



**Alternative Fuel Technology, LLC**

12237 WOODBINE DR. REDFORD, MI 48239

*Fueling the Future with DME*

# DME:

## Alternative or Imperative?

### An Overview of an Impending World Crisis and A Potential Solution

**IDA**

**International  
DME Association**

Dimethylether: A Fuel for the 21<sup>st</sup> Century

Alternative Fuel Technology



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Dimethylether: A Fuel for the 21<sup>st</sup> Century

## Introduction

- **AFT** is a Small R/D Organization Focused on the Development of DME Fuel Systems for Cars & Trucks
- **IDA** is a Trade Organization Promoting the Development and Use of DME as an Energy Alternative

# Background

- Global Urban Air Quality Rapidly Declining
- Emissions From Mobile Sources Significant Influence
- Major Oil Shortages on the Horizon
- Geo Political Problems Threaten Energy Security
- Global Warming Will Destroy Our Planet
- Clean Alternative Energy Sources Needed
- DME Can Mitigate These Problems



# Urban Air Quality Deteriorating

Mexico City



Beijing



Los Angeles



# Mobile Source Emissions A Major Problem

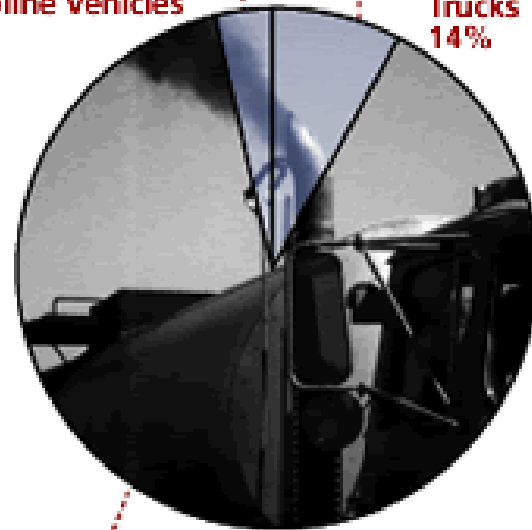


Motor vehicles are the main source of nitrogen oxides in air

## Particulate (PM<sub>2.5</sub>) Emissions

Heavy-Duty  
Gasoline Vehicles 8%

Cars and Light-Duty  
Trucks 14%



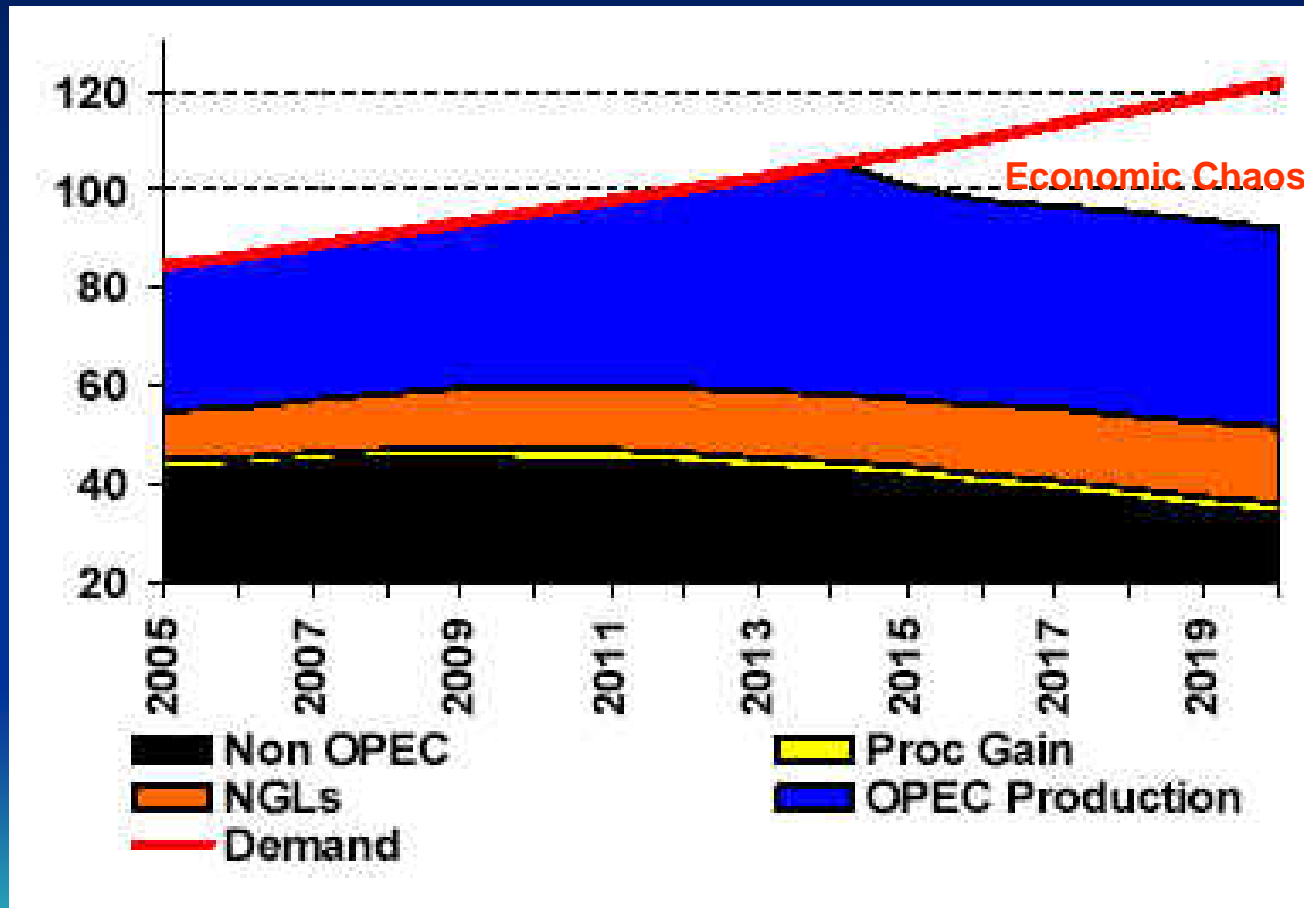
Heavy-Duty Diesel Vehicles  
78%

# Oil & World Politics: Energy Independence

- Bush: U.S. must cut dependence on Mideast oil

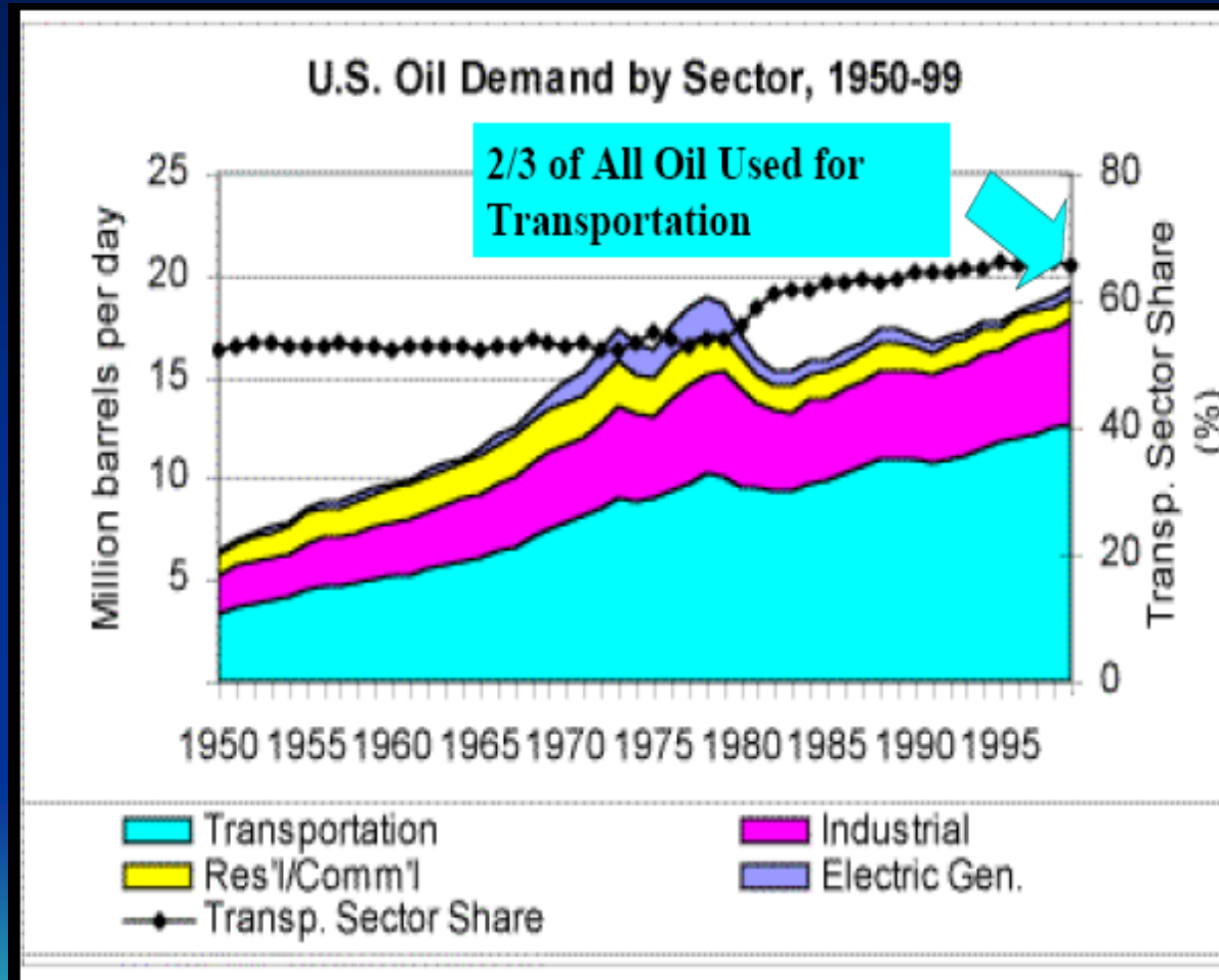


# World Oil Supply & Demand



Source: Michael Rodgers, PFC Energy

