices in **Sweden, Singapore, Australia, New Zealand** and **Canada**.
- Now with sales representation in France & Germany.



KALLT



FLOTECH



Greenlane Licensees

- **Chesterfield Biogas** - United Kingdom
 - UK is largest biogas producer
- **EnviTec Biogas** – Germany
 - world leading anaerobic digester technology
- **SBI** (Swedish Biogas International) – Sweden
- **KES** (Kobelco Eco Solutions) – Japan
- **North America** Licensee under negotiation



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Biogas Upgrading Explained

Biogas Upgrading

- Biogas is produced by the anaerobic digestion of organic matter such as manure, sewage sludge, industrial waste, the organic fractions of household waste, etc.
- Biogas can be upgraded to be a substitute for natural gas.
- The typical gas composition of biogas and biomethane are as follows:

Biogas

CH_4 : ~60%
 CO_2 : ~39%
 $\text{N}_2 + \text{O}_2$: <1%
 H_2S : 50 - 5000 ppm
 H_2O : Saturated
 Siloxanes: Trace



Biomethane

CH_4 : ~98%
 CO_2 : ~1%
 $\text{N}_2 + \text{O}_2$: ~1%
 H_2S : <1 ppm
 H_2O : <1 ppm
 Siloxanes: <1 ppm





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Biogas Upgrading Via Water Scrubbing



A Simple Concept

- Biogas is primarily methane (CH_4) and carbon dioxide (CO_2).
- Water under pressure can be used to separate these two gases through their different solubility in H_2O .





Water Regeneration

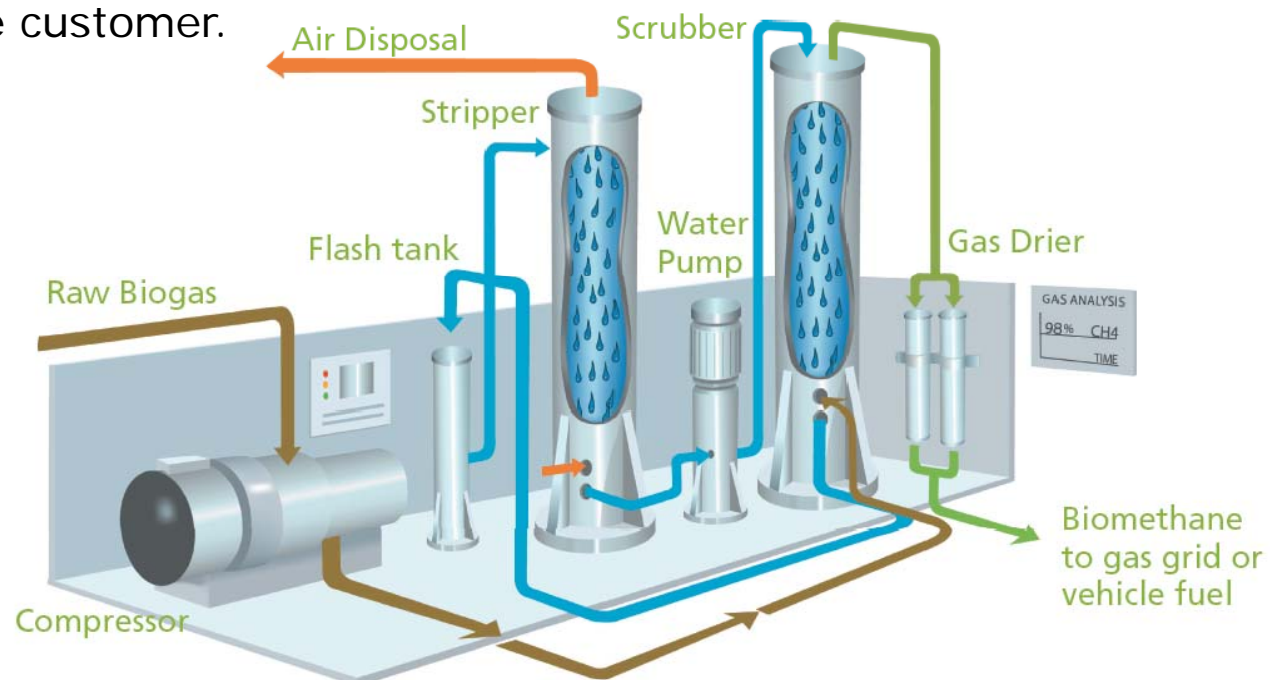
- Water from the scrubber is sent to a flash tank to depressurize, so the small amount of absorbed methane can be removed from the water.
- The water is then sent to a stripper that removes the gases absorbed in the water.



