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**Stacking Low Carbon Policies on the Renewable Fuels Standard: Economic and Greenhouse Gas Implications**


**Haixiao Huang, Madhu Khanna, Hayri Onal and Xiaoguang Chen**

**Energy Biosciences Institute, University of Illinois, Urbana Champaign**

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# Stacking Low Carbon Policies on the Renewable Fuels Standard: Economic and Greenhouse Gas Implications

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## Research Motivation

The Renewable Fuel Standard (RFS) is mandating the production of cellulosic biofuels and establishes thresholds for GHG intensity of biofuels. However, this does not create incentives to consume even lower carbon biofuels if they are more expensive.

A National Low Carbon Fuel Standard could be used to shift the mix of biofuels towards those with lower GHG intensity. However, its effects on total GHG emissions and fuel consumption are ambiguous.

In contrast to these policies, a carbon tax policy could achieve a reduction in GHG emissions and fuel consumption but is unlikely to incentivize high cost cellulosic biofuels.

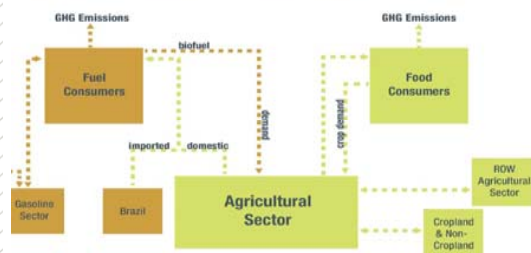
A mix of policies may therefore be needed to achieve the multiple objectives of energy security, GHG mitigation, and economic growth

## Research Questions

- To examine the economic and GHG implications of stacking the RFS with LCFS and carbon price policy
  - LCFS – 15% reduction in carbon intensity of fuel by 2035
  - Carbon price – \$ 20-\$65/ ton CO<sub>2</sub>
- To compare the performance of various policy combinations for food and fuel prices, fuel mix and fuel consumption.
- To analyze the economic costs and benefits of alternative policy combinations and their distributional effects for consumers and producers in the transportation and agricultural sector in the US.

## Methods

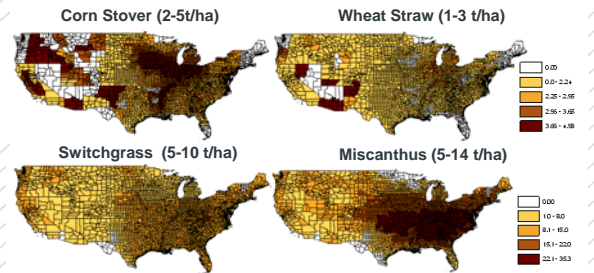
### Biofuel and Environmental Policy Analysis Model (BEPAM)



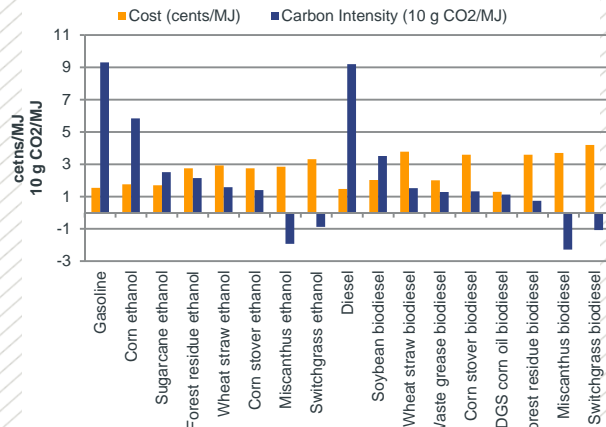
### Model Features

- Heterogeneity in returns to agriculture at crop reporting district level
- Crop, co-product, livestock and biomass markets
- First and second generation biofuels with endogenous learning by doing in production
- Open economy in crop and fuel sectors
- Life-cycle assessment of greenhouse gas emissions
- Welfare cost of policies

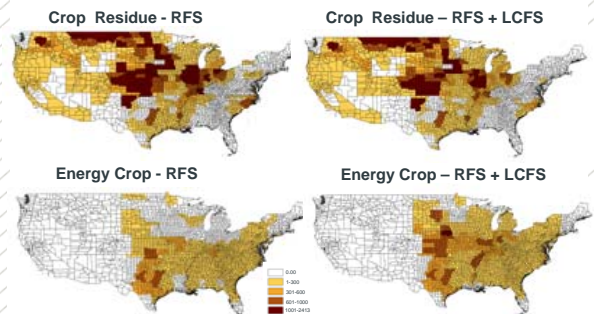
## Yields of Crop Residues and Energy Crops



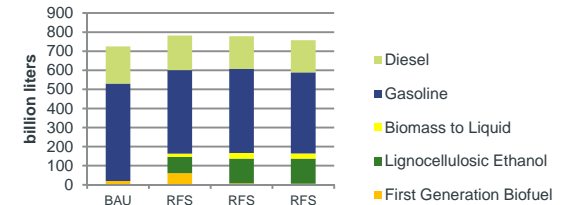
## GHG Intensity and Cost of Biofuel Production



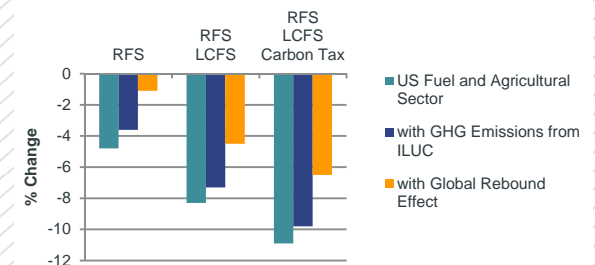
## Acreage under alternative policies in 2035 (1,000 acres)



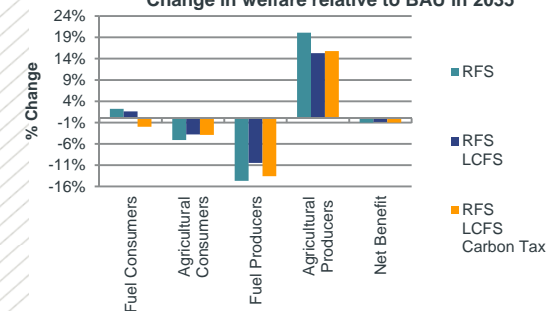
## Volumetric Mix of Fuels in 2035



## Change in emissions relative to BAU in 2035



## Change in welfare relative to BAU in 2035



## Conclusions

- The addition of a LCFS to the RFS can significantly change the mix of biofuels in favor of cellulosic ethanol and BTL
- Combining a carbon tax with the RFS and LCFS will increase GHG reduction and reduce fossil fuel consumption relative to the RFS alone
- All three policies lead to a marginal gain in net economic benefits due to improvements in the terms of trade for the US.

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