

# Biodiesel and Air Quality

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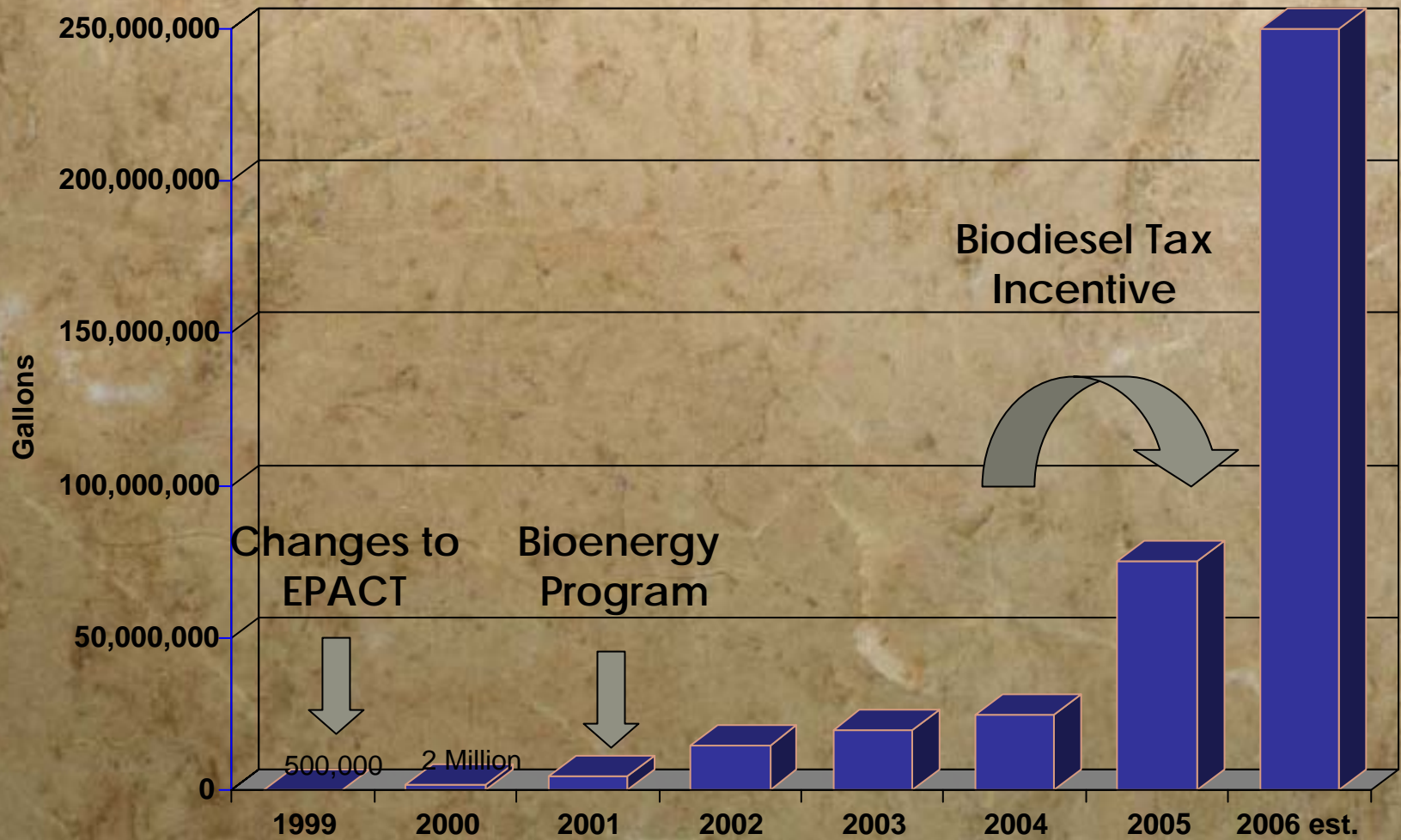


# The Big Picture

- Global demand for petroleum has exceeded the discovery of new reserves for the first time this year.
- The external costs of our increasing dependence on foreign petroleum are growing rapidly, both at home and abroad.
- Our society needs liquid energy. Without it everything grinds to a halt.
- Biodiesel can be a part of the solution working in the existing infrastructure.

