



terracastus
technologies

Technology for cleaning and upgrading biogas

Johan Beyer & Bill Brown

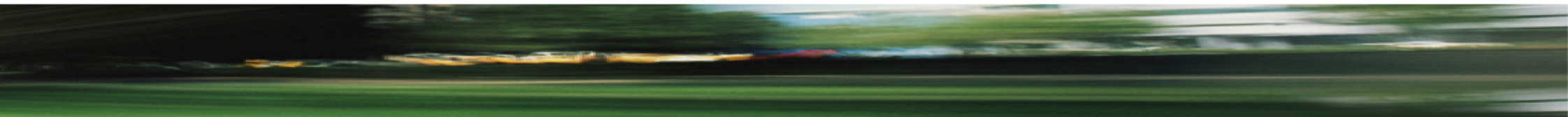
Terracastus Technologies

- Founded by Volvo Technology Transfer and Mack Trucks
- Patented technology
- Winner of R&D 100 Award



Why use biogas?

- Global warming - CO₂ emissions
- Rising prices of fossil fuels
- Independence from fossil fuel - locally produced biofuel
- Lower cost of operation



Why clean and upgrade biogas?

- Low energy density - only 40-60% methane
- Contaminants detrimental to engine life
- Upgraded biogas suitable as transportation fuel

