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Power of We™

Harvest Power Tulare RNG Station

Securing California's Clean Energy Future with Renewable Natural Gas
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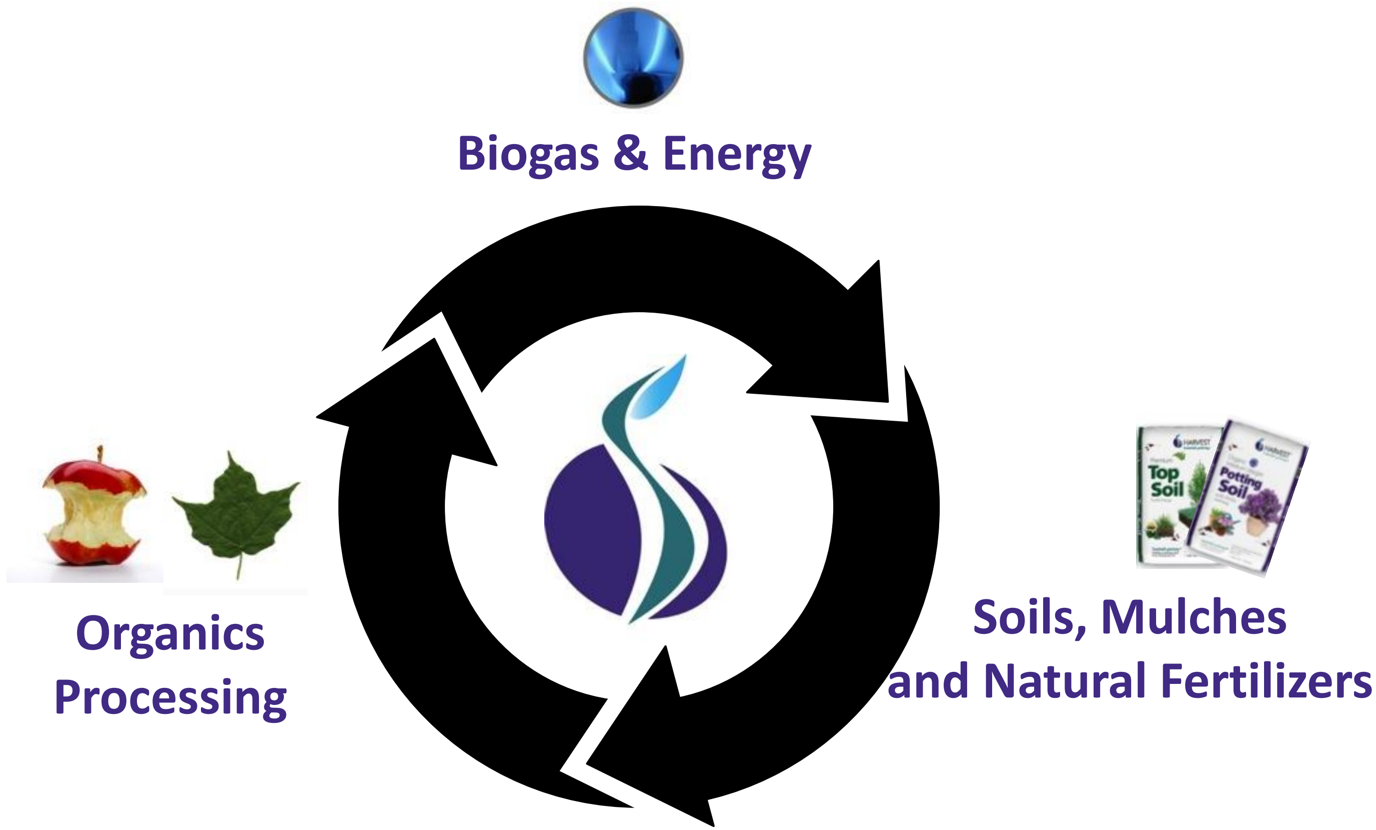
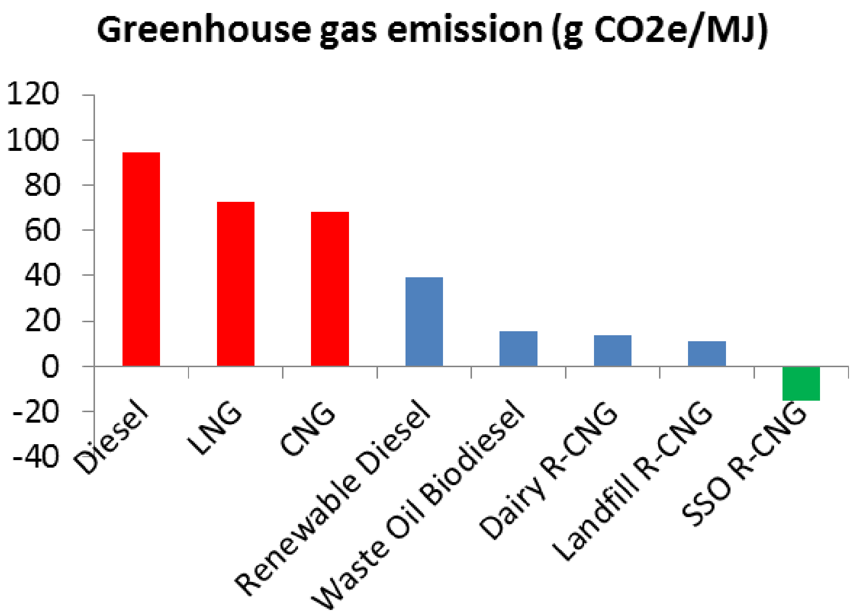
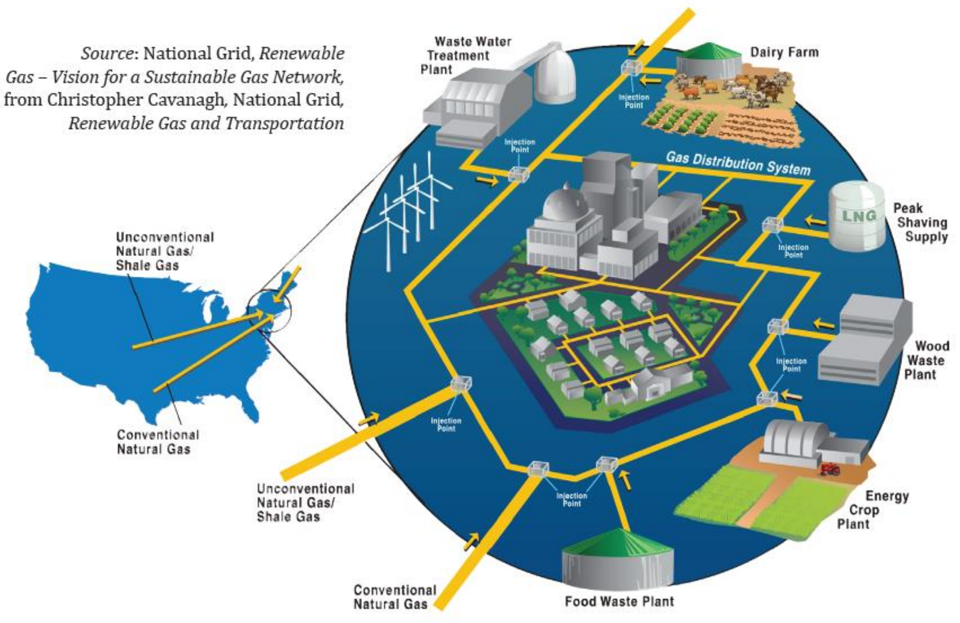
About Harvest



