Level of Carbon Tax Required for Switchgrass and Miscanthus to Compete with Coal for Generating Electricity

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INTRODUCTION

Coal is the primary fuel used by the nation's electric power industry. Coal produces 36% of the carbon dioxide emissions from energy use [1].

Cofiring with cellulosic biomass is more efficient in reducing greenhouse gas emissions than when it is used for producing ethanol. Cofiring requires only minor modifications and minimal investments in existing plants [2].

A key decision to ensure a cost-efficient long term supply of biomass feedstock depends on the selection of species and management practices.

Switchgrass (*Panicum virgatum*) serves as a model dedicated energy crop. Miscanthus (*Miscanthus x giganticus*) is an alternative.

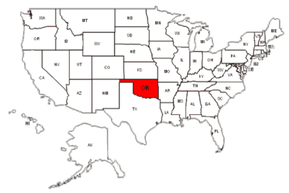
Biomass is more expensive than coal if the externalities of burning coal are ignored . A tax on CO_2 emissions could be used to incentivize cofiring with biomass.

OBJECTIVES

To determine the most economical species and harvest frequency (once or twice per year)

To determine the CO_2 tax required for either of the two candidate feedstocks to be an economically viable alternative for cofiring with coal to generate electricity

MATERIALS AND METHODS



Annual dry-matter yield and gross energy data were produced in side-by-side trials conducted in Stillwater Oklahoma.

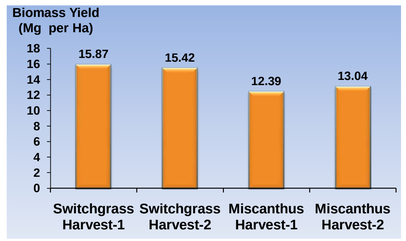
Fixed effects : Species and harvest levels
Random effects: Replication and year

Separate models were estimated with biomass yield and energy content as dependent variables using the MIXED procedure of SAS.

RESULTS

•Biomass yield differs across species. Annual yield is not enhanced by multiple harvest.

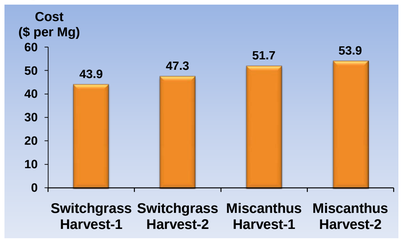
Fig 1. Biomass yield



•Switchgrass with a single annual post-senescence harvest produced more biomass than miscanthus.

•Energy production per land unit was greater with switchgrass.

Fig 2. Estimated cost to deliver biomass

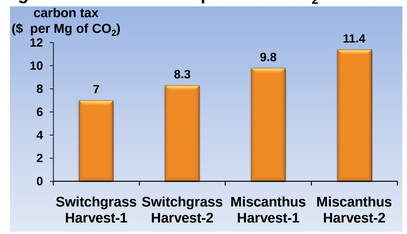


•For the U.S average coal price of $40 per Mg, the value of switchgrass biomass based on energy content is estimated to be $27 per Mg.

• The estimated cost to produce and deliver biomass a distance of 50 km was $44 per Mg for switchgrass and $52 per Mg for miscanthus.

RESULTS

Fig 3. Estimated tax imposed on CO_2 emission



•None of the treatment combinations would produce positive net revenue if the biomass price was based on energy content relative to coal.

•Among the treatment combinations, switchgrass with one harvest requires the smallest CO_2 tax to breakeven.

CONCLUSION

❑The best strategy for producing biomass in the region would be to establish switchgrass and harvest once a year after senescence.

❑Harvesting twice a year is not an economically viable cultural practice in the region for either species.

❑The carbon tax based on CO_2 emission, required for cofiring switchgrass biomass with coal to breakeven with using only coal is estimated to be $7 per Mg of CO_2.

❑The production of cellulosic biomass for cofiring is not financially viable without government intervention.

REFERENCES

[1] DOE/EIA. Emissions of green house gases in the United States. 2008. < http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/0573(2007).pdf>

[2] Fraas, A. and R. Johansson. Conflicting goals: energy security versus GHG reductions under the EISA cellulosic ethanol mandate. Discussion paper, Resources for the Future 2009.

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