# Transportation Fuel Dominates



# Global Warming: Significant Concern



Grinnell Glacier 1917



Grinnell Glacier 2000

## The Greenhouse Effect



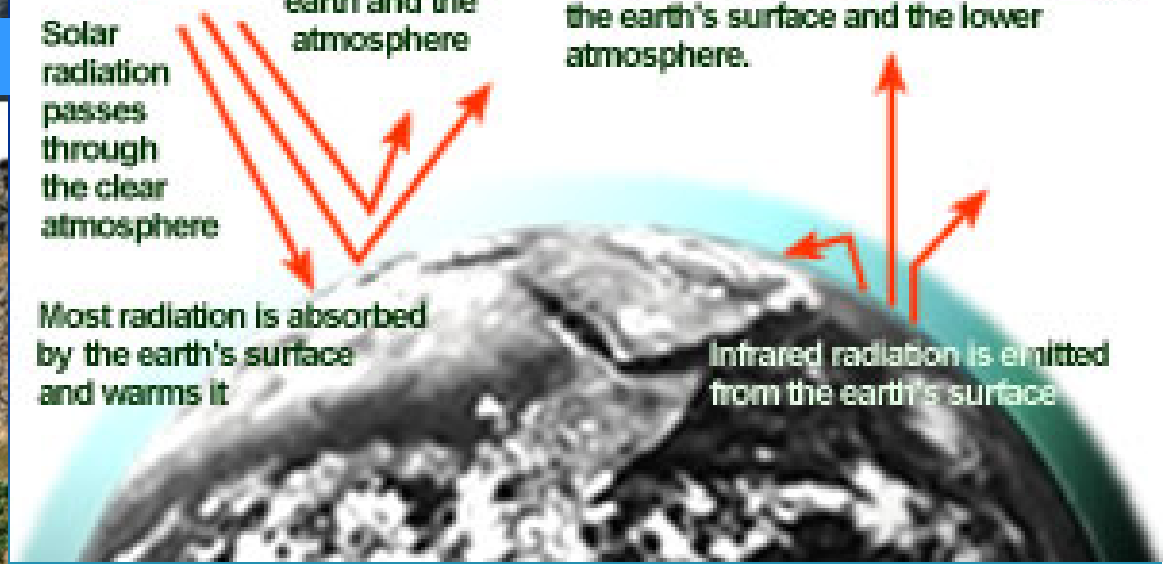
Some solar radiation is reflected by the earth and the atmosphere

Solar radiation passes through the clear atmosphere

Most radiation is absorbed by the earth's surface and warms it

Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the earth's surface and the lower atmosphere.

Infrared radiation is emitted from the earth's surface



# Clean Energy Alternatives Needed

- Criteria
  - Abundant, Distributed Feed Stocks
  - Low Exhaust Emissions Potential
  - Environmentally Benign
  - Cost Effective
  - Low CO<sub>2</sub> Emissions Potential
- **DME Can Meet These Criteria**

