Southern California Gas Company

A Sempra Energy utility®

2012 Bioenergy Demonstrations

Southern California Gas Company

PIER Advisory Group Meeting

January 24, 2012

© 2006 The Gas Company. All copyright and trademark rights reserved.

2012 Bioenergy Demonstrations

- Pipeline quality biogas from WWTP
- Nanoelectromecahnical (NEMS) gas monitoring technology for lower cost biogas interconnection
- Biogas-to-liquids - renewable natural gas to DME
- Biomass gasification – searching for cost-effective solutions
- TriGen
  - Power + CO2 recovery for biofuels production + desalination
- Algae-based CCUS / Combined algae + Solar thermal

Key link: "California's Energy Future - The View to 2050“
http://ccst.us/publications/2011/2011energy.php

Pipeline Quality Biogas Demonstration

Performance

Typical Run Time: 168 hr / wk

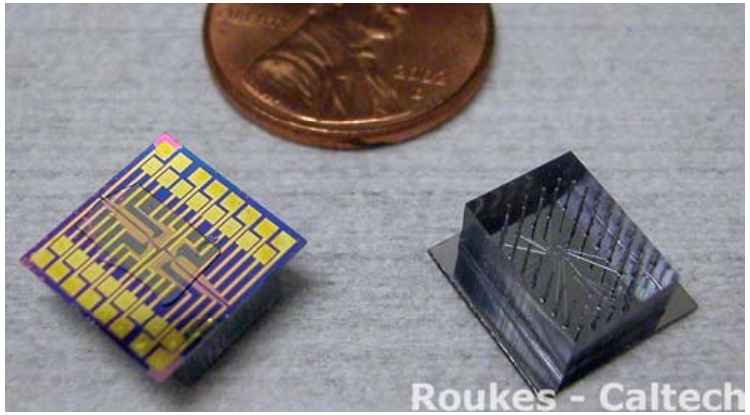
- Ave Feed Flow:177 scfm
- Ave Product Flow: 101 scfm
- Ave Product Quality: 99.0% methane
- Ave methane recovery: 89%
- Ave Product H2S: 0.4 ppm (Rule 30 limit is <4.0 ppm)
- 0 Safety incidents
- 92% up-time
- 100% reliability in producing pipeline quality during operations

Low-cost Biogas Interconnection System

- **New Sampling/Sensor Initiative (NeSSI) + NEMS instruments = Lower Cost Biogas Interconnection**

Centralized Gas Analysis

Distributed NeSSI NEMS Analysis

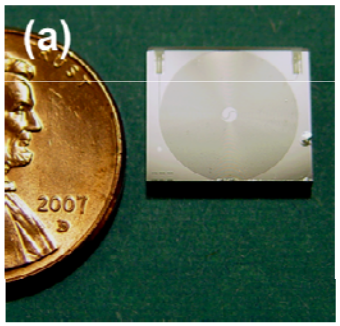


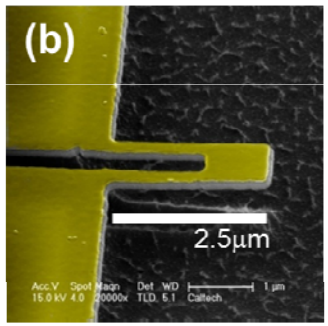
Microfluidics encapsulated BioNEMS chips, front and back, with penny for scale

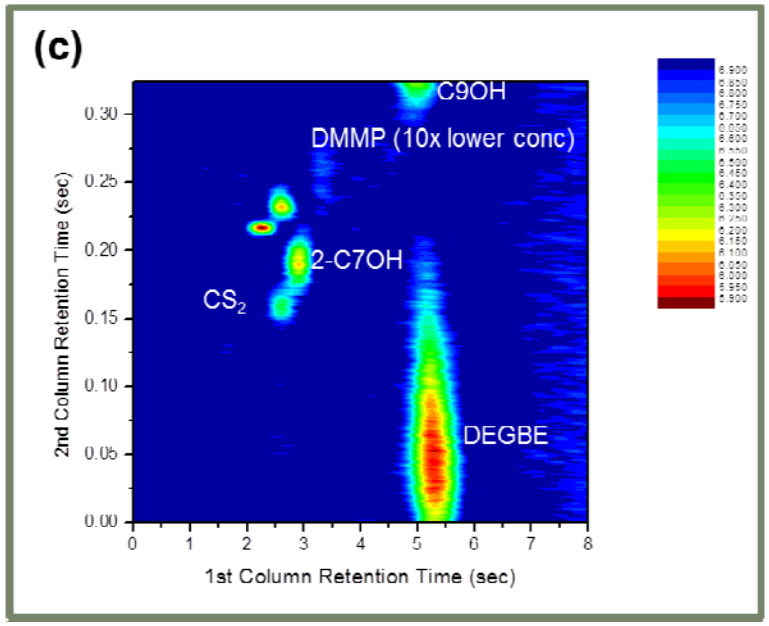
Links: http://depts.washington.edu/cpac/NeSSI/

