



April 17, 2012

DOCKET

11-ALT-1

DATE APR 17 2012

RECD. APR 17 2012

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 11-ALT-1
1516 Ninth Street
Sacramento, CA 95814-5512

To Whom It May Concern:

The need for a diesel alternative is more important than ever, and DME (dimethyl ether) is a promising solution that has been largely overlooked.

DME is a clean-burning, non-toxic, sulfur-free fuel that has been used as an energy source in China, Japan, Korea, Egypt, and Brazil. Various OEMs, such as Volvo, Isuzu, Hino, Nissan, Navistar, and Shanghai Automotive, have tested DME as a diesel fuel over the past two decades. After testing DME engines for the past eight years, Volvo has the most advanced testing program with ten heavy-duty, Class 8 DME trucks currently on the road in Sweden and driven by companies such as DHL, the Swedish Postal Service, and other commercial fleets.

Benefits of DME as a fuel are:

- *No particulate matter*, no SO_x, low NO_x emissions
- *Multiple feedstocks* including natural gas and biogas
- *Price stability*, not tied to the price of crude oil
- *Less expensive* than diesel
- *Low infrastructure cost* - simple storage and dispensing, similar to propane

DME as a transportation fuel has been explored by other companies in the past. Market forces including low natural gas prices, elevated and volatile oil prices, and stricter environmental regulations make now and the foreseeable future the right time for DME in North America.

Oberon Fuels has assembled a team with over 40 years experience launching and building companies and a technical team including the "Father of DME" Dr. Theo Fleisch and internationally-recognized DME engine expert Professor André Boehman. The company, which is based in San Diego, is focused on bringing DME to North America as a clean,



inexpensive, alternative to diesel for the truck and agricultural markets. Oberon offers a full-solution to customers, providing both the hardware to run a diesel engine on DME and the fuel itself. It has developed a proprietary skid-mounted, modular, small-scale process to convert methane and carbon dioxide to DME by using various domestic feedstocks such as natural gas and biogas (**Figure 1**).

With Southern California Gas Company and others, Oberon is building its first DME facilities in Imperial Valley, CA, and is working with engine manufacturers, fleet operators, and the agricultural community on pilot programs to test DME as a clean-burning, alternative to petroleum-based diesel.

Benefits of the proprietary Oberon process include:

- *Skid-mounted, modular, small-scale process*
- *Utilizes multiple, domestic feedstocks* including pipeline natural gas and biogas from agricultural digesters, the focus of Oberon's first production units
 - Natural gas feedstock: slightly lower greenhouse gas impact (GHG) than diesel, compressed natural gas, and liquified natural gas (**Figure 2**)
 - Biogas: net negative GHG impact
- *Can utilize waste carbon dioxide streams* from other industrial processes
- *Regional production*
 - Capital expenditure in sync with market growth, deploy more units as market grows
 - Reduced transportation costs & GHG impact

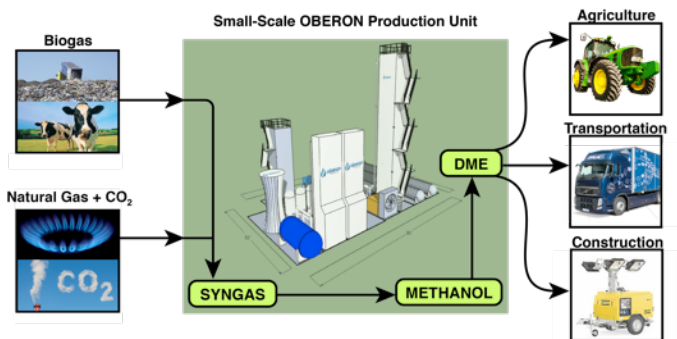


Figure 1. Oberon Process to Produce DME from Methane and Carbon Dioxide

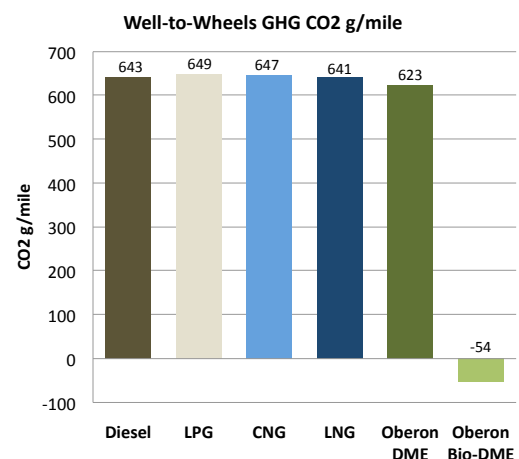


Figure 2. Comparison of DME's GHG Profile using Modified GREET Analysis

Currently, Oberon's first production unit is being built in the Imperial Valley region in Brawley, CA. The initial DME fuel productions are shown below:

- *Phase 1* - Methanol to DME (2012 Quarter 4)
- *Phase 2* - Natural gas to DME (2013 Quarter 4)
- *Phase 3* - Biogas to DME (2014 Quarter 2)



In addition to its environmental benefits, DME fuel production will create both permanent (plant managers, engineers, maintenance team members) and construction jobs. In parallel, Oberon is building an engine conversion business that will create additional jobs for engineers, manufacturing personnel, and mechanics. Supporting industries such as fuel distribution and conversion kit installation will also see job creation from this emerging DME industry.