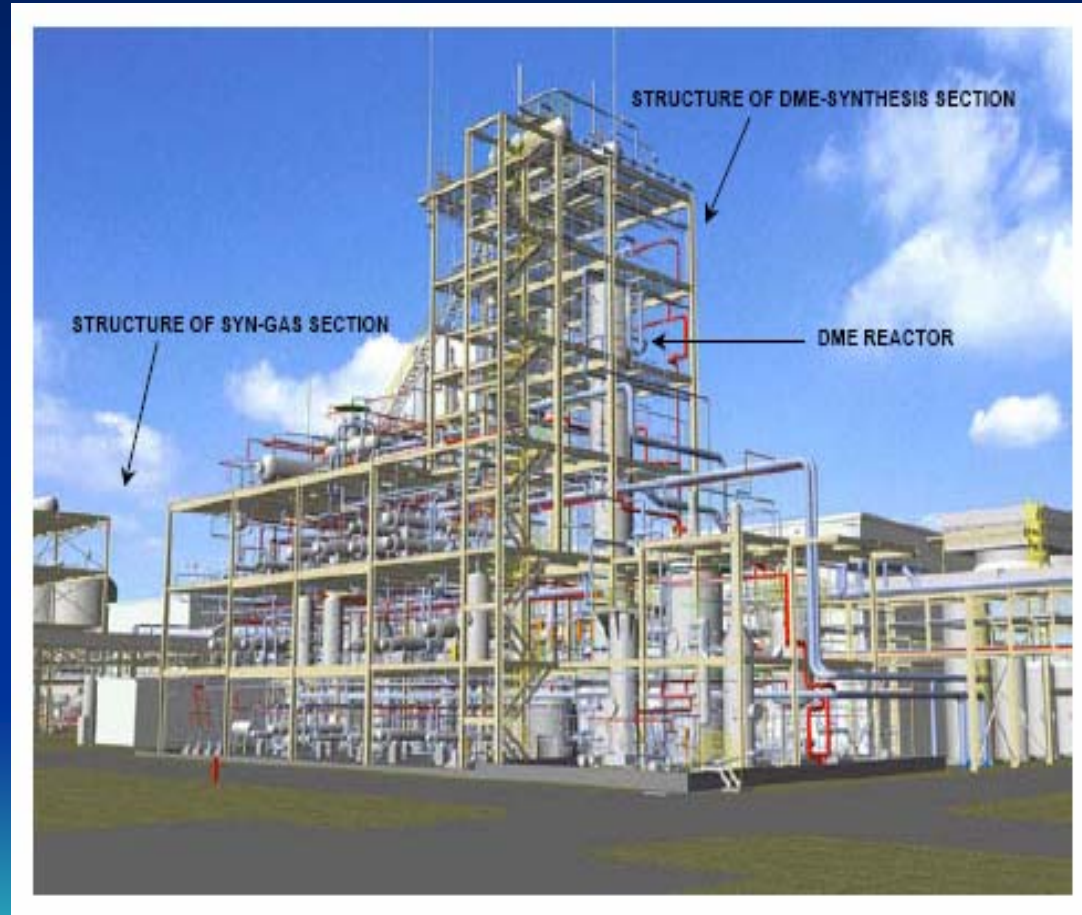


# DME Feed Stocks

- Stranded Natural Gas (Low Cost)
- Coal (Abundant, Widely Available)
- Biomass (Lowest Green House Gas Emissions-CO<sub>2</sub>)
  - Black Liquor, Wood
  - Switch Grass
  - Other

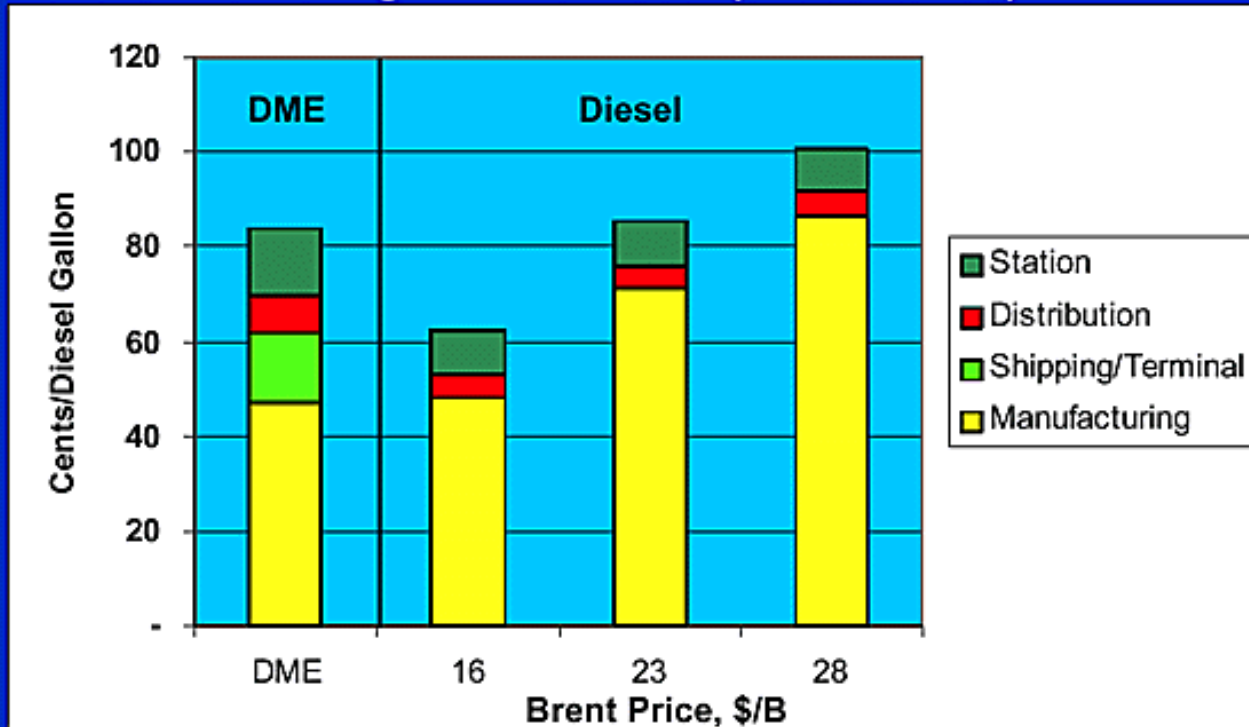


# NKK DME Plant (Natural Gas)



# DME From Stranded Gas

Cost for Delivering DME vs Diesel (ex fuel taxes)



*...DME is breakeven with diesel at \$23/bbl Brent*

*Provided by IDA for Illustrative Purposes*

# DME in China



## Shandong Jiutai Chemical Industry, Linyi, Shandong

- 30,000 T/yr. December 2003 start-up.
- 60,000 T/yr. Construction started January 2004
- Plans to increase production capacity to 300,000 T/yr by end of 2005; then to 1 million T/yr by 2009.