Low-cost Interconnection System (Cont'd)

- **Nanoelectromechanical system (NEMS)**







High-speed analysis of chemical mixtures using microscale and nanoscale components

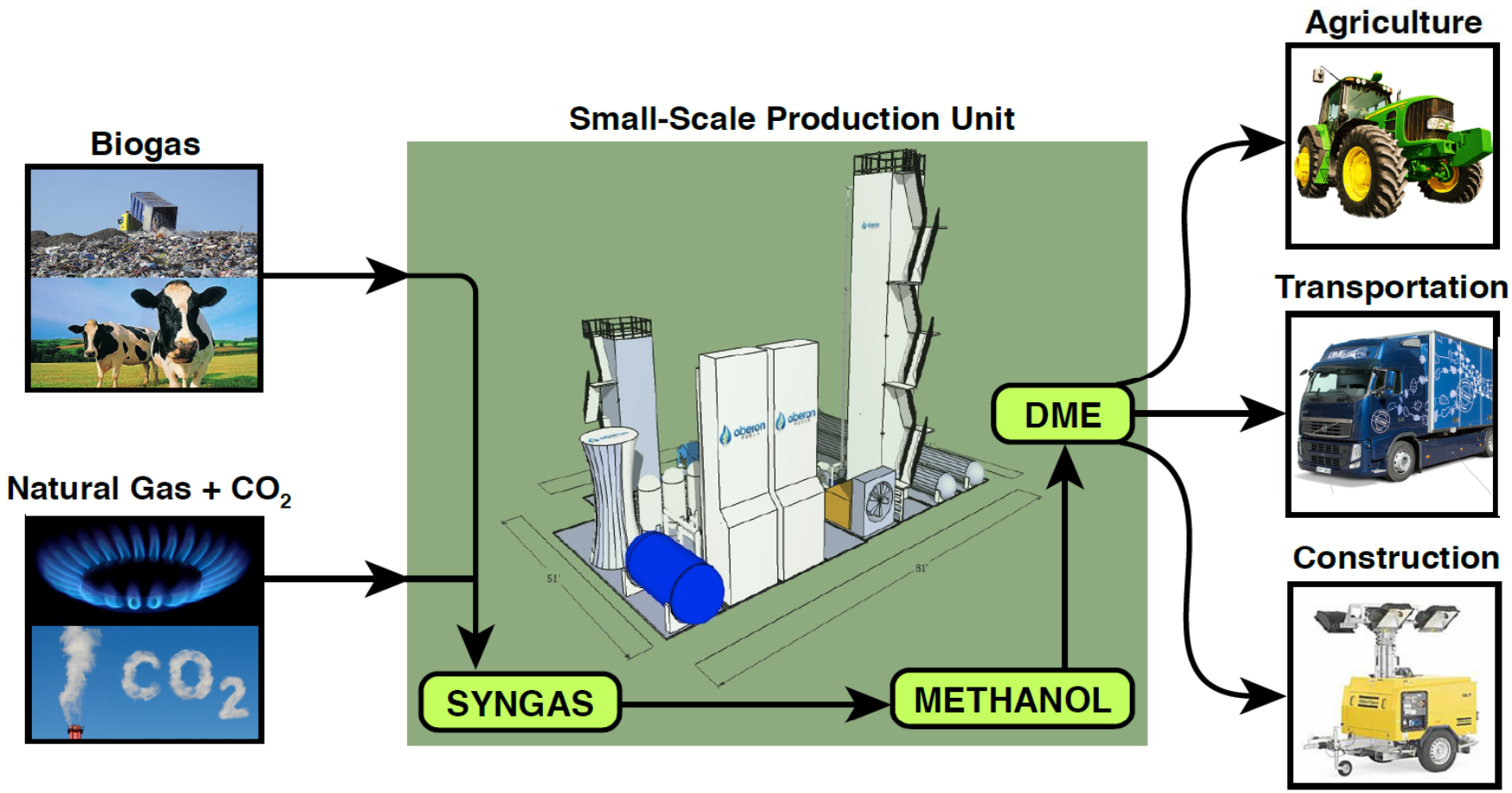
(a) Silicon gas chromatograph column developed by Sandia National Labs.

