



Water and Energy Nexus: Strategic Thinking

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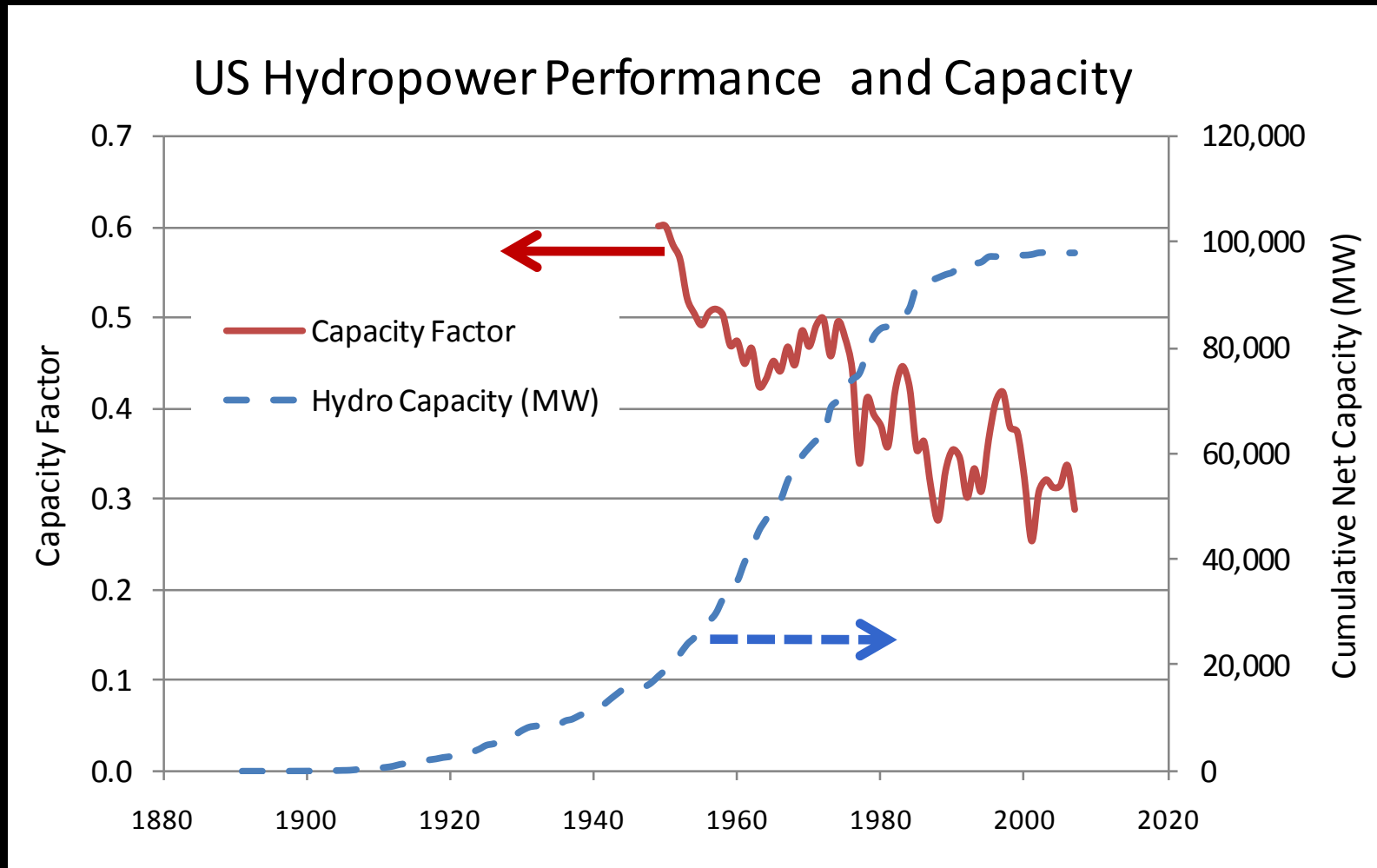
**Center for International Energy and Environmental Policy
The University of Texas at Austin**

April 15, 2010



Water for Energy: Electricity

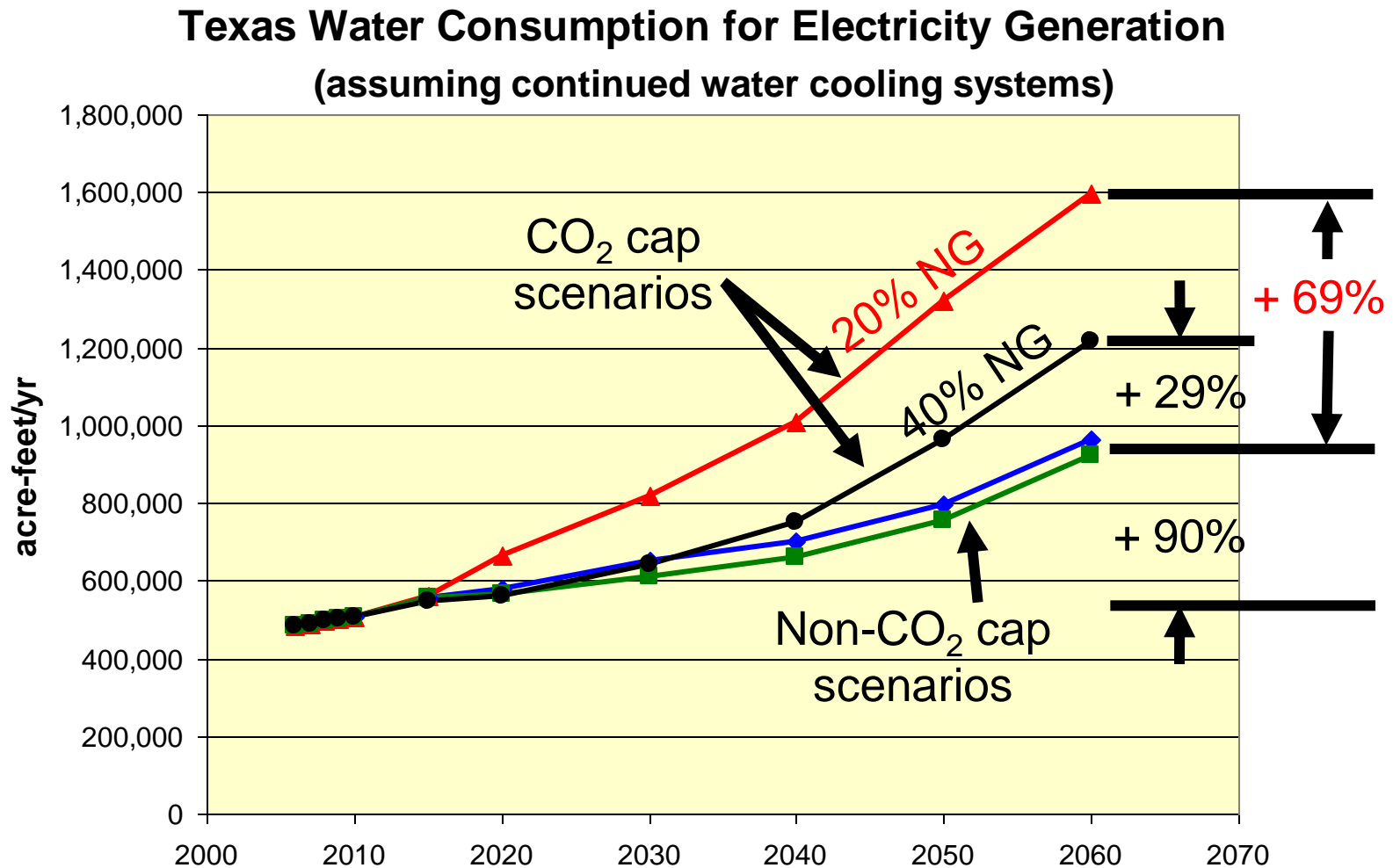
US hydropower exemplifies water limiting an energy resource



