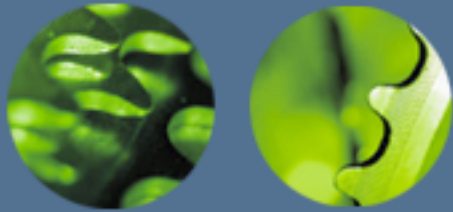




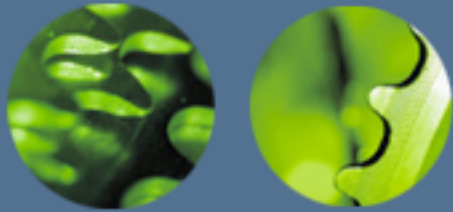
The Diesel Engine: *An Existing Technology To Address U.S. Passenger & Light-Duty Vehicle Carbon Dioxide (CO₂) Emissions*

By Lauren McIntire



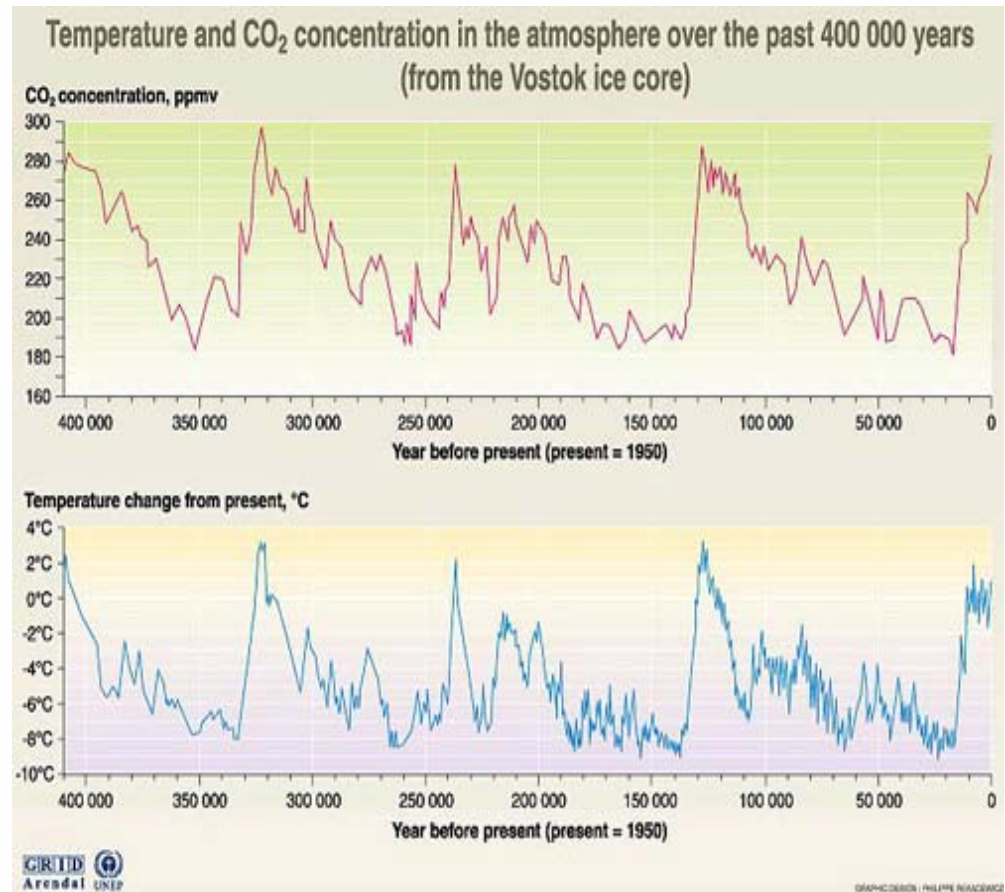
Presentation Outline

- **Issue Background**
 - The Issue Defined
 - The Effects
 - The Sources
- **Technical Methods for Addressing Issue**
 - Method 1
 - Method 2
- **Recommendations:**
 - Technical Method
 - AND***
 - Policy Implementation-Strategies



The Issue Defined

- **Atmospheric CO₂ Level:** Historical High and Increasing
- **Current Level:** 383ppm
- **NASA:** “CO₂ exceeding 450 ppm is almost surely dangerous [...]”