(b) Nanoelectromechanical (NEMS) resonator gas detector developed by Caltech.

(c) Through the use of two such columns and a NEMS sensor packaged in microfluidics, the analysis of a chemical mixture was performed in a bench-top demo setup. The analytical capability achieved by this demo show that potentially hundreds of chemicals may be separated and identified within seconds, at sizes and costs far below that of traditional GC-MS equipment.

Links:
http://nano.caltech.edu/index.html
http://www-leti.cea.fr/en
http://www.businesswire.com/news/home/20111213006011/en/CEA-Leti-Caltech-Alliance-Nanosystems-VLSI-Announce-Startup

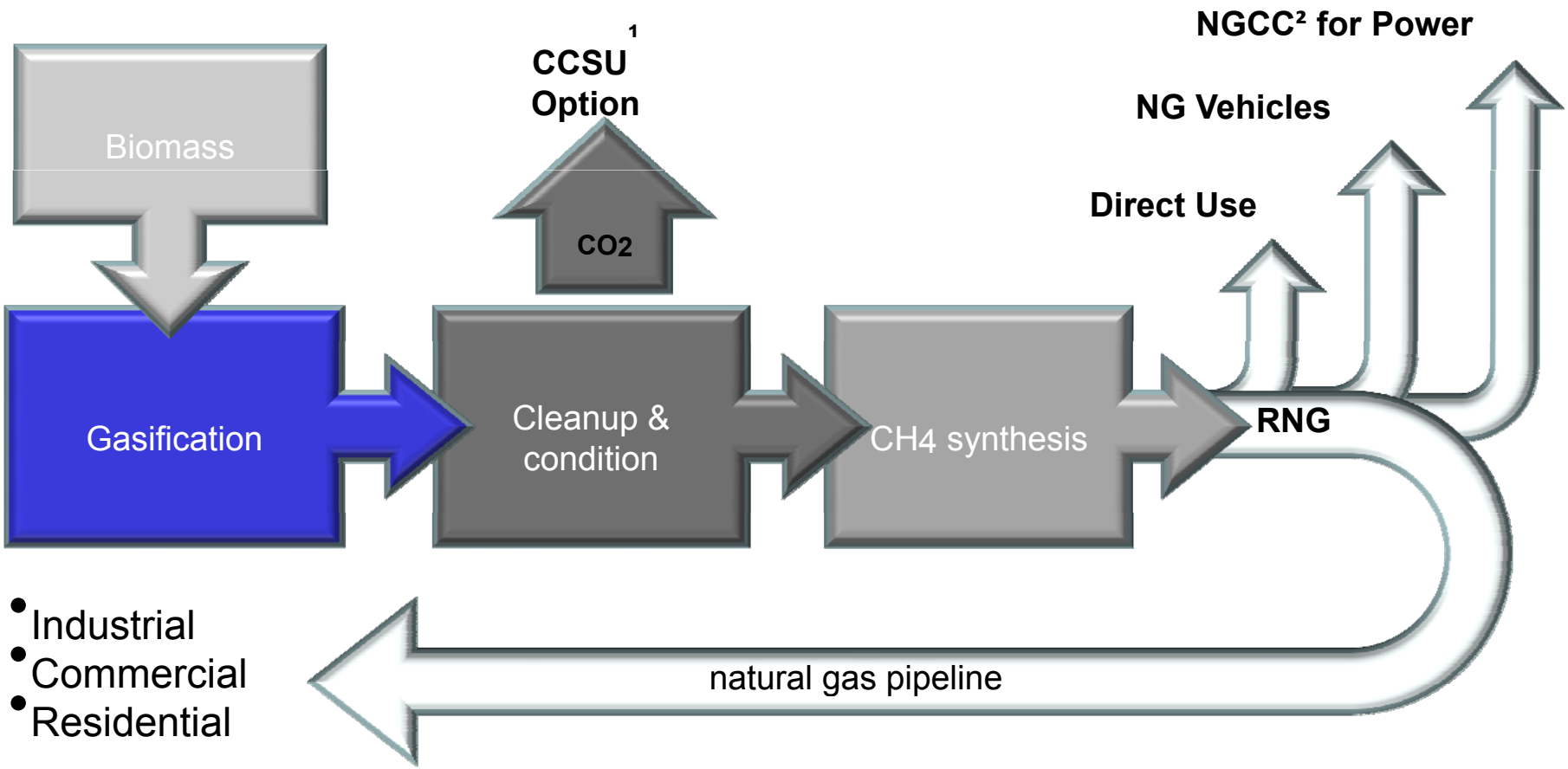
NG-to-DME



4,500 DEM G/D
2,400 DGE/D
$10 million

