Clean Fuels Program Advisory Group

Renewable Fuels Overview

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Sept. 19, 2006

Outline

- Context for Biofuels
- Ethanol
  - Background Facts
  - Low-level blends (e.g., 5.7% in gasoline)
  - E-85 Fuel Ethanol
- Biodiesel

Key Question for today:

Research Needs & Priorities?

Background

- President Bush's State of Union
  - E-85, FFV's & cellulosic ethanol
- Governor's Executive Order 06-06
  - *Biofuels production and use targets*
- Federal Renewable Fuel Standard (RFS)
- California ethanol industry economic development
- Need to address greenhouse gases
- Oil resource depletion = need for alt fuels
- AQ concerns about permeation / commingling

ETHANOL PRODUCTION BACKGROUND FACTS

2005 Consumption

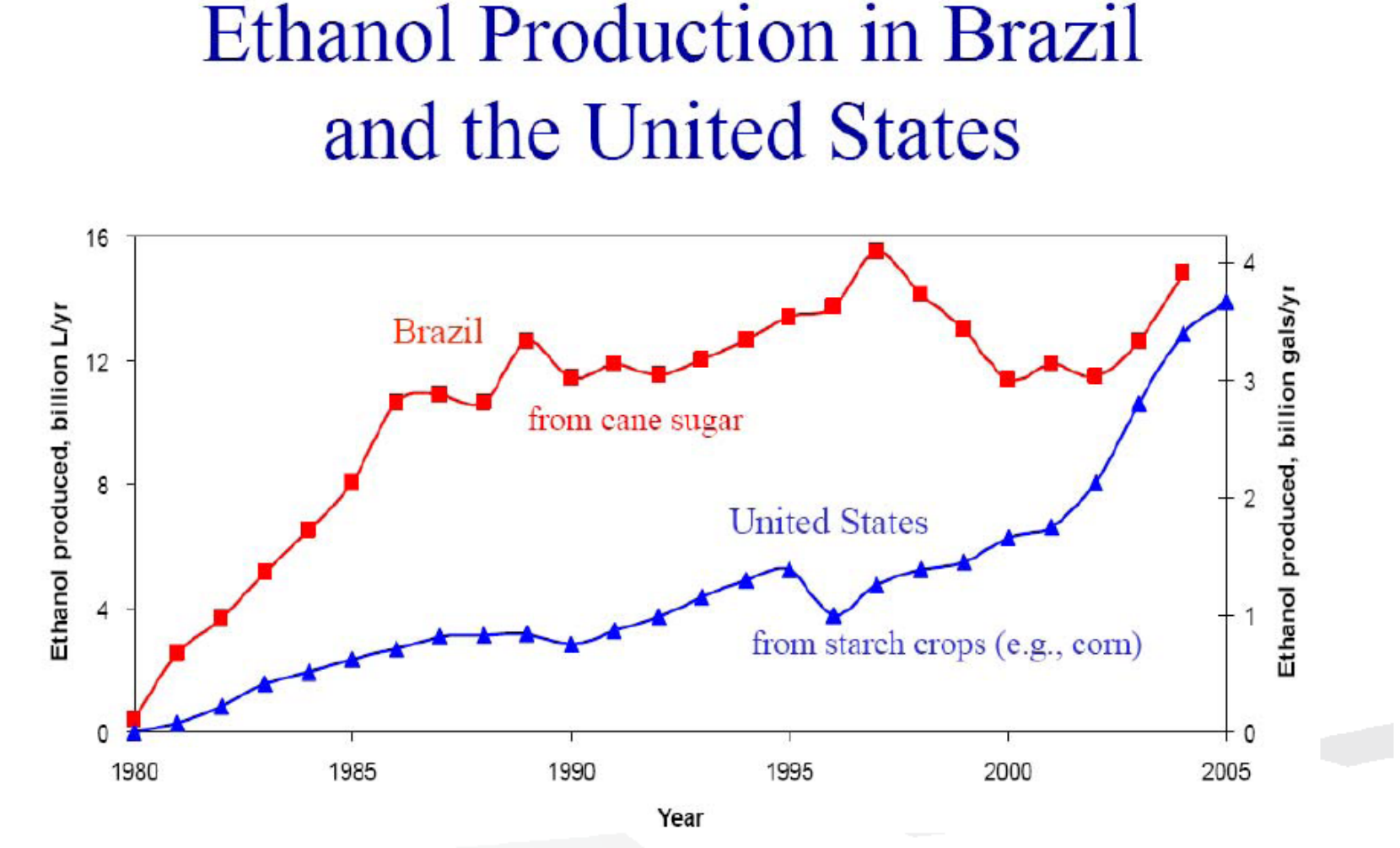
Billions of Gallons

	U.S.	California
Gasoline	**140**	**16**
Ethanol	**4 ***	**1**

**** 2.86% exceeds RFS "collective liability" for 2006 of 2.78%***

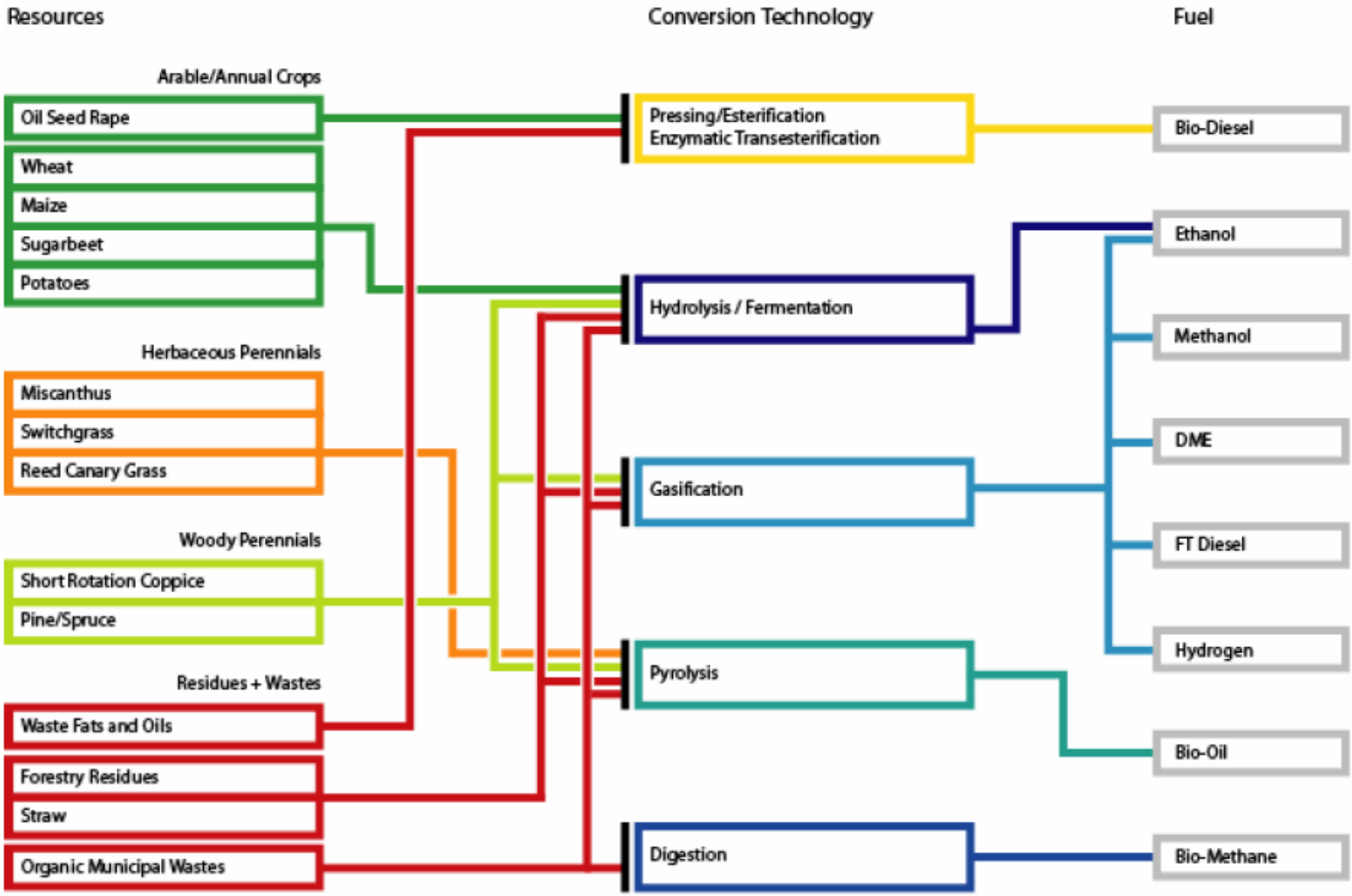
Acres of Corn Planted, 2006	**79,400,000**
Portion of U.S. corn production in ethanol production	14%
Acres in ethanol Production	11,300,000
Ethanol Production, *billions of gallons*	4.05
Average gallons per acre	**364**

Biofuel Growth Trends



Source: Charles Wyman, 2005

Possible Advanced Biofuel Pathways



Ethanol in California

- Demonstrations of E90 and E85
  - Volkswagen Rabbits and Pickup trucks- 1981
  - Fueling Stations
- Fuel Flexible Vehicles Production-Fleets
- Fuel Flexible Vehicles Production-Retail
- As a Gasoline blend stock- replacing MTBE
  - Currently @ 5.7% volume
- E85 and Petroleum Reduction

June 15 Ethanol Forum and Technical Roundtable Format

Morning:

- Technical Forum with 11 presentations

Afternoon

- Panel Discussion
  - Moderator
  - Each panelist allowed to raise questions

➢ Vigorous audience participation

➢ 90 + total attendance

Participants

- Auto industry
- Oil industry
- Ethanol industry
- ARB
- Technical experts
- General Audience

ETHANOL:

LOW LEVEL BLENDS

(i.e., 5.7% by volume)