EIA Annual Energy Review 2008.



Water Consumption depends heavily upon fuel + cooling system and carbon capture choices



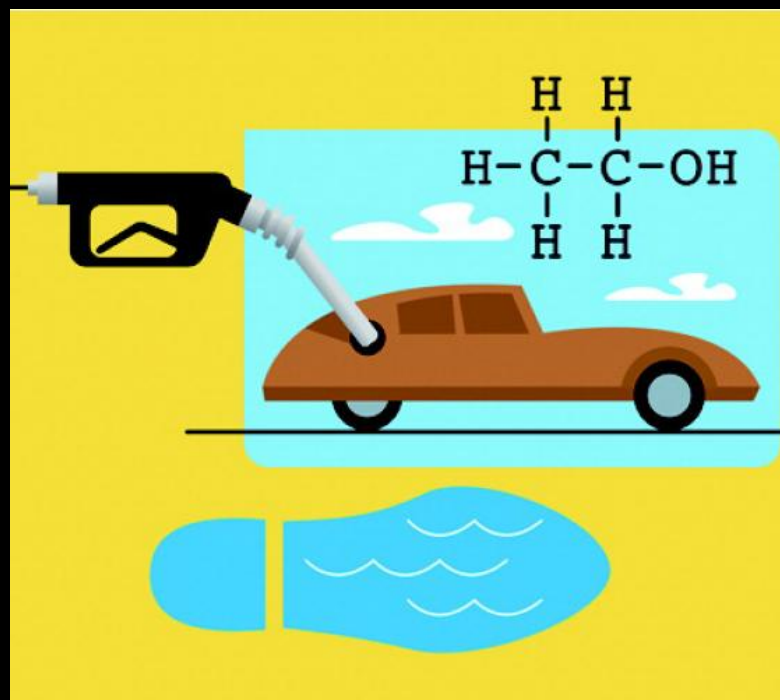
Power generation might have to adapt to low water consumptive technologies

- **Dry cooling**
 - **Solar thermal systems in desert Southwest**
 - **Prevent “Gal/MWh_{net}” increases due to auxiliary power and heat for CO2 capture**
 - **Proposed coal CCS in W. Texas plan dry cooling**
- **Wind, PV solar, and NG combustion consume very little water directly**
- **Legal water rights restrictions may be as influential as physical water availability**