Source: J.R. Petit, J. Jouzel, et al. Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica, Nature 399 (3 June), pp 429-436, 1999.



A Word From the Wise:

global warming is real





The Effects

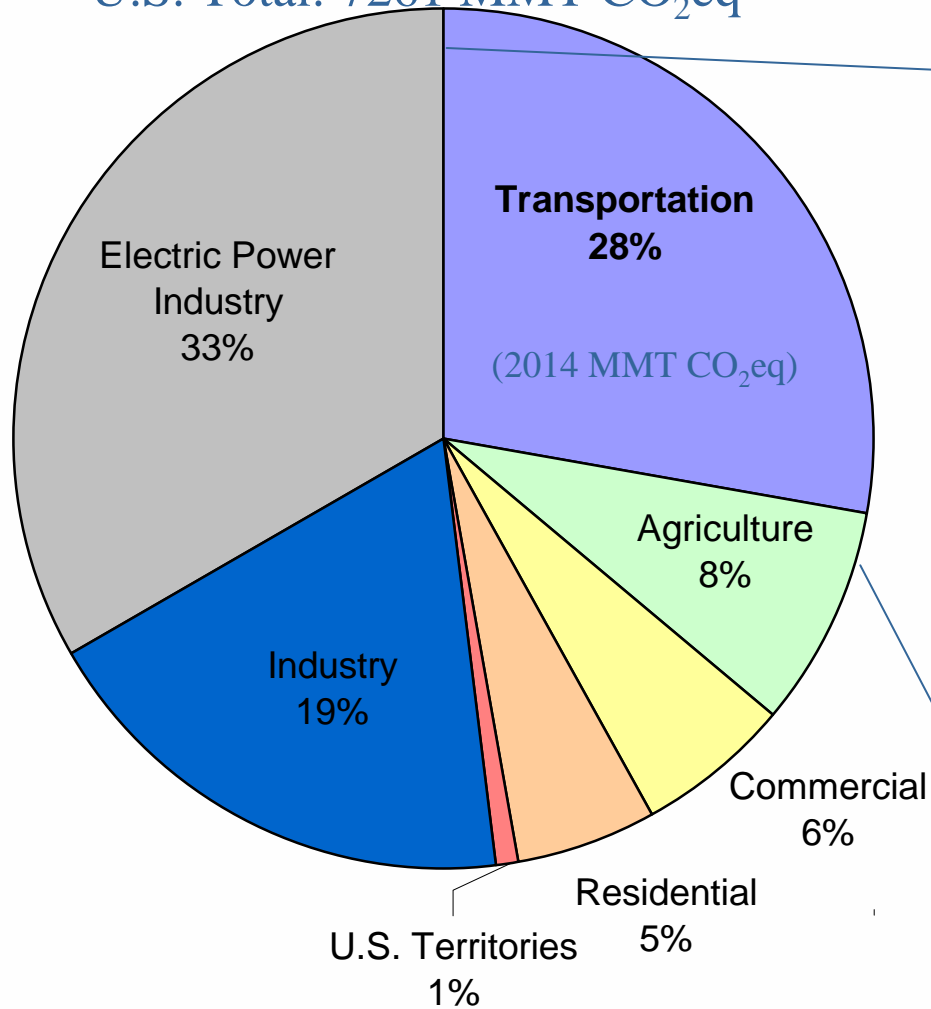


- **NASA:** “If global emissions of carbon dioxide continue to rise at the rate of the past decade, this research shows that there will be disastrous effects, including increasingly rapid sea level rise, increased frequency of droughts and floods, and increased stress on wildlife and plants due to rapidly shifting climate zones [...]