## Luthianhua Group Inc, Luzhou, Sichuan

- 10,000 T/y – Commercial DME plant for fuel use - August 2003 start-up. Toyo Engineering methanol dehydration technology.
- 110,000 T/y – with 2005 start-up

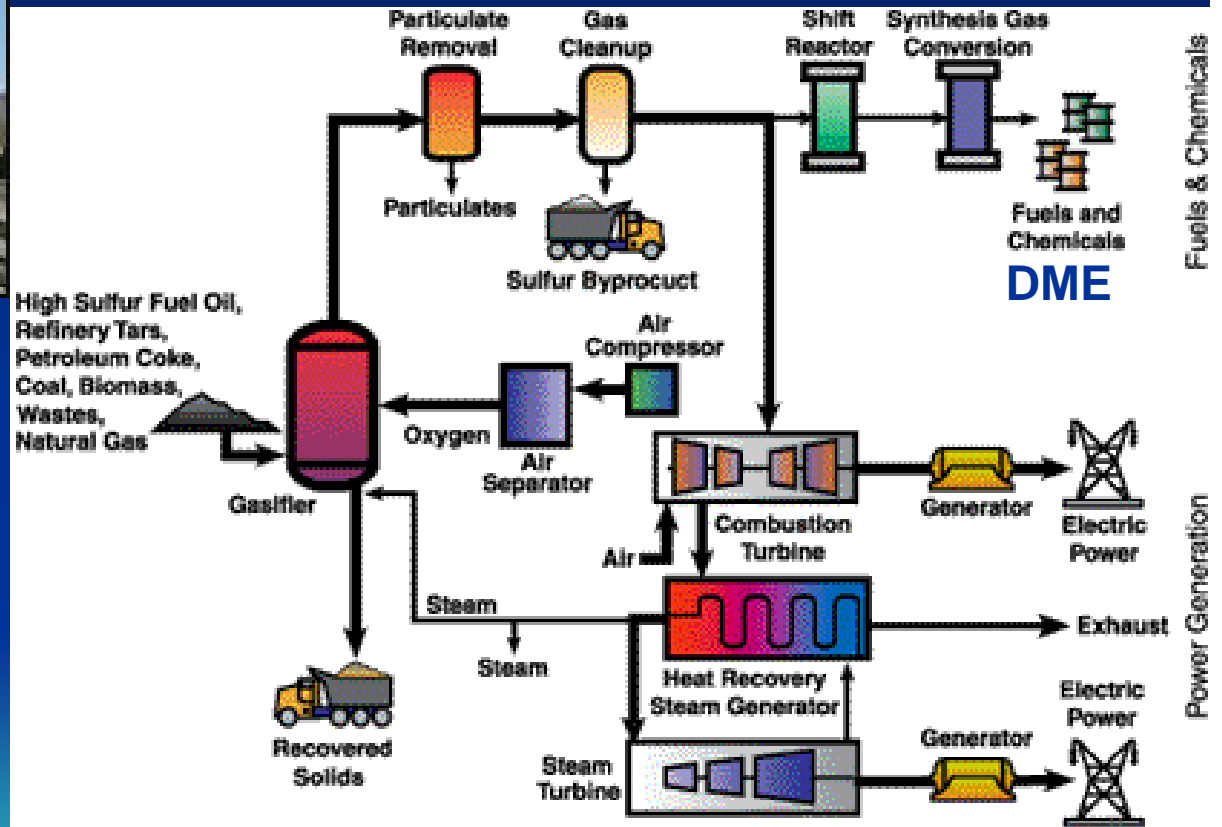
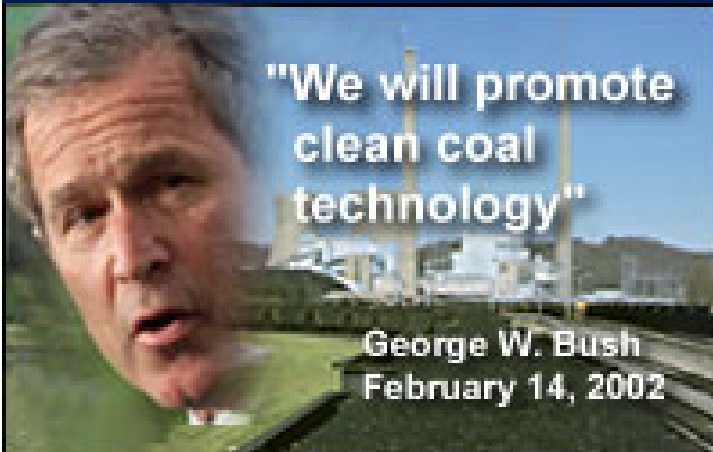


**-In the next 5 - 10 years, China will construct a group of large dimethyl ether units.**

**-Besides the units in Shandong and Sichuan, dimethyl ether units with different capacities will also be put up in Ningxia, Shanghai, Xinjiang and Shaanxi.**