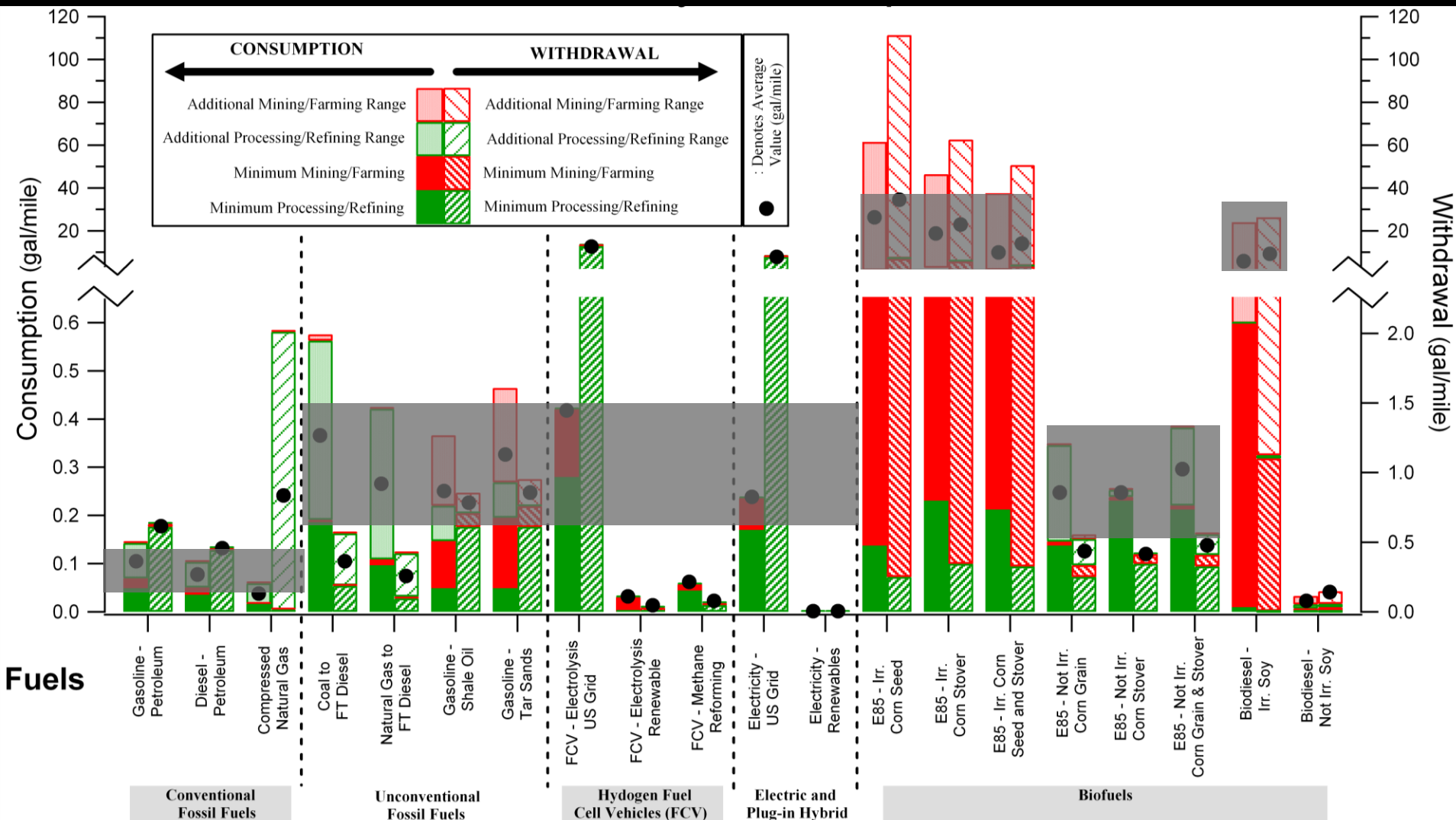


Water for Energy: Transportation Fuels

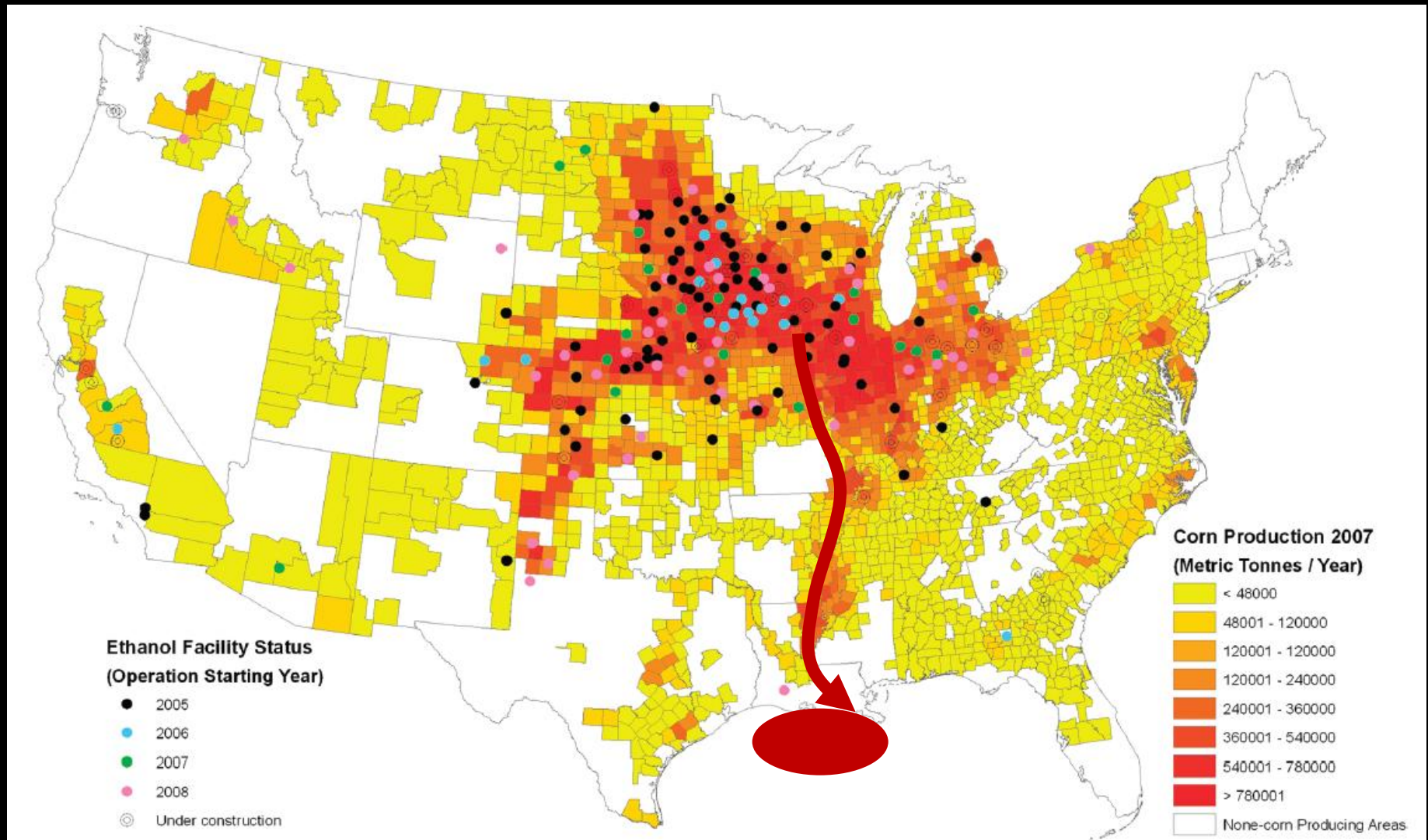


Dominguez-Faus et al. *Environ. Sci. & Technol.* **2009** **43** (9), 3005-3010.

