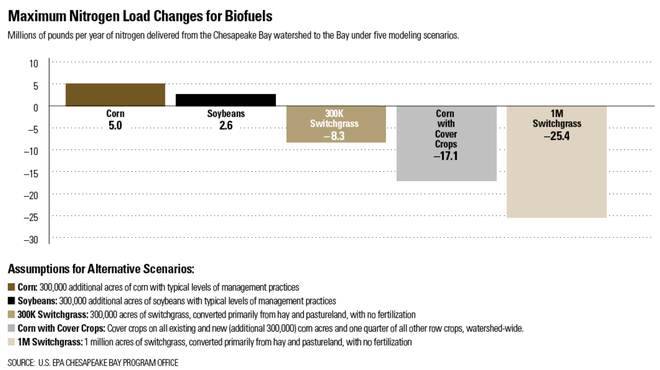
ASCENT # 1
Alternative Jet Fuel Supply Chain Analysis of the Mid-Atlantic

Motivation and Objectives

How much do we have to pay farmers to convert corn-soybean fields to switchgrass?

- Switchgrass provides environmental benefits compared to corn-soybeans
- Can payments for ecosystem services (PES) help generate the necessary biomass supply & market demand?



Methods and Materials

Model Features

- Dynamic optimization
- Net present value (NPV)
- Random shocks
- Crop yields
- Uncertain returns (risk)
- Conversion costs
- Reversible conversion decisions
- PES: $100/acre PES to farmers who convert to switchgrass based on the price Maryland paid for planting a rye cover crop (Woodbury et al.)

Simulated in MATLAB
Extends Song et al. (2011)

Summary

- Renewable jet fuels are 2-10 times more expensive than fossil jet fuel (de Jong et al. 2015)
- Farmers require about 50% more than the breakeven price to convert corn-soybean fields to switchgrass
- PES for growing switchgrass present an opportunity to start to close this price gap

Conclusions and Next Steps

- The foundation for market-based strategies to reduce both high biomass feedstock costs and water quality challenges for the Chesapeake Bay Region

Next Steps

- Range of subsidy values
- Targeted payments instead of uniform
- Conversion from other land uses such as marginal land
- Simulate conversion decisions across a landscape (such as the Chesapeake Bay watershed) using the estimated switching boundaries
- Link these simulated landscapes of switchgrass conversion to water quality models

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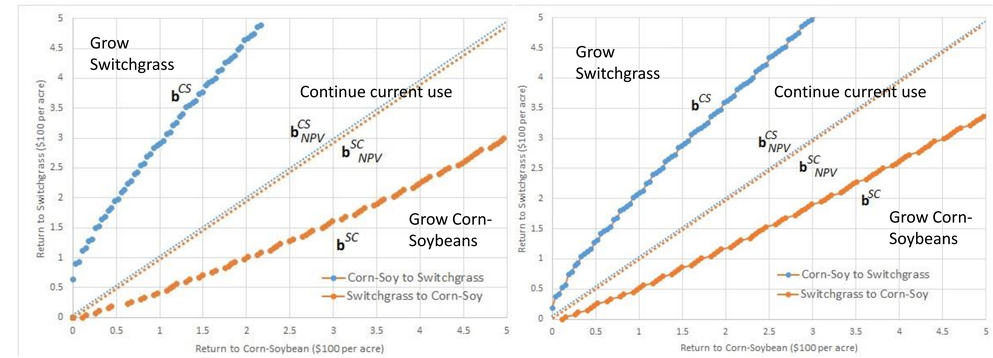
September 27-28, 2016

This work was funded by the US Federal Aviation Administration (FAA) Office of Environment and Energy as a part of ASCENT Project 1 under FAA Award Number: 13-C-AJFE-PSU-028. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA or other ASCENT Sponsors.

Results and Discussion

Net Present Value vs. dynamically optimal conversion boundaries



a. No subsidies offered **b. $100 per acre subsidy to grow switchgrass**

The real annual returns (Song et al. 2011) vs. the dynamically optimal conversion boundary

PES to grow switchgrass	Real annual returns for corn-soybeans	Real annual returns for switchgrass	Minimum return from switchgrass needed to convert from corn-soybean to switchgrass
$0	$230/acre	$337/acre	$512/acre (or $10.22/GJ)
$100	$230/acre	$337/acre	$399/acre (or $7.92/GJ)

Farmers must receive higher returns than the breakeven returns to convert to switchgrass.

A $100 subsidy to grow switchgrass lowers the returns needed to incentivize conversion to switchgrass by $113.

Due to risk, uncertainty, and the option value.

References
- Chesapeake Bay Commission. 2010. Chesapeake biofuel policies: Balancing Energy, Economy and Environment. Available at: http://www.chesbay.us/Publications/biofuels%20report%20v3.corrected.pdf
- de Jong, S., R. Hoefnagels, A. Faaji, R. Slade, R. Mawhood, M. Junginger. 2015. The feasibility of short-term production strategies for renewable jet fuels – a comprehensive techno-economic comparison. *Biofuels, Bioproducts and Biorefining* 9.6 (2015): 778-800.
- Song, Feng, Jinhua Zhao, and Scott M. Swinton. Switching to perennial energy crops under uncertainty and costly reversibility. *American Journal of Agricultural Economics* 93.3 (2011): 764-779.
- Woodbury, P., A.R. Kemanian, M. Jacobson, and M. Langholtz. Improving water quality in the Chesapeake Bay using payments for ecosystem services for perennial biomass production. (Under Review)