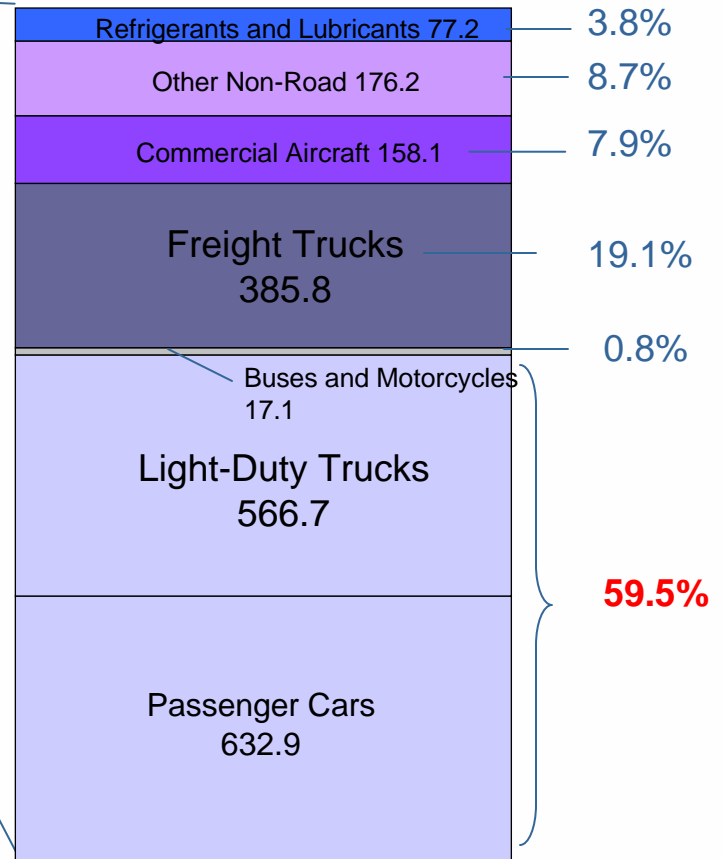
The Sources

U.S. Total: 7261 MMT CO₂eq

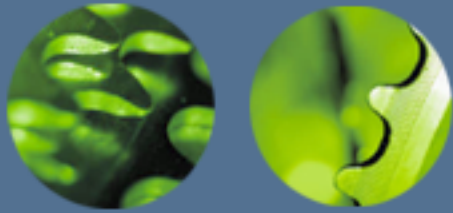


Sources of Transportation GHGs

Share of Transportation GHGs

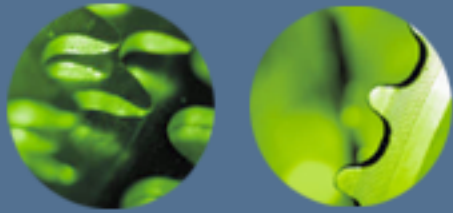


Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005



Transportation Sector: A Significant Source

- **Passenger & Light-Duty Vehicle Class Emissions**
 - CO₂ Emissions Contributed:
 - Transportation Sector
 - 59.5%
 - Overall
 - 16.6%
- **The Question:**
 - *How do we decrease CO₂ emissions from this vehicle class?*