Water intensity of LDVs varies from 0.1 to > 60 gal/mile for consumption



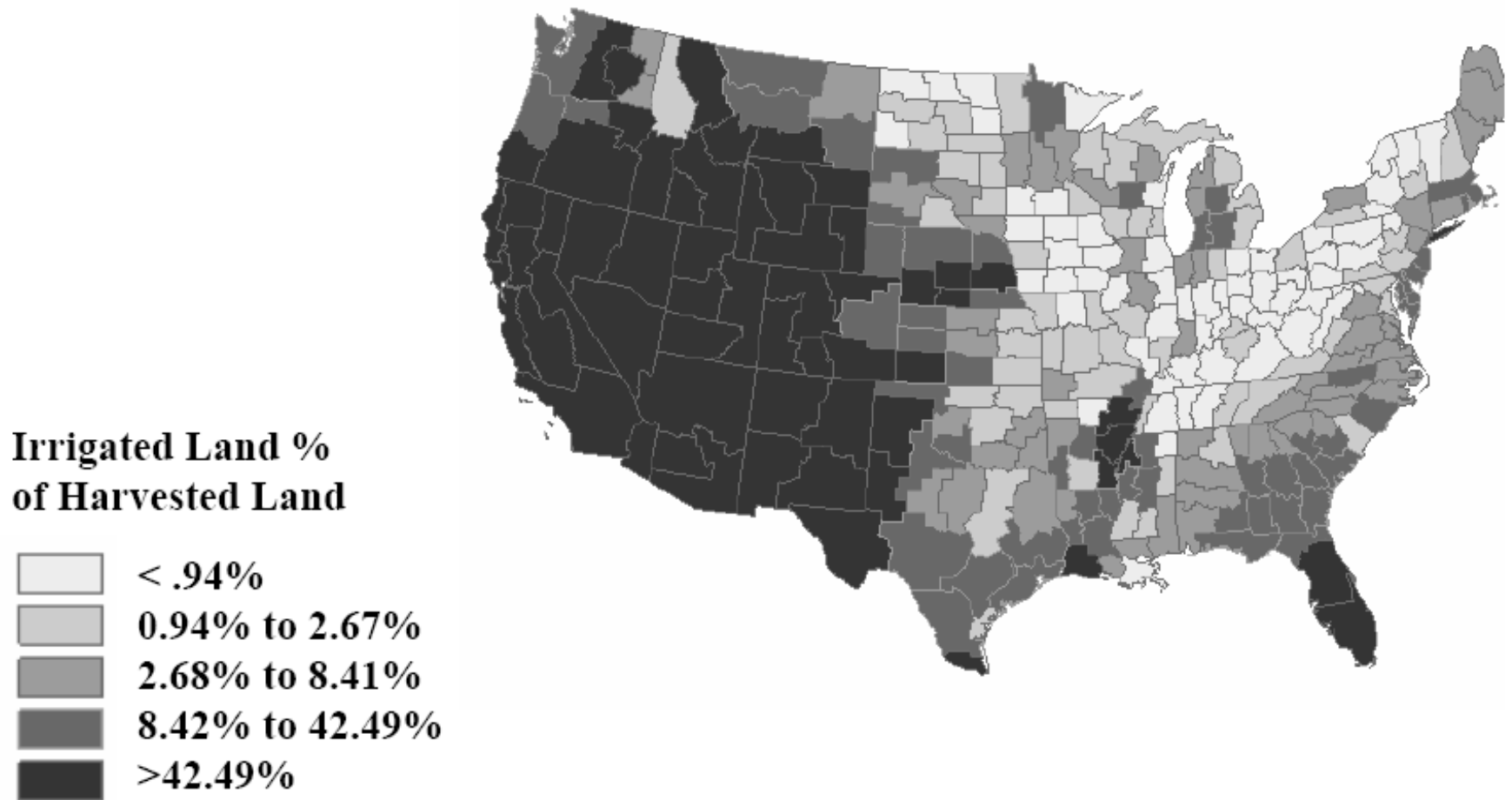
Most corn (and ethanol) in US is in Midwest



Chiu, et al. Water embodied in bioethanol in the U.S. *Environ. Sci. and Technol.* **2009** 43 (8), 2688-2692.

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CSIS: Food, Water, & Energy 8
April 15, 2010

Most intensive irrigation in Western US and Central Plains



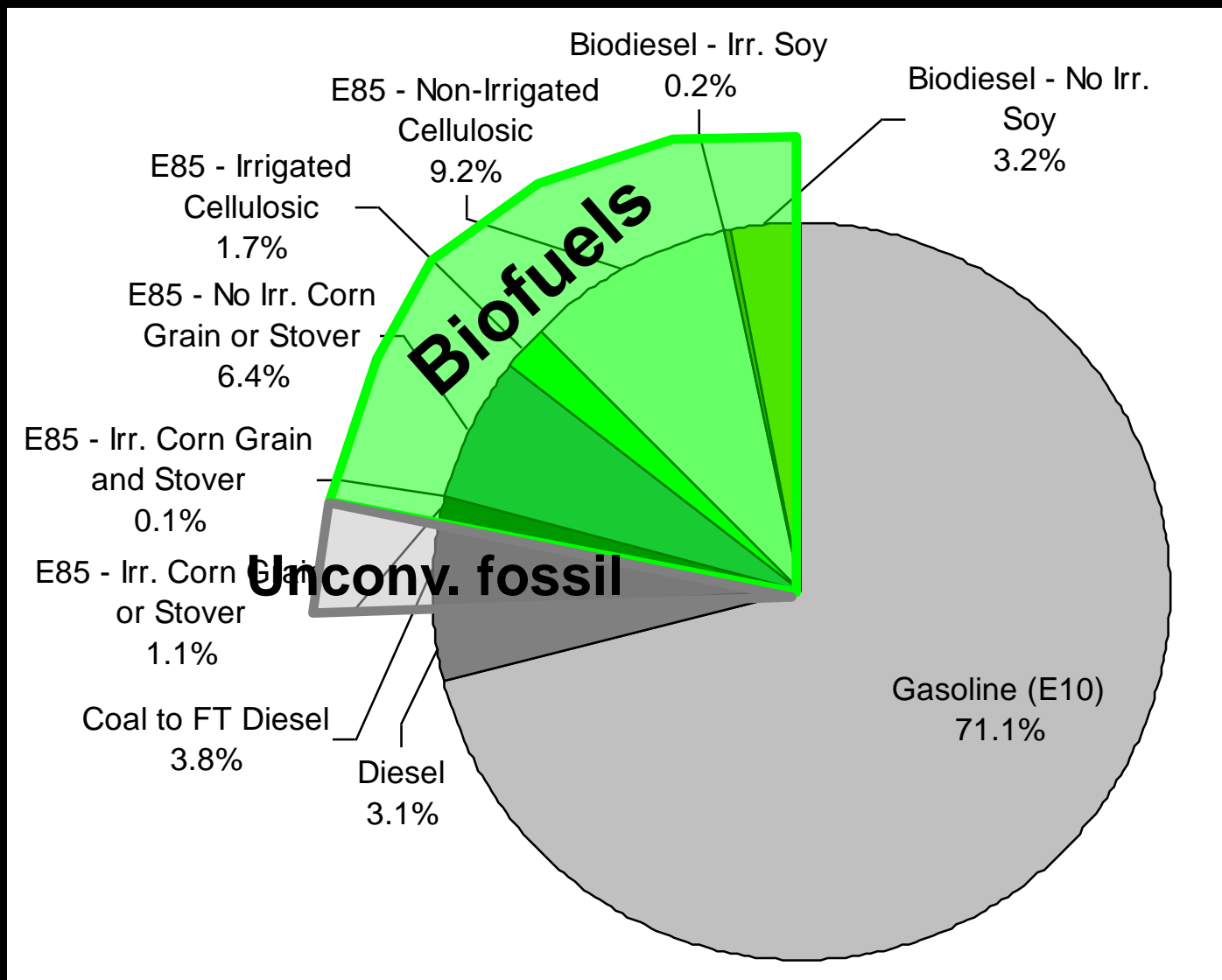
De La Torre Ugarte, D.G., et al., *Estimating Agricultural Impacts of Expanded Ethanol Production: Policy Implications for Water Demand and Quality*, in *Annual Meeting of the American Agricultural Economics Association*. 2008: Orlando, FL.