**So: China Chemical Reporter, May 26, 2004**

# DME From Coal



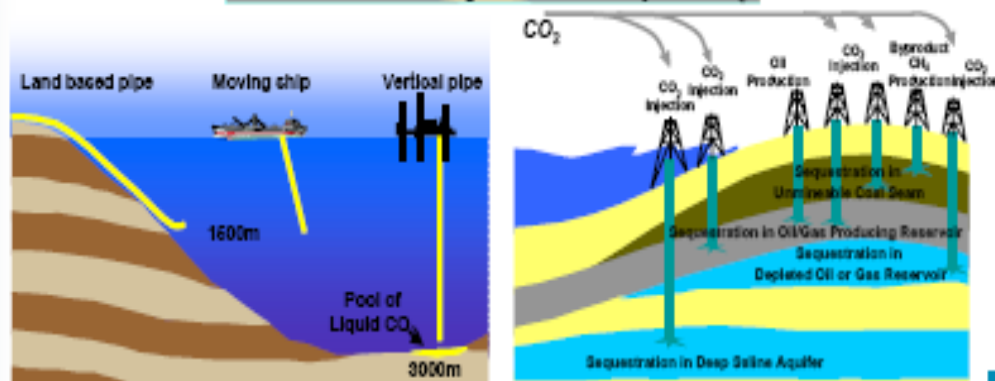
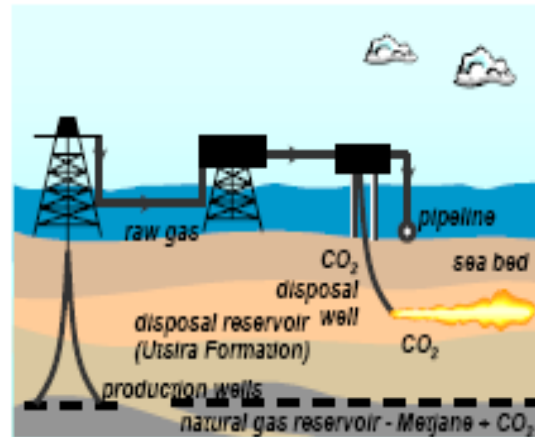
## Coal Utilisation - Gasification



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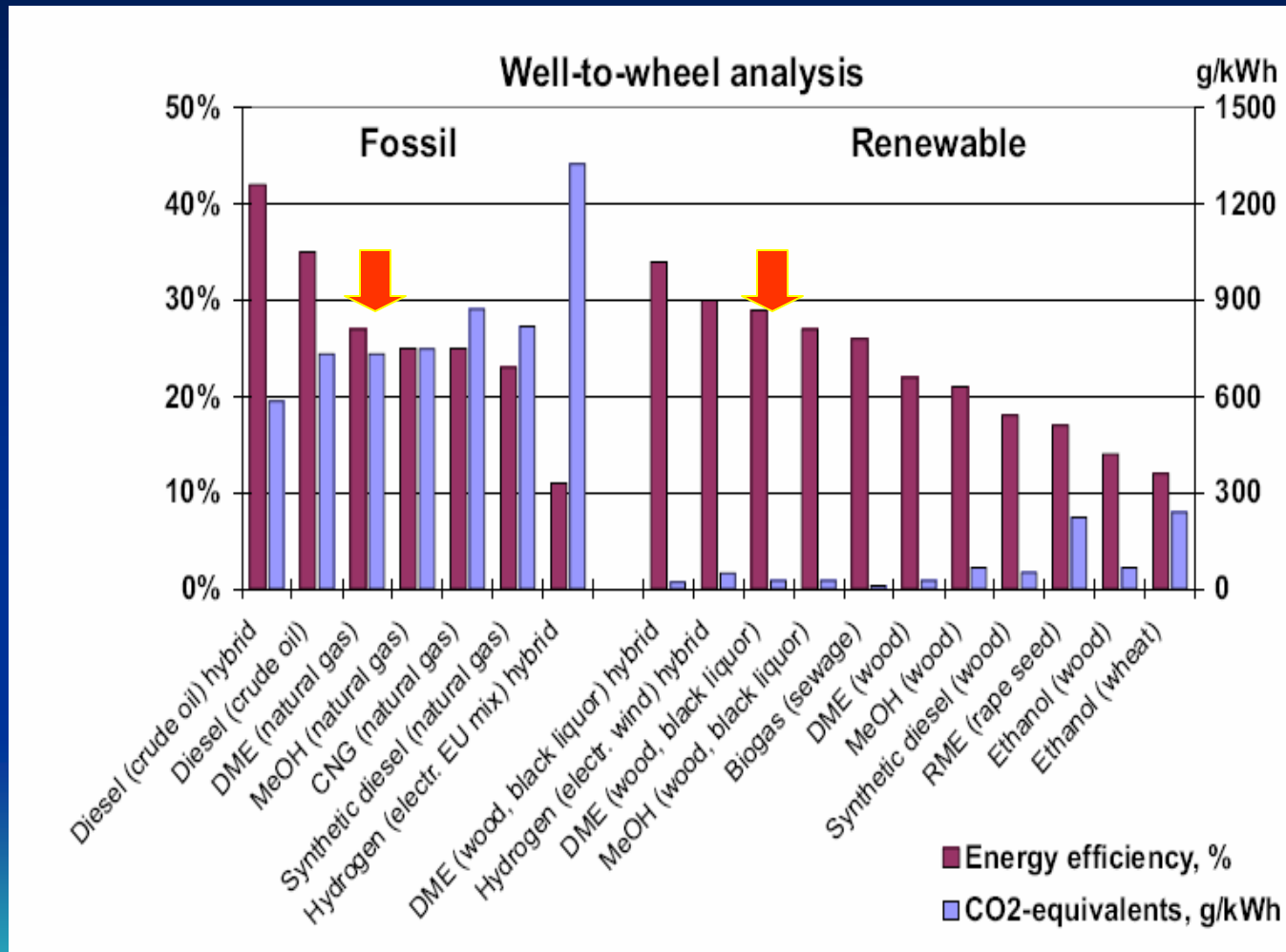
# Sequestration of CO<sub>2</sub>