- The water can then be reused (recycled) to clean more biogas

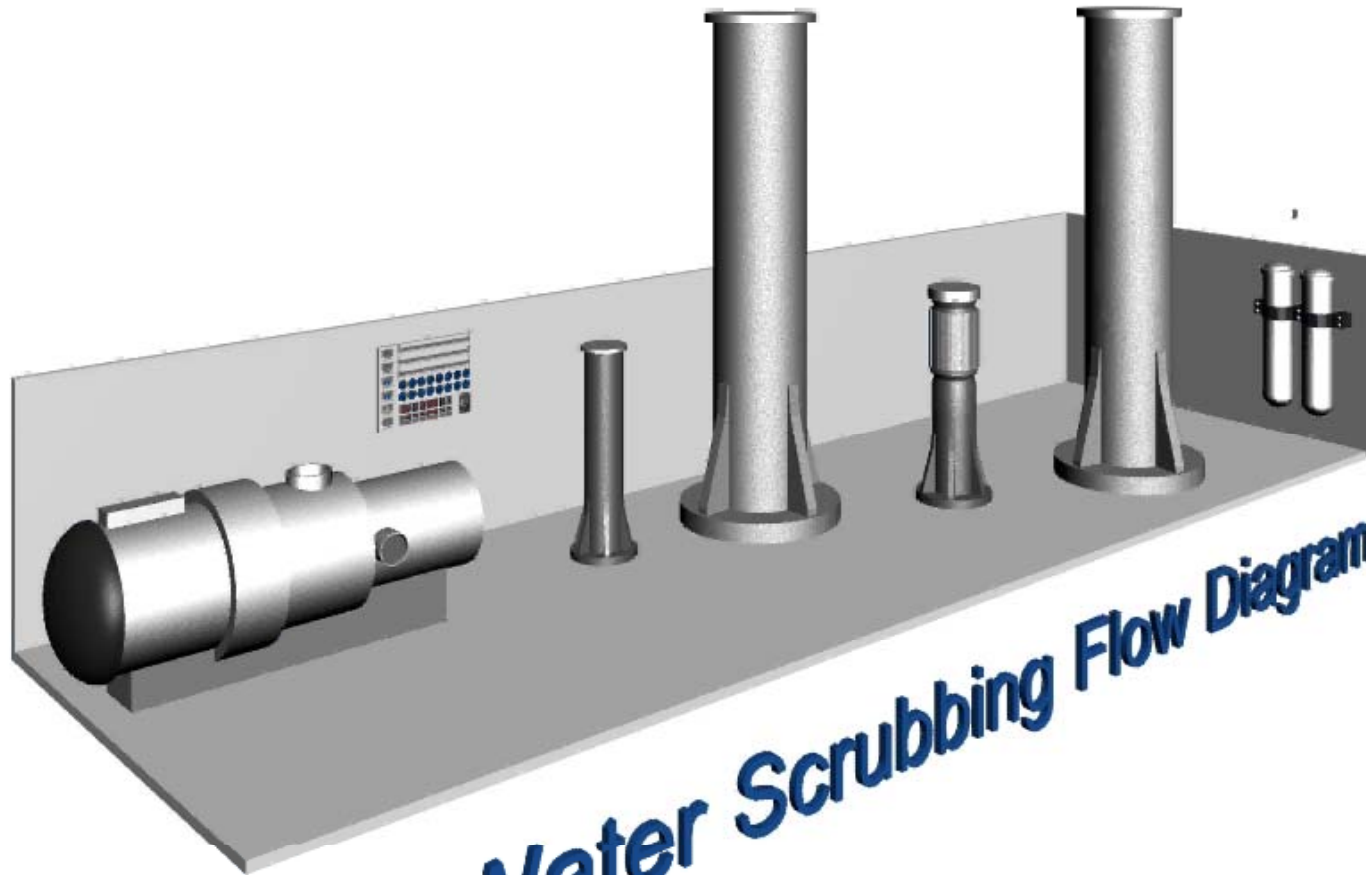
How Water Scrubbing Works

- The raw biogas is compressed, then fed to a 'Scrubbing' vessel where it is contacted with water. CO_2 , H_2S and siloxanes are preferentially absorbed by the water.
- Absorbed methane is 'Flashed' off, in a vessel at a lower pressure and recovered by returning it to the start of the process.
- Product gas is dried and further purified, before being analyzed and delivered to the customer.





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Water Scrubbing Flow Diagram



Greenlane's Water Scrubbing Experience

Greenlane has unparalleled experience with ~40 installations and ~20 years of experience.





