Liquefied Natural Gas from Waste: A Cost-effective and Environmentally Friendly Alternative to Diesel Fuel

The Canadian Institute
Waste-Based Energy

Toronto, Ontario
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Linde’s profile

Global organization: $16 billion revenues, 50,000 employees, over 100 countries

Leading supplier of cryogenic and compressed gases, and engineering & equipment

Canada
• 1,000 employees
• full range of liquid and compressed industrial and specialty gases, welding, cutting and scientific equipment, and safety products and accessories
Part of Linde’s renewable fuels portfolio

Renewable liquefied natural gas [R-LNG] production (Altamont, CA)

Green hydrogen production (Magog, QC)

Biogas fueling (Stockholm, Sweden)

Hydrogen fueling of fork lift trucks
Natural gas vehicle fuels

- Vehicles can use liquefied natural gas or compressed natural gas
  - LNG and CNG

- Natural gas vehicles displace the equivalent of 200 million gallons of petroleum per year in the United States
  - The majority is consumed in high fuel use urban fleet vehicles
    - Transit and school buses, trash trucks, urban delivery vehicles as well as shuttle, port and airport vehicles

- With proper government support, this could grow to 10 billion gallons per year by 2017

Source: NGVAmerica.org
Biogas defined

• A mixture of methane and other gases produced from the decomposition of organic materials

• Produced naturally in landfills

• Can be made by processing (“anaerobically digesting”) animal waste, sewage, crop waste, and cellulosic and non-cellulosic crops

• Can be upgraded and converted to LNG and CNG

• A U.S. Department of Energy study concluded that the potential from these sources is 10 billion gasoline gallon-equivalents per year

  – If all this were used in vehicles, it would reduce greenhouse gases by 500 million metric tons of CO2 per year

    — equivalent to 90 million light-duty gasoline vehicles off the road

Source: NGVAmerica.org
Canadian interest in LNG and biogas

• Challenger Motor Freight Inc., Westport Innovations Inc. and Enbridge Gas Distribution implemented a one-year demonstration project named the Clean Air Corridor with Transport Canada's Freight Sustainability Demonstration Program financial support (2005-6)
  - Evaluated replacing 90% of diesel with LNG on heavy-duty trucks
  - Concluded the trucks delivered high reliability and driver satisfaction, comparable fuel economy and 20 to 25% fewer greenhouse gas emissions

• Wastech completed a pilot with Westport Innovations, Terasen and IMW Industries confirming the viability of liquefied natural gas (LNG) as an alternative fuel to diesel for trucks that transport waste between Vancouver and Cache Creek
  - Wastech plans to convert its fleet of 28 trucks from diesel to LNG and upgrade its landfill gas to LNG

• Recent interest in LNG for the 401 Corridor and Trans-Canada Highway
The biogas-to-fuels supply chain

Biogas Production

On-site Storage and Pipeline Injection

Logistics/Distribution

Equipment for Use

End Customers
Altamont, CA landfill gas to LNG project
Waste Management and Linde

- 13,000 gallons per day LNG plant
  - Single processing train
    → economies of scale
  - Mixed refrigerant liquefaction technology licensed from gti
    → high-efficiency
  - Multi-step purification
    → significant system development and testing
    → proprietary design & unique combination of steps

- $15.5 million total capital
  - 10% government funded

- Started up September 2009
Altamont, CA landfill gas to LNG project
Features and Benefits

• Very low carbon-intensity fuel
  • Reduces GHG emissions up to 30,000 tons/year
  • Will be a key contributor to meeting California’s Low Carbon Fuel Standard

• LNG will initially be used in Waste Management’s trucks
  • Can supply other local diesel markets cost-effectively

• Worlds largest landfill gas to LNG plant
  • But, we can go larger

Well to Wheels GHG Emissions

ULSD  B20  B100  NA CNG  NA LNG  Biogas to CNG  Biogas to LNG
Video: From Refuse to Refueling

Go to:

http://www.youtube.com/watch?v=SjCjWVY3MOw
Conclusions

Development is difficult and complex, but also technically and economically viable

What is needed to make this happen?
- Government support to reduce early-stage risks
- Technological expertise
- Capital
- Collaboration and partnering
- Value for being green

It is happening