

Biofuels and Sustainability: An Industry Perspective

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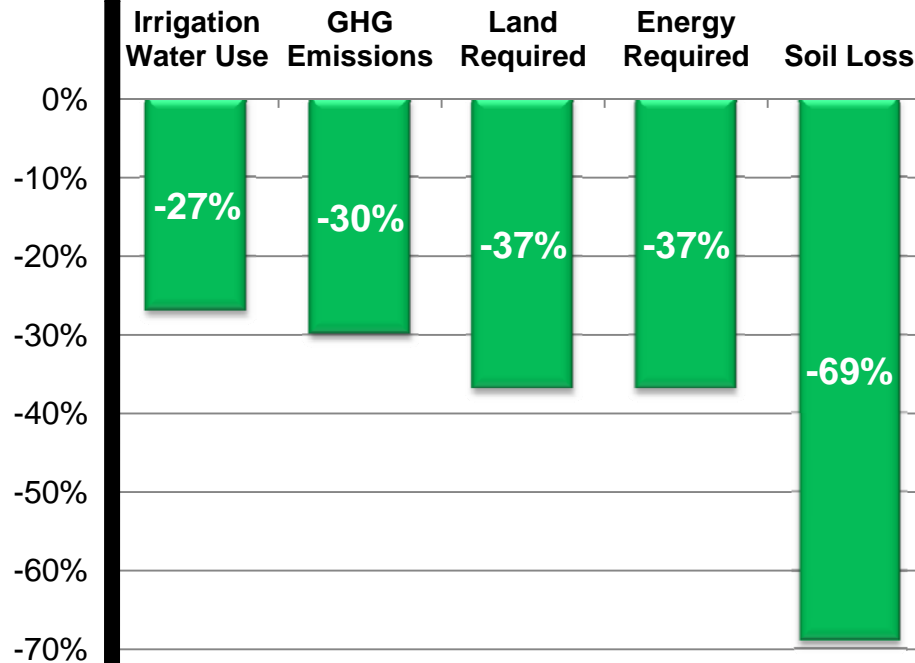
Sustainability

- How is sustainability defined?
- How do you measure sustainability?
- Who is responsible for sustainability?
- Sustainable compared to what?
- How is environmental sustainability balanced with economic and social needs?

Corn Ethanol Efficiency Indicators

Corn Impacts, 1987-2007

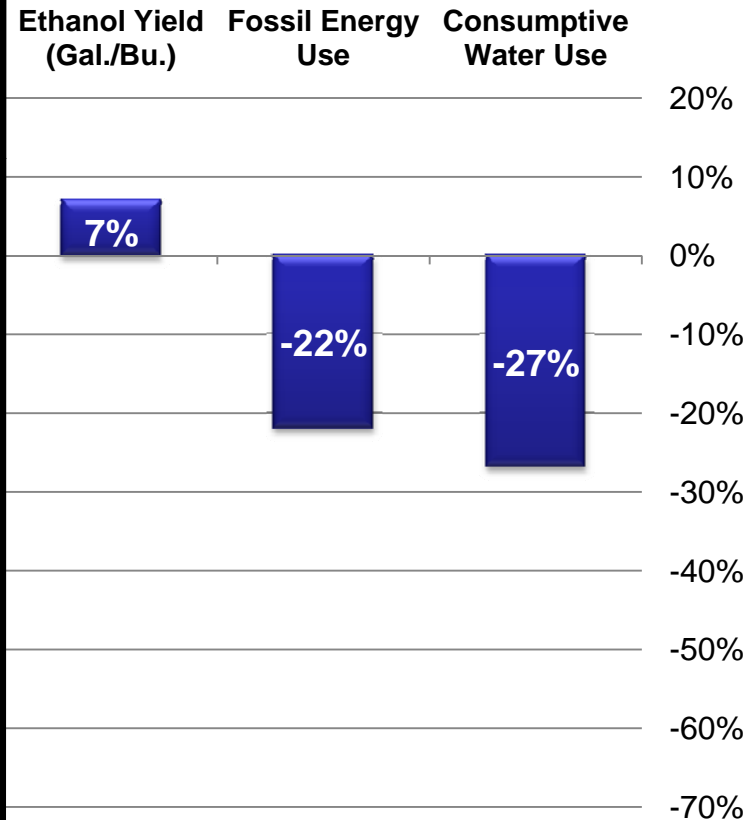
(expressed as per bushel produced)



Source: *Field to Market: The Keystone Alliance for Sustainable Agriculture*, "Environmental Resource Indicators for Measuring Outcomes of On-Farm Agricultural Production in the United States," First Report, January 2009. (Available online at http://keystone.org/spp/env-sustain_ag.html)

Ethanol Processing Impacts, 2001-2007

(expressed as per gallon produced)



Source: "Analysis of the Efficiency of the U.S. Ethanol Industry 2007," May Wu, Center for Transportation Research Argonne National Laboratory, March 2008. (Available online at: www.ethanolrfa.org)

“Improvements in Life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn-Ethanol” (2009)

- “Direct effect GHG emissions were estimated to be equivalent to a **48% to 59% reduction compared to gasoline**, a twofold to threefold greater reduction than reported in previous studies.
- “Ethanol-to-petroleum output/input ratios ranged from **10:1 to 13:1** but could be increased to 19:1 if farmers adopted high-yield progressive crop and soil management practices.
- “An advanced closed-loop biorefinery with anaerobic digestion **reduced GHG emissions by 67% and increased the net energy ratio to 2.2**, from 1.5 to 1.8 for the most common systems.
- “These results suggest that corn-ethanol systems have **substantially greater potential to mitigate GHG emissions and reduce dependence on imported petroleum** for transportation fuels than reported previously.”

Source: Liska et. al. Improvements in Life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn-Ethanol, Journal of Industrial Ecology, 2009, 13:1, 58-74

Land, Water and Air

- We **do not** need to bring more land into agriculture in the U.S. to meet RFS2 targets and LCFS goals
- Water impacts need to be put in perspective
 - 85-90% of U.S. corn acres are NOT irrigated
 - Consumptive H₂O use at ethanol biorefinery is ≤ avg. gasoline H₂O requirements
 - Water profile improving rapidly and dramatically
 - Permitting requirements prevent placing undue strain on local water resources
- EBI/UCB/L. Berkeley Lab study: “...a biofuel eliminating even 10-percent of current gasoline pollutant emissions would have a substantial impact on human health in this country, especially in urban areas.” (avoided health damages = 5,000 – 20,000 DALY)
 - Study examined: direct particulate matter, indirect fine particles (2.5 micrometers or smaller) from emissions of sulfate and nitrite gases, volatile organic compounds and ammonia, plus ozone, toxic air pollutants, emissions to surface and ground water, and emissions to soil.

What's Next For Biofuels?

- Continued evolution of existing industry
 - CHP/biomass power
 - New processing technologies
 - New co-products, including chemicals
- New feedstocks
 - Potential to decrease energy & water inputs
- New fuel molecules
 - Butanol, etc.
- Change is evolutionary—not revolutionary

Recommendations

- Be consistent in assigning analytical boundaries
- Recognize that ALL fuels have indirect effects
- Compare new fuels to the fuels they displace in the marketplace (i.e. marginal vs. marginal)
- Allow the science to catch up with the policy direction
- Engage the right experts
 - LCFPs cut across a wide spectrum of disciplines
 - Agronomists, animal scientists, forestry experts, etc.
- Ensure a public and transparent process
 - Including availability of LCA and economic models
- Ensure harmonization with other policies
 - Avoid market confusion, inequities