Biogas: Clean Burning and Movable



Source: National Grid, *Renewable Gas – Vision for a Sustainable Gas Network*, from Christopher Cavanagh, National Grid, *Renewable Gas and Transportation*



Storage Upstream or Downstream?

- Upstream
  - Double membrane roofs on digesters (low pressure low volume) but relatively inexpensive investment cost for storage
  - Double membrane bladders, slab on grade (low pressure low volume) but relatively inexpensive investment cost for storage

- Downstream
  - Commercial Gas Cylinders with cascade (high pressure large volume) expensive capital cost

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Balancing Generated Energy vs. Demand

- Island Station creates balancing issues
  - Digester operates 24*7*365
  - Incoming feedstock's 8hrs per day 6-days a week
  - Producing 600,000 DGE/Yr.
  - 40-50 Trucks per day at 30-40 DGE per Truck
  - No pipeline injection point (very expensive and long lead time to complete engineering and agreements)
  - CHP can eliminate this problem by sending Kwhrs to the grid

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Fast Fill vs. Slow Fill?

- Fast fill
  - Time to fill is similar to filling you car at the gas station
  - Investment cost are higher for high volume dispensing (compression)
  - Can fill several vehicles in a short amount of time

- Slow Fill
  - Lower investment cost due to lower compression requireme
  - Do you have space to park vehicles to overnight?
  - Mainly used for one client (no POS)

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CNG Specifications

Specification	Value*	Test Method
Methane	88.0 % (min.)	ASTM D 1945-81
Ethane	6.0 % (max.)	ASTM D 1945-81
C3 and higher HC	3.0 % (max.)	ASTM D 1945-81
C6 and higher HC	0.2 % (max.)	ASTM D 1945-81
Hydrogen	0.1 % (max.)	ASTM D 2650-88
Carbon Monoxide	0.1 % (max.)	ASTM D 2650-88
Oxygen	1.0 % (max.)	ASTM D 1945-81
Inert Gases: Sum of CO2 and N2	4.5 % (max)	ASTM D 1945-81
Particulate Matter	The natural gas shall not contain dust, sand, dirt, gums, oils, or other substances in an amount sufficient to be injurious to fueling station equipment or the vehicle being fueled.	
Odorant	The natural gas at ambient conditions must have a distinctive odor potent enough for its presence to be detected down to a concentration in air of not over 1/5 (one-fifth) of the lower limit of flammability.	
Sulfur	16 ppm by vol. (max.)	Title 17 CCR Section 94112

Pipeline Injection Specifications

SoCalGas Standard

http://www.socalgas.com/documents/business/Rule30_BiomethaneGuidance.pdf

Rule 30 Biomethane Gas Delivery Specifications LIMITS and ACTION LEVELS

Parameters	**Limits[1] and/or Action Levels[2]**	Monitor and/or Sampling Method References	Test Method(s)
Water vapor content	**7 lb/MMscf (or 20°F if P>800 psi)**	Moisture Analyzer	GPA 2261, ASTM D1142/D5454/D3588, *Laser*
Hydrocarbon Dew point	**45°F at 400 psi or P, if P<400 psi (or 20°F at 400 psi if P>800 psi)**		ASTM D1142, GPA2286
Heating Value Wobbe Number, Major Components: C^1 to C^{6}+ CO^2, N^2, O^2, CO, H^2	**990 ≤HHV≤1150 Btu/cf** **1279 ≤WN≤1385** **4% Inerts**	Gas Chromatograph	ASTM D1945/D7164, GPA 2261
Oxygen	**0.20%**	O^2 analyzer	*Electrochemical*
Carbon Dioxide	**3%**	CO^2 analyzer (new)	*Laser, FTIR*
Hydrogen Sulfide, Mercaptan and Total Sulfur	**0.25 gr. H^2S/100 scf** **0.30 gr. S/100 scf** **0.75 gr. S/100 scf**	H^2S and Sulfur speciated analyzer	ASTM D4084/D6228/D4468 D5504/D7166
Dust and Gum	**Free of**	In-line filter	EPA Method 5, 0.1μm filters
Temperature	**50°F ≤T≤ 105°F**	Thermocouple	
Vinyl Chloride[3]	**1170 ppbv**	Summa Canister, Tedlar Bag, XAD-2	GC/MS, EPA8270C,B, EPA T0-15
Aldehydes and Ketones	Spot <0.1 ppm^v	Sorbent Tube	EPA TO-11, HPLC
Ammonia	Spot <0.001%	OSHA ID-188 or cylinder sample	GC, NCD, OSHA ID 164 Modified
Biologicals	100 per scf	Filter, SKC Biosampler	MPN, qPCR, Microbe test kit (APB, SRB, IRB)
Hydrogen	Spot < 1%	Cylinder	ASTM D1945/D7164
Mercury	Spot < 0.01 mg/m^3	Gold plated silica beads	AA, AFS ASTM D5954/D6350
Volatile Metals	Spot < 0.01 mg/m^3	Nitric acid and peroxide aqueous	ICP, AAS
Siloxanes	Commercially free of (or ND<0.1 mg Si/m^3 continuously[4])	Impinger, tedlar bag, Summa Canister Summa Canister, XAD-2	EPA TO-14, 15 GC/ELCD, GC/AED, GC/MS
VOCs	Spot <1 ppm^v		GC/MS, EPA8270C,B, EPA T0-14, 15
Halocarbons			
SVOCs		XAD-2	EPA 8270
PAHs		PUF/XAD	EPA TO-13A