Low Level Blend Issues	Findings
▪**Permeation**	✓Significant in near term and in out years: estimated HC increase in SCAB: 26 tpd (2005) and 14 tpd (2020) ✓Permeation emissions double for each 10^{o}C ✓No known retrofit technology ✓ARB will incorporate in Predictive Model ✓Full mitigation may require more than fuel strategies
▪**Predictive Model Accuracy / Robustness**	✓Current data set is heavily skewed with old vehicle and fuels data ✓New data on ULEV and SULEV show complicated interaction between gasoline volatility and ethanol ✓Update should make sure science is right—model can have big effect on emissions as well as economic viability of reformulated gasoline ✓10% ethanol blends do not look favorable with new data
▪**Mitigation strategies**	✓ARB required by state law to ensure control measures do not increase emissions—permeation increases emissions from reformulated gasoline control measure ✓ARB will evaluate both fuel and non-fuel strategies to mitigate emission increases ✓Predictive model could provide fuel strategy if resulting reformulated gasoline is economic ✓Summertime zero ethanol policy is non-fuel strategy but would not be favored by refining or ethanol industries
▪**CO / HC tradeoffs**	✓Ethanol industry suggests that HC increases are fully offset by CO reductions ***if CO reactivity is adjusted as proposed by the ethanol industry.*** ✓ARB is updating its analysis and the predictive model but do not expect for CO ***reactivity*** to completely offset permeation increases
▪**Commingling**	✓Blending of ethanol in non-ethanol blends recognized as a problem and could have been partially responsible for SCAB's high ozone in 2003
▪**Certification test fuel**	✓Current gasoline certification based on MTBE (Phase 2) hence reason for permeation surprise ✓Auto manufacturers view any change in certification as major ✓Phase 3 gasoline use could affect PZEV certification
▪**Greenhouse Gas Benefits**	✓Corn-based ethanol at best only provides marginal benefits ✓Cellulosic feedstocks offer major GHG benefits

