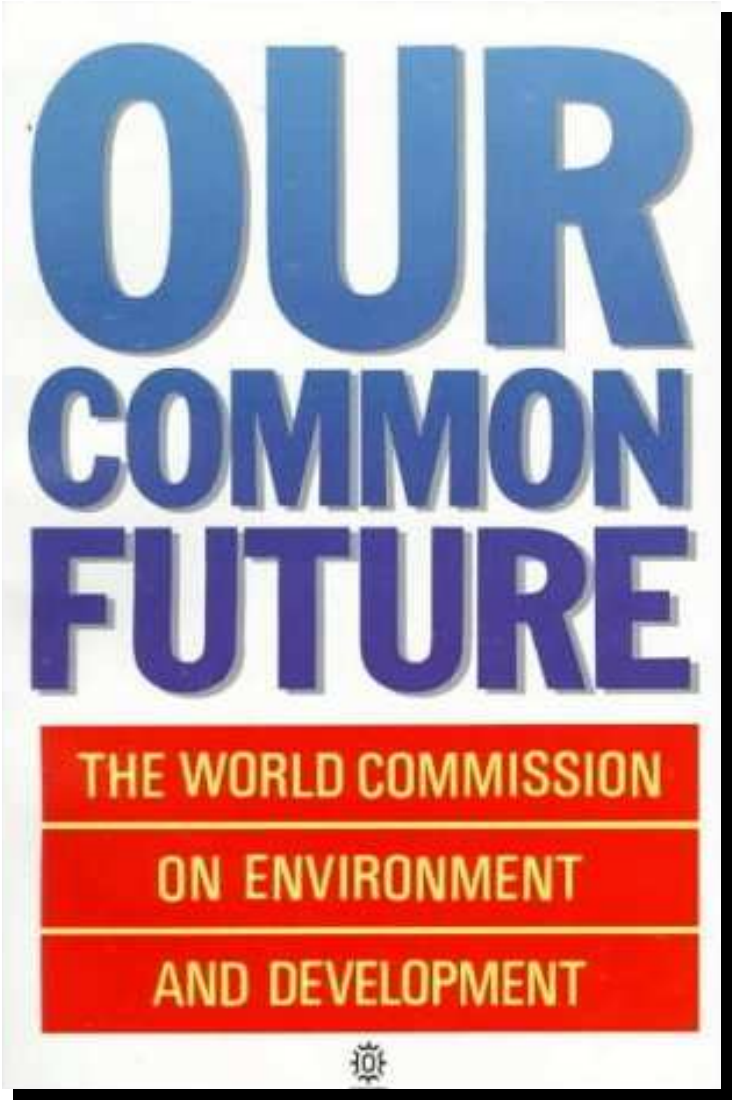
Sustainable biofuels

John Sheehan

INSTITUTE ON THE
ENVIRONMENT

The idea of sustainability

"Sustainable development meets the needs of the esent without compromising the needs of the future generations."
UN Commission (1987)



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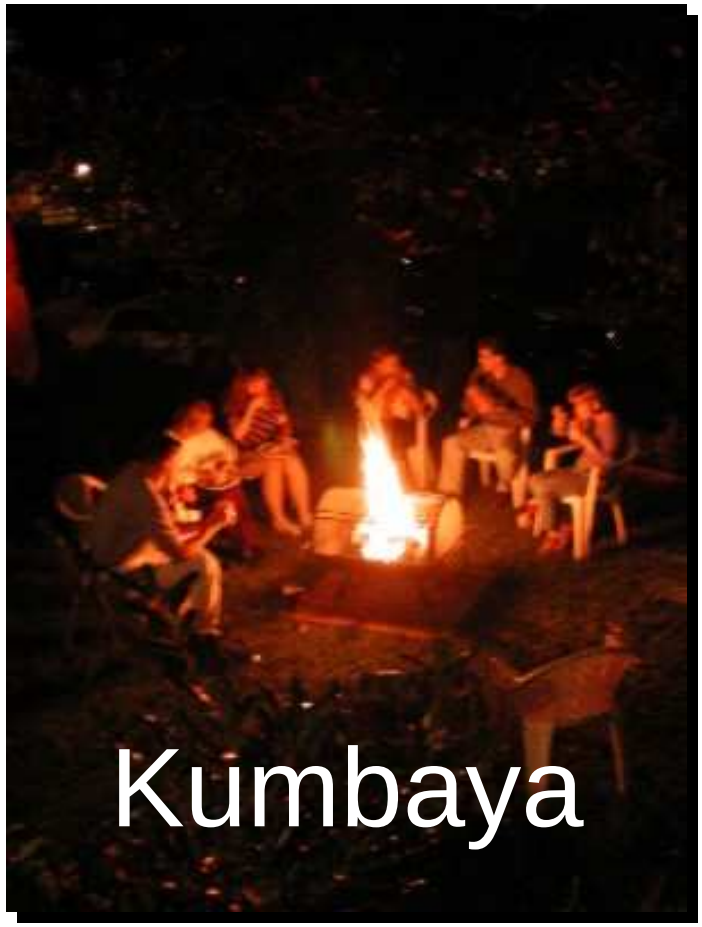
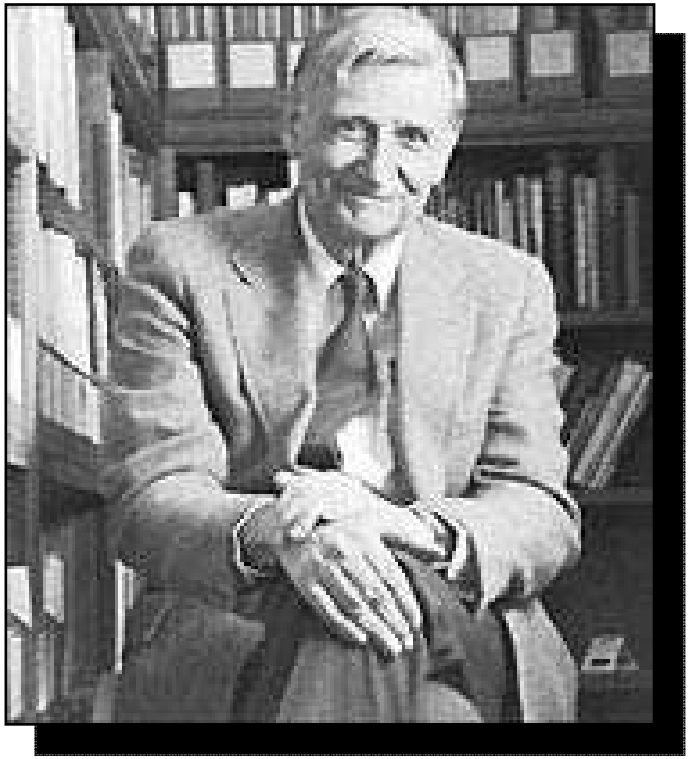