GREENLANE[®] PRODUCTS



Model Name	Nominal Capacity NM ³ /h Raw Gas	Capacity Range NM ³ /h	Estimated Plot Dimensions Containerised Length/Width/Height	Estimated Weight (Tonnes)	
				Shipping	Operating
Manuka	80	40 - 80	6080 x 2440 x 12300 [1 x std 20' container]	7	8
Manuka+	130	40 - 130	6080 x 2440 x 12300 [1 x std 20' container]	7.5	8.5
Kanuka	300	100 - 300	6080 x 2440 x 12300 [1 x std 20' container]	9	11
Rimu	800	250 - 800	12192 x 2440 x 14200 [1 x std 40' container]	18	22
Matai	1200	400 - 1200	23000 x 2440 x 14800 [1 x std 40' con + skid]	32	38
Totara	2000	650 - 2000	24000 x 2440 x 15400 [1 x std 40' con + skid]	40	48



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Catalyst Biomethane Project



Case Study – Catalyst Power

- Location: Abbotsford BC, ~1 hour drive east of Vancouver, ~3 miles from the US border
- First ADG to biomethane project in Canada
- Project developer is also the farm owner
- Project financing a mix of equity and debt, with 25% through a clean energy grant
- Digester feedstocks include dairy, hog, poultry, vegetable waste.
- The biogas production at full capacity is expected to be ~3 MW equivalent



Catalyst Farm – Fall 2009



Catalyst Digester Pad – February 2010



Case Study – Catalyst Power

- Digester construction started in February 2010





Case Study – Catalyst Power

- PlanET designed and installed the two stage digester
- The biogas in the 800Nm³/hr first phase is upgraded to biomethane via a water Greenlane water scrubber manufactured by Flotech
- The overall system is fully automated with a remote monitoring package to minimize the time requirement for on-site attention
- Biomethane quality measurement by Flotech and Terasen



Greenlane Main Container Arrives – June 2010



Catalyst Site – August 2010



Case Study – Catalyst Power

- First ADG to biomethane project in Canada
- Terasen, the local gas utility, confirms gas quality and pressure before the biomethane is added to the local gas grid.



Terasen's Biomethane Measurement and Odourization Skid



Catalyst Greenlane® RIMU – Fully Installed



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Other Installations



Case Study – Güstrow, Germany

- Largest ADG to biomethane project in the world
- Biomethane has been feeding a high pressure regional natural gas line since early 2009
- Over 10,000 Nm³/hr of biogas processing capacity
- ~99% CH₄ yield and low operating costs



Greenlane® Biogas Upgrading Plant - Gustrow, Germany



Anaerobic Digesters - Gustrow, Germany



Greenlane® Biogas Upgrading Plant - Gustrow, Germany



Case Study – Lille CVO

- Largest biomethane project in France, ~750 scfm
- First biomethane addition to the French natural gas network
- Two gas uses: pipeline natural gas and CNG fuel for buses
- Biogas generated from the anaerobic digestion of household waste from the city of Lille.





Case Study – Motala, Sweden

- Biogas from a small wastewater treatment plant (WWTP), with a typical biogas flow $\sim 80\text{Nm}^3/\text{hr}$
- Biomethane is used to fuel vehicles at a public fueling station outside the WWTP's gate
- This design incorporates several Greenlane patents
- Six of these small biomethane systems are operating in Europe



Greenlane® MANUKA - Motala, Sweden, Opening Ceremony (2009)



Greenlane® MANUKA - Motala, Sweden
Opening Ceremony (2009)