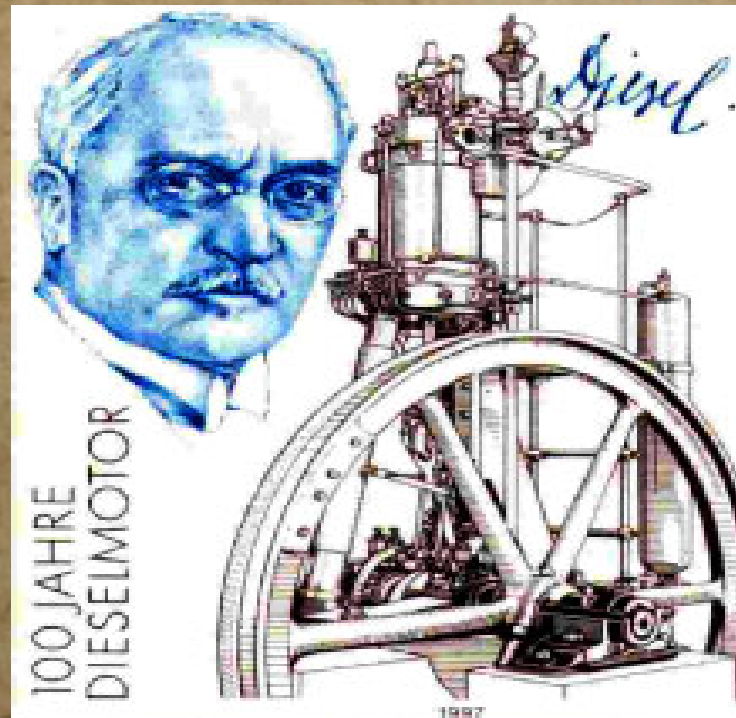


# US Biodiesel Demand



- “The use of plant oil as fuel may seem insignificant today. But such products will in time become just as important as kerosene and these coal-tar-products of today.”