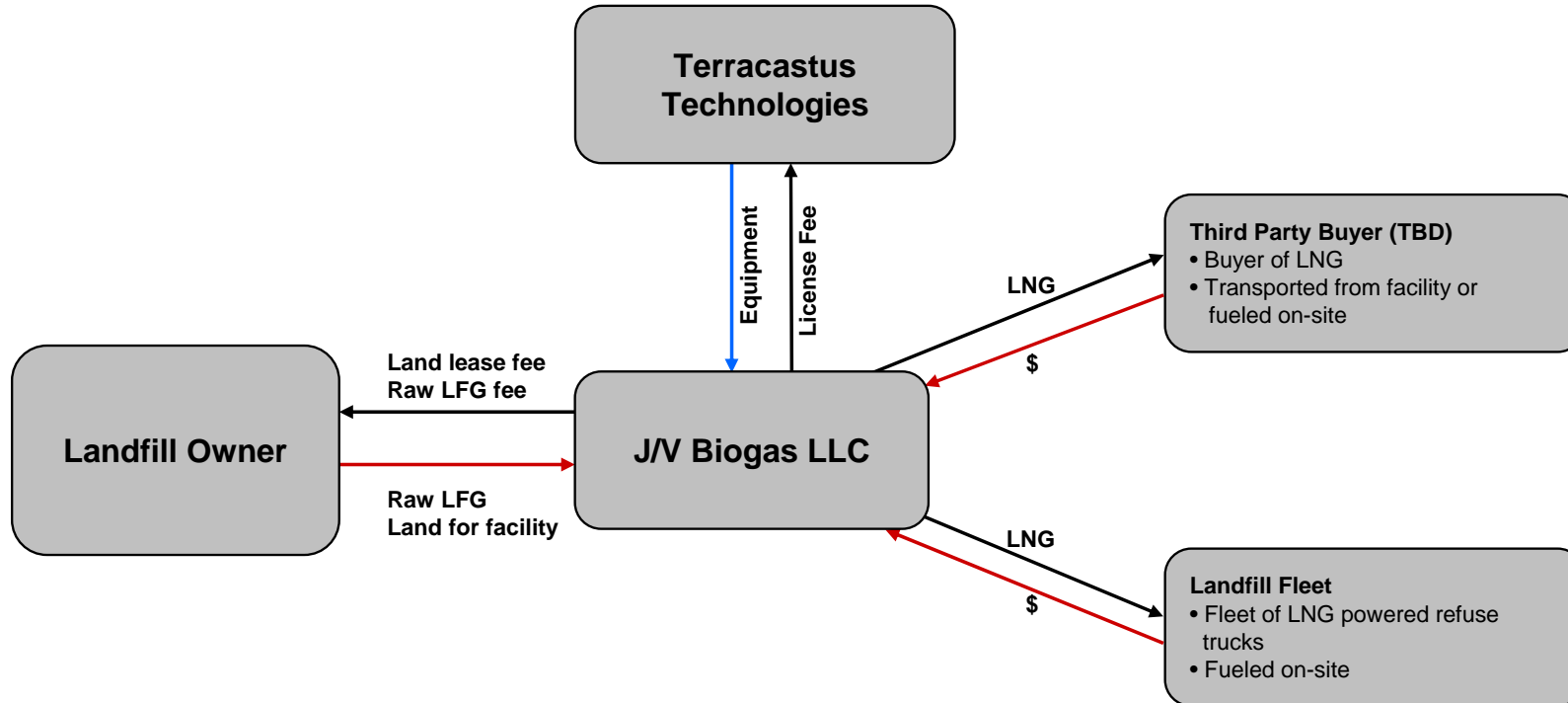


LNG benefits

- LNG is cheaper and easier to distribute than CNG
- A proven fuel for heavy vehicles such as trucks and buses
- Easily converted to CNG at fueling sites
- Lower environmental impact than fossil fuels

