Defining sustainable biofuels
or, "It isn't easy being green"

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The idea of sustainability

“Sustainable development meets the needs of the present without compromising the needs of the future generations.”

UN Commission (1987)
The idea of sustainability

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The idea of sustainability

“The common aim must be to expand resources and improve quality of life for as many people as heedless population growth forces upon Earth, and do it with minimal prosthetic dependence. That, in essence, is the ethic of sustainable development.”

E.O. Wilson, *Consilience*
Tackling the sustainability of biofuels

Life cycle analysis
A directional system-wide perspective

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Expanding resources

The infamous net energy balance

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Expanding resources

Ethanol and fossil energy use
Tackling the sustainability of biofuels

Expanding resources

Biodiesel and fossil energy use
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Expanding resources

Biofuels and petroleum

Leveraging petroleum usage with biofuels

Petroleum energy consumed per unit of fuel energy produced

- Gasoline/Diesel: 1.2
- Corn Ethanol: 0.15
- Biodiesel: 0.05
- Cellulosic Ethanol: 0.05

Fossil energy investment breakeven point

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The Earth
Ethanol and Greenhouse Gases

Greenhouse Gas Emissions (gr CO2 per mile on E85)

- Corn Stover: 75 gr CO2 per mi
- Wood: 110 gr CO2 per mi
- Grass: 130 gr CO2 per mi
- Corn Grain: 350 gr CO2 per mi
- Gasoline: 470 gr CO2 per mi

Includes greenhouse gas emissions from the 15% gasoline portion of the E85 fuel

GHG from 15% gasoline portion: 99 gr CO2 per mi

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The Earth

Biodiesel and Greenhouse Gases

![Bar chart comparing Diesel and Biodiesel emissions]

- Diesel: 633 units
- Biodiesel: 136 units
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Land resources
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Land resources

“EU did not foresee the problems raised by its policy to get 10% of Europe's road fuels from plants.”
BBC News January 2008
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The effect of land use change on greenhouse gas emissions of biofuels
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Water resources

Can we afford 5 gallons of water per gallon of biofuels?

“The Future Is Drying Up”
The New York Times Magazine
October 2007
Ethics and the sustainability of biofuels

E.O. Wilson, *Consilience*
Ethics and the sustainability of biofuels

Quality of life
The tortilla effect

“Thousands in Mexico City Protest Rising Food Prices” The New York Times
January 2007
Ethics and the sustainability of biofuels

Quality of life
The brewery effect?

“Biofuel brews up higher German beer prices”
Associated Press, May 2007

“Hops shortage coming to a head”
Rocky Mountain News, January 2008
Ethics and the sustainability of biofuels

Quality of life
Developing countries’ developing demand

The Food Chain: A Global Need for Grain That Farms Can't Fill
The New York Times
March 2008

Nigerian appetite for grain
Ethics and the sustainability of biofuels

“We need an LCA process that addresses all sustainability issues and is accepted worldwide”

Paraphrased from talk by Dean Sимерoth, CARB, commenting on hurdles facing implementation of a low carbon fuel standard in California
Ethics and the sustainability of biofuels

LCA as a framework for dialogue

Defining Sustainable Biofuels 21
Ethics and the sustainability of biofuels

“Let us engage in the serious business of conducting our discussion rationally and logically to discover the truth about points on which we differ.”

—Mortimer J. Adler