

Biofuels: Unlocking the Potential

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International Symposium
on Biofuels

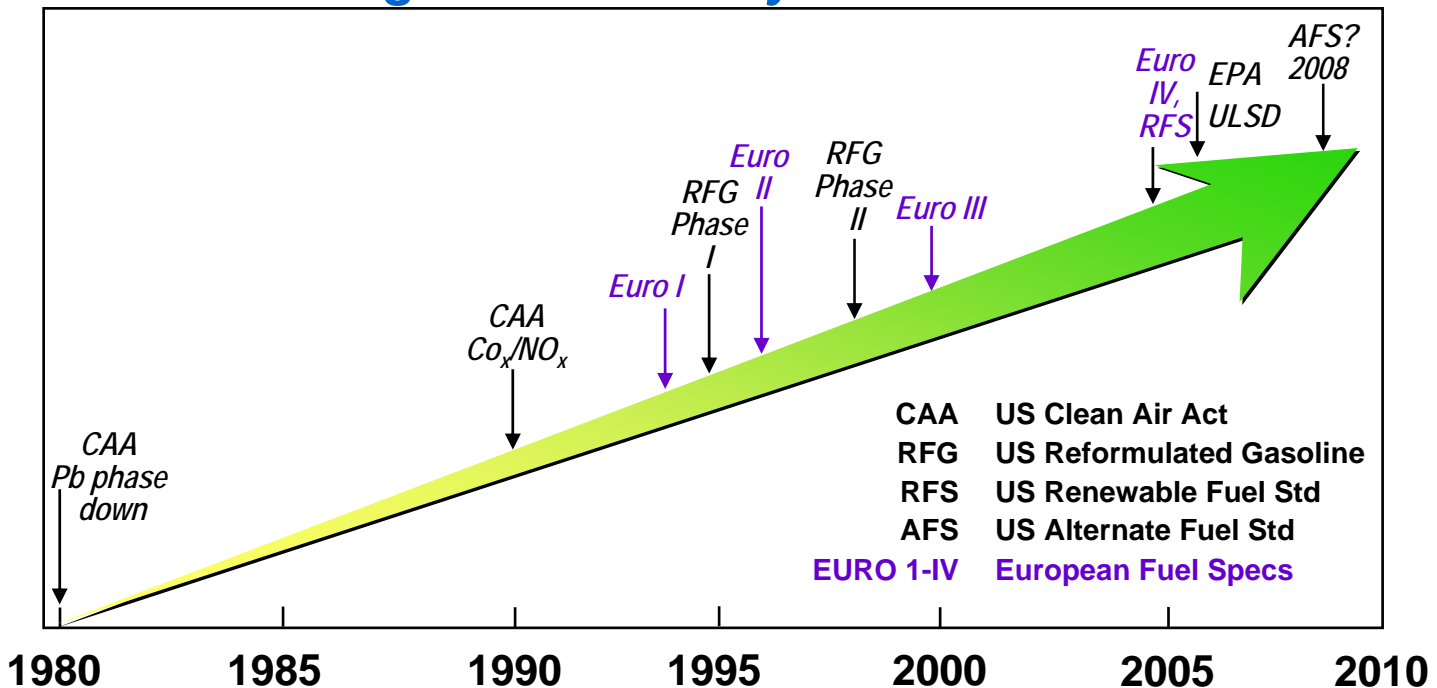
September 25-26, 2007
New Delhi, India



Primary Energy & Biofuels Growth: 2004 to 2015

- Primary Energy Growth - 1.7-2.5%/yr
- Biofuels Growth - 15.1%/yr
- Government legislation drives biofuels growth