~R. Diesel, 1912

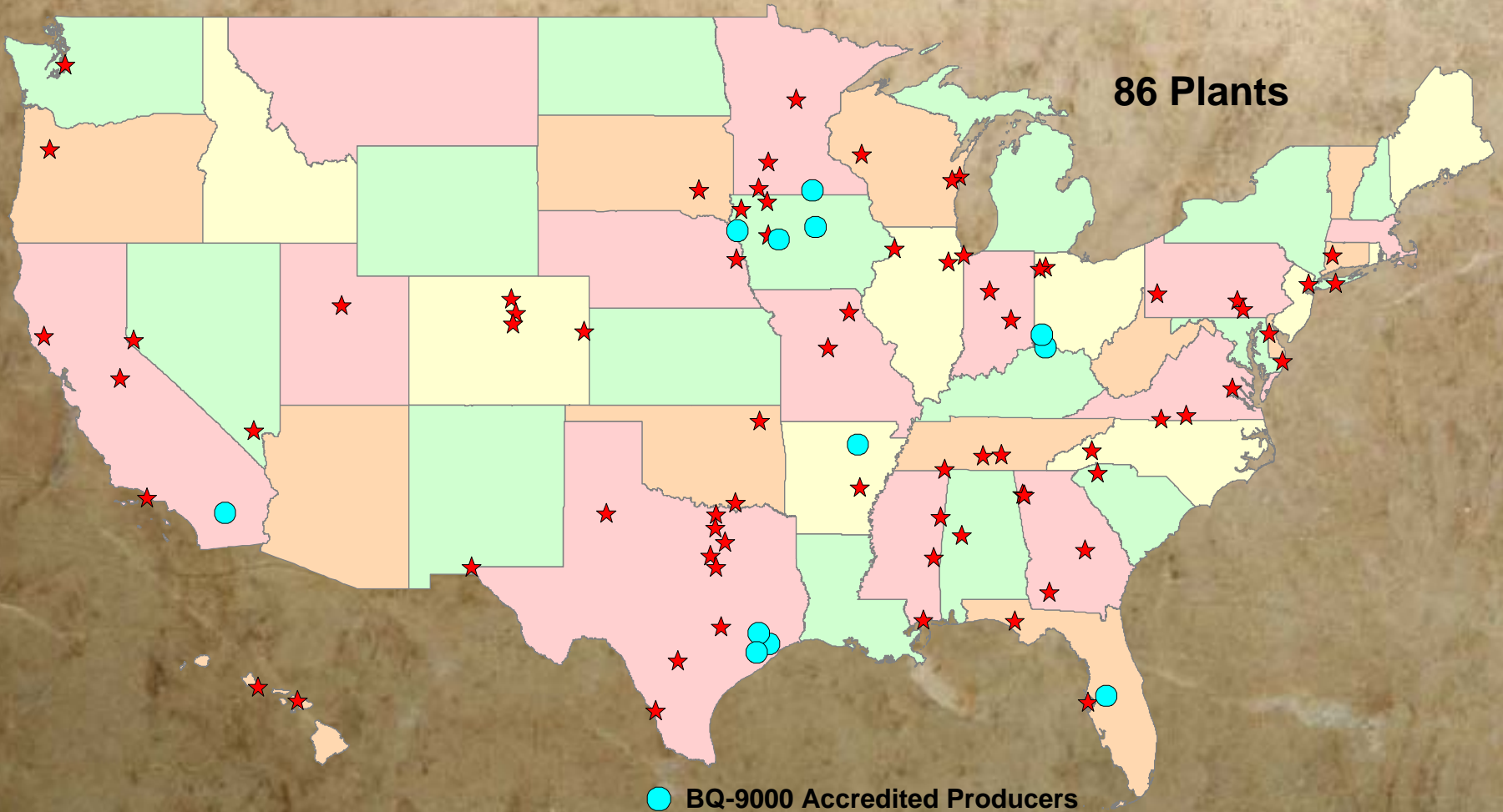


# Biodiesel Benefits

- Cleaner burning & non-toxic
- Domestically produced (energy security)
- Little to no infrastructure change needed to implement biodiesel
- Closed economic loop (\$ stays in state)
- Supports regional farmers
- Apolitical American fuel