As the California Energy Commission continues to encourage the adoption of alternative and renewable fuels in the state of California, we ask that the CEC consider inclusion of DME in the upcoming 2012-2013 Investment Plan and future plans. DME is already listed in Assembly Bills 118 (Article 11, Section 5) and 109 (Article 2, Section 6) as an allowable fuel.

Specific inclusion in grant opportunities would facilitate the launch of this fuel, the development of the supporting industries, and the creation of green jobs in the state of California. In particular, funding categories of Alternative Fuel Production (biomethane feedstock to produce DME), Alternative Fuel and Advanced Technology Vehicles (advanced vehicle demonstrations of DME trucks), Manufacturing (DME conversion systems), and Workforce Development & Training (Imperial Valley DME production and engine conversion manufacturing facilities) would accelerate the launch of this important industry in the state of California.

The Oberon Fuels team looks forward to working with the CEC to create a cleaner California that continues to lead the world with innovative alternative and renewable transportation solutions. Thank you for your consideration.

All the Best,

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DME: A Cleaner, Alternative to Diesel

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CURRENT STATUS

- Finalizing strategic partnership with international OEM for DME engine solution
- Finalizing licensing terms for DME fuel conversion technology
- Building first DME production unit (Imperial Valley, CA)
- Performing DME pilot runs with 1) heavy duty trucks and 2) agricultural engines

COMPETITIVE ADVANTAGE

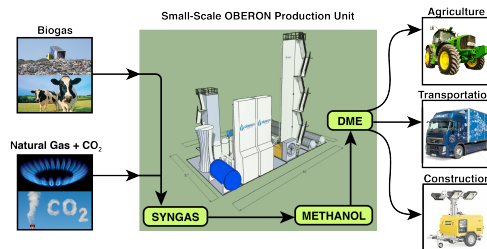
- **Oberon Process**
 - Skid-mounted, modular, small-scale process
 - Utilizes multiple, domestic feedstocks (natural gas, biogas, waste gas from landfills)
- **Regional Production**
 - Capital expenditure in sync with market growth, deploy more units as market grows
 - Reduced transportation costs & GHG impact
 - Utilize regional feedstocks which provide price stability and customer choice
- **DME as a Fuel**
 - Lower cost than diesel, not tied to the price of crude oil
 - Clean Burning - Burns with NO particulate matter/soot and minimal NOx, sulfur-free
 - Low Infrastructure Cost - simple storage and dispensing, similar to propane

TEAM MEMBERS

- **Neil Senturia, Interim CEO**, 25+ years experience with diverse entrepreneurial endeavors. Led 6 technology companies, selling them to Cisco, Lockheed Martin, and Kofax.
- **Rebecca Boudreaux Breitenkamp, Ph.D., President**, Management and Board experience with early-stage biotech, materials, and high tech companies. B.S. (U. Southern Miss.), M.S. & Ph.D. Polymer Science & Eng. (UMass).
- **Elliot Hicks, COO**, Senior management positions in several technology startups (LEDs, solar cells, online media, software). B.S., Mech. Eng. (MIT), MBA (SDSU).
- **Theo H. Fleisch, Ph.D.**, Under his leadership at Amoco, DME was identified and developed as a new clean fuel. Internationally-recognized expert in gas conversion to liquid fuels.
- **André Boehman, Ph.D.**, DME Engine Expert. Penn State Professor of Fuel Science and Materials Science and Engineering.
- **Ravi Randhava**, Co-founder of Unitel Technologies, an engineering firm with a track record for designing DME operational plants.
- **Amy Stapp**, Experience with process modeling for biomass gasification, DexCom, Vical.
- **Frits Dautzenberg, Ph.D.**, VP Scientific Development. Shell, Catalytica, ABB Lummus.
- **Richard K. Herz, Ph.D.**, UCSD Professor of Chem. Eng. Expert in heterogeneous catalysis, chemical reaction eng., and process design.