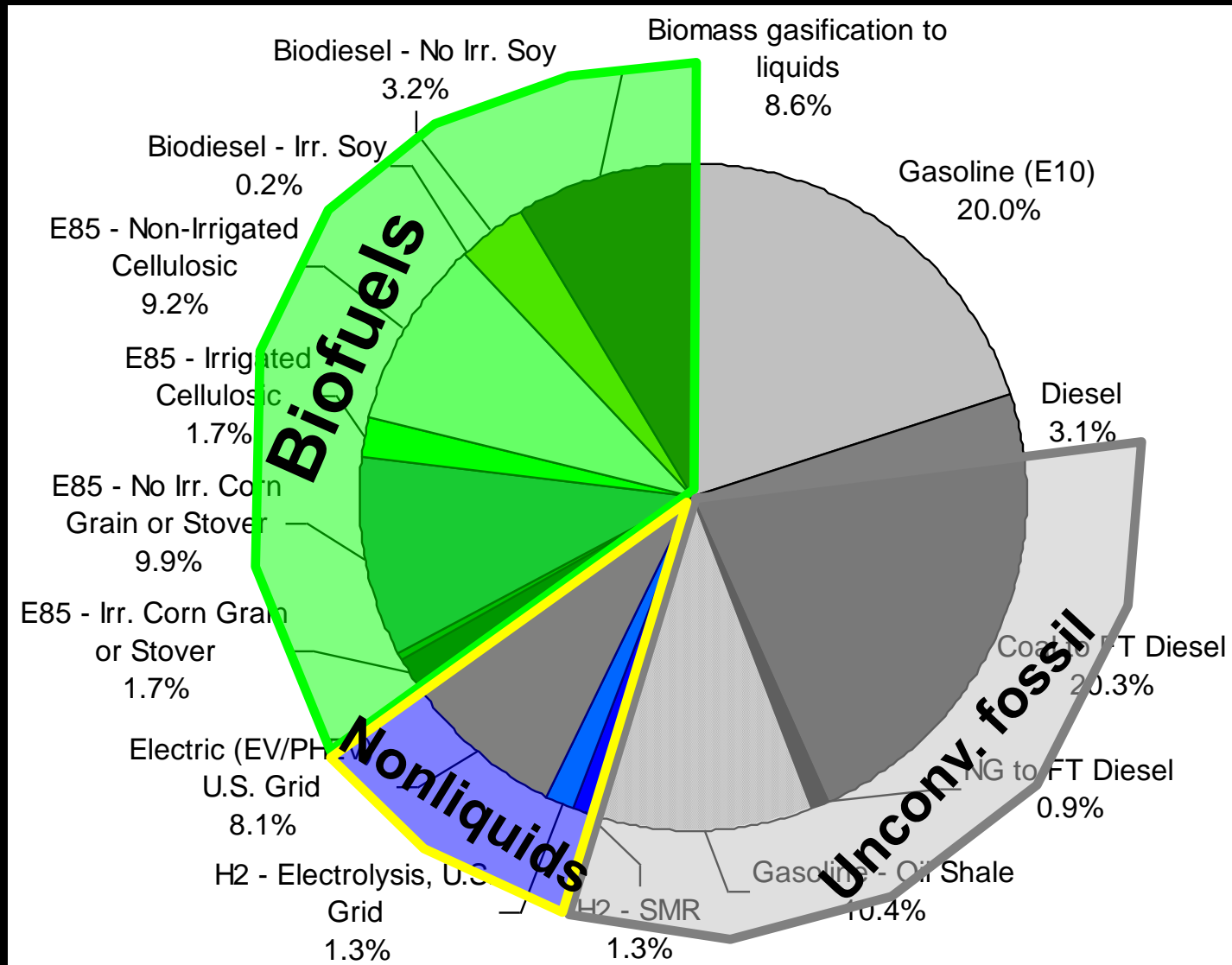


***How does diversity in transportation fuels
affect direct water consumption?***

“Low Diversity Scenario for 2030”: AEO 2008 Ref. case still 65% petroleum based (4.1 trillion miles)

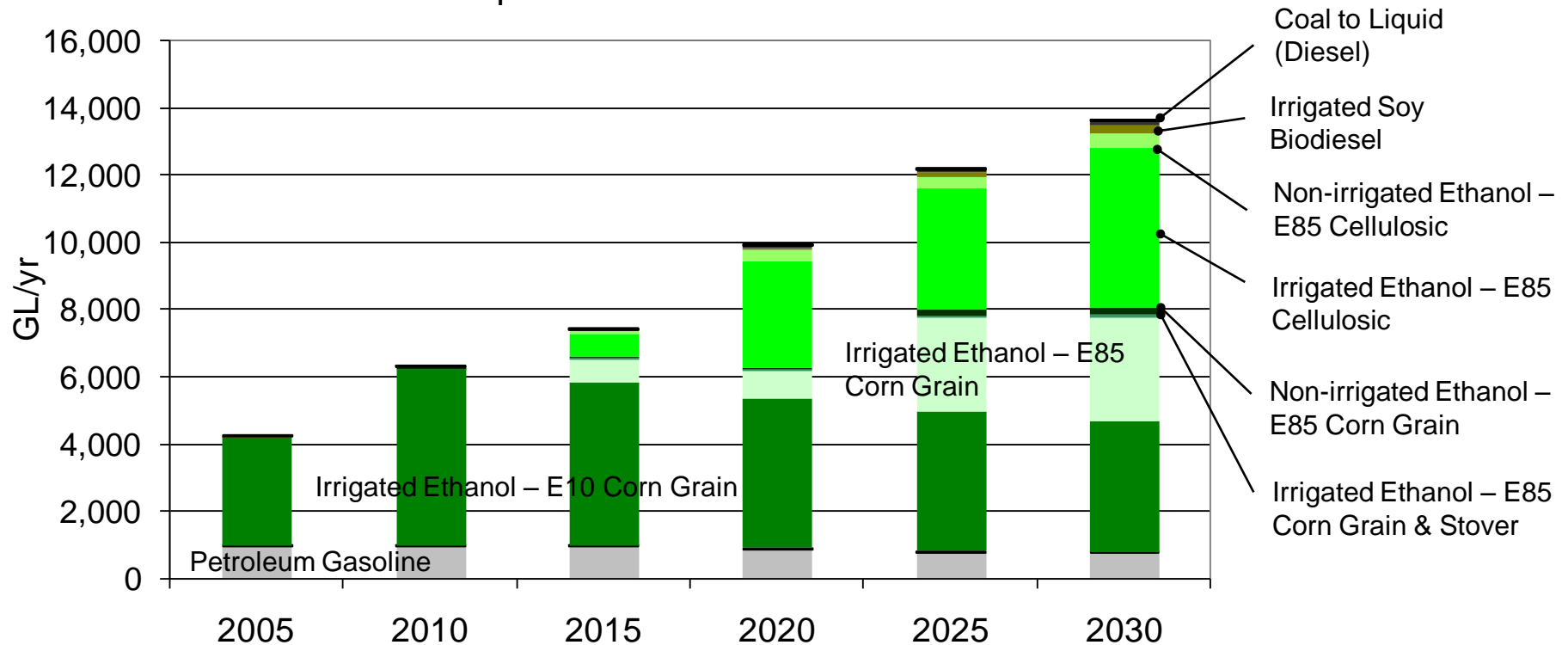


“High Diversity Scenario for 2030”: ~ 20% conventional petroleum (4.1 trillion miles)