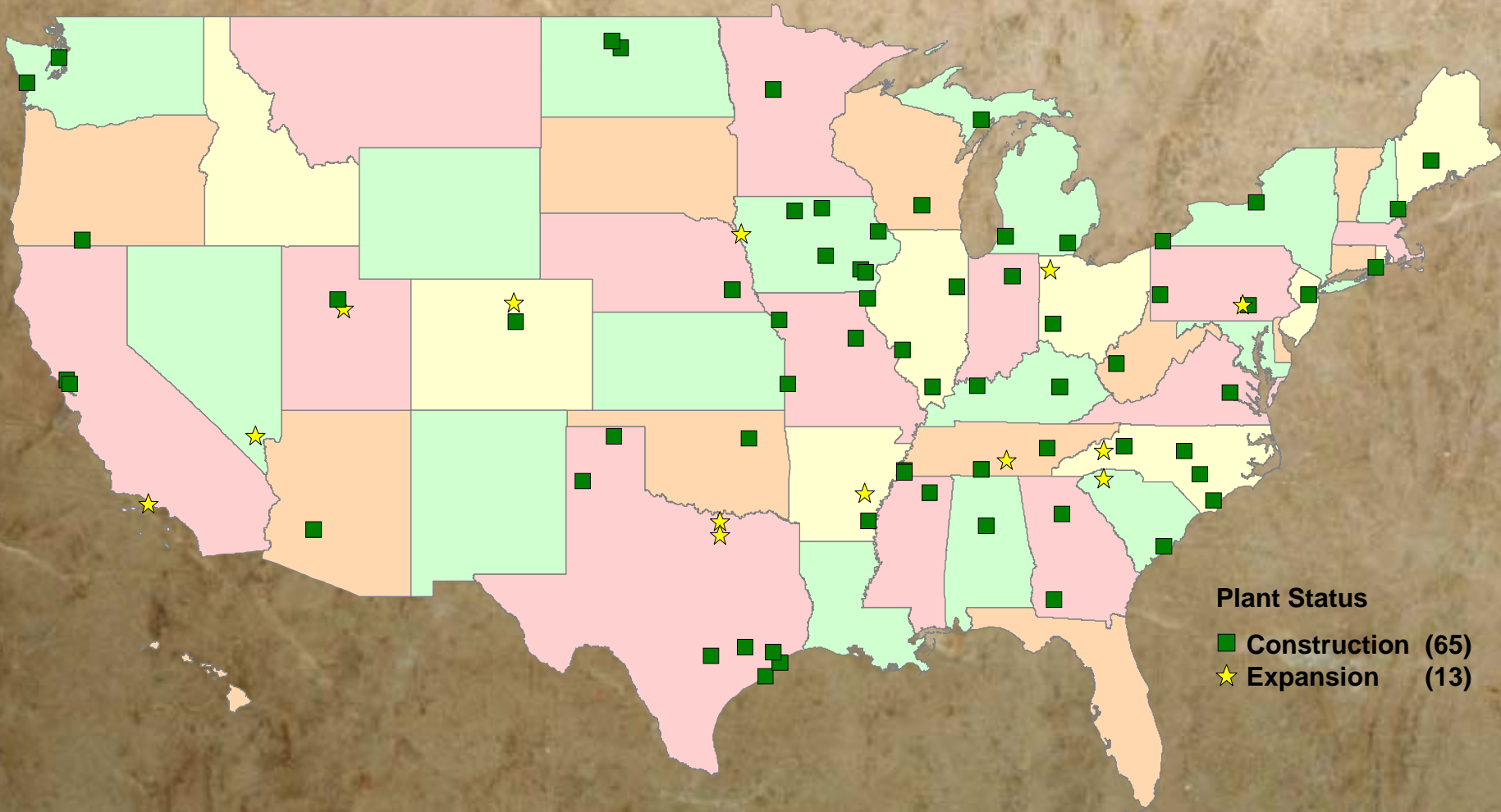
# Production Locations

(9/13/06)