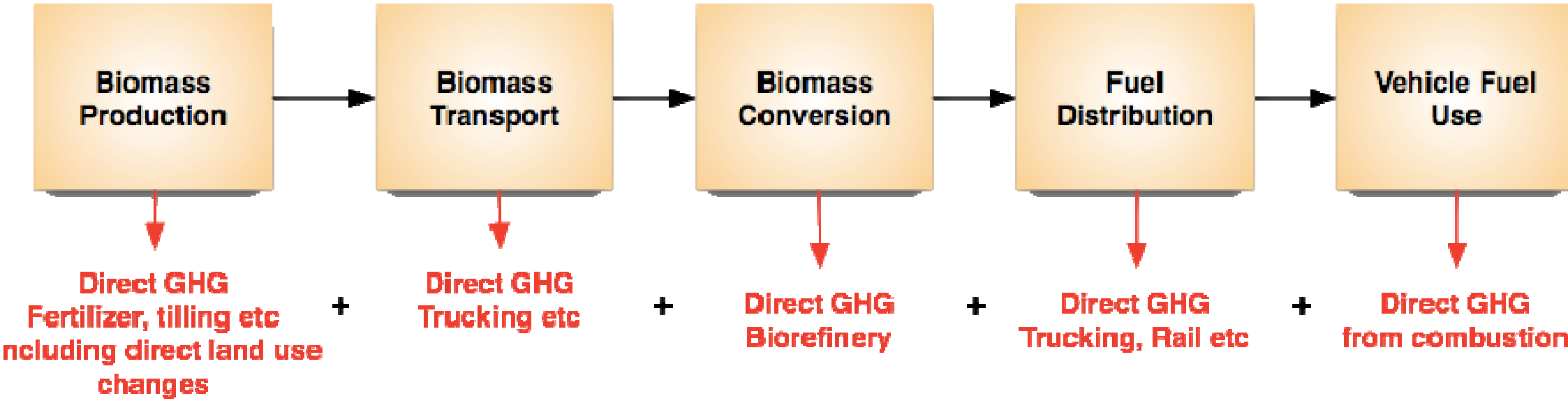
The buzz saw of sustainability

The idea of sustainability

he common aim must be to expand esources and improve quality of life for as many people as heedless opulation growth forces upon Earth, and do it with minimal prosthetic pendence. That, in essence, is the ethic of sustainable development."