Issues Discussed at AQMD Ethanol Forum

- Need for near-term permeation emissions relief
- Long term summer oxygenate policy options
- Summertime commingling of E-0 with E-5.7 blends
- Role of E-85 and FFV's
  - **Status of Enhanced Vapor Recovery**
- Biofuels Executive Order implementation
- Vehicle certification with Phase 3 gasoline
  - **Rather than with 11% MTBE (i.e., phase 2 gasoline)**

✓ **AQMP revisions to attain / maintain NAAQS**

✓ **Renewable / sustainable transportation fuels**

Next Steps in the Process

- **Summary of Workshop prepared by Tiax**
- **Distribute to participants & the public**

<u>Issues Still Needing Attention:</u>

- **Permeation emissions impact finalized**
- **Predictive Model revisions**
- **Short-term mitigation strategies**
- **Long-term AQMP policy direction**
  - **Low level blends**
  - **E-85**

Overall SCAQMD Perspective

- **Concerns about permeation effects of low level blends**
- **Concerns about commingling effects in E-85 Flexible Fuel Vehicles**
- **Significant challenge to attain 8-hour ozone and PM 2.5 standard**
- **Better data needed on ethanol impacts**
- **AQMD has an open mind**
  - ***Policy issues will be assessed in the context of the upcoming 2007 Revision to the AQMP***

ETHANOL:

Fuel Ethanol

(i.e., E-85 or 85% by volume)

E85 FFVs in California

- Estimated 250,000 FFVs now
- Future FFV production for California?
- E85 Fueling Stations- 1 Retail, 3 total
- Business Case and EVR Certification

Key Issues for E85

- **Enhanced Vapor Recovery Certification for Fuel Stations**
- **Securing a Competitively Priced Fuel Supply**
- **FFV California Emissions Certification**
- **In-state Ethanol Production-grain & cellulose**
- **Business Case for E85 Stations**
- **FFV Developments - Hybrids and PZEVs?**

6 Fundamental Questions:

- ✓ How fast can OEM's certifiy to P-ZEV to keep FFV's salient as "cutting edge" for emission reductions?
- ✓ What will it take for Ford and DC to be encouraged to re-introduce FFV's in California ?
- ✓ What is needed for cellulosic ethanol production to evolve from pilot scale plants (*such as Iogen in Ottawa, Canada*) to pre-commercial scale and ultimately to full scale, within California?

6 Questions…. (cont.)

- ✓ **What are the near-and medium term economics of E-85?**
- ✓ **What strategies are feasible to ensure that for at least a 10 year ramp-up period, the oil companies do not undercut E-85 retail price competitiveness the way they did with M-85?**

Issues Raised at SCAQMD Ethanol Forum re: E-85

- **Availability of Vapor Recover**
- **FFV use of commingled fuel**
- **Ethanol exhaust reactivity**
- **In-use emissions verification**
- **Permeation emissions**
- **OEM availability**
- **Prices**
- **Supply Availability**
- **Technology Optimization**

BIODIESEL:

e.g.

B-2, B-20, B-100 etc


Soy Bean
Oil
Soy Bean
Methyl Ester
Cooking Oil
Cooking Oil
Methyl Ester

SCAQMD Biodiesel Policies

- Need to specify composition / source
- Initial focus: agricultural uses
- Focus on blends ≤ 20%
  - *start with lowest blends of 2 to 3%, etc.*
- Need for no net increase in NOx
  - *NOx reductions achieved concurrently*
- Need to better test data
  - D*iversity of engines, test cycles, durability etc.*