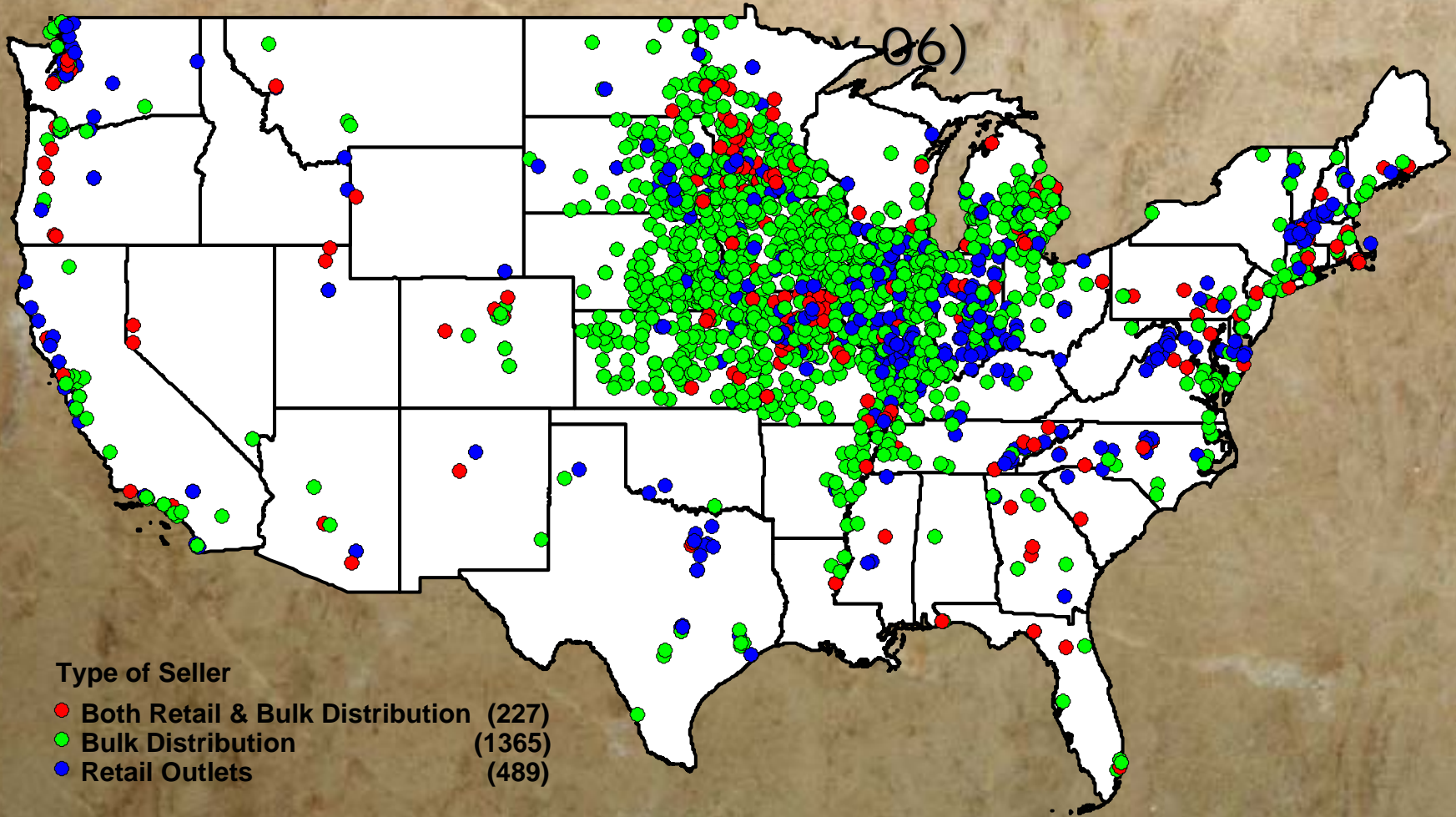


# Biodiesel Plants Under Construction & Expansion

(9/13/06)