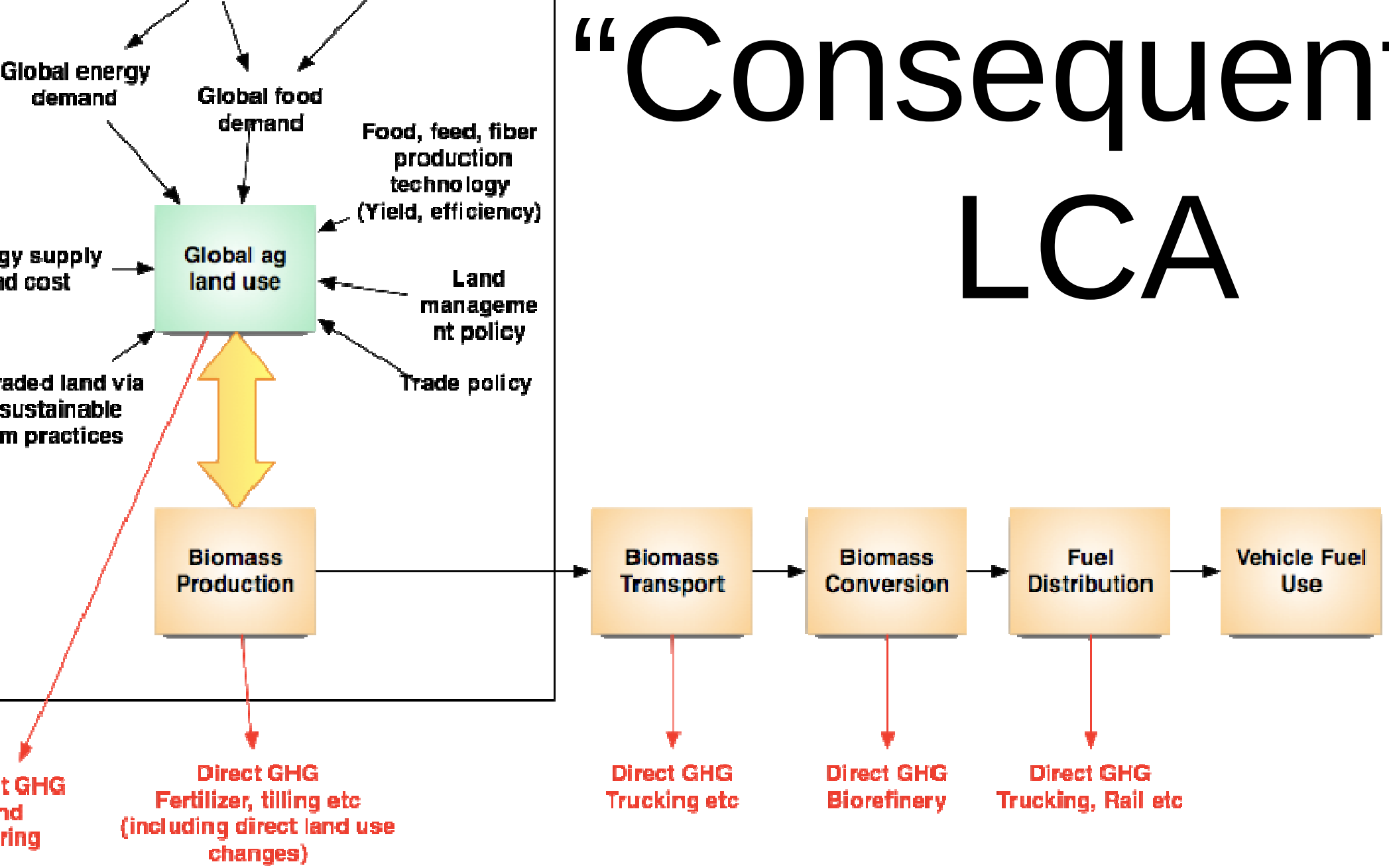


Attributional LCA

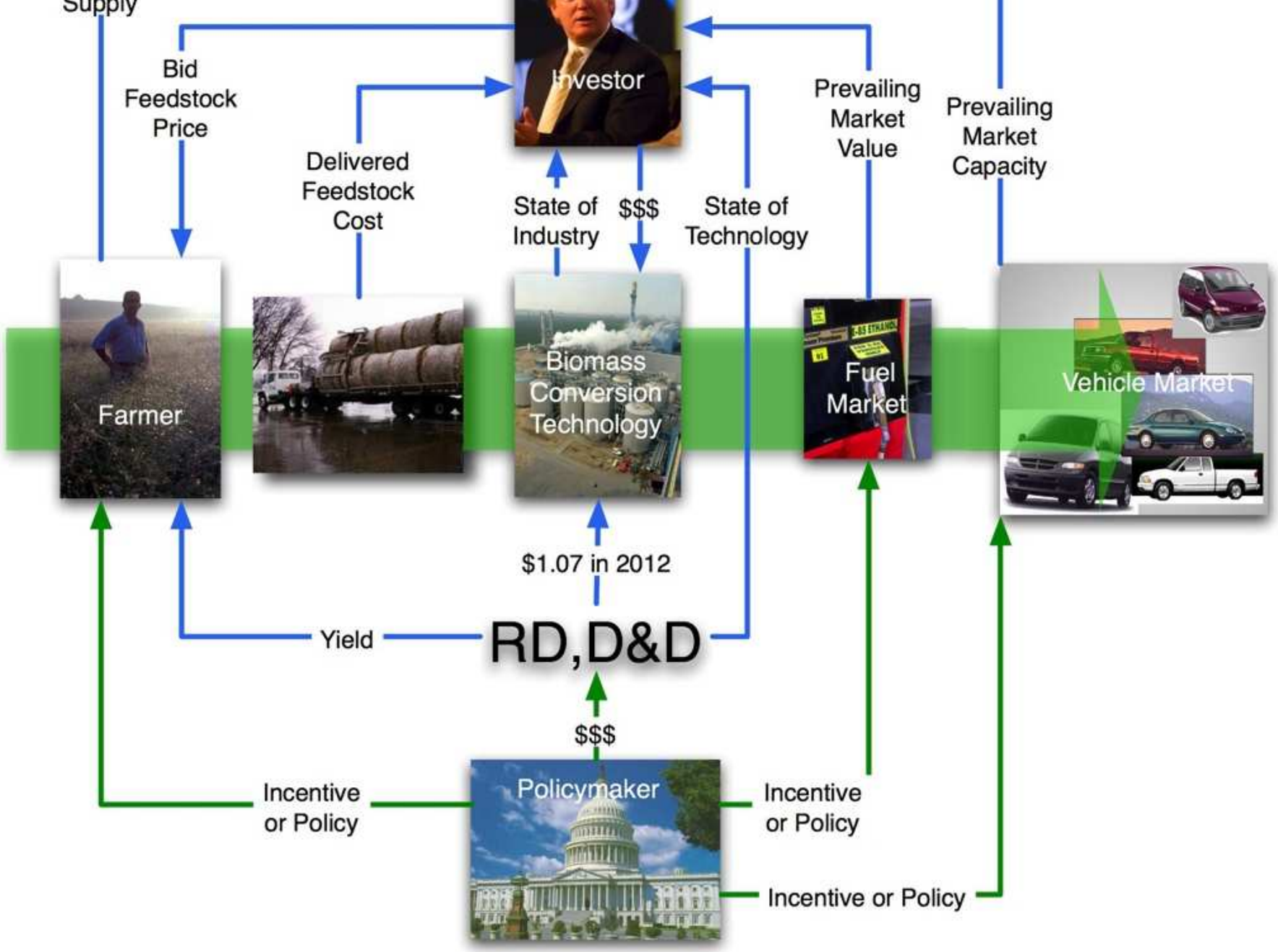


A systems view

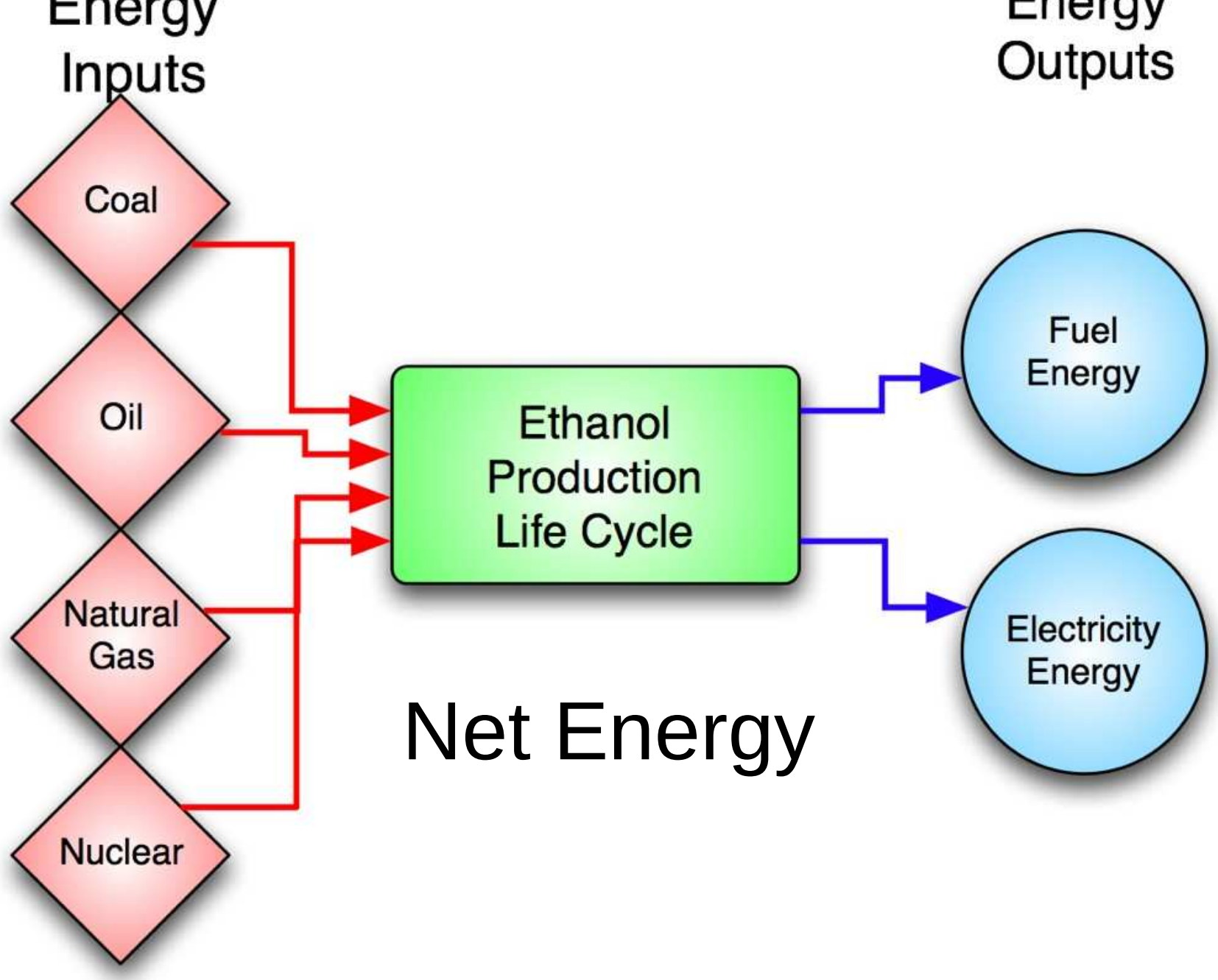
“Consequentia LCA



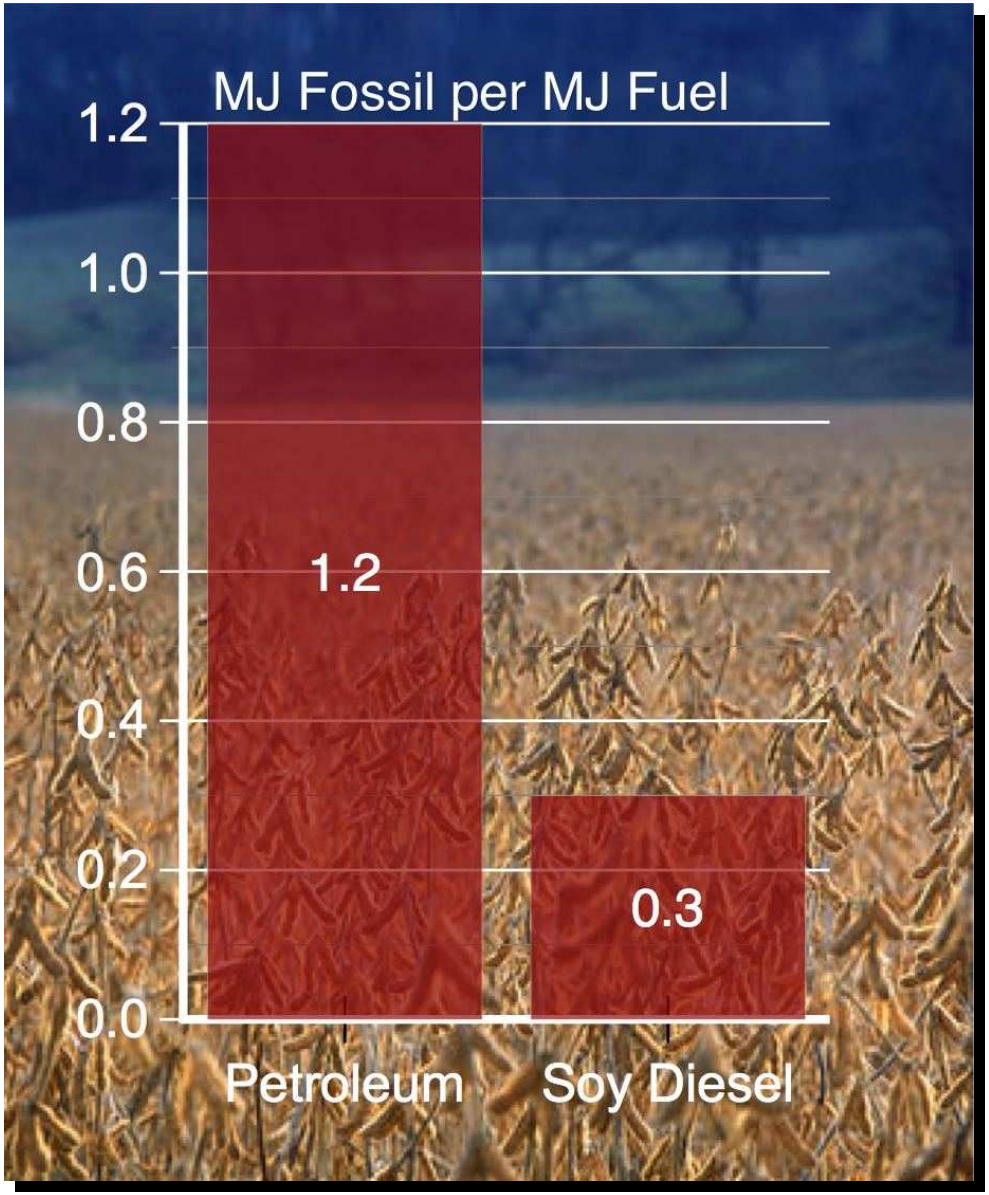