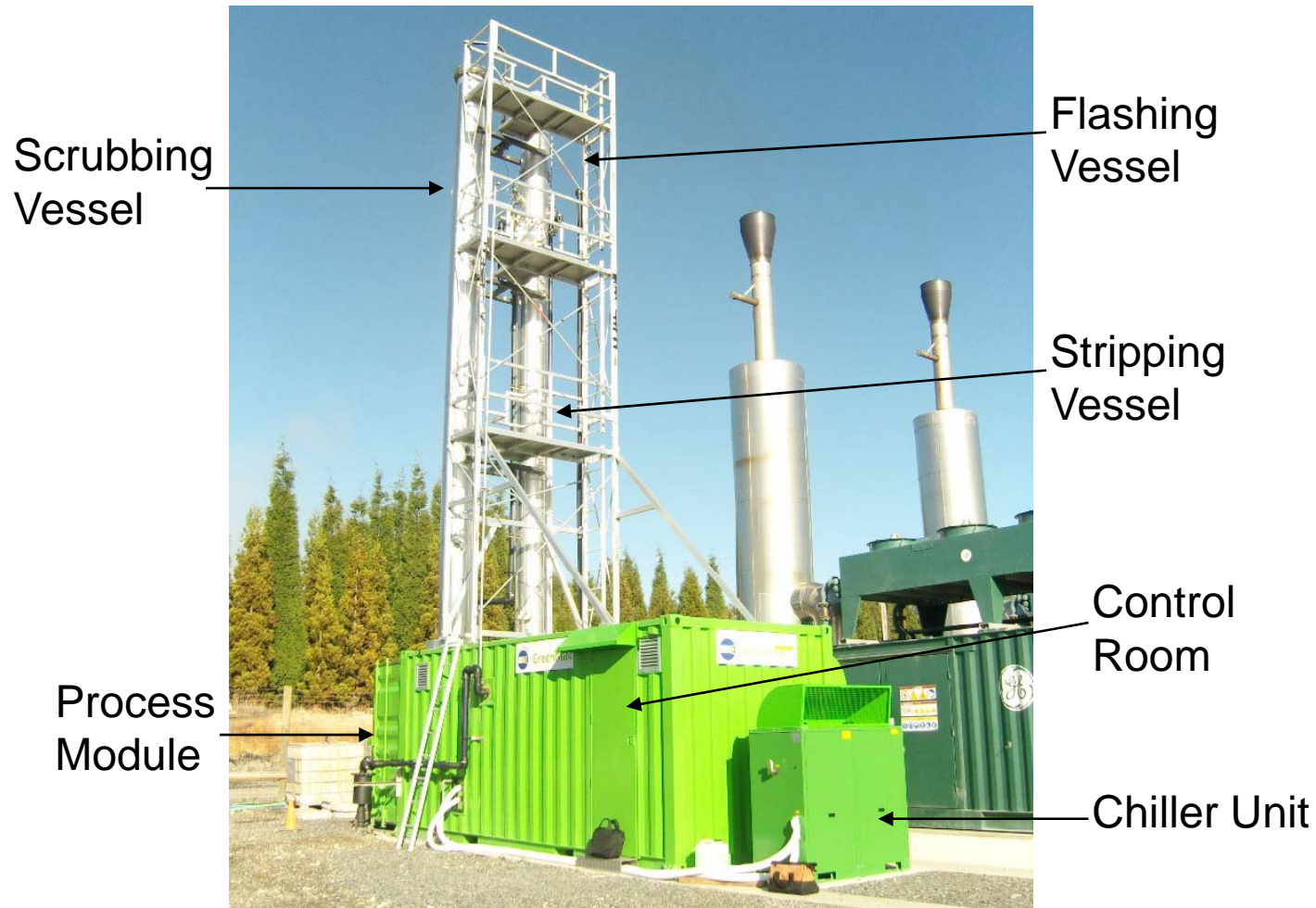
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Collaborative Biogas Project at Redvale Energy Park



Redvale Project

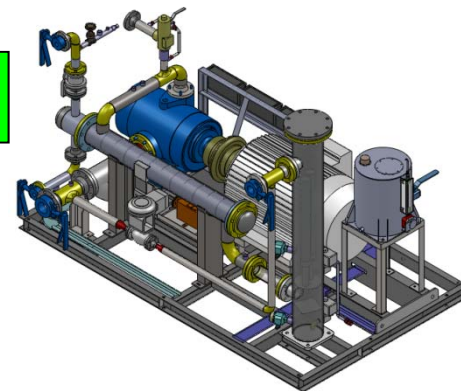
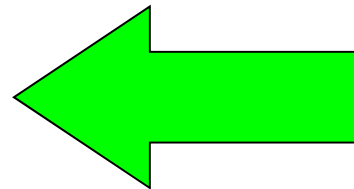
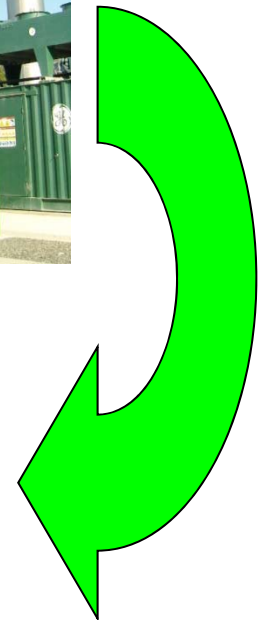
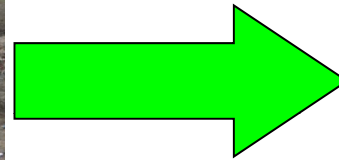
Greenlane® Manuka - 80 Nm³/hr Capacity





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Redvale Colaborative Project





Research and Development

- Improve Hydrogen Sulfide Removal
- Improve removal of Carbon Dioxide
- Improve Energy Efficiency
- Investigate Removal of Inert Gases
- Water Flooded Screw Improvements



Thank you for your attention!



www.greenlanebiogas.com