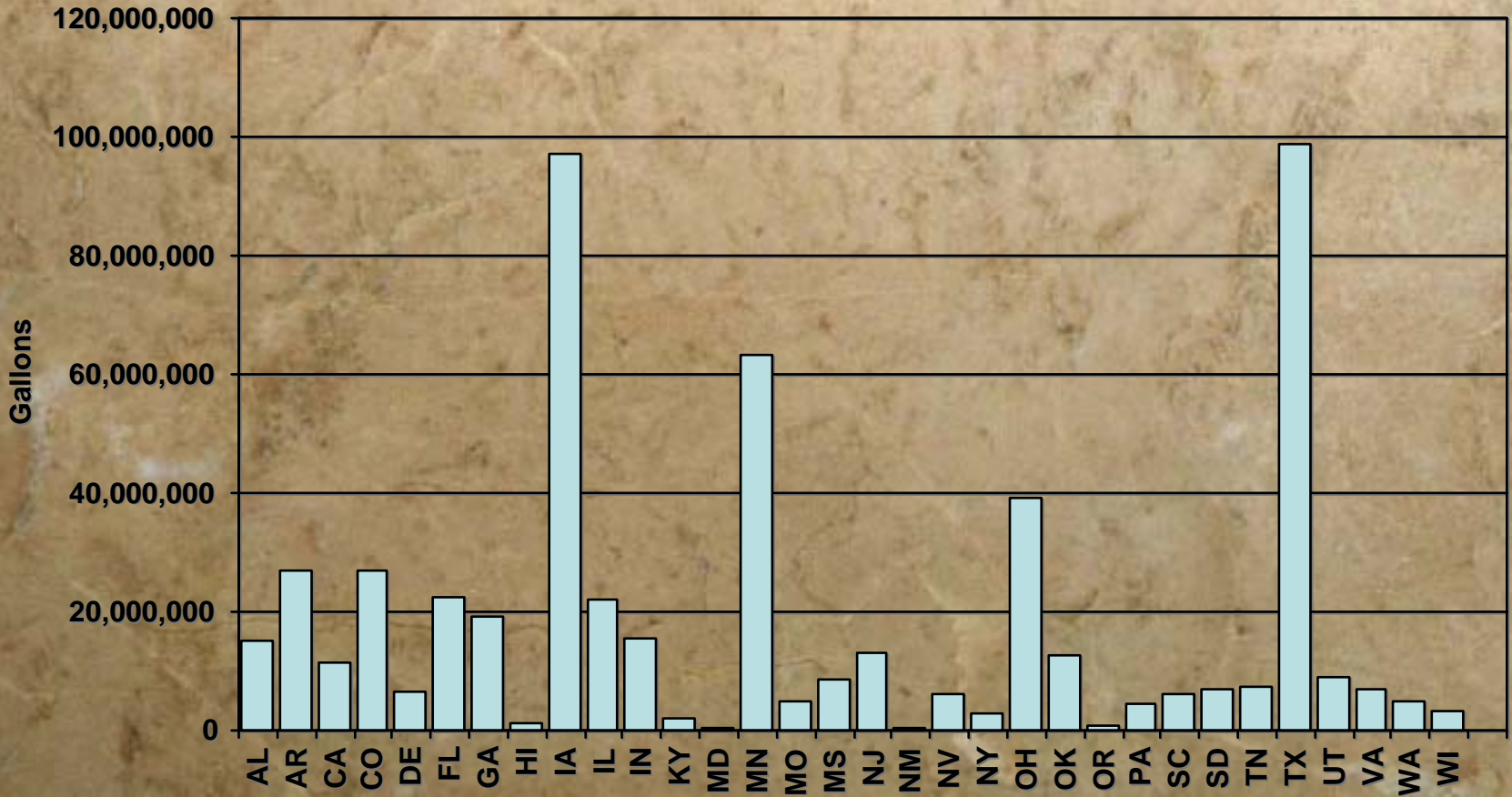


# Distribution Locations





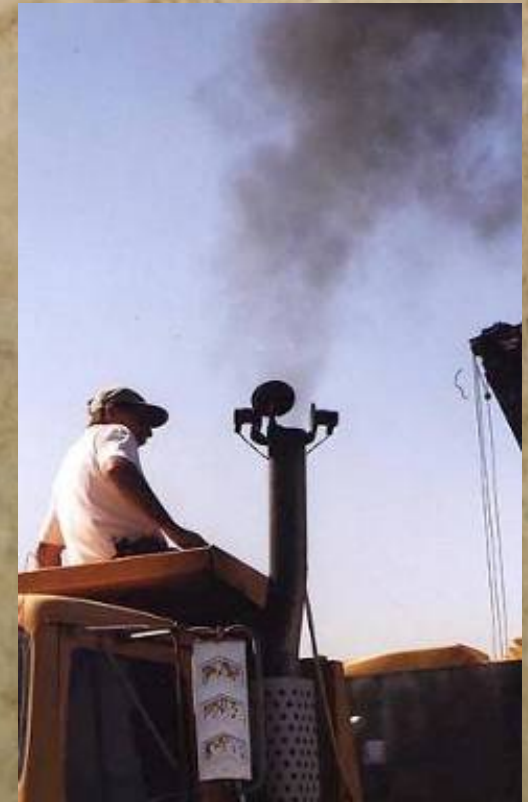
# Production Capacity by State (8/28/06)



# Biodiesel Benefits

- Less toxic than table salt
- Biodegrades as fast as sugar
- Low volatility, minimum flashpoint of 130°C (266°F)
- Emissions compared with petroleum diesel

<b>Emission Type</b>	<b>B100</b>	<b>B20</b>
<b>Total Unburned Hydrocarbons</b>	<b>-67%</b>	<b>-20%</b>
<b>Carbon Monoxide</b>	<b>-48%</b>	<b>-12%</b>
<b>Particulate Matter</b>	<b>-47%</b>	<b>-12%</b>
<b>Sulfates (SO<sub>x</sub>)</b>	<b>-100%</b>	<b>-20%</b>
<b>Nitrogen Oxides (NO<sub>x</sub>)</b>	<b>*Neutral</b>	<b>*Neutral</b>



# Biodiesel Consumers

- More than 500 fleets nationwide including:
- National Forest Service
- US Department of Energy
- Department of Defense
- NASA
- National Park Service
- TXDOT, ODOT, IDOT, VDOT, MODOT, NJDOT, and many other Departments of Transportation