A systems view



A systems view

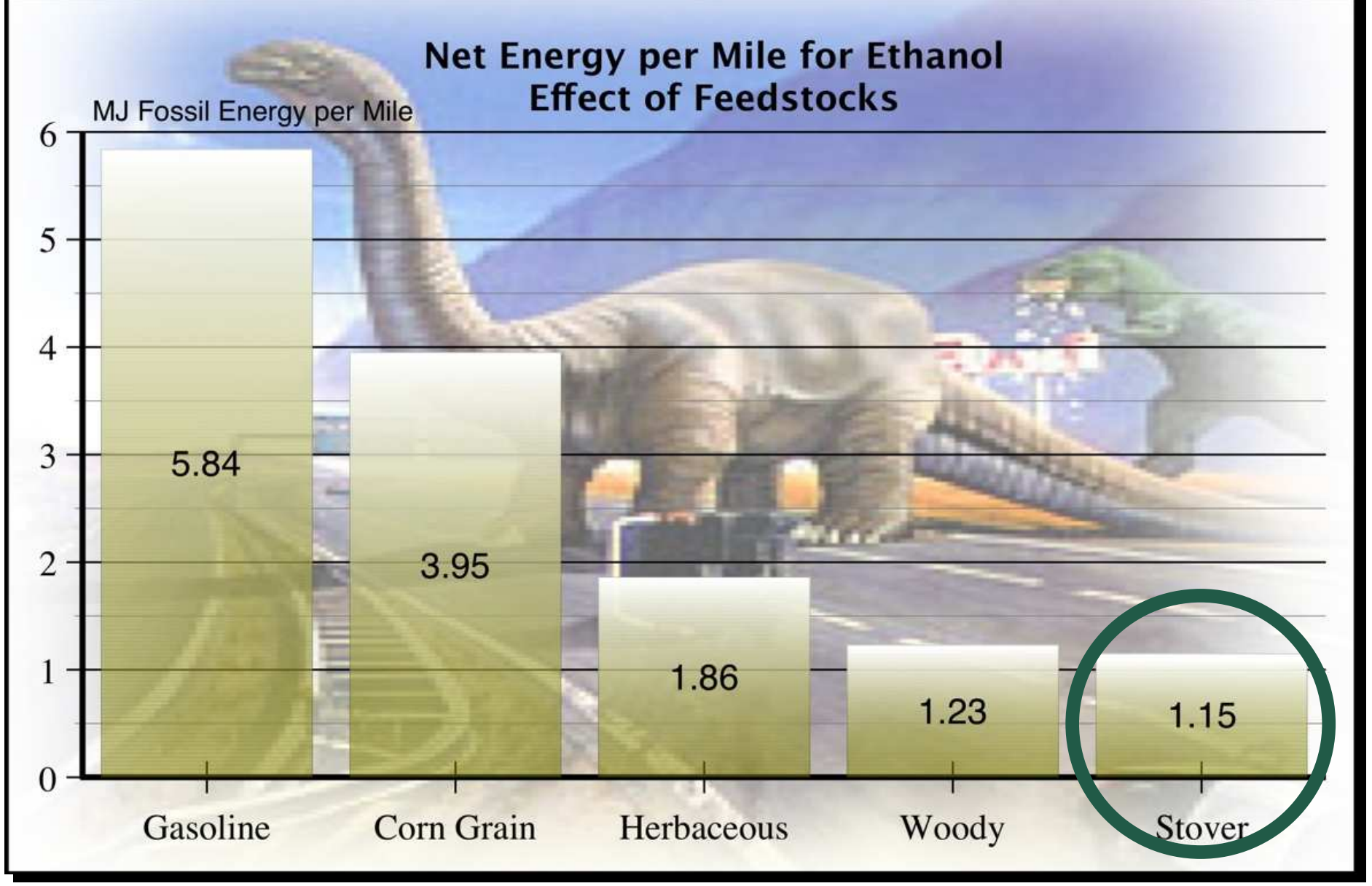


Expanding resources



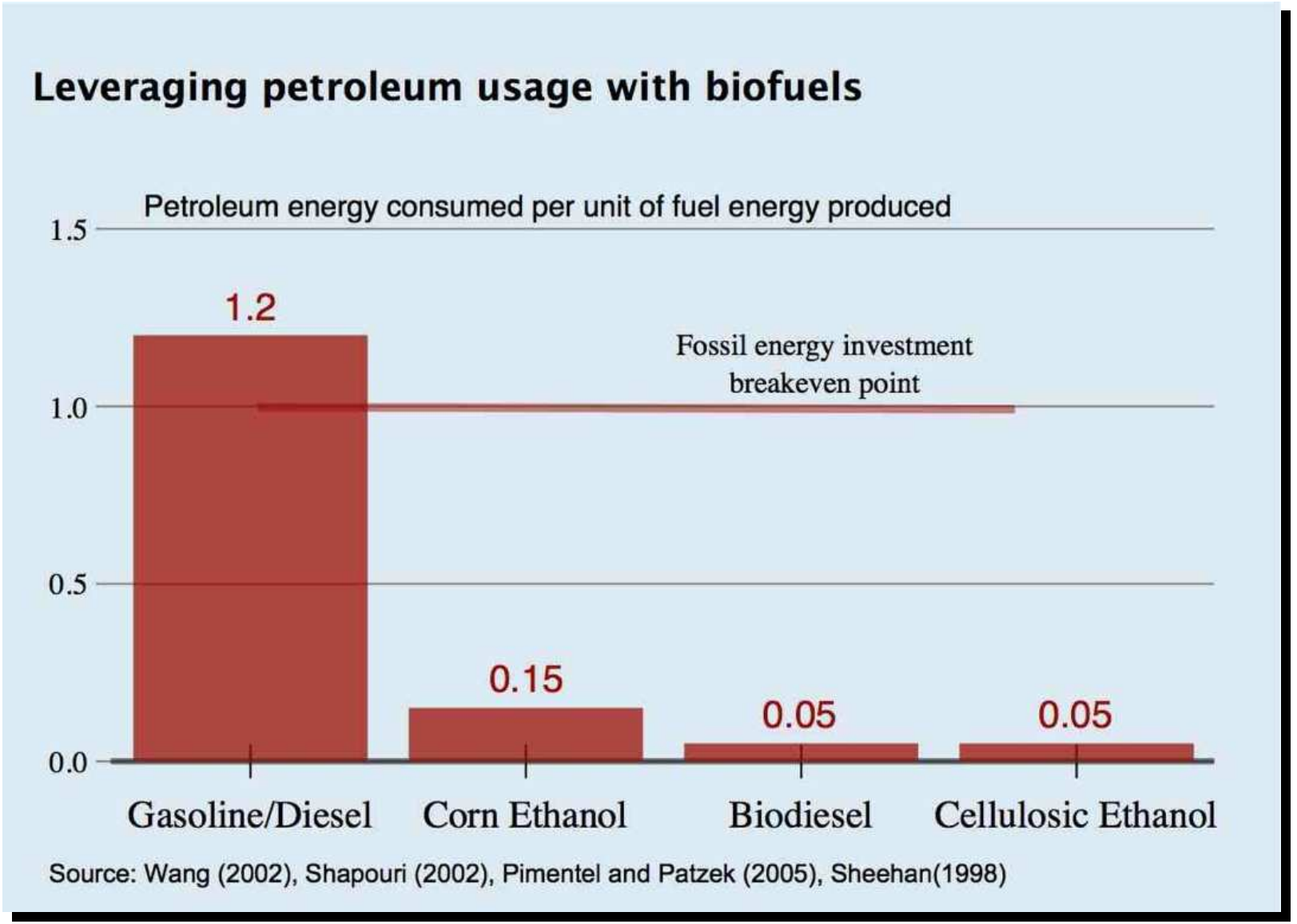
4 to 1 fossil energy balance

Biodiesel



4 to 1 fossil energy balance

Ethanol



Petroleum savings

“EU did not foresee the problems raised by its policy to get 10% of Europe's road fuels from plants.”BBC News January 2008

Land

“The Future Is Drying Up”

