



**Union of  
Concerned  
Scientists**

Citizens and Scientists for Environmental Solutions

# Sustainability of Low Carbon Fuels

*October 27, 2009 Stakeholder Meeting, Newark, NJ*

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# The Science is Clear

*To avoid perverse incentives and harmful unintended consequences, biofuels programs must account for fossil fuel carbon **and** carbon emitted from changes in land use*

## **Direct Conversion of Land to Biofuels Production**

- Righelato, R. and D. V. Spracklen. **2007** *Science*
- Gibbs, H.K., et al. **2008**. *Environmental Research Letters*
- Fargione, J., et al. **2008**. *Science*

## **Indirect Land Use Change Caused by Biofuel Production**

- Searchinger, T., et al. **2008**. *Science*
- California Air Resources Board. **2009**
- US Environmental Protection Agency. **2009**

## **Perverse Outcomes of Flawed Accounting for Land Use Change**

- Wise, M., et al. **2009** *Science*
- Searchinger, T. et al. **2009** *Science*
- Melillo J. M. **2009** *Scienceexpress*



# Scientists' and Economists' Statement

More than 200 scientists and economists with relevant expertise agree

***There are uncertainties inherent in estimating the magnitude of indirect land use emissions from biofuels, but assigning a value of zero is clearly not supported by the science.***

***Grappling with the technical uncertainty and developing a regulation based on the best available science is preferable to ignoring a major source of emissions.***

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# Water Quantity and Quality

## Water consumption for biofuel and gasoline production

Argonne National Laboratory, 2009

Table 1. Consumptive Freshwater Use for Ethanol and Petroleum Gasoline Production		
Fuel (feedstock)	Net water consumed <sup>a</sup>	Major factors affecting water use
Corn ethanol	10–324 gal/gal ethanol <sup>d</sup>	Regional variation caused by irrigation requirements due to climate and soil types
Switchgrass ethanol	1.0–9.8 gal/gal ethanol <sup>d</sup>	Production technology
Gasoline (U.S. conventional crude) <sup>b</sup>	3.4–6.6 gal/gal gasoline	Age of oil well, production technology, and degree of produced water recycle
Gasoline (Saudi conventional crude)	2.8–5.8 gal/gal gasoline	Same as above
Gasoline (Canadian oil sands) <sup>c</sup>	2.6–6.2 gal/gal gasoline	Geologic formation, production technology

<sup>a</sup> In gal of water per gal of fuel specified.

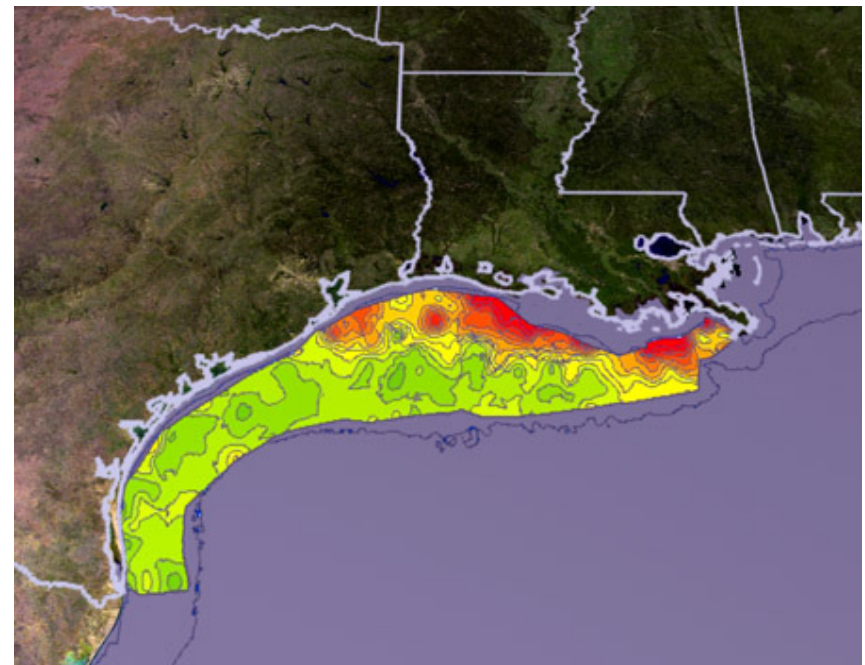
<sup>b</sup> PADD II, III, and V combined.

<sup>c</sup> Including thermal recovery, upgrading, and refining.

<sup>d</sup> All water used in ethanol conversion is allocated to the ethanol product.

## Impact of Biofuel Crop Production on the Formation of Hypoxia in the Gulf of Mexico

Costello et al. 2009 *Environ. Sci. Technol.*,



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# Sustainable Low Carbon Biofuels

Biofuels can provide sustainable low carbon transportation

Balance food, fuel and climate change mitigation

1. Perennial plants grown on degraded lands abandoned from agricultural use
2. Crop residues.
3. Sustainably harvested wood and forest residues
4. Double crops and mixed cropping systems
5. Municipal and industrial wastes

Tilman, D., et al. **2009** *Science*



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Thank You

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*celebrating 40 years of working for a healthy  
environment and a safer world*