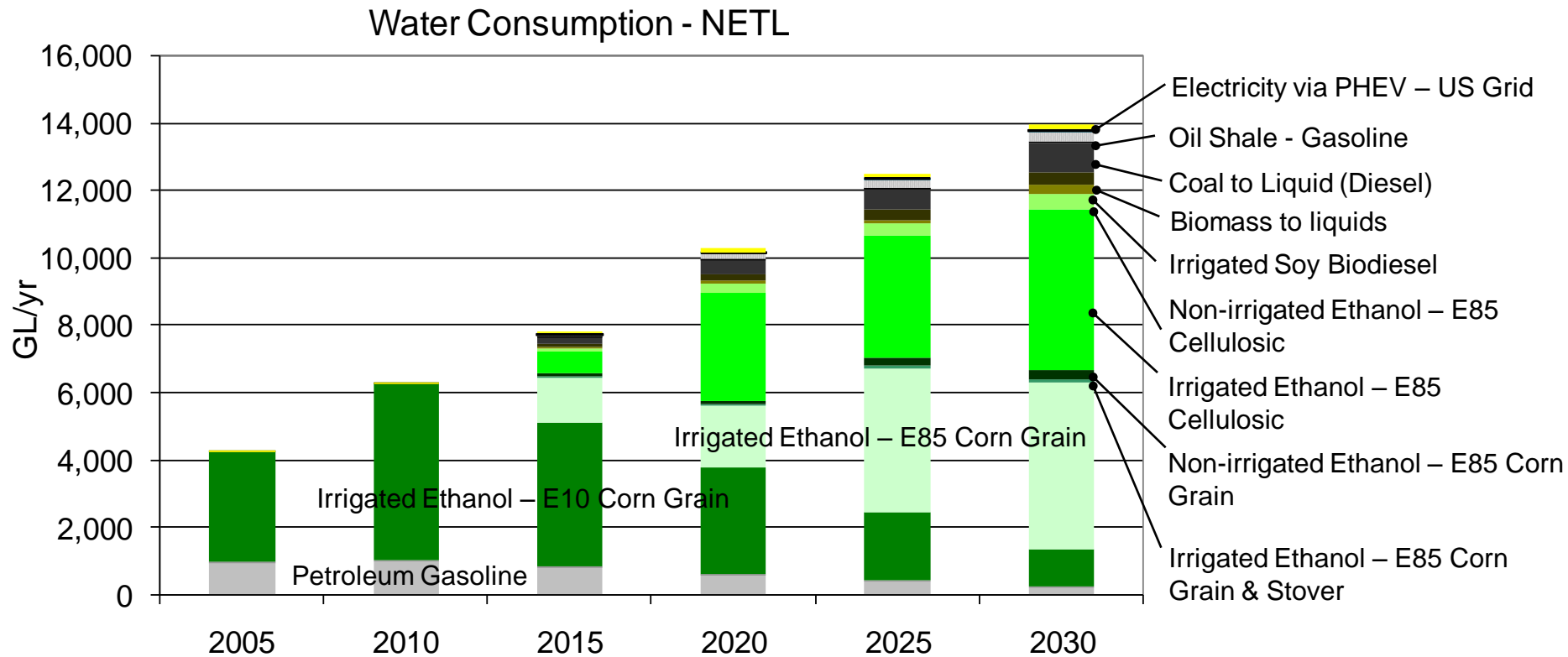


“Low Diversity Scenario” shows H₂O consumption to 14,000 GL by 2030

Water Consumption - AEO 2008 Reference



“High Diversity Scenario” also shows consumption of 14,000 Billion Liters in 2030



“domestic water” for “foreign oil”?

- Direct water for LDVs
 - 2005 ~ 4,000 GL/yr (3% US total)
 - 2030 could go to 14,000 GL/yr (10% US total)
 - ~ 9,000 GL/yr w/o irrigation of grasses
- US total consumption: 140,000 GL in 1995 (USGS, 1998)
- Comparisons for *consumption*
 - Thermoelectric sector ~ 3% – 4%
 - Irrigation ~ 80%
 - *Biofuels are now a subset of irrigation*





***Water – energy – climate becoming
more important in policy***

Future Water and Energy Policy: How does Water influence Energy and GHG?

- **American Clean Energy Leadership Act of 2009 of 2009** (in committee)

“... include a lifecycle assessment of the quantity of water withdrawn and consumed in the production of transportation fuels ...”