Harvest Power Tulare LLC

- AB-118 Grant $5M
- HSAD Technology
- 660,000 DGE/Yr.
- 4,000,000 kW/Yr.
- Fast Fill
  - 50 Trucks/day
- 500 Kw CHP
- Feedstocks 40,000 – 60,000 tpy
  - Green Waste
  - Food Waste
  - FOG
- Generating RIN's
- LCFS Credits @ -15.29 g CO2e/MJ
- Begin construction this year
- COD December 2014

High Solids Case Study:
Harvest Energy Garden - Richmond, BC

Key Statistics

Start-Up: Spring 2013

Capacity: 40,000 tonnes /yr. organics (mixed food & yard waste, 30,000 tpy initial)

Energy Output: 2.2 MW combined heat-and-power

Product Output: 21,000 MT /yr. high quality compost

Public Outreach: Visitor Center to host educational tours and promote Zero Waste

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Low Solids Case Study:

Harvest Energy Garden - London, Ontario

Key Statistics

Start-Up: Spring 2013

Capacity: 70,000 tons /yr. ICI (Institutional, Commercial, Industrial) organics

Energy Output: 6 MW combined heat-and-power

Product Output: 5,200 MT /yr. granular fertilizer

Customers: Commercial food processors, grocery stores, restaurants, rendering plants.

Low Solids Case Study:

Florida Energy Garden Overview

Key Statistics

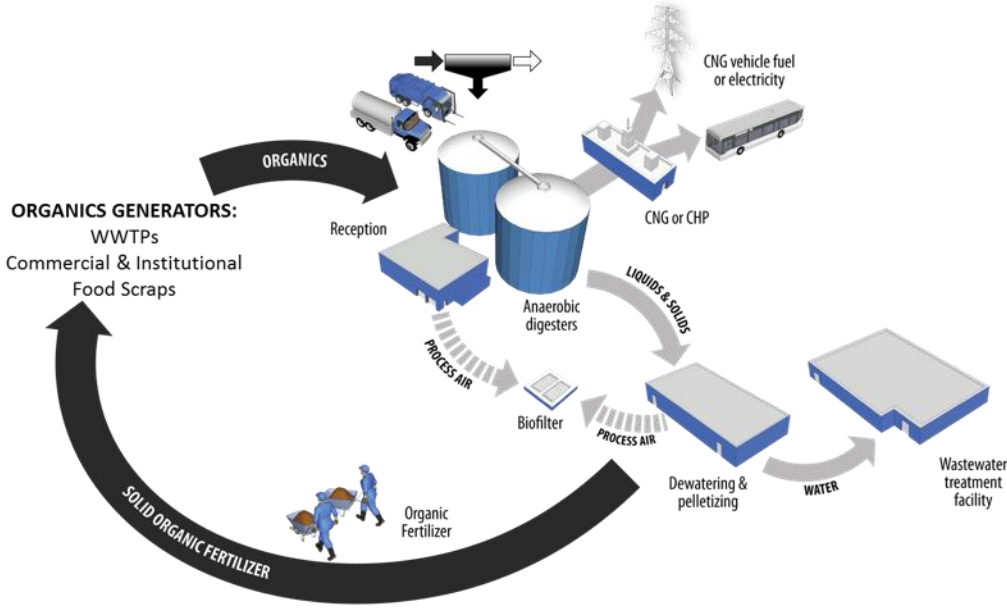
Start-Up: Autumn 2013

Capacity: 120,000 tons /yr. ICI (Institutional, Commercial, Industrial) and biosolids organics

Energy Output: **6 MW** combined heat-and-power

Product Output: 3,200 MT /yr. granular fertilizer

Customers: Located at WWTP and co-digesting biosolids with ICI food wastes



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