Feedstocks for Biodiesel

Vegetable Oils and Animal Fats

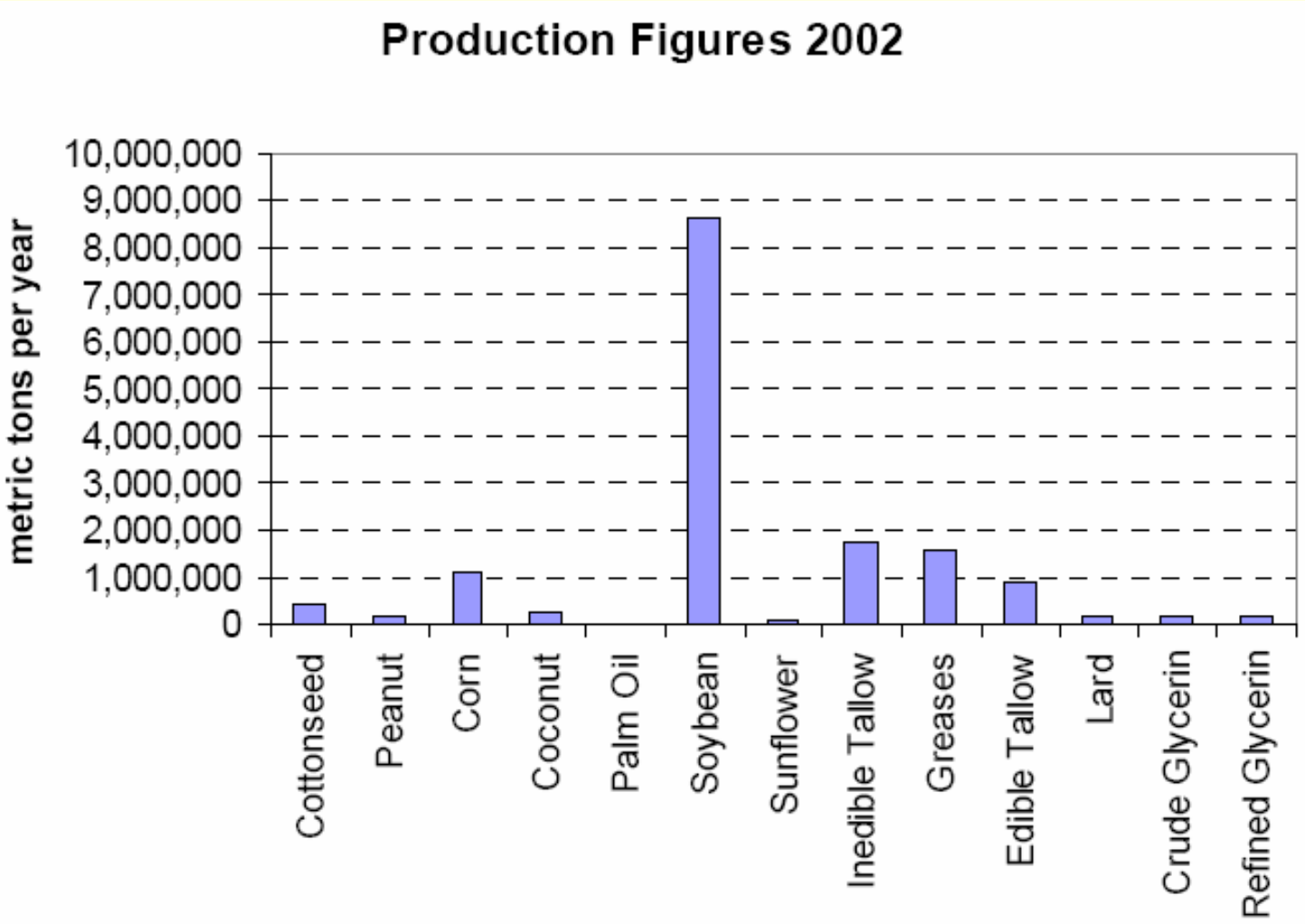
- Soybean
- Canola / Rape Seed
- Sunflower / Safflower
- Corn
- Mustard Seed
- Cotton Seed
- Palm Seed / Palm Kernel
- Coconut
- Beef Tallow
- Others

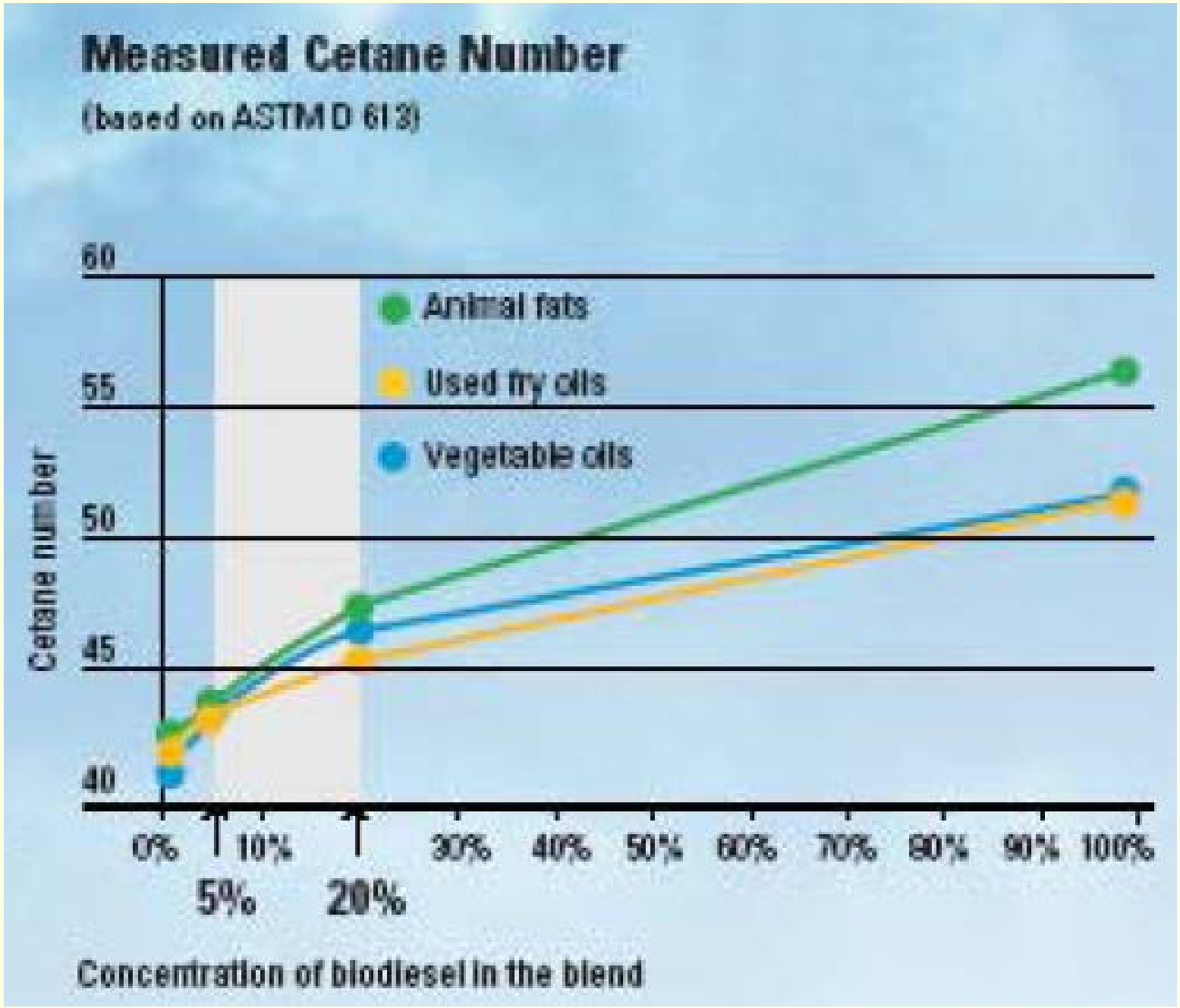
Biodiesel Commercialization Trends:

- World Energy current largest US biodiesel producer
- Total of 19 million B100 gallons in 2004
- 50 million gallons projected in 2005
- CA usage of B100 $\approx$ 2 million gallons for 2005
- Strongest users: US military fleets
- Not a compliance option under AQMD fleet rules
- Neste Oil (Finland) – 2nd generation: 84 – 99 cetane
- Most effective incentives:
  - blender incentives & excise tax relief

Production Figures 2002

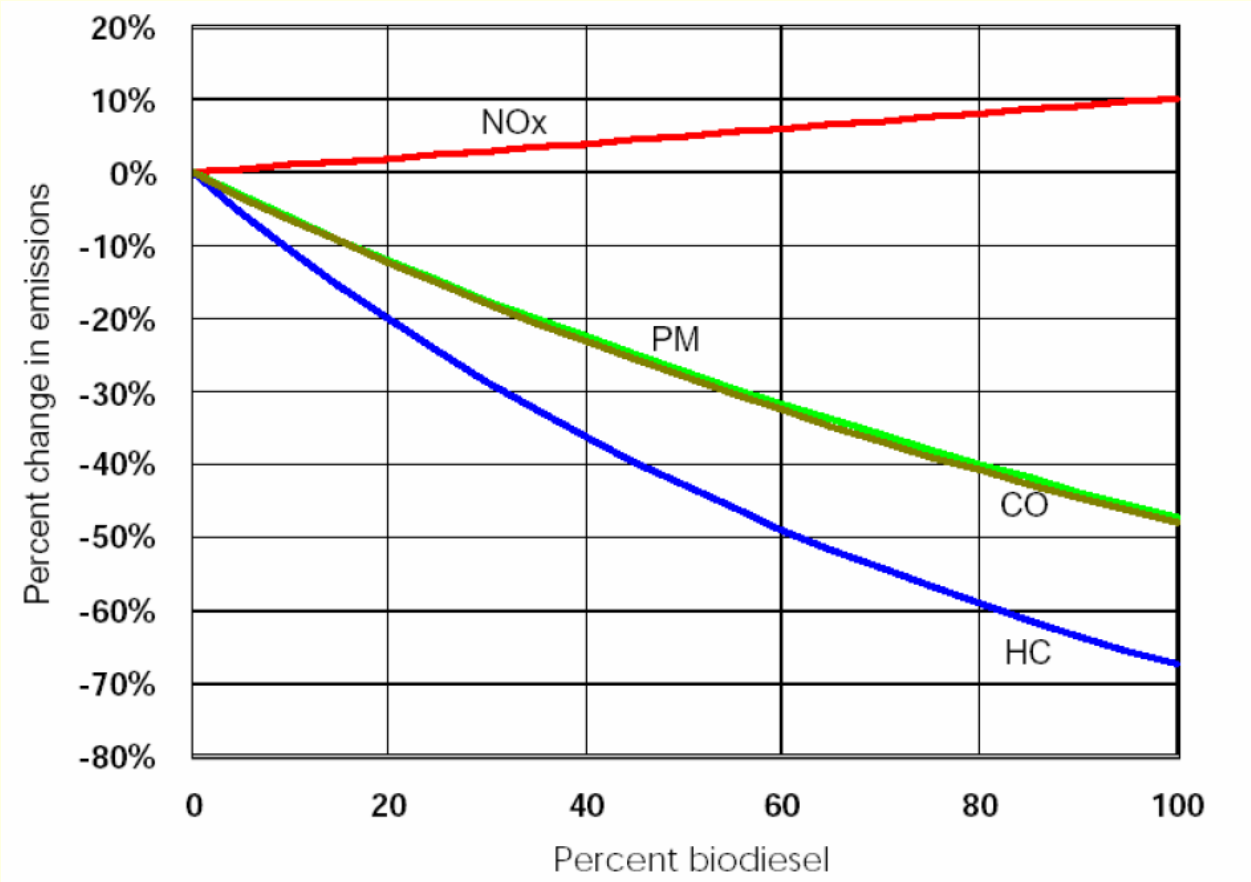
Of Oils and Fats in the US




Measured Cetane Number
(based on ASTM D 613)
60
55
50
45
40
Cetane number
Animal fats
Used fry oils
Vegetable oils
0%
10%
30%
40%
50%
60%
70%
80%
90%
100%
5%
20%
Concentration of biodiesel in the blend