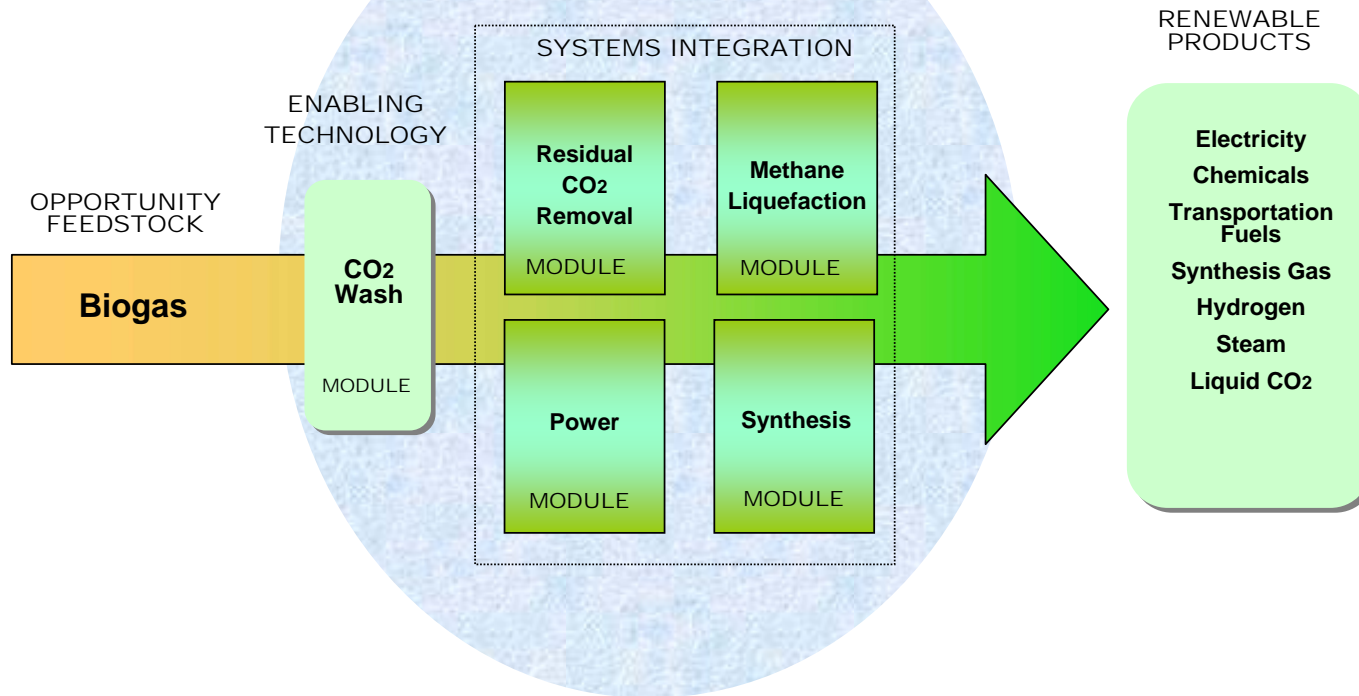


Business structure

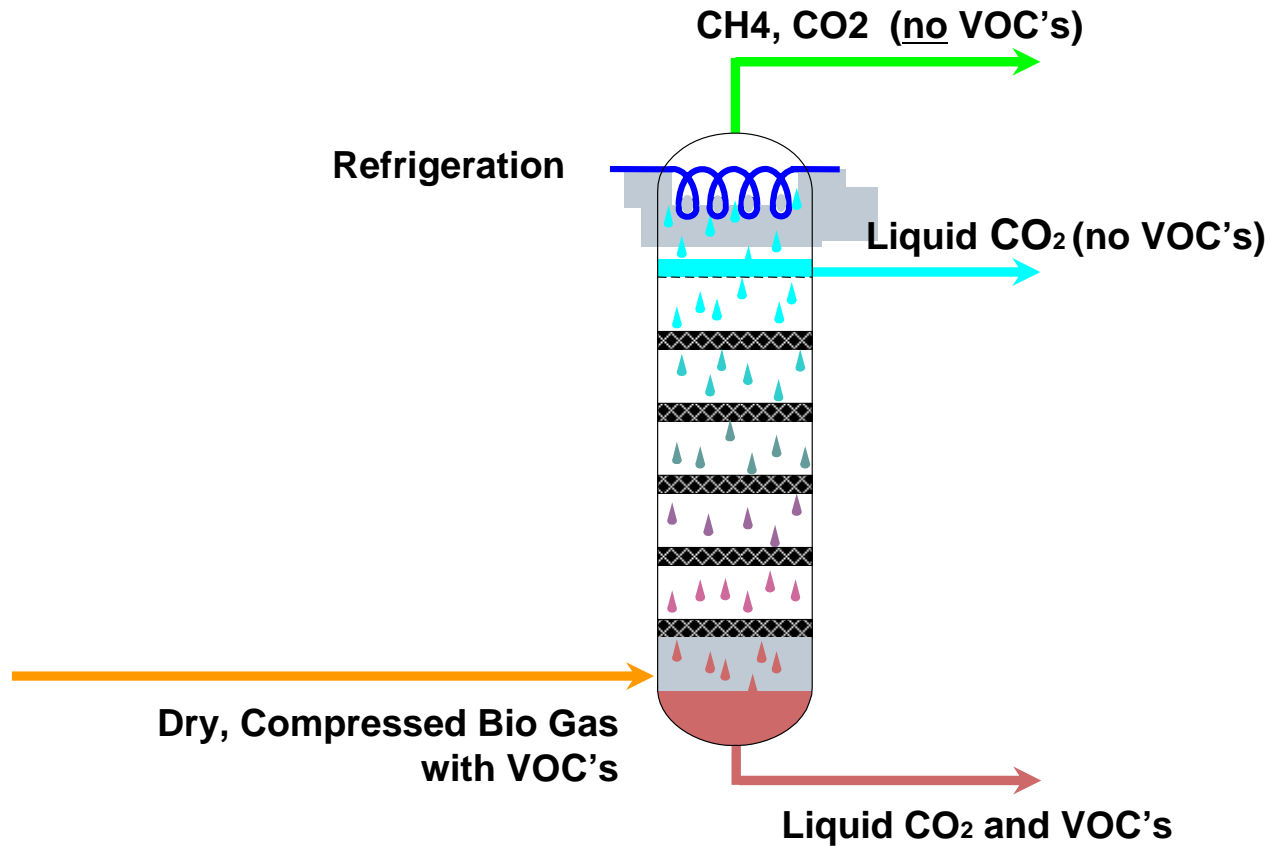




CO₂ Wash® Enabling Technology

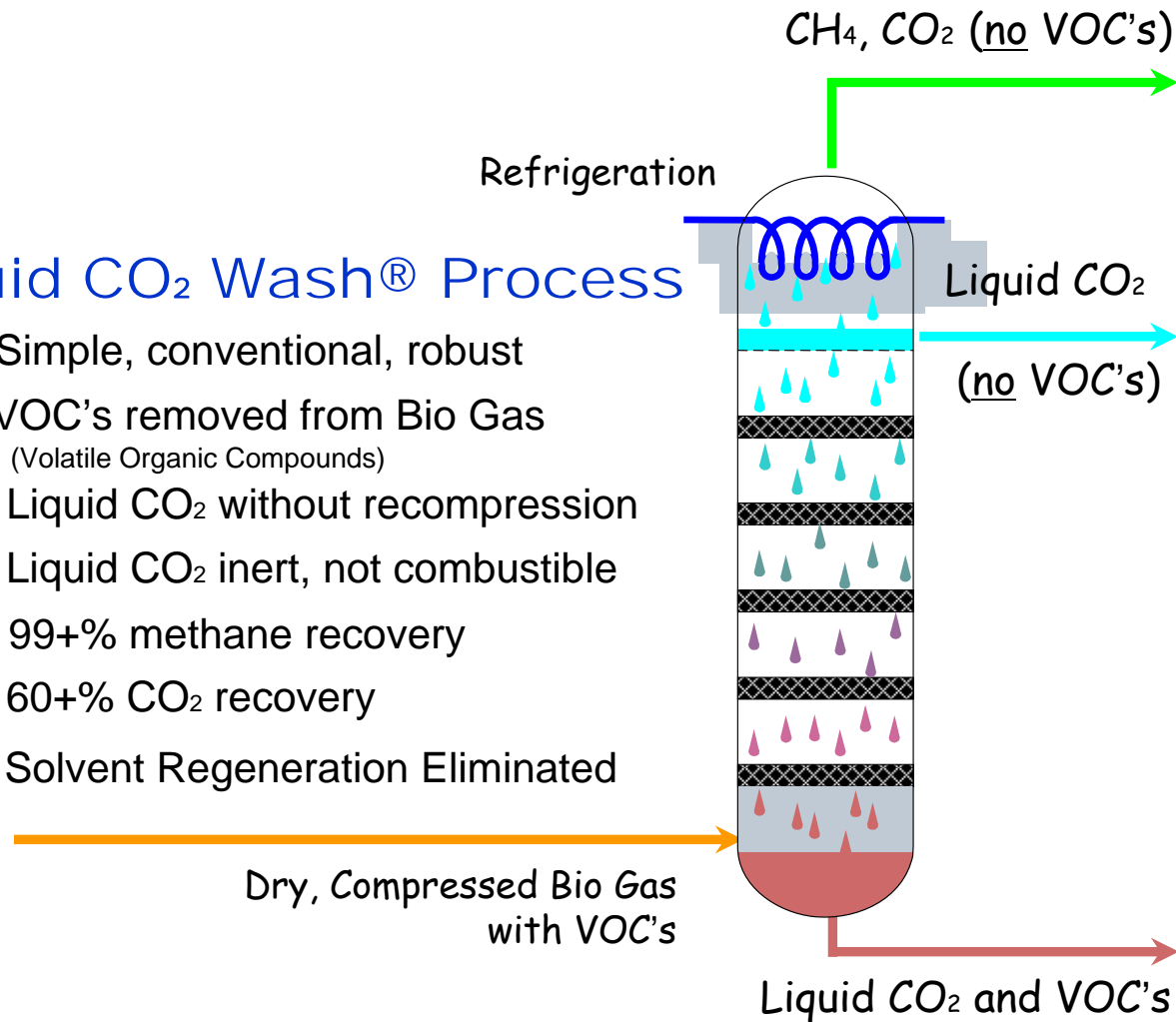


CO₂ Wash® Process



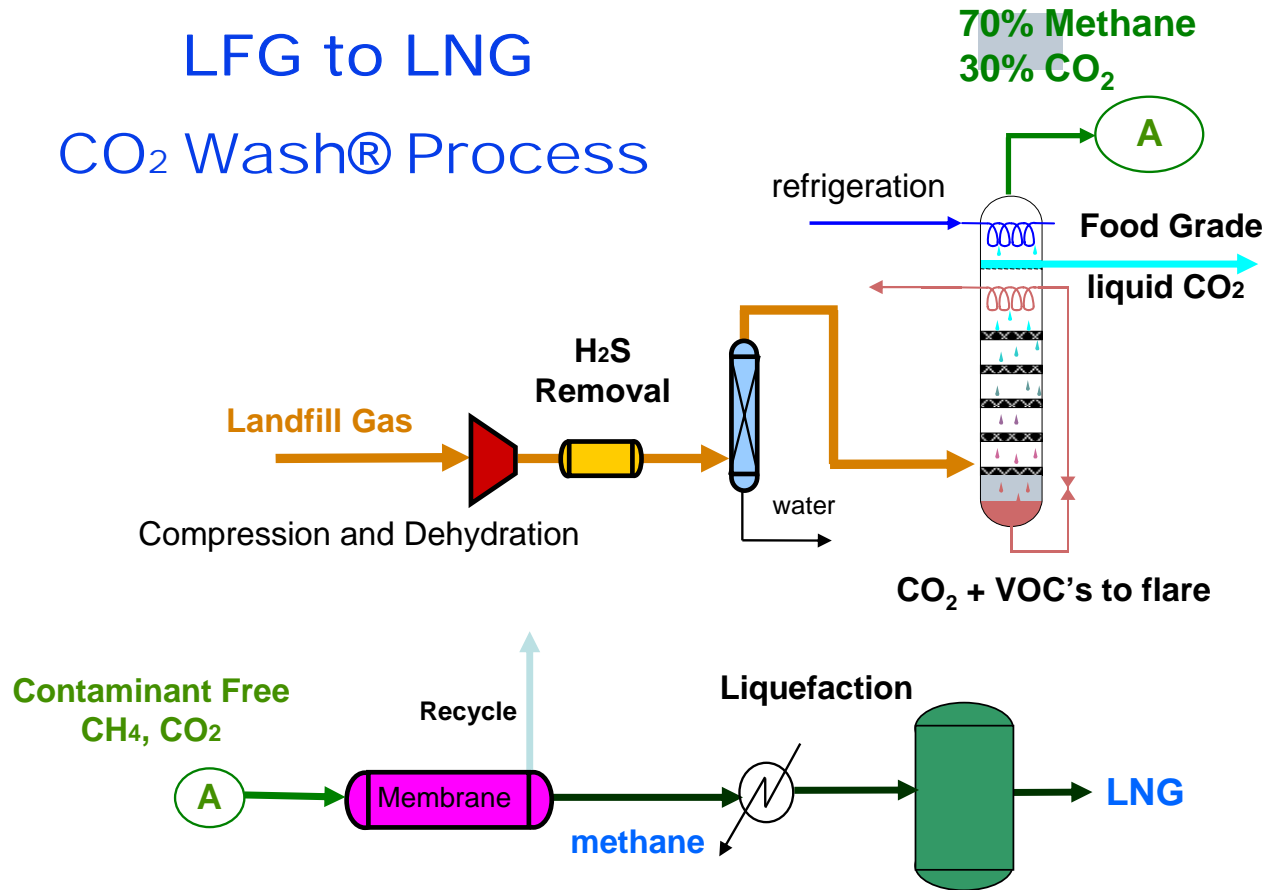
Liquid CO₂ Wash[®] Process

- Simple, conventional, robust
- VOC's removed from Bio Gas
(Volatile Organic Compounds)
- Liquid CO₂ without recompression
- Liquid CO₂ inert, not combustible
- 99+% methane recovery
- 60+% CO₂ recovery
- Solvent Regeneration Eliminated



LFG to LNG

CO₂ Wash® Process



Typical gas qualities

Raw biogas

- Methane 40-60%
- Carbon dioxide 30-40%
- Oxygen < 2%
- Nitrogen < 10%
- Siloxanes 2-5 ppm
- Sulfur in raw gas < 50 ppm

Terracastus upgraded LNG

- Methane 98-99%
- Carbon dioxide N.D (det.limit 0.1%vol)
- Oxygen N.D (det.limit 0.1%vol)
- Nitrogen < 2%
- Siloxanes N.D (det.limit 5 ppb)
- Sulfur in raw gas N.D (det.limit 50 ppb)