Methods for Decreasing CO₂ Emissions

- **Two Methods:**

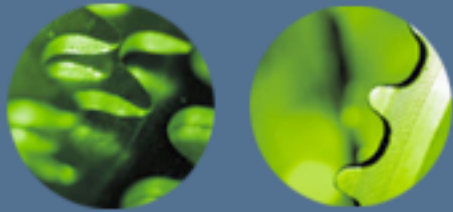
- (1) Increase Fuel Economy

- Via powertrain alterations

- (2) Use Low-carbon Fuels

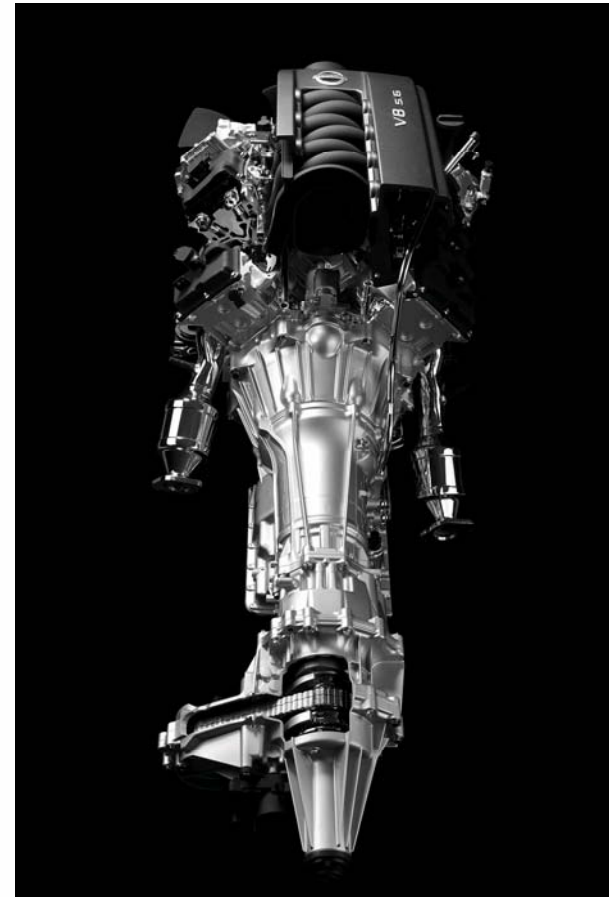
- Via sources with decreased hydrocarbons, blended with or aside from crude oil

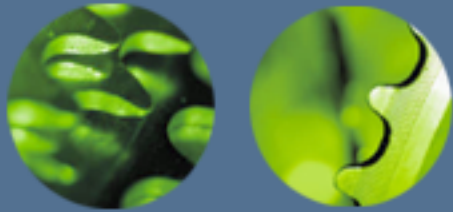




Method 1: Increasing Fuel Economy

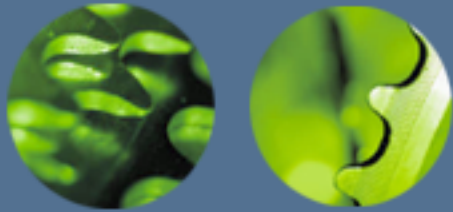
- **Address the Following Vehicle Features:**
 - Weight
 - Aerodynamics
 - ***Powertrain***
 - *Transmission & Engine*





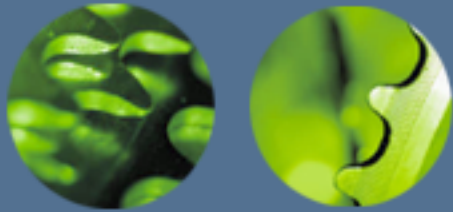
Engine Types

- **Major Engine Types:**
 - Spark Ignition (SI, Gasoline Engine)
 - Compression Ignition (CI, Diesel Engine)
- **Note:**
 - CI engines (using petrodiesel) get 20%-30% higher fuel economy than equivalent gasoline-running SI engines!
 - Biodiesel gets 2% less fuel economy than petrodiesel



Method 2: Using Low-Carbon Fuels

- **Electricity** (*Hybrid, a regenerative system*)
 - Engine Type:
 - *Presently*- SI (for gasoline drive) coupled with an electric motor/generator and battery package (for electric drive)
 - *Future*- CI (for bio and/or petrodiesel) coupled with an electric motor/generator and battery package (for electric drive)
- **Biodiesel**
 - Engine Type:
 - ****CI: Diesel****



Method 2: Biodiesel as Fuel

- **Biodiesel:**

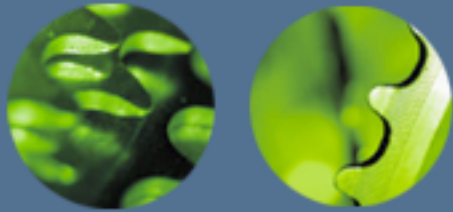
- “a renewable diesel fuel substitute that can be made by chemically combining any natural oil or fat (*i.e. biomass*) with an alcohol (*methanol)”

- **Biomass Development:**

- When photosynthetic organisms use solar energy to combine water with CO_2

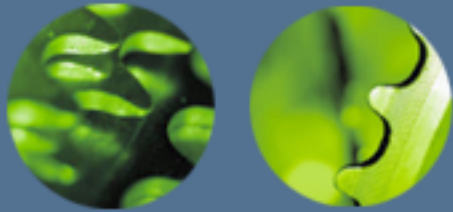
- **Life Cycle Analyses:**

- “look at the whole picture of how a fuel is made, from “cradle to grave.”
 - Extraction of all raw materials *to fuel combustion*