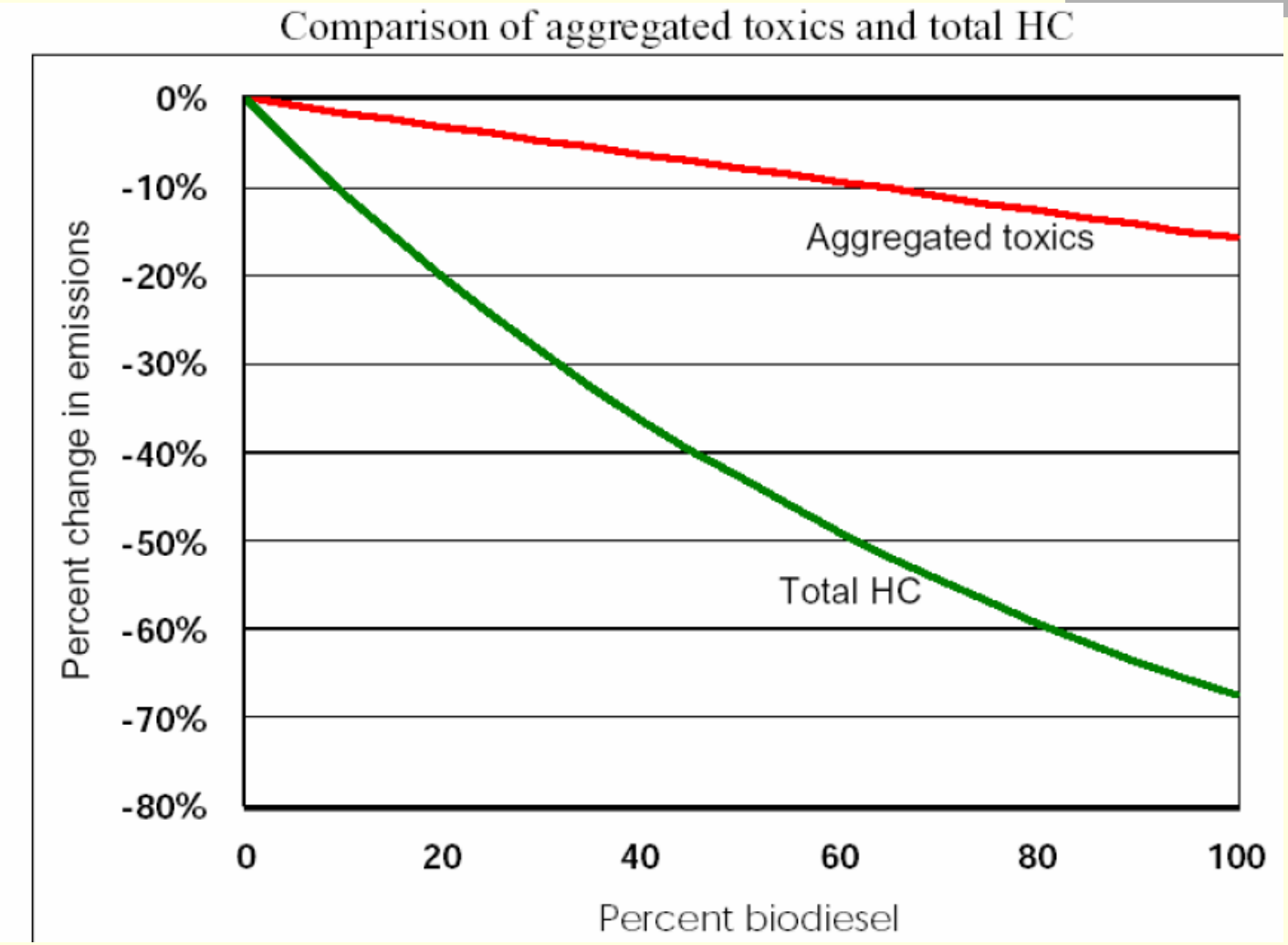
EPA Engine Test Results - 2002

	PM	NOx
B-5	- 5%	uncertain
B-20	- 12%	+ 2% +/-
B-100	- 48%	+ 10% +/-



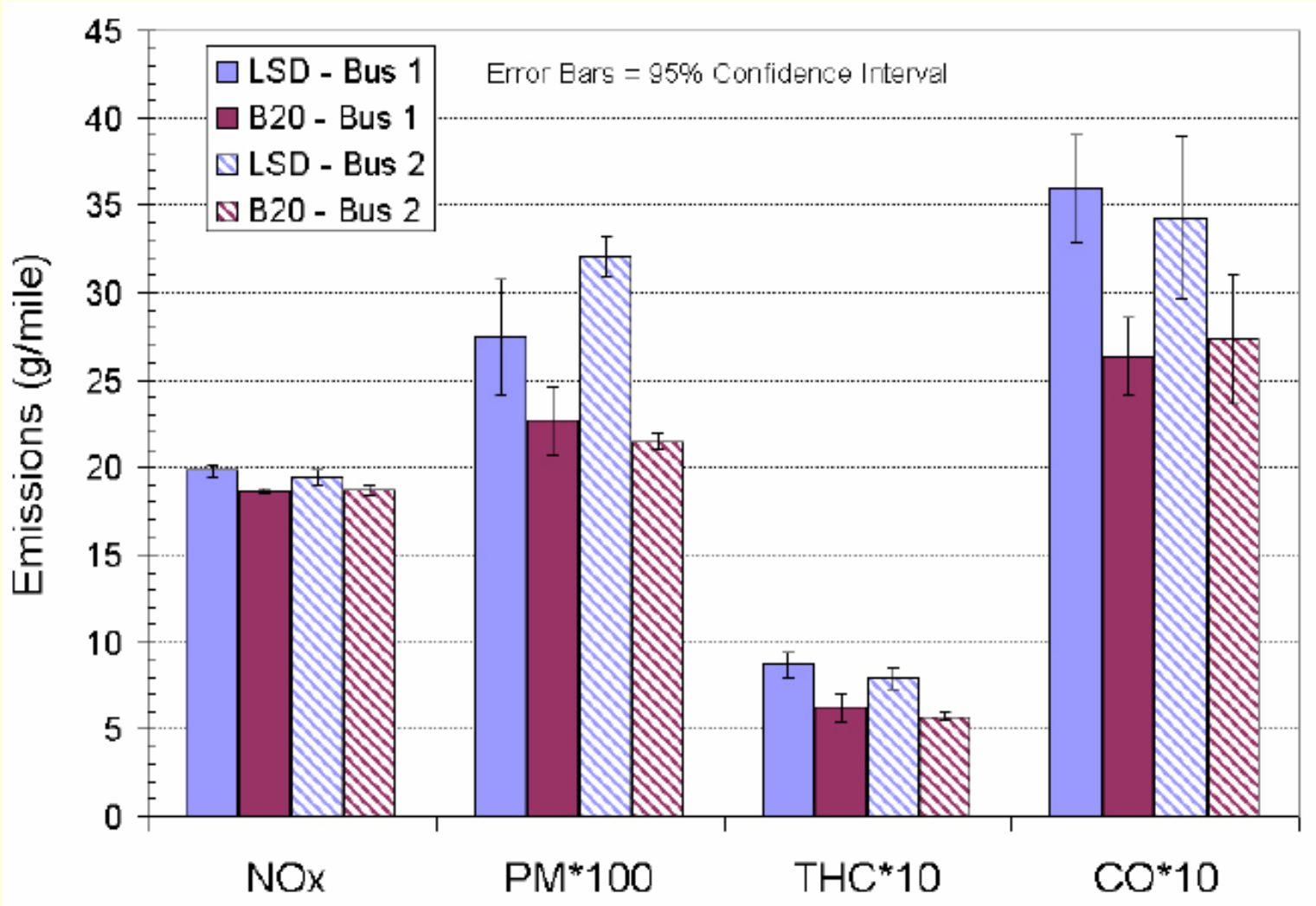