# Biodiesel Market Growth

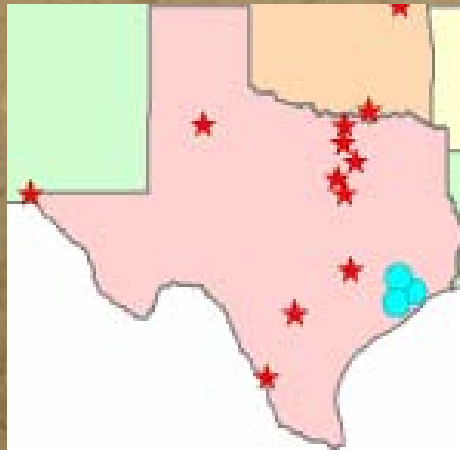
Demand for biodiesel is growing for many reasons:

- Strong bi-partisan political support
- Energy Security
- Air Quality
- Renewable Fuel Standards
- State and local mandates
- EPA CT fleets
- Publicly popular fuel
- Cost competitive
- Premium diesel



# Texas Leadership in Biofuel Production

- **Texas is the largest producer of biodiesel in the US**
- Over 100 million gallons of biodiesel production in place
- More than 87 million gallon capacity under construction
- Largest Ethanol Facilities in the nation are coming online in Texas



# Biodiesel Attributes

- *Meets requirements of Texas Low Emission Diesel*
  - High Cetane (average over 50)
  - Zero aromatics
  - Ultra Low Sulfur (average ~ 2 ppm)
- Registered with EPA under Clean Air Act 211(b)
  - As a fuel (B100) that can be blended into any other registered fuel
    - As a blending component
    - Biodiesel can be used as a pure fuel
    - Not considered an additive above 1%
  - As a fuel additive at levels below 1%

# Biodiesel Reduces Emissions of Soot and Toxic Compounds

- B20 reduces soot (or PM) emissions by 10% or more
- CO is reduced 11%
- Total hydrocarbon is reduced by more than 20%, including many toxic compounds

# Historical Overview of NO<sub>x</sub> Issue

- **Up until early in 2005 it was widely accepted that B20 caused a small, 2%, increase in NO<sub>x</sub>**
  - Conclusion of EPA review published in 2002
  - Based in large part on data acquired by DOE's NREL
- **Recent reviews of EPA's analysis showed that nearly half of the data reviewed in this study were for one engine model**
- **Subsequent studies using a representative sampling of engine models are finding changes in NO<sub>x</sub> that range roughly from about +4 to -4%**
  - Varies with engine model
  - Average change is zero



# Recent Studies Show No Effect on NO<sub>x</sub>

***Technical data from the following independent studies completed in 2005 and 2006 show NO<sub>x</sub> neutrality without the use of additives:***

- DOE/NREL study published October 2006
  - Reviewed engine and vehicle testing studies published from 2002-2006, no change in NO<sub>x</sub> on average (12 vehicles or engines)
  - Tested range of heavy-duty vehicles, found no change in NO<sub>x</sub> on average
  
- U.S. Navy study from June 2006
  - Tested on-highway HDDV's, found no change in NO<sub>x</sub> on average
  
- Texas Transportation Institute at Texas A&M University, August 2006
  - Tested group of school buses, found no change in NO<sub>x</sub> on average
  
- North Carolina State University study from 2005
  - Tested 12 DOT dump trucks, found NO going down