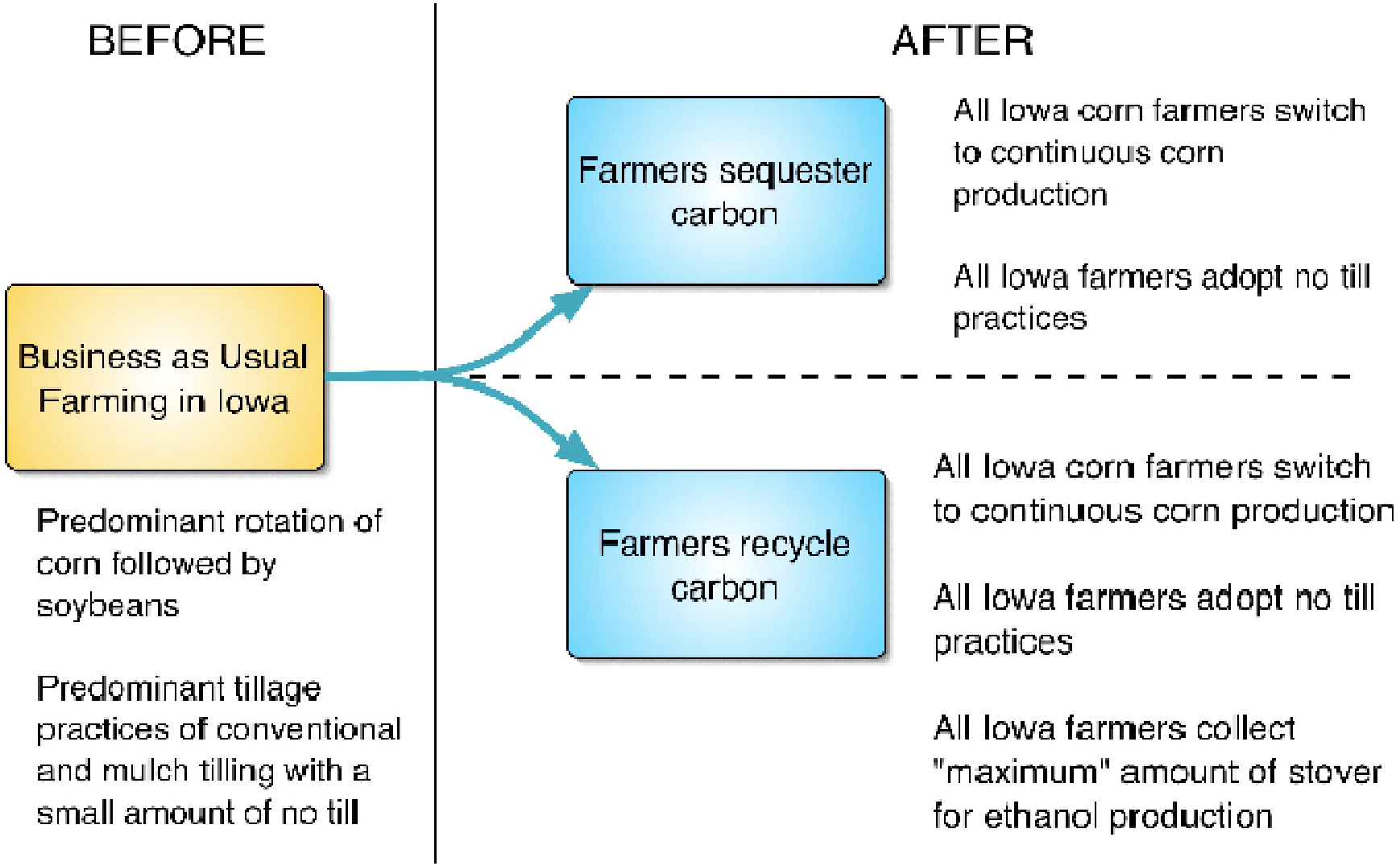
The New York Times Magazine

October 2007

Water

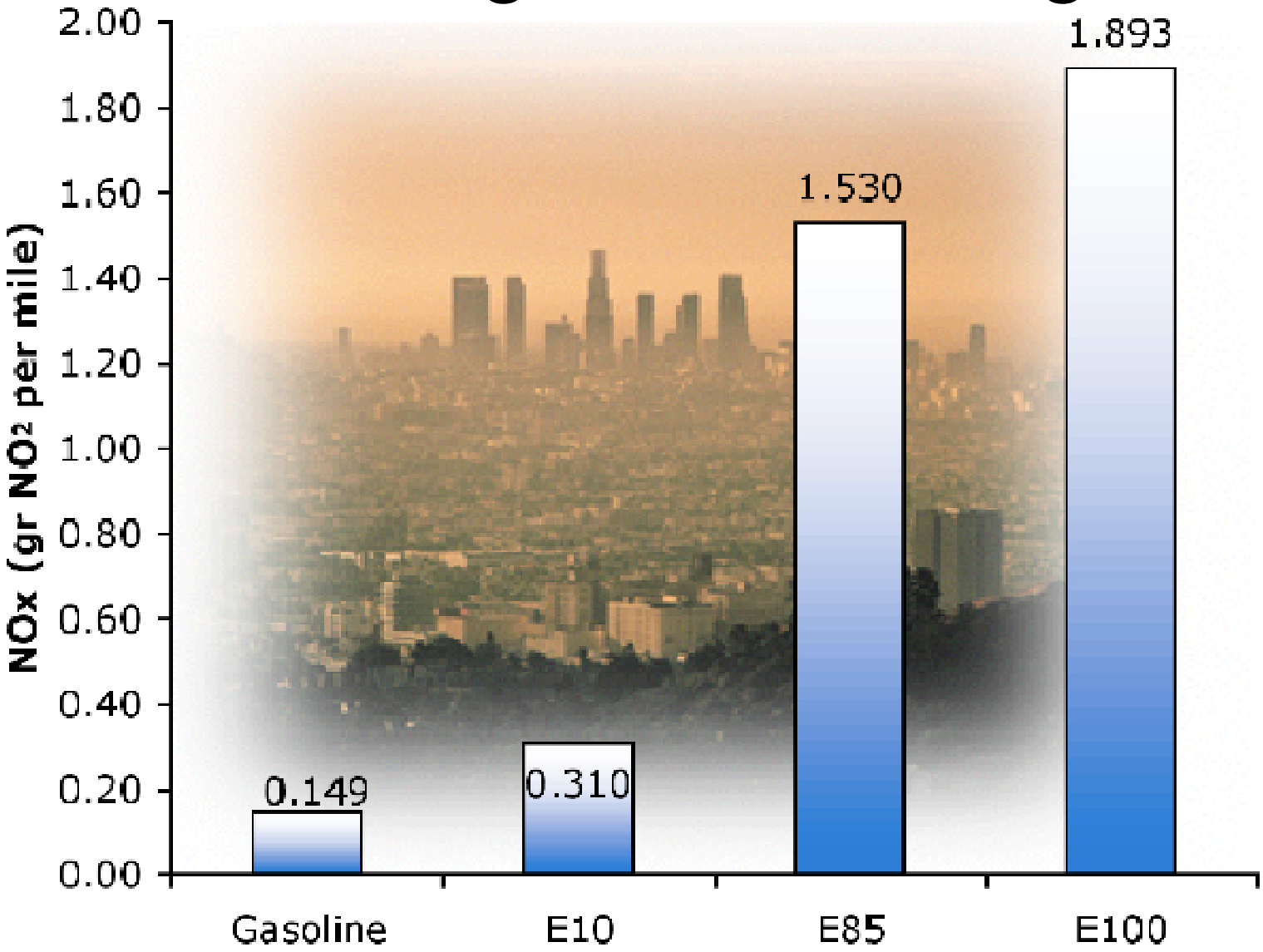
Water

Water


BEFORE
AFTER
Business as Usual Farming in Iowa
Predominant rotation of corn followed by soybeans
Predominant tillage practices of conventional and mulch tilling with a small amount of no till
Farmers sequester carbon
All Iowa corn farmers switch to continuous corn production
All Iowa farmers adopt no till practices
Farmers recycle carbon
All Iowa corn farmers switch to continuous corn production
All Iowa farmers adopt no till practices
All Iowa farmers collect "maximum" amount of stover for ethanol production

Soil

Accounting for soil nitrogen



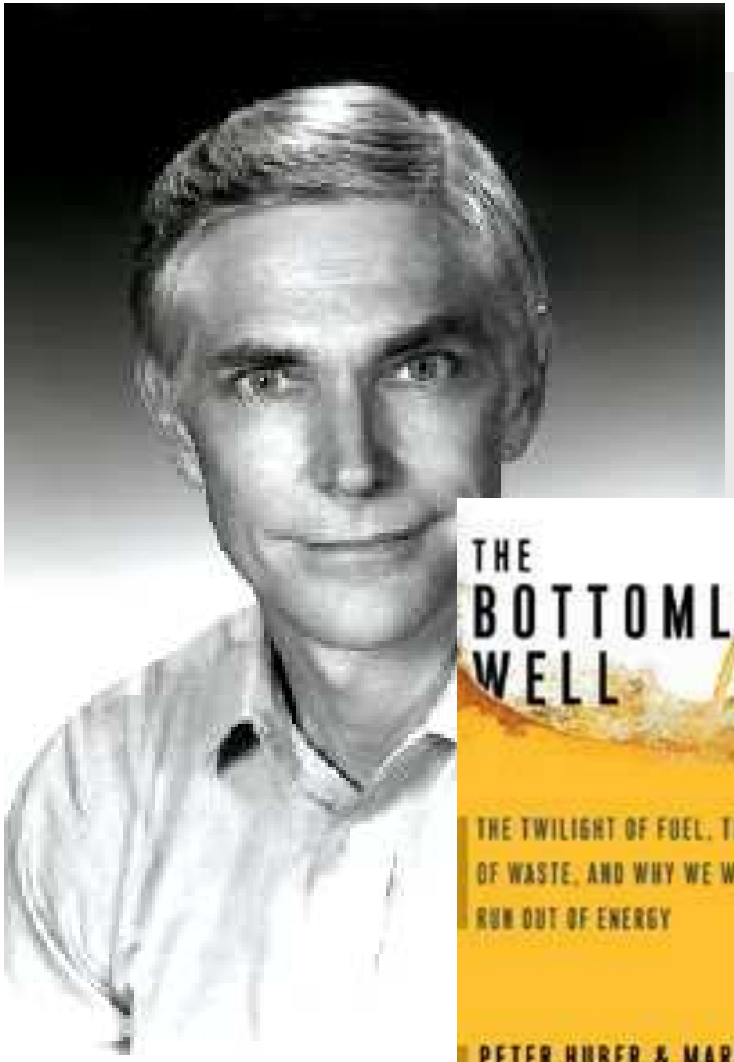
Air & water quality

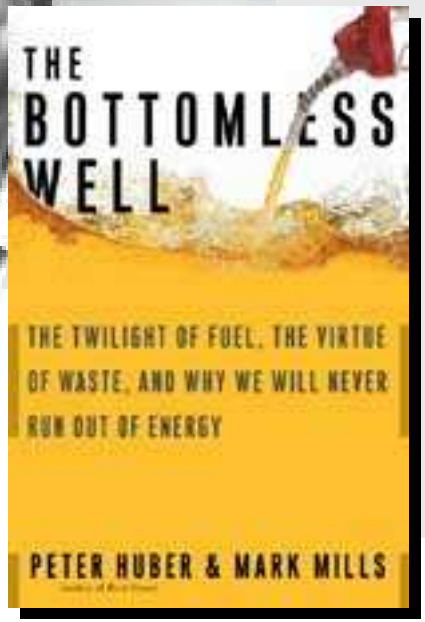
The Food Chain: A Global Need for Grain That Farms Can't Fill