Biomass Gasification

Challenge: Cost-effective Systems



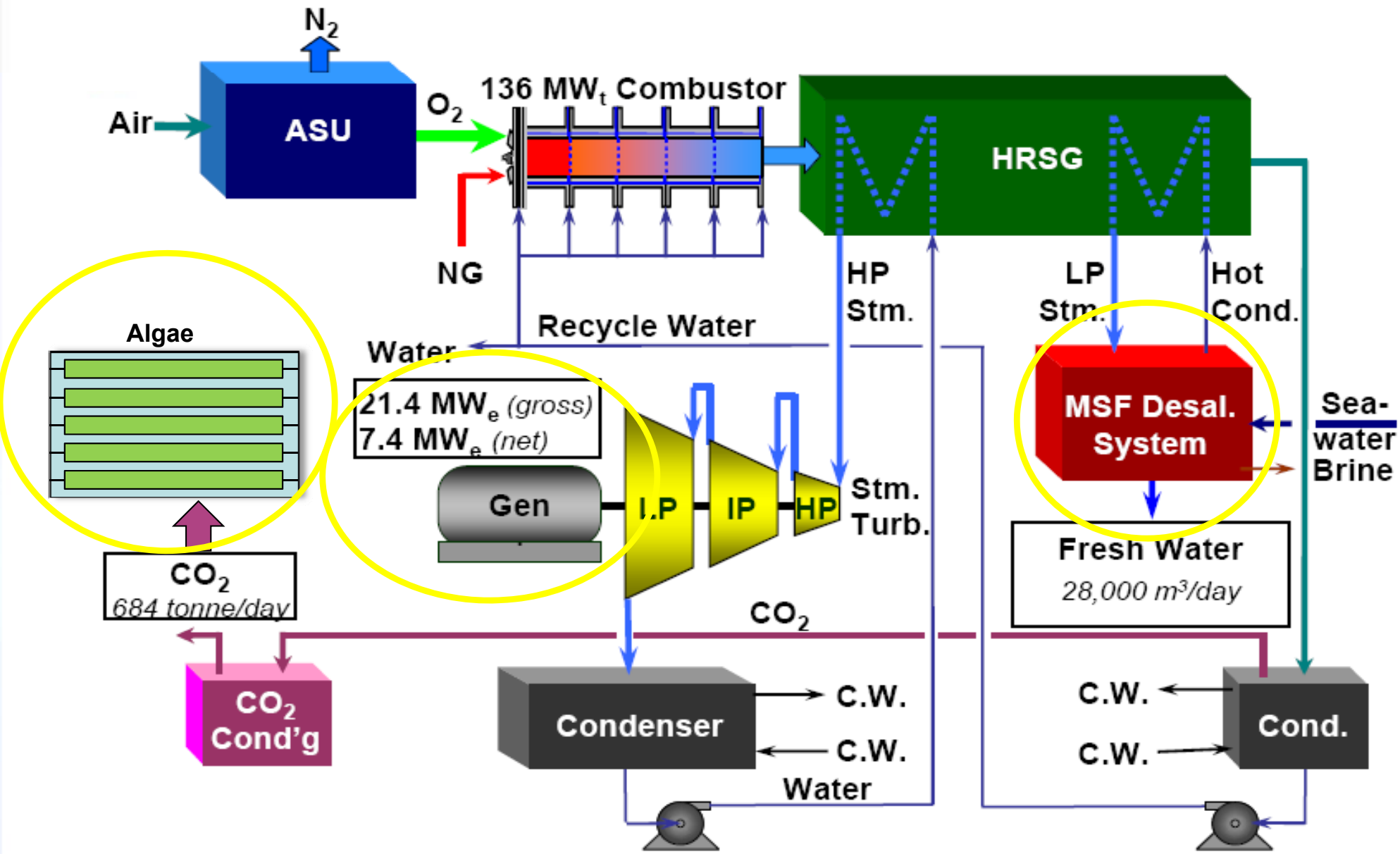
- Industrial
- Commercial
- Residential

[1] carbon capture utilization & storage
[2] natural gas combined cycle

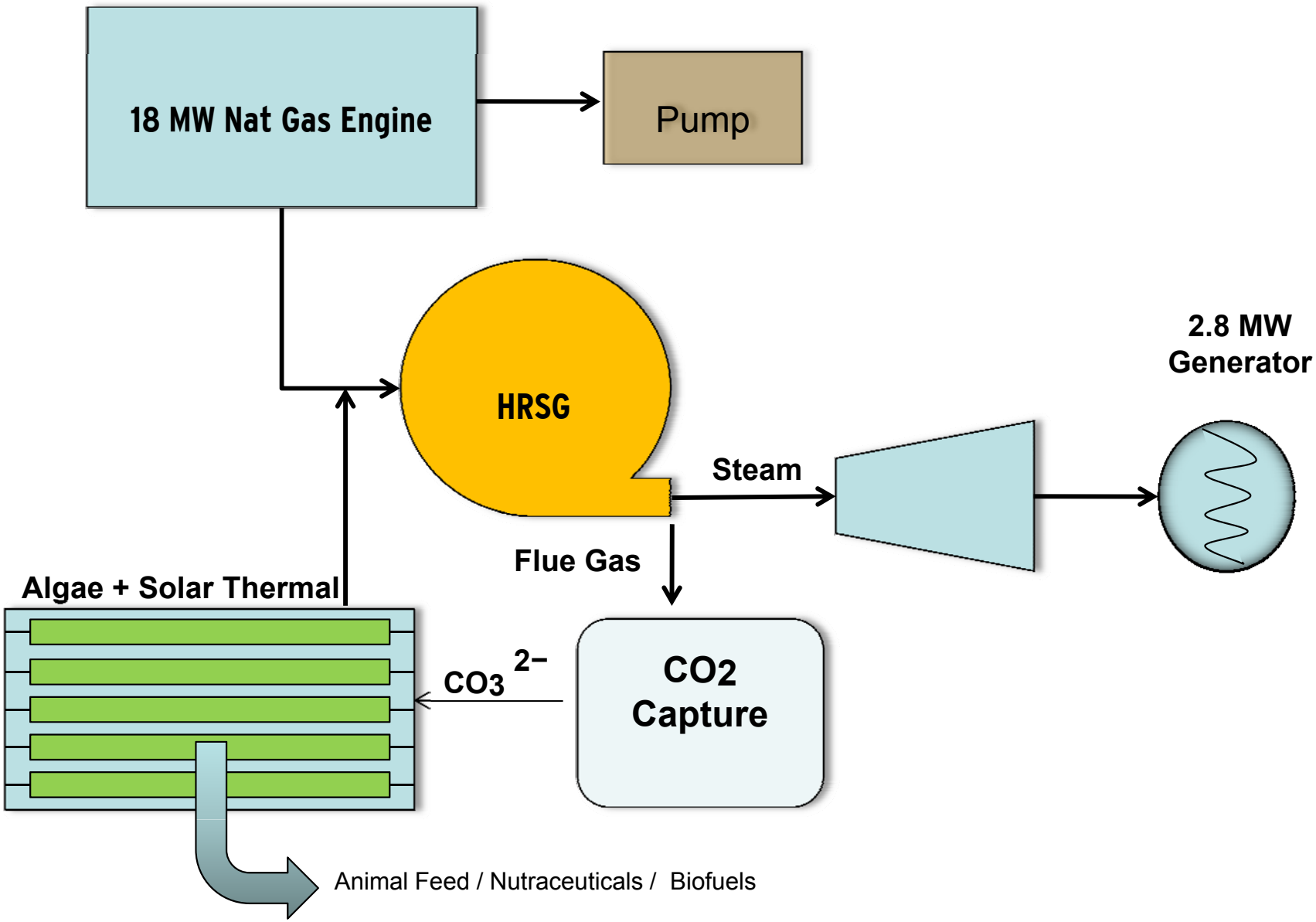
Gasification Examples

- Austrian/Swiss RNG Demo: Repotec FICFB gasifier 8 MW (~ 150 T/day wood) integrated with a 1 MW RNG PSI methanation reactor http://members.aon.at/biomasse/kiev.pdf
- GoBiGas project in Göteborg Sweden: 20 MWRNG plant by 2012 and then another 80 MWRNG by 2016 http://www.goteborgenergi.se/English/Projects/GoBiGas__Gothenburg_Biomass_Gasification_Project
- GAYA project: GDF Suez leading a 1 MW demo of woody biomass to RNG in France http://www.ecn.nl/fileadmin/ecn/units/bio/Biomassa/Syngas_and_SNG/Gasification_2010/GAYA_project__A_unique_demonstration_platform_in_Europe.pdf
- Dutch RNG Demo: ECN and HVC (Dutch Utility) to build a 10 MW (wood) CHP plant in Netherlands by 2012 which will be expanded to produce ~3.9 MMSCFD RNG by year 2017 http://www.ieabcc.nl/meetings/task32_Berlin_ws_system_perspectives/full_report.PDF
- Swedish Energy Agency: funding a 500-kW demo of the Cortus WoodRoll™ process for RNG http://www.cortus.se/technology.html
- Bio2G Project: E.ON utility is participating in a test program at GTI on wood-to-RNG and developing designs for 200-600 MWRNG http://sng2010.udt.cl/tl_files/www/congreso/sng2010_ppts/SNG2010_S02_03-Owe.Jonsson.pdf