The Terracastus process

- Pilot Plant co-funded by U.S. Department of Energy
- Upgrading Landfill Gas to Liquid Methane (“LNG”) truck fuel at Burlington County



Positive test results

- Sample refuse trucks accumulated more than 600 hours of operation per vehicle using produced fuel
- Post analysis showed no degradation of engines
- Liquid CO₂ used for crop growth research at Burlington County



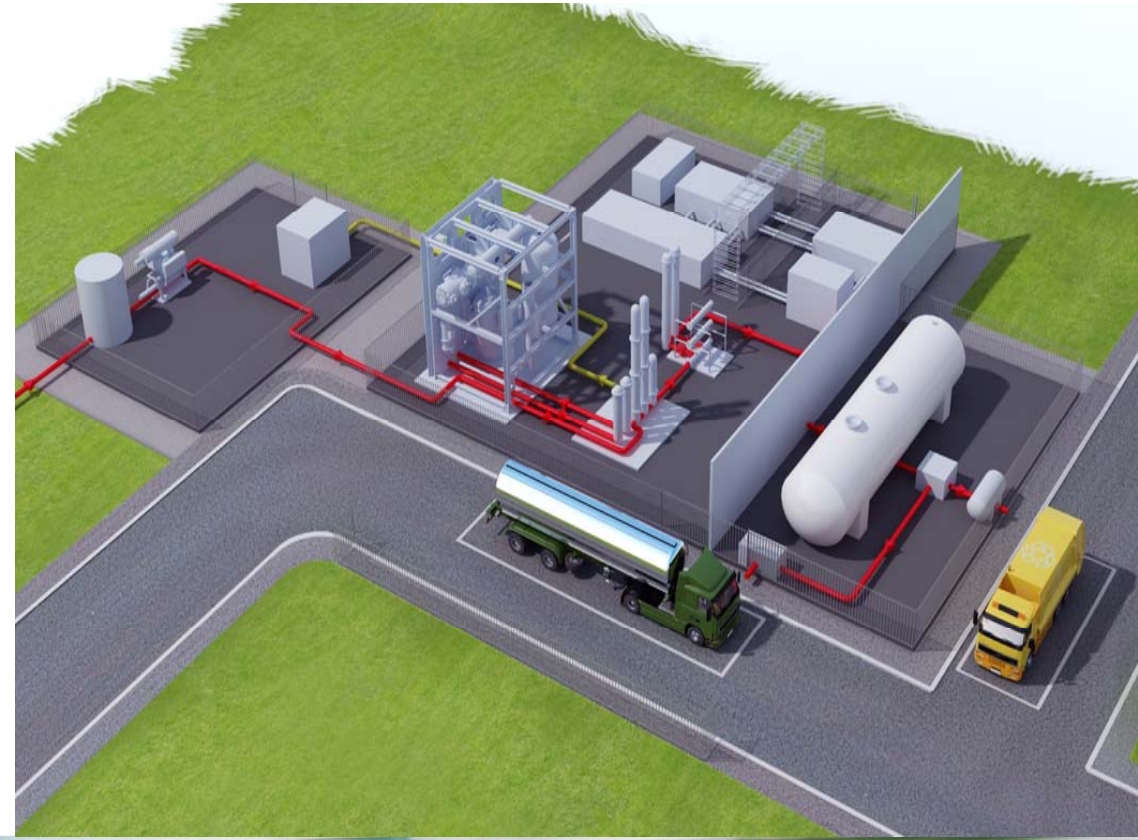
The test in figures

- Raw LFG processed: 70 scfm
- Methane liquefied: 350 gallon/day
- Fuel quality: 98-99% CH₄
- Production: 10,000 gallons
- Truck service: > 600 hours each
- Engine inspection: clean



Offer

- Biogas cleaning and LNG facility
- High methane recovery
- LNG production:
9500/19000/38000 liters per day
- Raw biogas volume:
500/1000/2000 Nm³/h





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Contact information
johan.beyer@terracastus.com
Booth B10:19