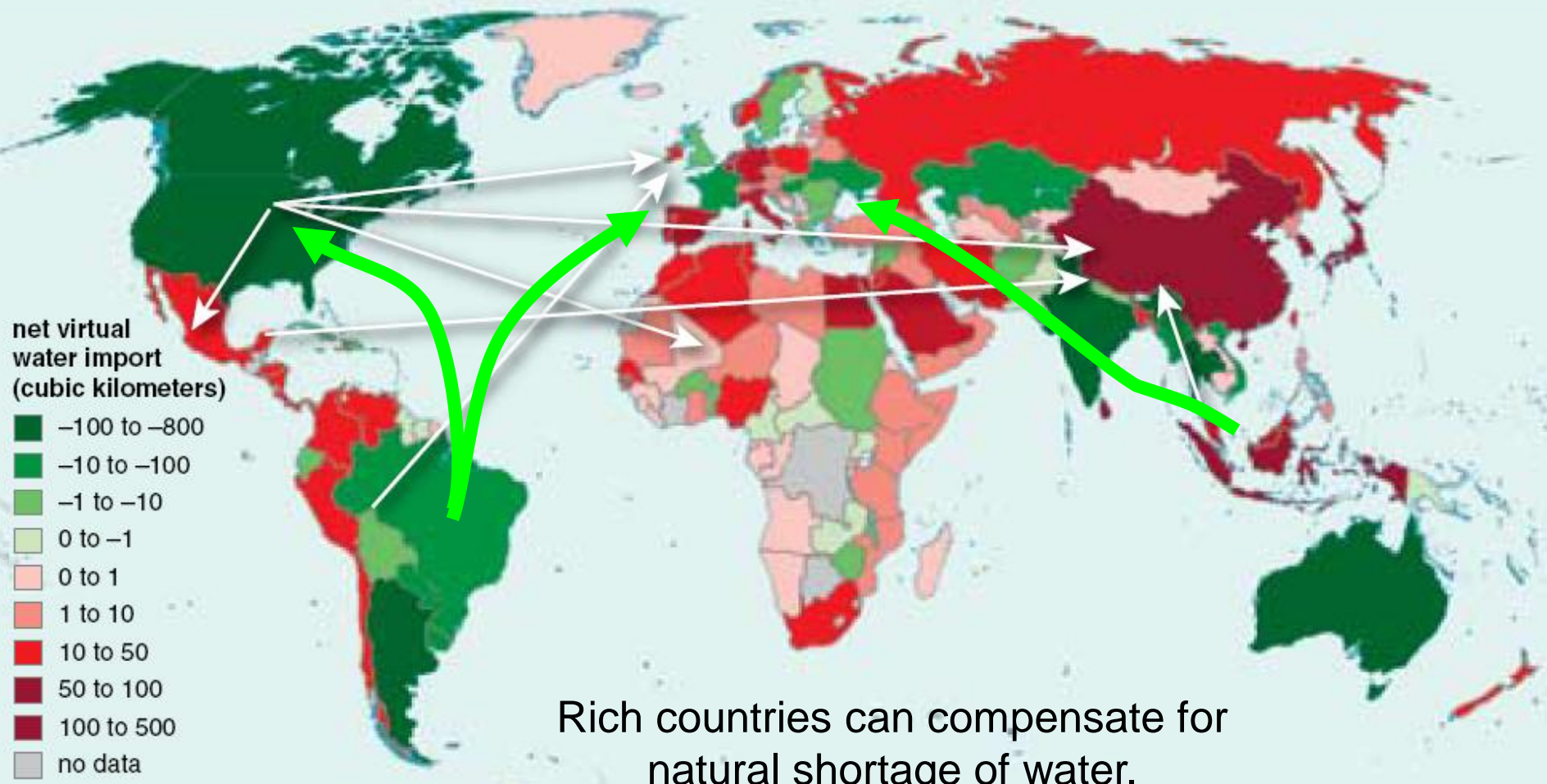
– i.e. calculate as **gal H₂O/mile**

King & Webber (2008) *Env. Sci. and Tech.*

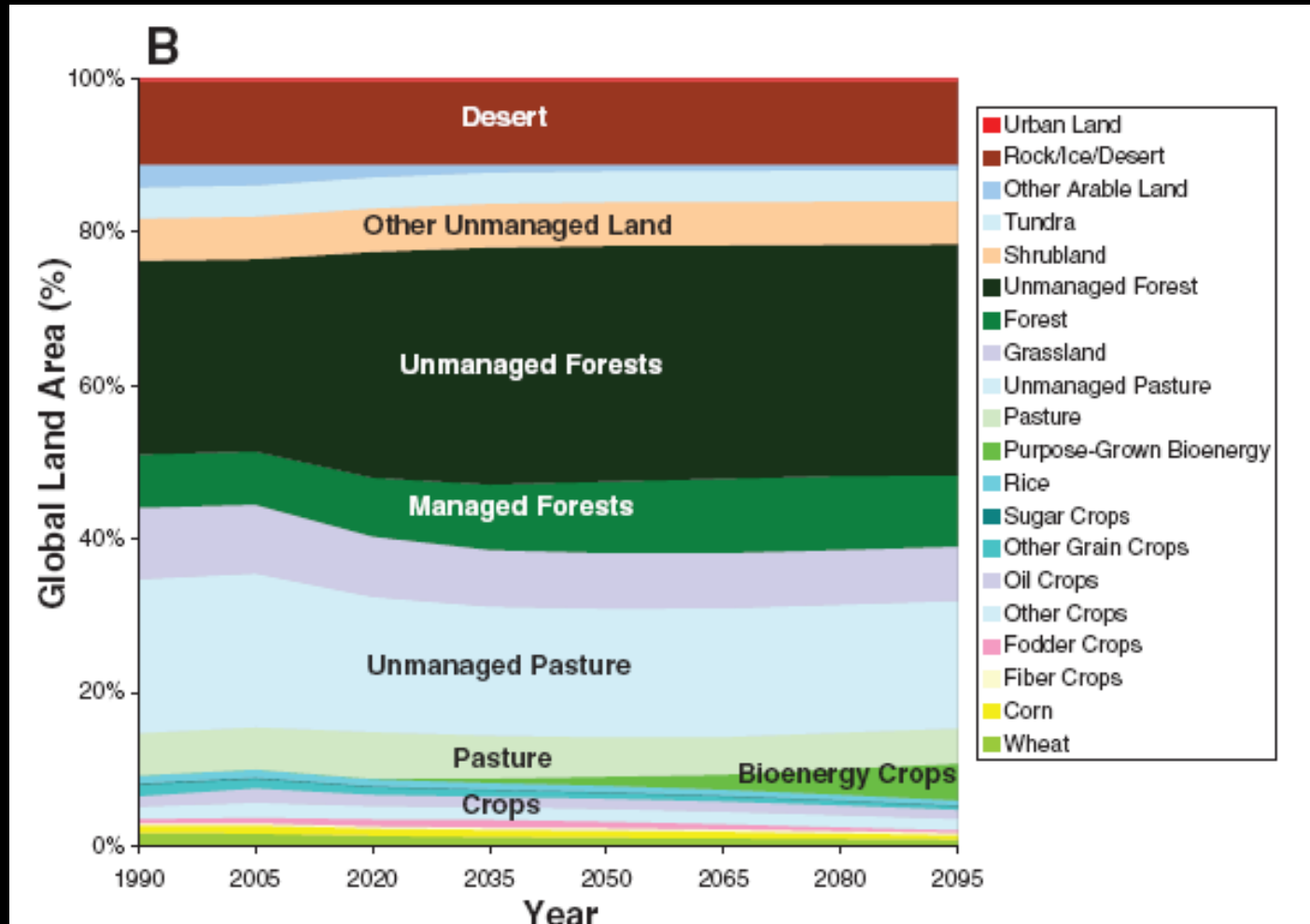


“Virtual” required water trade

What about Biofuels?