Reduction in HC + Toxic Emissions

Based on EPA 2002 Test Data



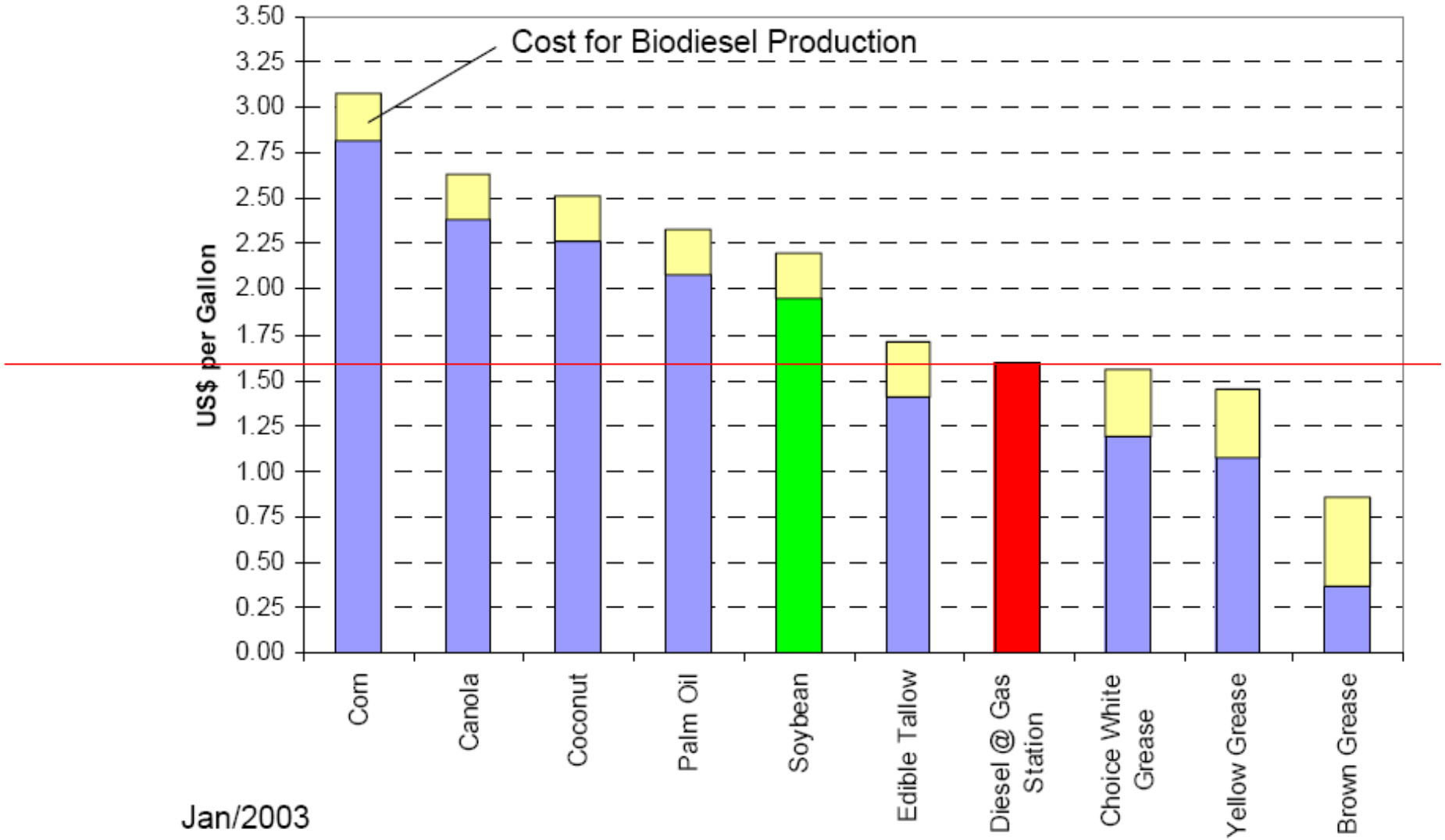
NREL Chassis Test Data – B-20 *vs* Diesel