Clean Fuels: US/EU Legislative History



*Refining Community and UOP have delivered
on the promise of clean fuels*

Together we are well positioned to meet the biofuel challenge

Emerging Issues

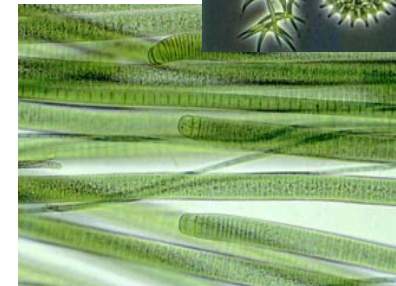
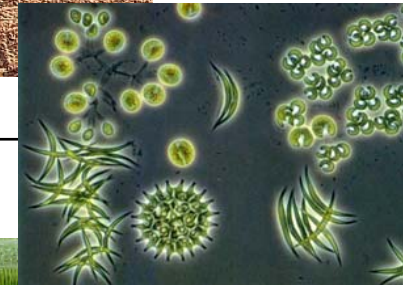
Food supply: small impact on the fuel market, yet large impact on food supply



Land and water: competition for land and water resources that are already in high demand



Environmental: loss of biodiversity, soil erosion, nutrient leaching, soil and water pollution and deforestation



Second generation development can ease these issues

Fuel Additives / Blends

Ethanol

Biodiesel

Fuels

Diesel

Petrol

UOP's Bio-Fuels Technology Goals

Identify and utilize processing, composition, and infrastructure synergies to lower capital investment, minimize value chain disruptions, and reduce investment risk.

Inedible Oils: Jatropha

Generation 1

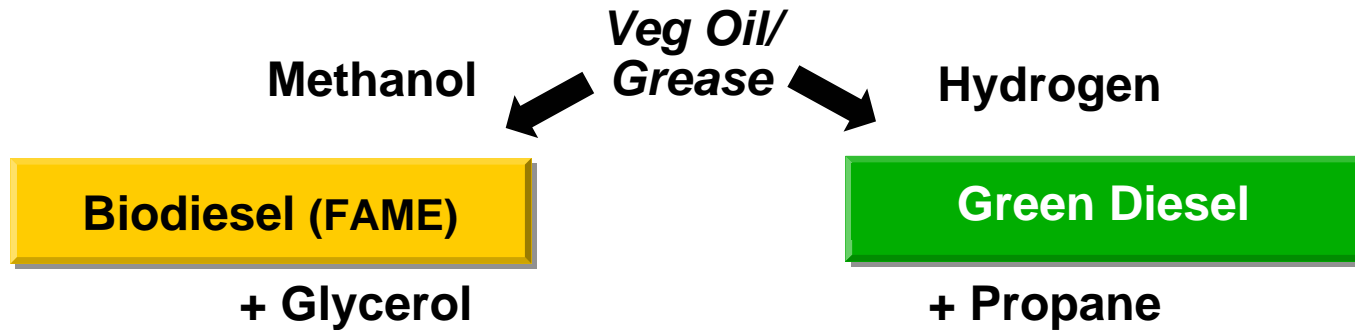
- Vegetable oils to diesel, petrol and jet fuel



Generation 2

- Lignocellulosic biomass to fuels
- Algal oils to fuels

Green Diesel vs. Biodiesel (FAME)



	<i>Petro-Diesel</i>	<i>Biodiesel (FAME)</i>	<i>Green Diesel</i>
NOx Emission	Baseline	+10	-10 to 0
Cetane	40-55	50-65	75-90
Cold Flow Properties	Baseline	Poor	Excellent
Oxidative Stability	Baseline	Poor	Excellent

- Green diesel can be transported via pipeline and used in existing automotive fleet
- UOP/Eni Ecofining™ for green diesel production commercial start-up in 2009
- Technology is extensible to the production of jet fuel

Achieving Sustainability

- **Second generation feedstocks, cellulosic waste and algal oils, have the potential to make significant contributions**
- **Technology breakthroughs are required**
 - **Biomass collection and densification**
 - **Conversion of lignocellulosic waste**
 - ◆ Biochemical platform
 - ◆ Thermochemical platform
 - **Algal oil growth, harvesting and oils extraction**
- **Inedible oils such as Jatropha can provide a bridge between 1st generation and 2nd generation biofuels**
- **Technology neutral and performance based standards will prevent standardization of old technology**