ENERGY \* TECHNOLOGY



# DME Efficiency & CO<sub>2</sub> Emissions

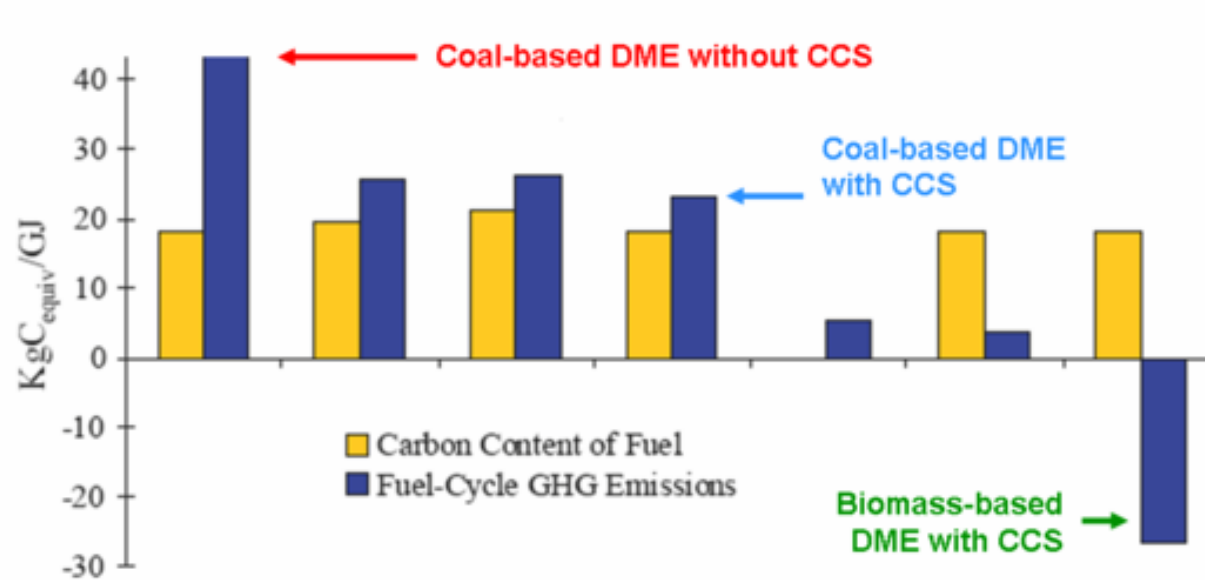


Source:

**VOLVO**

# CO<sub>2</sub> Mitigation

Carbon Content and Fuel-Cycle GHG Emissions for Alternative Fuels and Primary Energy Sources



Energy Carrier	DME	Gasoline	Diesel	DME	Hydrogen	DME	DME
Primary Energy Source	Coal	Crude Oil	Crude Oil	Coal	Coal	Biomass	Biomass
CO <sub>2</sub> Capture and Storage?	No	No	No	Yes	Yes	No	Yes

Princeton Environmental Institute

# An Optimum Mix of Feed Stocks

- Coal w/ $\text{CO}_2$  Sequestration Provides Energy Security & Low Emissions
- Biomass Gives Lowest  $\text{CO}_2$  But Supply is Limited
- Stranded Natural Gas is Lowest Cost But Least Secure (Off-Shore)
- A Balanced Mix of Feed Stocks is Needed



# DME Engine Technology

- DME- An Ideal Diesel Fuel
- No Major Engine Changes Needed
- New Fuel System Required
  - Fuel Storage (Propane Technology)
  - Fuel Injection...***New Technology Needed***
- Very Low Engine-Out Emissions Possible
- U.S. 2010 HDD Emissions Possible w/o Particulate Filter or (possibly) NOx Trap  
(SAE 2006-01-0053, Teng & McCandless)



# Engine Technology Status

- Production Feasible Fuel Injection System Developed (Common Rail)
- Low Emissions Demonstrated
  - Passenger Cars (U.S. Tier 2)
  - HD Trucks Euro V
- HD Volvo Truck Demonstrated
- HD Volvo Truck Field Test In Process