2 Buses – May, 2005 – "Suburban" test cycle



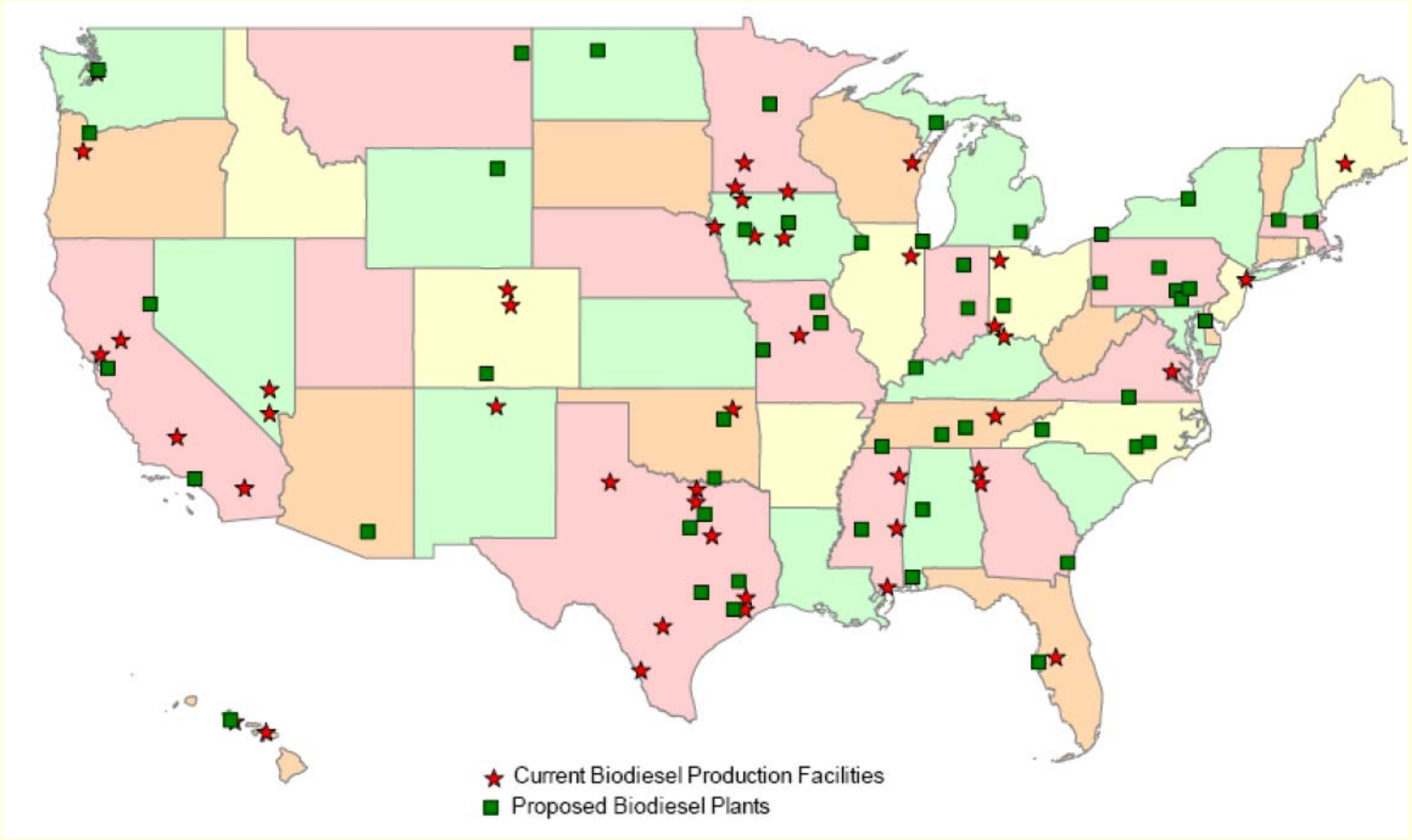
Raw Material Costs per Gallon

Benchmark: Petroleum Diesel Without Subsidies



Current and Proposed Biodiesel Production Plants

September 2005



Market Development Issues:

- Feedstock reliability / blending homogeneity
- Consistency of Product Formulation
- Blend level policy
  - < 2% ?
  - ≤ 5% ?
  - ≤ 20% ?
- Oxidative Stability
- Gumming potential
- Engine Durability
- Effects on Warranties *(OEM + retrofit devices)*
- In-use off-cycle effects
- "Unintended consequences": Multimedia Review
- Effect on Fuel Economy