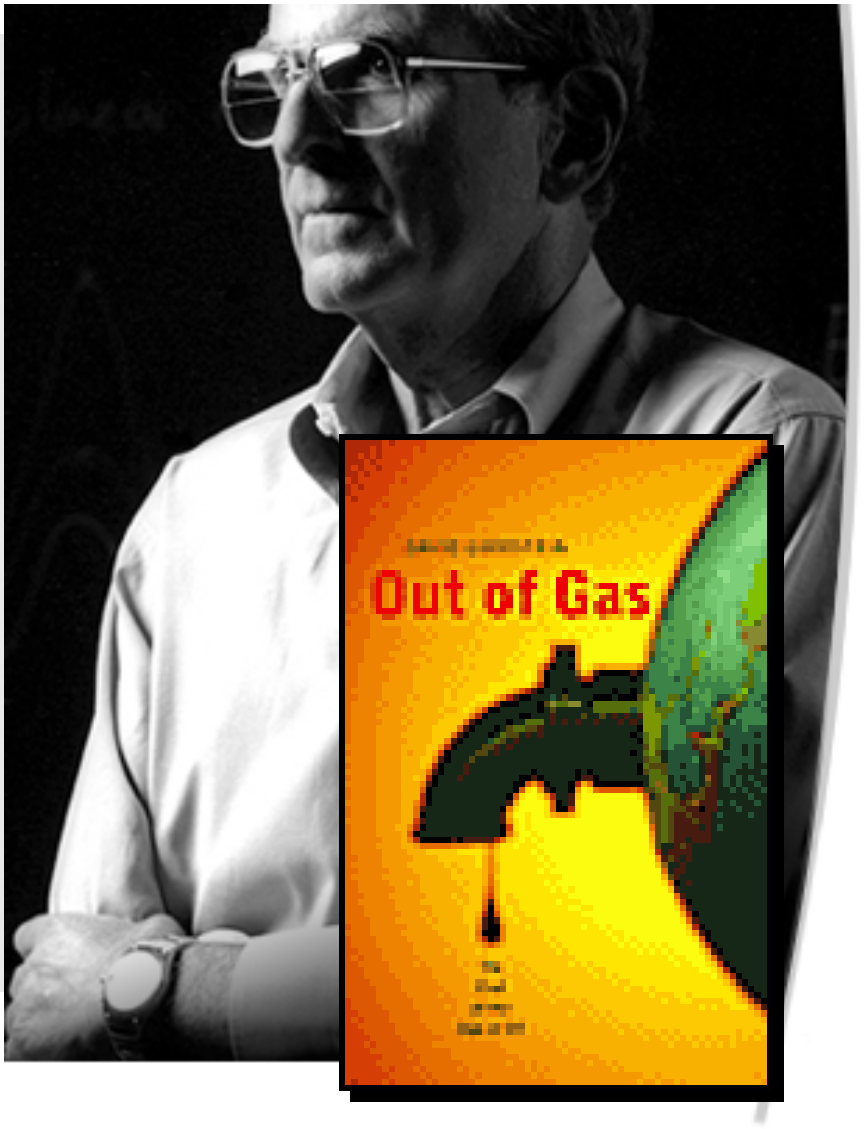
The New York Times

March 2008

Ethics and society



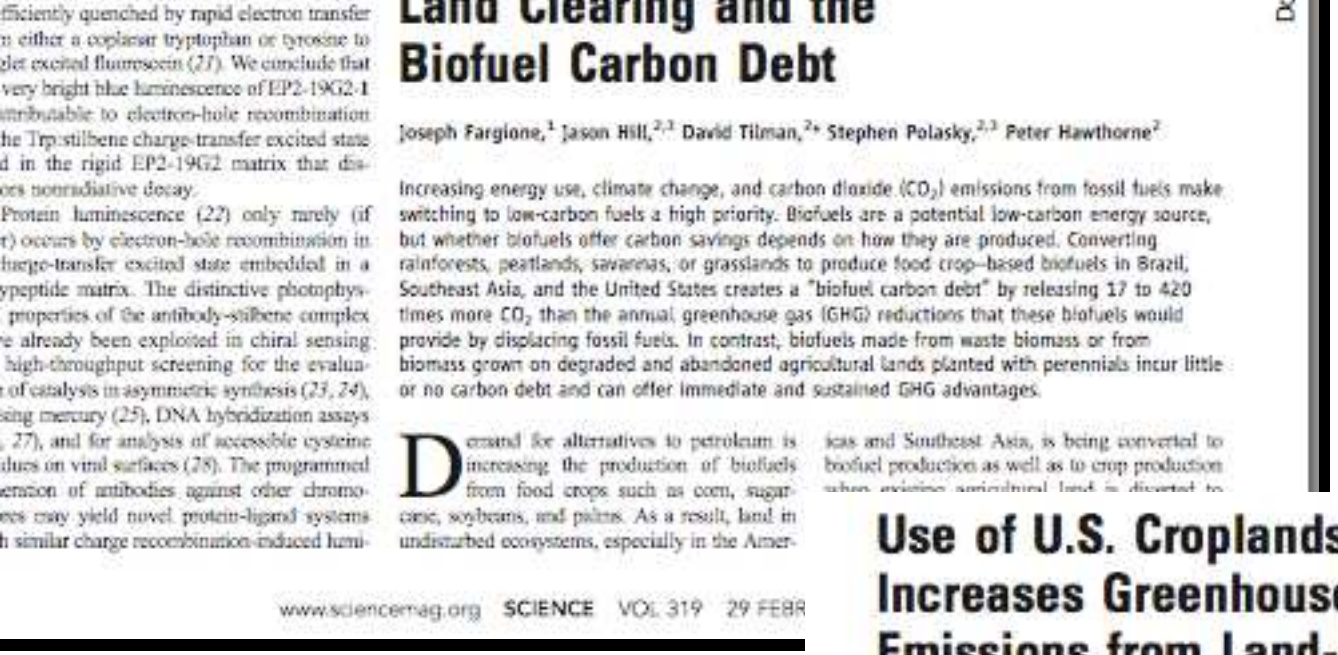

THE
BOTTOMLESS
WELL
THE TWILIGHT OF FUEL, THE VIRTUE OF WASTE, AND WHY WE WILL NEVER RUN OUT OF ENERGY
PETER HUBER & MARK MILLS


Out of Gas

Dialogue

Debating ethanol at the
National Press Club

Dialogue



fficiently quenched by rapid electron transfer
n either a coplanar tryptophan or tyrosine to
glet excited fluorescein (*21*). We conclude that
very bright blue luminescence of EP2-19G2-1
ntributable to electron-hole recombination
he Trp:stilbene charge-transfer excited state
d in the rigid EP2-19G2 matrix that dis-
oes nonradiative decay.
Protein luminescence (*22*) only rarely (if
r) occurs by electron-hole recombination in
harge-transfer excited state embedded in a
ypeptide matrix. The distinctive photophys-
properties of the antibody-stilbene complex
e already been exploited in chiral sensing
high-throughput screening for the evalua-
of catalysts in asymmetric synthesis (*23*, *24*),
sing mercury (*25*), DNA hybridization assays
, *27*), and for analysis of accessible cysteine
dues on viral surfaces (*28*). The programmed
eration of antibodies against other chromo-
es may yield novel protein-ligand systems
h similar charge recombination-induced lumi-

Land Clearing and the Biofuel Carbon Debt

Joseph Fargione,[1] Jason Hill,[2,3] David Tilman,[2]* Stephen Polasky,[2,3] Peter Hawthorne[2]

Increasing energy use, climate change, and carbon dioxide (CO_2) emissions from fossil fuels make switching to low-carbon fuels a high priority. Biofuels are a potential low-carbon energy source, but whether biofuels offer carbon savings depends on how they are produced. Converting rainforests, peatlands, savannas, or grasslands to produce food crop–based biofuels in Brazil, Southeast Asia, and the United States creates a "biofuel carbon debt" by releasing 17 to 420 times more CO_2 than the annual greenhouse gas (GHG) reductions that these biofuels would provide by displacing fossil fuels. In contrast, biofuels made from waste biomass or from biomass grown on degraded and abandoned agricultural lands planted with perennials incur little or no carbon debt and can offer immediate and sustained GHG advantages.

Demand for alternatives to petroleum is increasing the production of biofuels from food crops such as corn, sugarcane, soybeans, and palms. As a result, land in undisturbed ecosystems, especially in the Amer-

icas and Southeast Asia, is being converted to biofuel production as well as to crop production

Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change

Timothy Searchinger,[1]* Ralph Heimlich,[2] R. A. Houghton,[3] Fengxia Dong,[4] Amani Elobeid,[4] Jacinto Fabiosa,[4] Simla Tokgoz,[4] Dermot Hayes,[4] Tun-Hsiang Yu[4]

Most prior studies have found that substituting biofuels for gasoline will reduce greenhouse gases because biofuels sequester carbon through the growth of the feedstock. These analyses have failed to count the carbon emissions that occur as farmers worldwide respond to higher prices and convert forest and grassland to new cropland to replace the grain (or cropland) diverted to biofuels. By using a worldwide agricultural model to estimate emissions from land-use change, we found that corn-based ethanol, instead of producing a 20% savings, nearly doubles greenhouse emissions over 30 years and increases greenhouse gases for 167 years. Biofuels from switchgrass, if grown on U.S. corn lands, increase emissions by 50%. This result raises concerns about large biofuel mandates and highlights the value of using waste products.

in the case of cropland, carbohydrates, proteins, and fats), dedicating land to biofuels can potentially reduce GHGs only if doing so increases the carbon benefit of land. Proper accountings must reflect the net impact on the carbon benefit of land, not merely count the gross benefit of using land for biofuels. Technically, to generate greenhouse benefits, the carbon generated on land to displace fossil fuels (the carbon uptake credit) must exceed the carbon storage and sequestration given up directly or indirectly by changing land uses (the emissions from land-use change) (Table 1).