ELEVATOR PITCH

With oil's rising cost and price volatility due to political instability, the need for a diesel alternative has never been more evident. Oberon Fuels is bringing DME (dimethyl ether) to North America as a clean, inexpensive, alternative to diesel for the truck and agricultural markets. Oberon offers a full-solution to customers, providing them both the hardware to run a diesel engine on DME and the fuel. Using various, domestic feedstocks such as natural gas and biogas, Oberon has developed a skid-mounted, modular, small-scale process to convert methane and carbon dioxide to DME. Partnered with Southern California Gas Company and others, Oberon is building its first DME facilities in southern California, and is working with engine manufacturers, fleet operators, and the agricultural community on pilot programs to test DME as a clean-burning, alternative to petroleum-based diesel.



PROBLEM

The need for a diesel alternative has never been more evident. Oil's rising cost, price volatility due to political instability, the national security issues resulting from foreign oil reliance, and stricter federal emission regulations all support the need for a diesel fuel alternative. While numerous energy options (ethanol, electricity, fuel cells, natural gas, algae-derived fuels) are being explored, DME is a largely overlooked but promising diesel alternative. DME is a clean-burning, non-toxic, sulfur-free fuel that has been used for decades as an energy source in China, Japan, Korea, Egypt, and Brazil. DME offers improved performance in diesel engines while meeting strict, new emission standards, which has led OEMs such as Volvo, Isuzu, Hino, and Shanghai Automotive to test DME as a diesel alternative.

OBERON SOLUTION

Oberon Fuels is bringing DME to North America using its skid-mounted, modular, small-scale process. Using various feedstocks such as natural gas or biogas, the Oberon units produce 3,000-36,000 gallons of DME per day to service regional markets via a hub and spoke model. In addition to providing DME, Oberon Fuels offers a full-solution to customers, providing them both the **hardware** to run a diesel engine on DME and the **fuel**. No modifications to the internal workings of a diesel engine are necessary when running on DME.

With regards to the fuel itself, the Oberon process cost-effectively converts inexpensive natural gas to DME, a higher-valued transportation fuel. The modular design can be deployed to remote stranded gas locations that would otherwise be difficult to harvest or to industrial operations where it can utilize waste CO₂ streams. In addition, feedstocks such as shale gas and waste methane from wastewater treatment plants, landfills, and agricultural operators can be converted to DME and monetized using the Oberon process.

MARKETS

- **Transportation.** Heavy duty, closed-loop trucking industry is an initial target. LOI with Estes Express Lines, 17th-largest trucking company in US, to test DME trucks in their LA-based fleet.
- **Agricultural Operations.** Irrigation pumps, farm equipment, and crop-hauling trucks run on diesel engines. Due to the large volume of diesel consumed by farmers, they are sensitive to diesel's price volatility as crop selling prices are determined in advance.
- **Aerosol Propellant.** DME is an environmental-friendly aerosol propellant, and 350,000 tons per year are produced for this use.

FINANCIAL

Oberon's model is to build, own, and operate the production units. The first unit will be online 2012 Q3. Presently, Oberon is negotiating a take-or-pay agreement with a major, international chemical company for that unit. Oberon achieves scale by deploying more units, lowering the administrative and maintenance costs. The company's 10-year forecast is 250 deployed units with \$800 million in revenue (EBIT \$215 million). Oberon is in advanced discussions with potential strategic partners including OEMs and various private trucking, chemical, and oil/gas production companies.

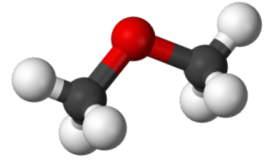


DME: A CLEANER, ALTERNATIVE DIESEL



WHAT IS DME?

DME (dimethyl ether) is a cleaner, alternative diesel. DME is used in Asia, Europe, and South America as a fuel and is often blended with propane. Despite its large-scale production abroad, DME adoption is just beginning in North American markets.



Structure of DME
CH₃-O-CH₃



WHY DME?

- Lower fuel costs than diesel – not tied to the price of crude oil
- Meets strict emissions standards without expensive treatment technology
 - Burns with No PM and minimal NO_x
 - Sulfur-free
- Simpler engine → lower maintenance costs
- Safe, rapid dispensing similar to propane
- Will not contaminate soil if spilled
- Energy density suitable for extended range applications



HOW DOES DME COMPARE TO DIESEL & NATURAL GAS?