# DME Fueled Passenger Car Engine

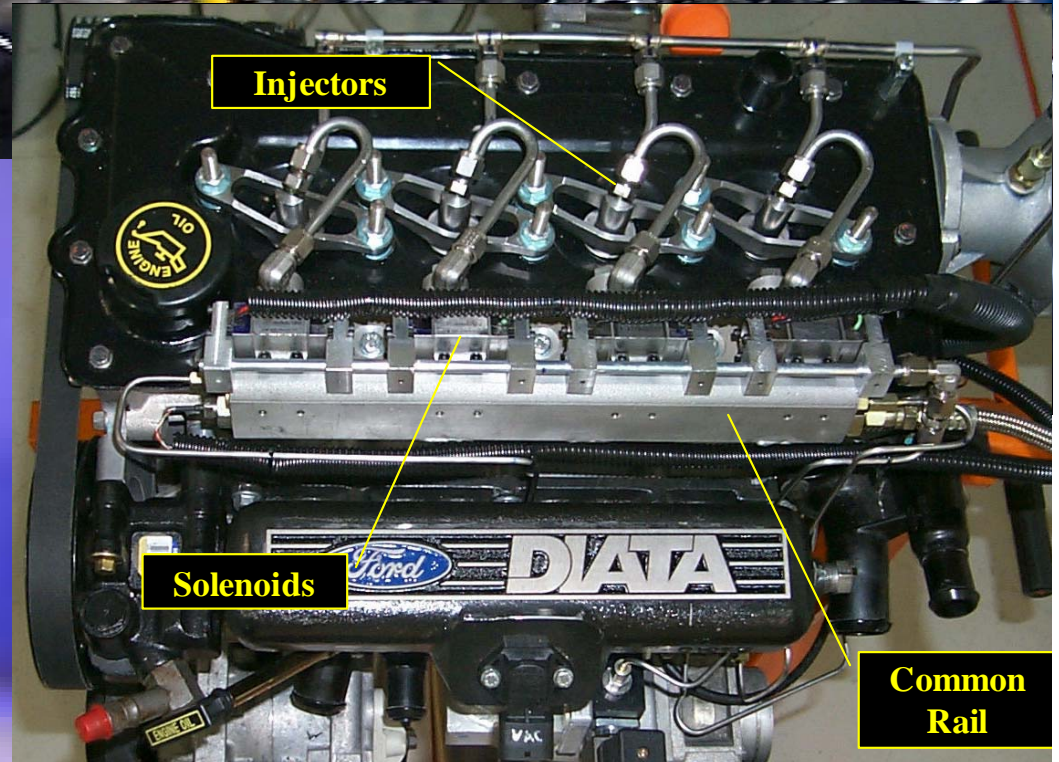
## U.S. Tier II Emissions Capability

*PN GV - DME*

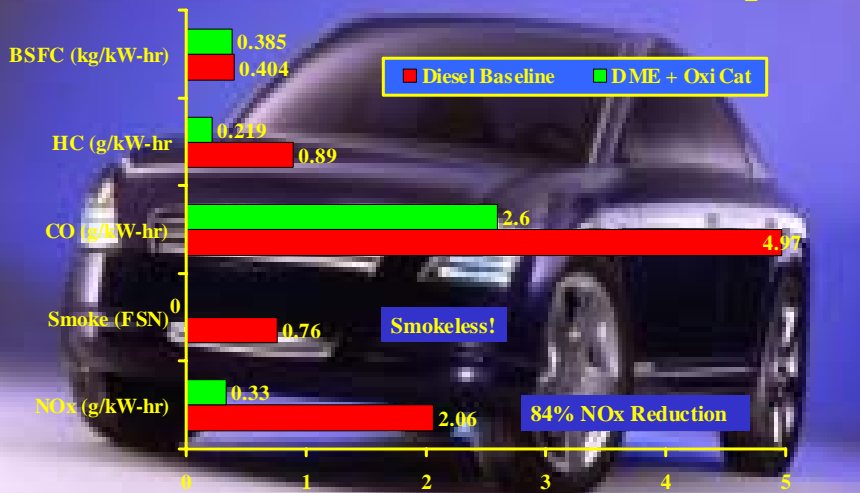
*Emissions Demonstration*

**AVL**

Powertrain Technologies, Inc



### Road Load Emissions & Fuel Consumption



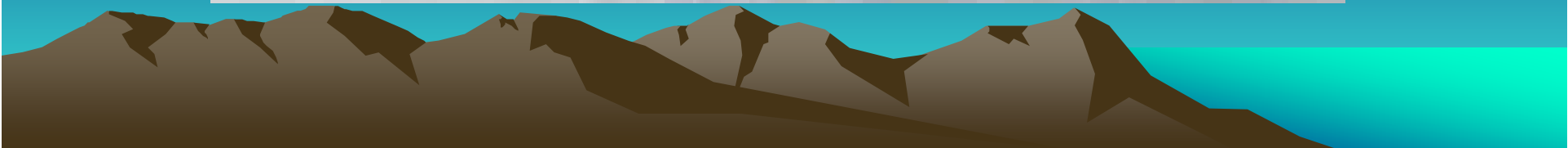
# DME Fueled Volvo HD Engine



# DME Fueled Volvo Truck



# Volvo DME Truck Demonstration



# Summary & Conclusions

- DME is a Clean Diesel Fuel Replacement
- Can Be Economically Produced From Abundant Feed Stocks
- Can Mitigate Global Warming & Provide Energy Security
- Engine Technology Proven-Production in 2010
- DME is an Imperative, Not an Alternative





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