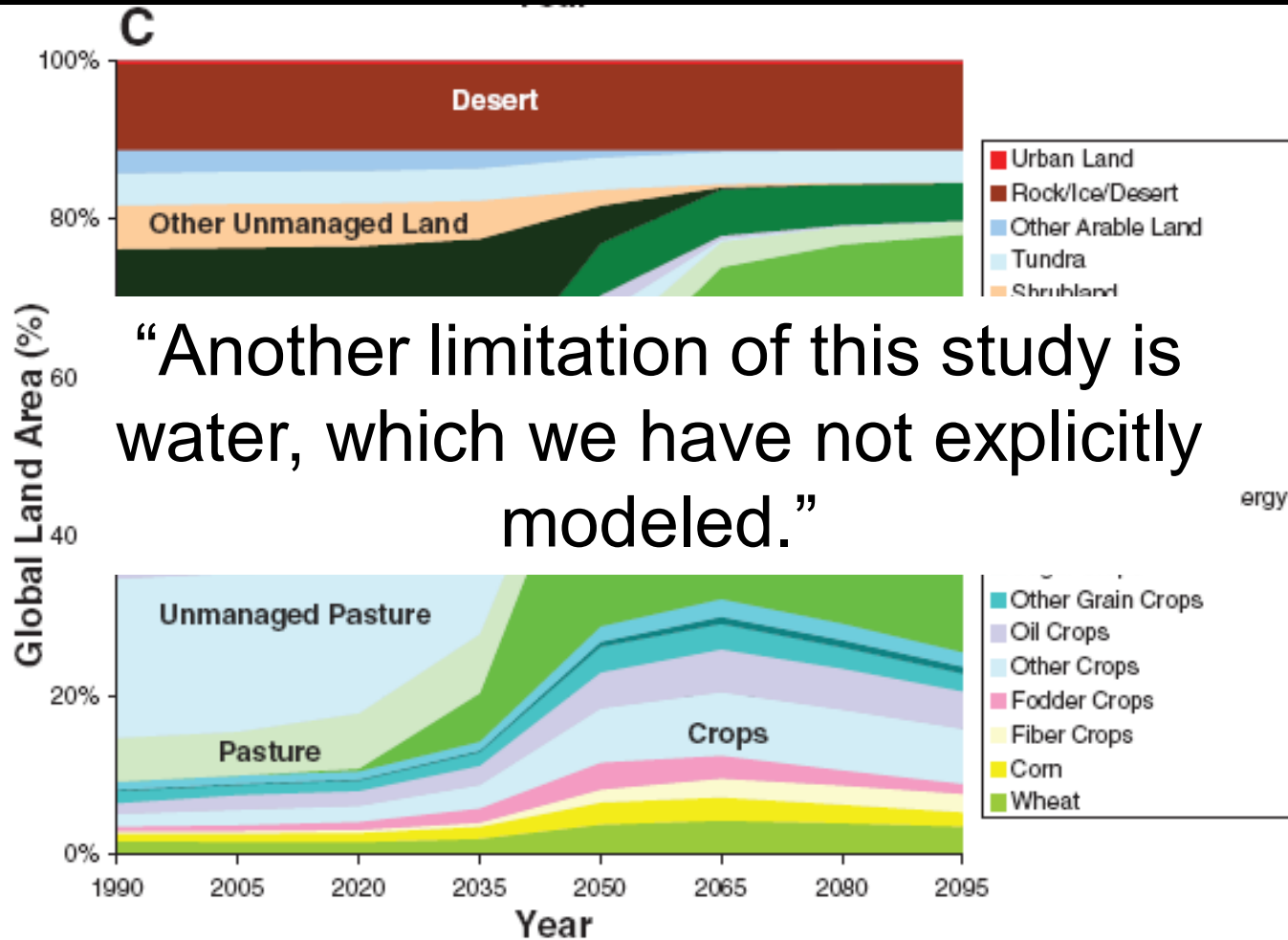


Global energy and GHG models predict wide variability in long term land use change



C tax:
fossil fuels
+
land use
change

Global energy and GHG models predict wide variability in long term land use change

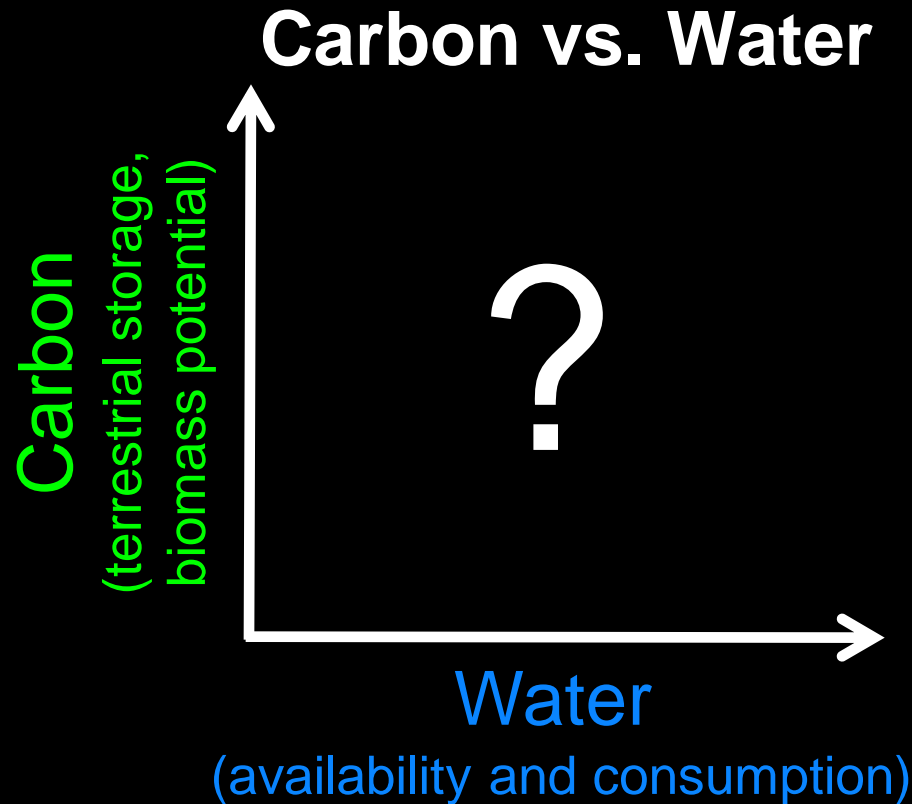


“Another limitation of this study is water, which we have not explicitly modeled.”

C tax:
fossil fuels
only



New data, modeling, and interpretation are needed



“If links between water use and carbon emissions/sinks can be articulated, funds from carbon markets might become available to improve water management.”



How should we think about end uses of water resources?

- **Food vs. fuel – water and land coupled**
 - **Research organizations focusing on rainfed biofuel feedstocks**
 - **Do we care what the crop is for or how the crop is grown?**
- **What % of available and consumptive water is “acceptable” for energy?**
- **Water footprints**
 - **Product-specific (gal/widget)**
 - industry, consumer
 - **Geographically-expanse (gal/watershed)**
 - government, NGO





Thank You



<http://www.jsg.utexas.edu/cieep>

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