# Detailed citations:

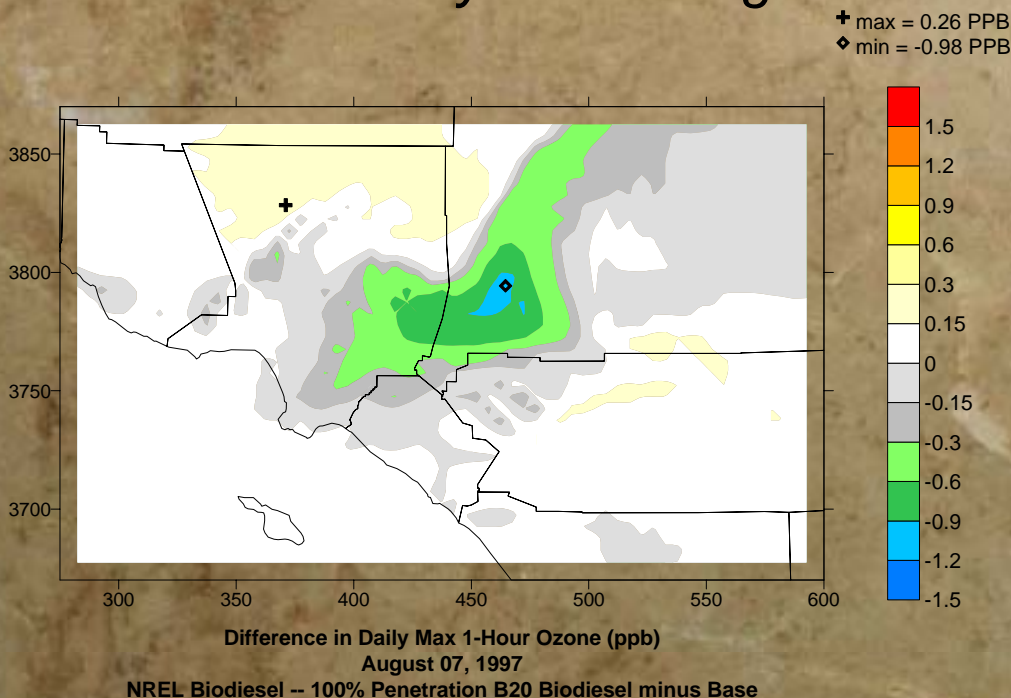
- Holden, B., Jack, J., Miller, W., Durbin, T. "Effect Of Biodiesel On Diesel Engine Nitrogen Oxide and Other Regulated Emissions" Technical Report TR-2275-ENV, Naval Facilities Engineering Command, Port Hueneme, California. May 2006.
  - Tested 6 on-highway vehicles, found no change in NO<sub>x</sub> on average
- Farzeneh, M., Zietsman, J., Perkinson, D.G. "School Bus Biodiesel (B20) NO<sub>x</sub> Emissions Testing" Texas Transportation Institute at Texas A&M University, August 2006
  - Tested 5 school buses, found no change in NO<sub>x</sub> on average
- NREL study to be published October 2006 (McCormick, et al., NREL/MP-540-40554)
  - Reviewed engine and vehicle testing studies published from 2002-2006, no change in NO<sub>x</sub> on average (12 vehicles or engines)
  - Tested 8 heavy-duty vehicles, found no change in NO<sub>x</sub> on average
- Frey, H.C., Kim, K. "Operational Evaluation of Emissions and Fuel Use of B20 versus Diesel Fueled Dump Trucks" Research Project No. 2004-18 FHWA/NC/2005-07, September 2005.
  - Tested 12 DOT dump trucks, found NO going down

# Understanding of Biodiesel and NO<sub>x</sub> Changing

- EPA is currently evaluating new report and working to update its data set
  - EPA makes the following statements in their draft 2002 draft report:
    - *“While a Technical Report such as this may be a factor in such a rulemaking, the Technical Report is not intended to be a determination of SIP credits for a State fuel program.”*
    - *States to consider additional evidence on emissions effects, as it becomes available*
- Dialogue with CARB
  - CARB has explicitly allowed biodiesel since at least 1999
  - CARB has recently proposed to continue approval of biodiesel
    - Based in part on newer emission testing data showing no increase in NO<sub>x</sub>
    - To consider B20 and lower blends as California diesel fuel
    - To allow use with verified emission reduction technologies

# Air Quality Modeling for Biodiesel

- Air quality modeling performed by Environ
- Impact of 100% market penetration of B20 on air quality in Chicago area, Northeast Corridor, and South Coast Air Basin.
- Air-shed scale effects –assuming 2% increase in  $\text{NO}_x$ :
  - *$\text{NO}_x$  from B20 use has no negative air quality impact*
  - *Changes in ozone less than ~1 ppb*
  - *Ozone actually decreasing!*



Analysis from NREL/SR-540-33793, April 2003

# New Conclusion on Biodiesel and NO<sub>x</sub>:

*“Based on newer data for more than 43 different engines, we conclude that B20 biodiesel has, on average, no impact on emissions of No<sub>x</sub> “*

- Oct 2006 DOE/NREL Comprehensive Report on Biodiesel emissions