Many prior studies have acknowledged but failed to count emissions from land-use change because they are difficult to quantify (*1*). One prior quantification lacked formal agricultural modeling and other features of our analysis (*1*, *10*). To estimate land-use changes, we used a worldwide model to project increases in cropland in all major temperate and sugar crops by country or region (as well as changes in dairy and livestock

Debating land use effects

Dialogue

"The Searchinger paper is a very important paper. They have made the first effort to ntify the effects of producing ofuels as they ripple through the global economy."
Alex Farrell

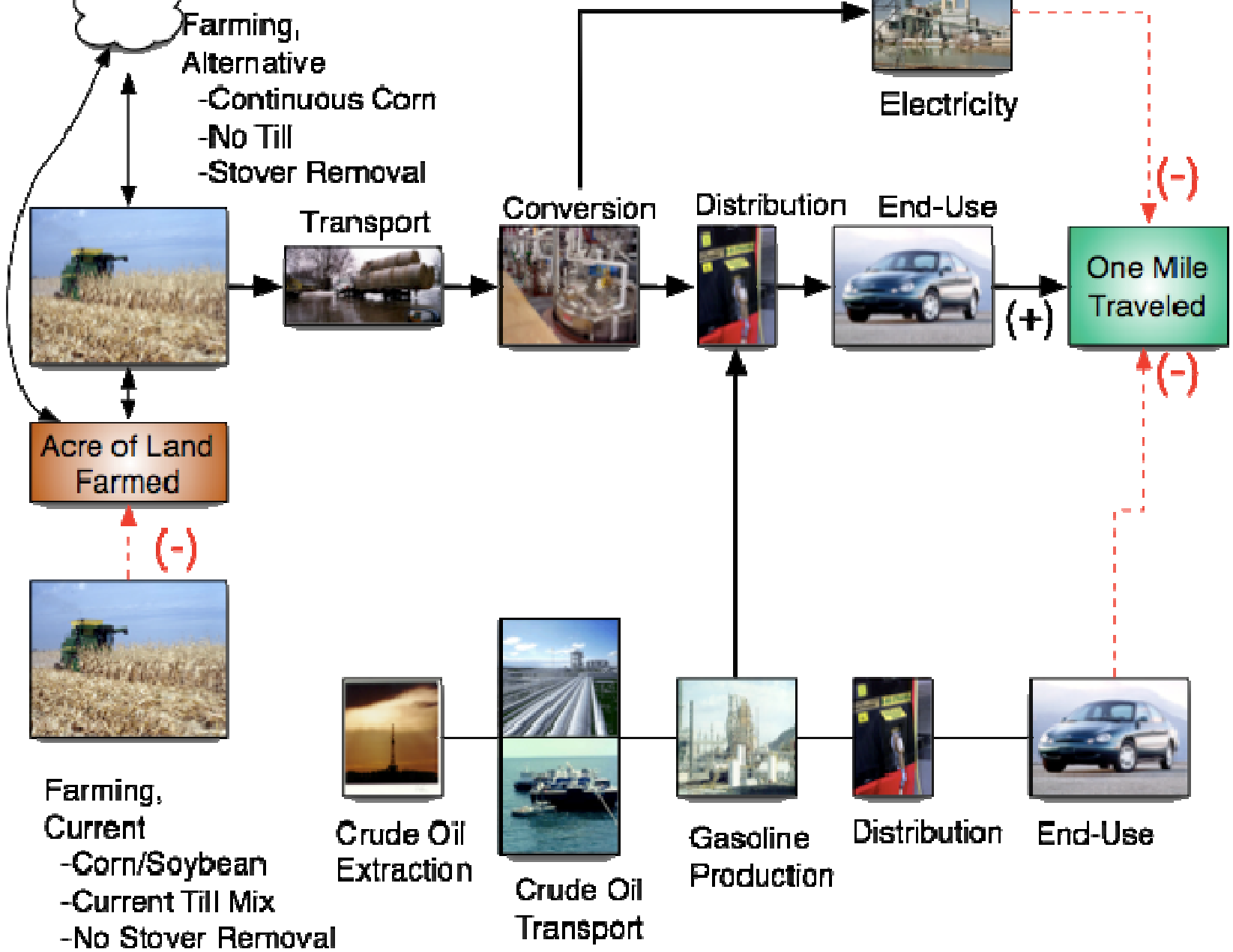
Debating land use effects

Dialogue

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

Paraphrased from talk by Dean Simeroth, CARB, commenting on hurdles facing implementation of a low carbon fuel standard in California

California Environmental Protection Agency



LCA as dialogue

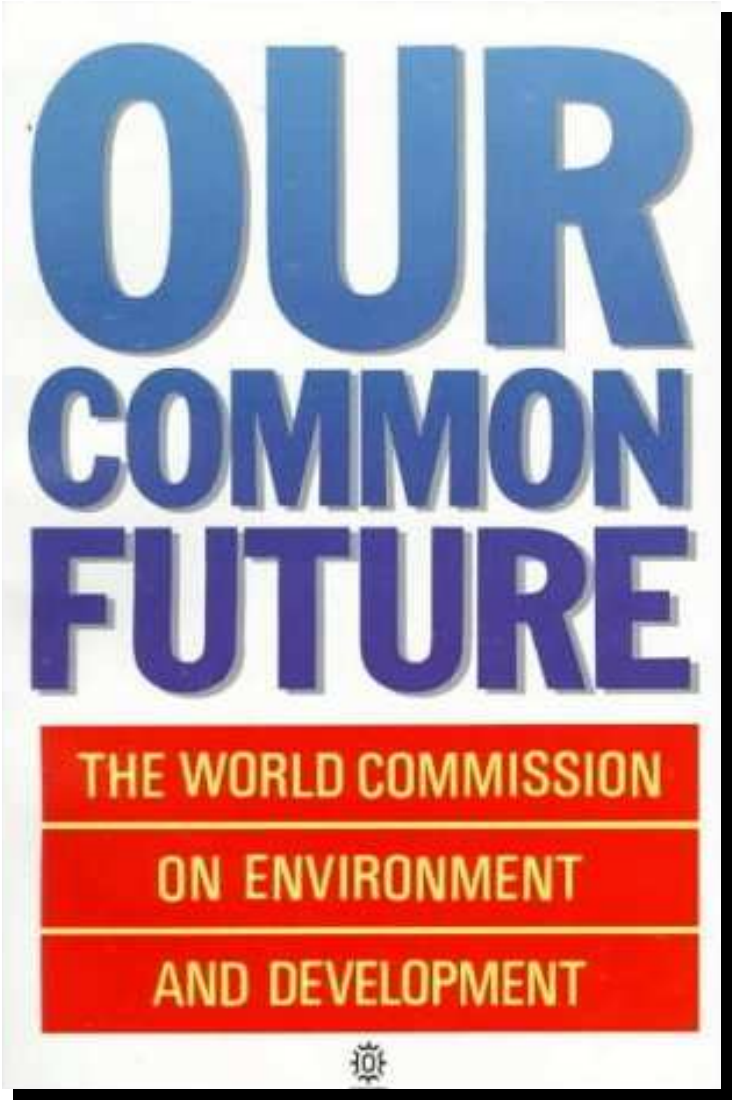
“Let us engage in the serious business of conducting our discussion rationally and logically, to discover the truth about points on which we differ.”

Mortimer J. Adler

Ready or not—standards for sustainable biofuels are on the way

- ✓ European Union
- ✓ Germany
- ✓ The Netherlands
- ✓ United Kingdom
- ✓ U.S. EPA sustainability criteria for RFS
- ✓ California Air Resources Board
- ✓ Council on Sustainable Biofuels Production
- ✓ Roundtable on Sustainable Biofuels
- ✓ Global Bioenergy Partnership

“[S]ustainable development meets the needs of the present without compromising the needs of the future generations.”



A pipe dream?

I hope not