Variables Relative to Diesel	DME	LNG CI/SI*	CNG CI/SI*	Diesel
Fuel Cost (energy equivalent)	\$\$	\$	\$	\$\$\$
Storage and Dispensing Cost	\$	\$\$\$	\$\$\$	\$
Cost to Meet EPA 2010 Standards	\$	\$\$\$/\$	\$\$\$/\$	\$\$\$
Fuel Efficiency	-	- / ↓	- / ↓	-
Engine Performance	↑	- / ↓	- / ↓	-
Extended Range Applications	✓	✓		✓
Reliable, Rapid Refilling	✓	✓		✓
Long-term Storage	✓			
Reduction in GHG Impact	↑	↑	↑	-

*CI/SI = Compression Ignition/Spark Ignition



DME'S ENVIRONMENTAL PROFILE

Tailpipe Emissions

- Clean-burning fuel (No PM, No Sulfur)
- Minimal NO_x which can be managed to meet EPA 2010 regulations via:
 - **Selective Catalytic Reduction (SCR)**
injects urea into catalytic converter to remove NO_x from exhaust gas.
 - **High Pressure Injection** through fuel pump and injector design

- DME fuel system under development
 - Enable EPA 2010 NO_x compliance without additional equipment

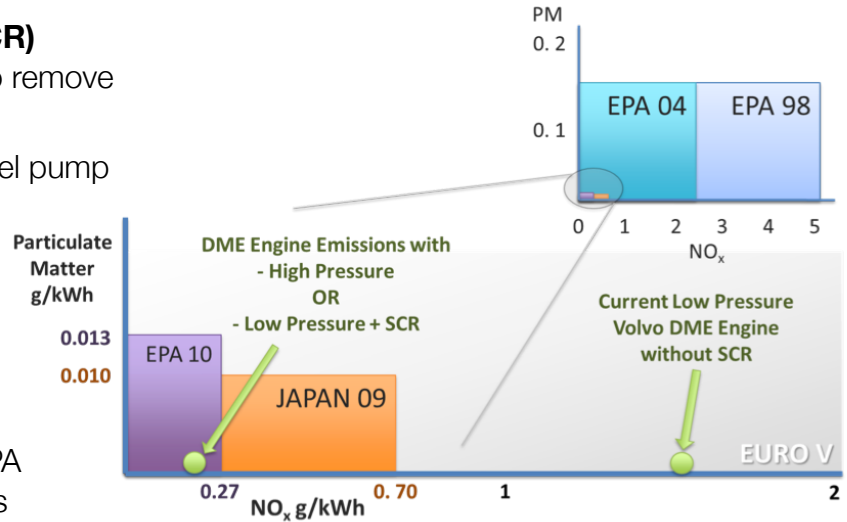
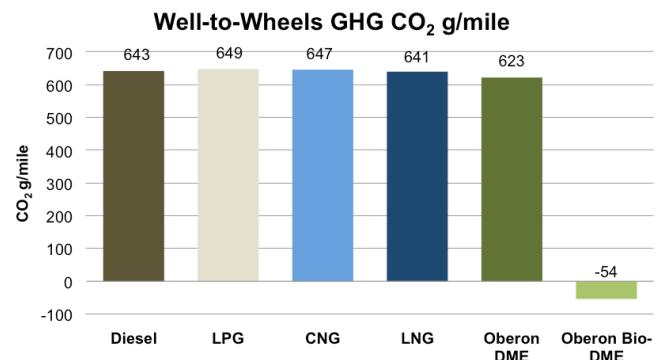


Figure 1. DME's Compliance with EPA Particulate Matter and NO_x Standards

Greenhouse Gas Emissions

- DME compares well with other alternative fuels
- Oberon process creates DME from methane and CO₂ from natural gas or biogas
 - **Natural gas-based DME** requires more processing than CNG or LNG but DME's higher efficiency in engines (no spark plugs required) results in lower overall GHG impact.
 - **Biogas-based DME** results in net negative GHG impact (*sources* - agricultural digesters, landfill gases, wastewater treatment plants)

- Unlike natural gas, DME not a potent GHG when released into the atmosphere
- Like propane, can be stored at low pressure long-term without degrading or venting like LNG





WHY NOW?

Increasing Emissions Regulations

- EPA 2010, Euro VI, Japan 2009
- Driving up cost of trucks and maintenance

Fuel System Technology Available

- No internal engine changes required

Increasing Global DME Production

- China, Korea, Japan, & Brazil have significant DME production facilities
- With the majority of global DME production, China has added 10 million tons of annual production in the last decade

New DME Trucks

- Volvo, Nissan, Toyota, Isuzu, Shanghai Automotive are building and testing DME engines



Long-term Price Stability

- Multiple feedstock options result in long-term pricing stability
- Can be produced domestically to displace foreign oil



WHY OBERON FUELS?

Minimized DME Transport And Handling Costs

- Regional production facilities
- Onsite, central refueling stations similar to propane

Low GHG Emissions

- Low carbon fuel
- BioDME for renewable fuel standards

Working With Established DME & Alternative Fuels Industry Experts





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