The Land and Water Implications of Biomass Co-Firing in the MISO region

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**Objectives**

- Investigate the heterogeneous potential of co-firing across coal-fired power plants in the MISO region
- Identify biomass supply zones for all coal-fired power plant and the generated extra benefit from corn production inside each supply zone
- Explore the induced land use changes to production of corn from other crops and the heterogeneity of land use changes across and inside the supply zones
- Investigate the further implications on nitrogen leaching to water system and heterogeneity of the implications across regions

**Motivations**

- Most states in MISO region created State Renewable Portfolio Standards that require power plants generate a certain portion of renewable and clean energy.
- Accordingly, power plants adopt certain practices, including biomass co-firing in coal-fired power plants.
- Due to the high transportation cost of biomass feedstock, the potential for co-firing at a given coal-fired power plant depends very much on the local availability of biomass.
- Corn residue is the most feasible biomass for co-firing in the MISO region, which, in turn generates extra benefit for corn production compared to production of other crops. The extra benefit motivates farmers to switch production from other crops to corn and results in cropland use changes and further implications on nitrogen leaching.

**Methods**

- Estimate supply functions of different types of biomass for each power plant
- Simulate the final demand of biomass for co-firing at each power plant using Power Planning and Operations Model
- Calculate market equilibrium of biomass and simulate land use changes induced by co-firing in different area using SIMPLE-on-a-Grid model

**Results**

- **Supplied quantity of biomass at $75/dry ton**
- Supply zones of corn residue for all coal-fired power plants
- Heterogeneous extra profits generated from biomass co-firing
- Heterogeneous cropland use changes
- Heterogeneous implications on nitrogen leaching to water system

**Data**

- Forest Inventory and Analysis (FIA) dataset
- USDA Cropland Data Layer (CDL)
- Parameters in literature