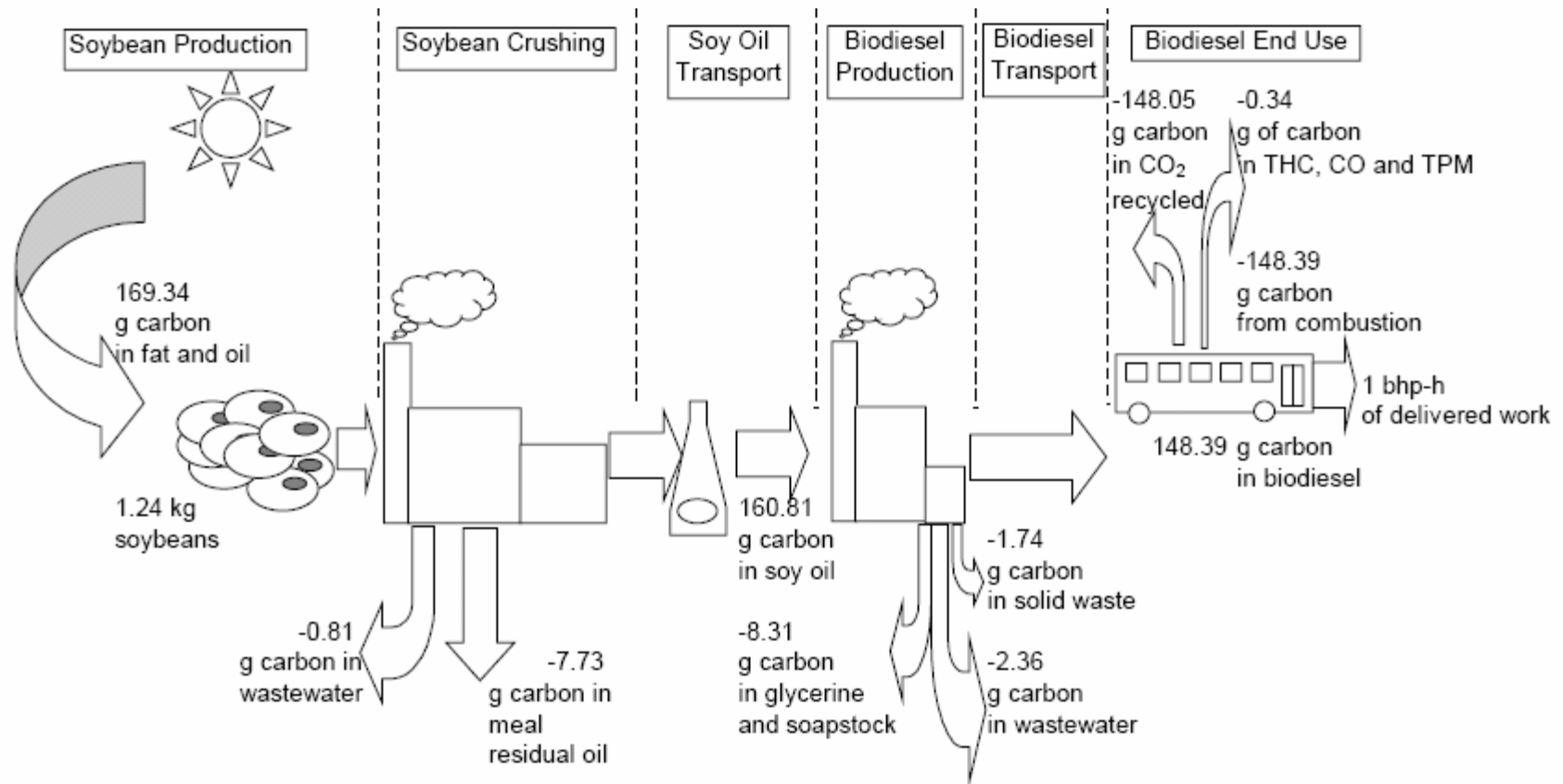


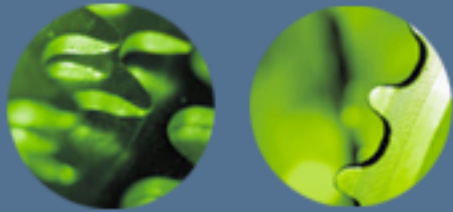
Biodiesel Biomass: Two Priority Sources

- **Existing Source:**
 - **Soybean Oil**
 - U.S. is the world's largest producer
 - Most common biomass source
- **Source Being Researched:**
 - **Algae Oil**
 - **1978-1996:** *“Aquatic Species Program (ASP): Biodiesel from Algae;” U.S. DOE & NREL*
 - Universities continue to conduct research in this area