TriGen 1:
Power + Desalination + Bioenergy

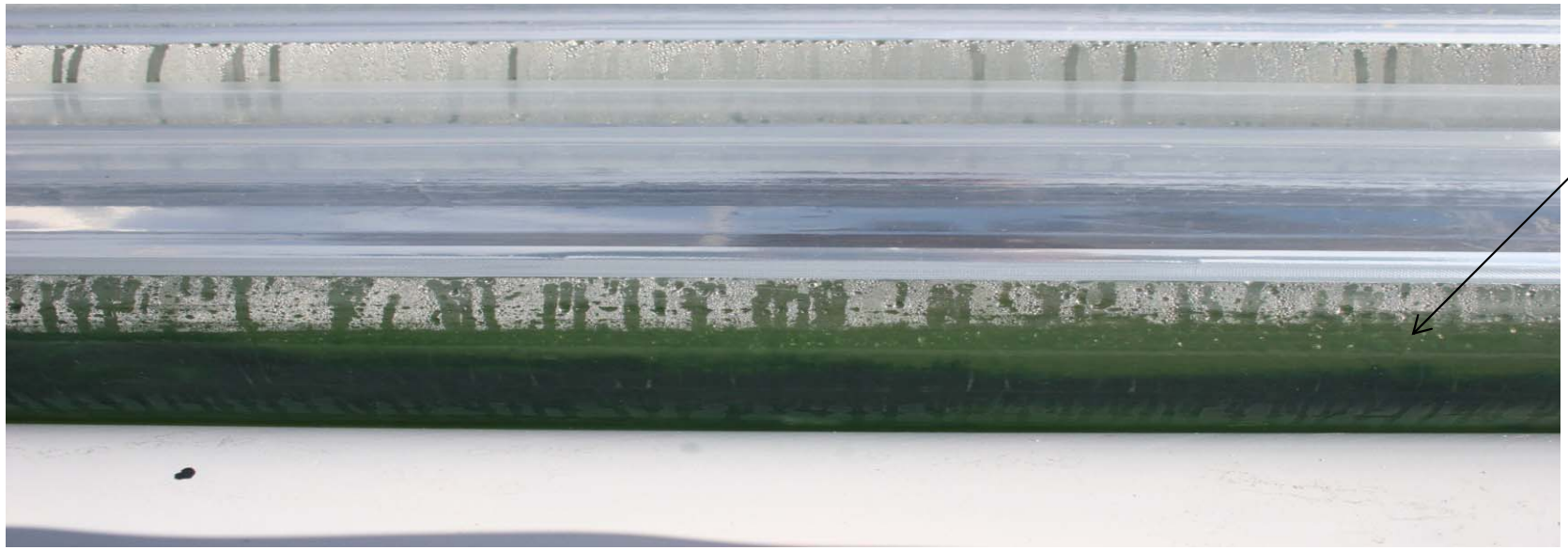


TriGen 2:
Water Pumping + Bioenergy + Power

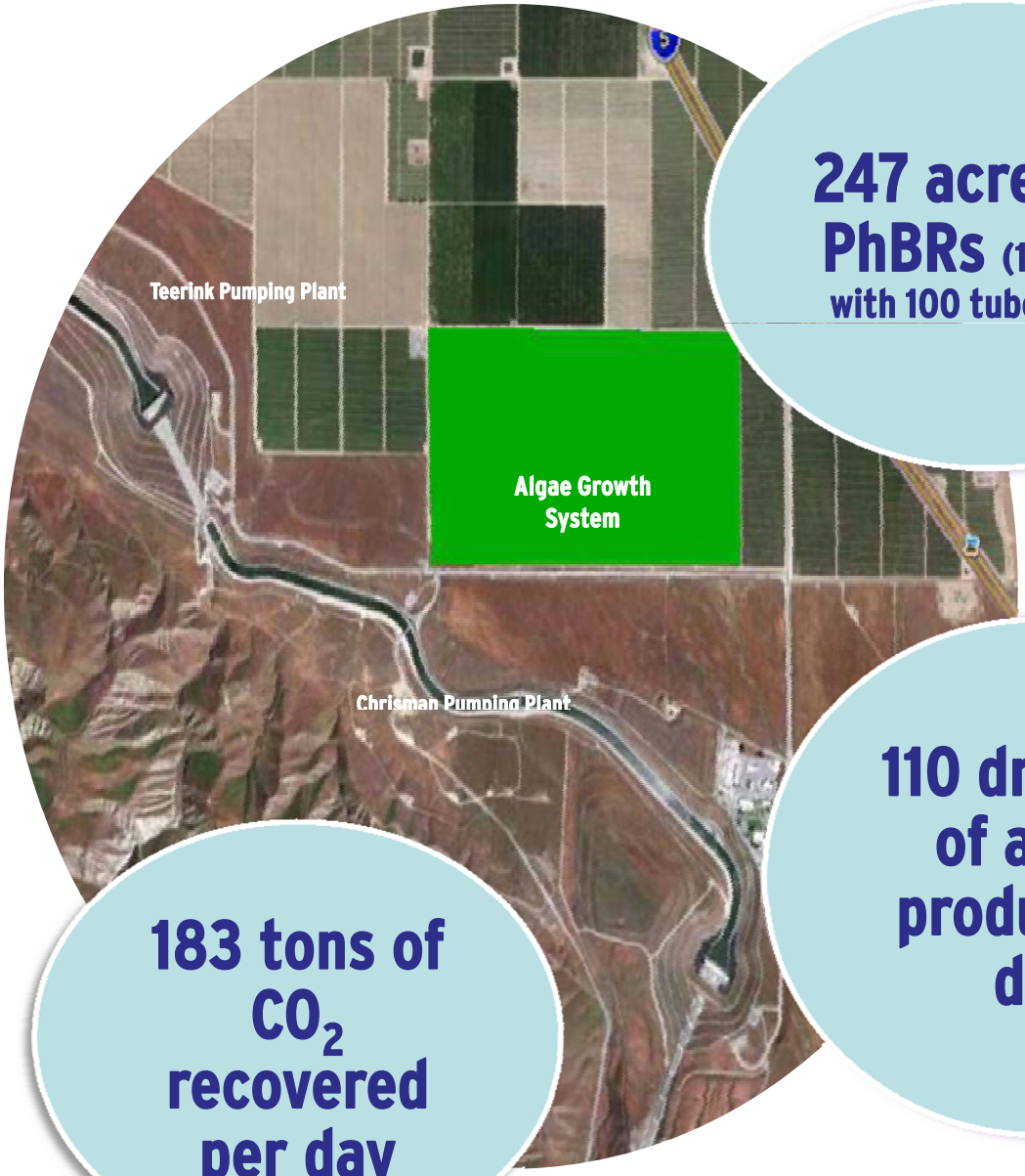


Combined Algae and Solar Thermal

- Concept: inexpensive algae cultivation system that generates more than enough power for the harvesting and oil extraction processes. This solves a major problem that has limited the success of algal energy to-date.



Algae-based CO_2 Recycling



247 acres for PhBRs (175 units with 100 tubes/unit)

110 dry tons of algae produced / day

183 tons of CO_2 recovered per day

$18 million/yr in revenue @$450/dry ton