Biodiesel Biomass: Soybean Oil Life Cycle

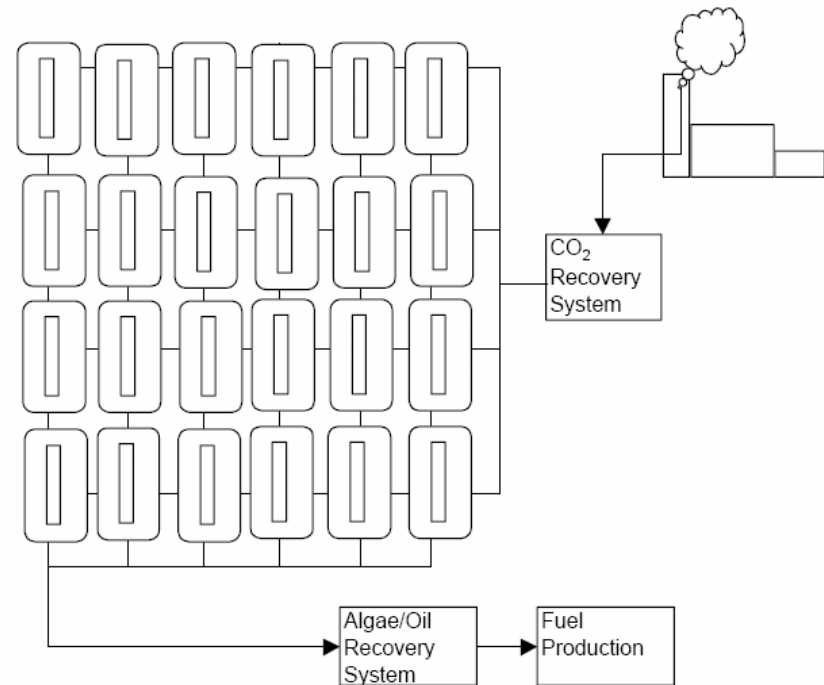




Biodiesel Biomass: Algae Oil Life Cycle

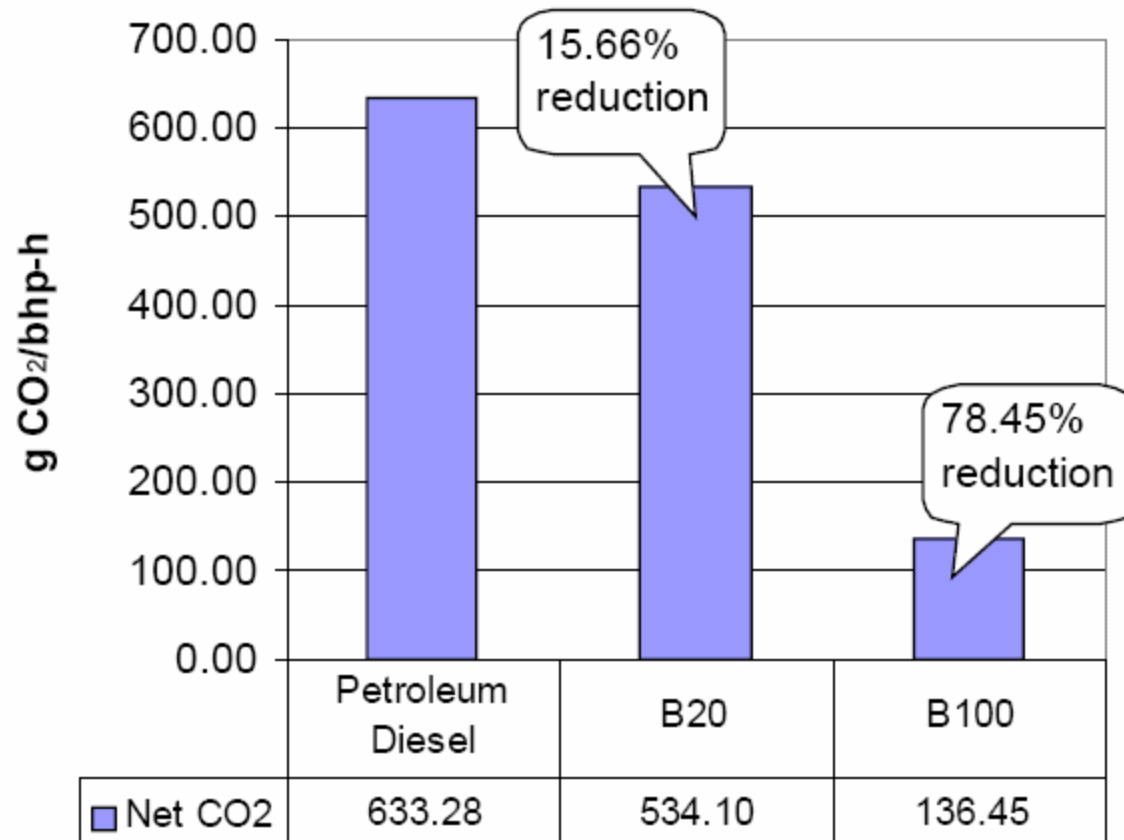
- **Results:**

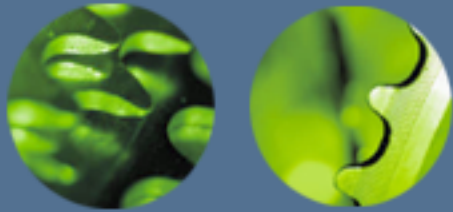
- Need to “maximize the overall productivity of algae mass culture systems [...] (however) program serve(s) as a strong foundation for further genetic enhancements of algae.”





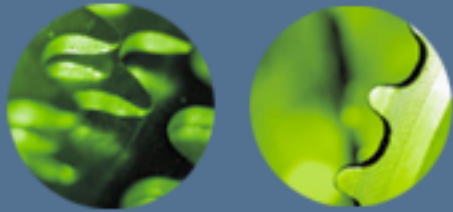
Petrodiesel, Biodiesel, and Blends





Technical Recommendations

- Method 1:
 - Replace SI engines with CI engines
 - Including hybrids**
 - Several automanufacturers producing diesels for class
- Method 2:
 - Use standardized B20 now
 - Continue R&D for biodiesel to ultimately achieve B100



Implementation Recommendations

- Method 1:
 - Increase CAFE standards (2007 Energy Bill)
 - Produce Initiatives (Fed, State, & Local)
 - Ex: NYC Taxis to be all hybrids by 2012
 - Produce Tax Credits (Fed & State)
- Method 2:
 - Produce Initiatives (Fed, State, & Local)
 - Ex: HOV lane use privileges to hybrid owners
 - Increase R&D for Biodiesel



Conclusion

- **Issue:**
 - CO2 Emission Exceedances
 - Climate Change Effects
 - 16.6% of Emissions from Targeted class
- **Technical Methods for Addressing Issue**
 - Increased Fuel Economy
 - Use of Low-carbon Fuels for Petroleum-based Fuels
- **Recommendations:**
 - Phase-in CI over SI Engines; Use B20+; Develop Diesel Hybrids
AND
 - Increase CAFE Standards; Provide Tax Credits & Initiatives; & Fund R&D Efforts for Biodiesel



Acknowledgements

- **Trade Associations:** MECA, AIAM, AAM
- **Federal Agencies:** DOE, EPA
- **WISE:** Tim Mellon, Dr. Jackson

To Name a Few!



Images

- http://www.lunargoutpost.com/gallery/earth/image/s/earth_full_hires%20copy.jpg
- http://www.rightblueeye.com/blog/wp-content/uploads/2006/08/boogerboy_-_global_warming_is_real.jpg
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- http://l.yimg.com/us.yimg.com/i/us/aut/ph/gc/roadtrack_48_img1.jpg
- NREL: ASP & Soybean Oil Study