Biomass producer decision making: direct and indirect transfers in different spheres of interaction

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Outline

- Motivation
- Objectives
- Approaches
  - Conceptual framework
  - Case study: Corn stover for ethanol in Iowa, USA
- Key findings
- Summary

Motivation

- Inconsistency between the boundaries defining an agent’s decision space and consequence space
- Interest of stakeholders in various scopes of impacts
- Needs for more comprehensive assessments of impacts

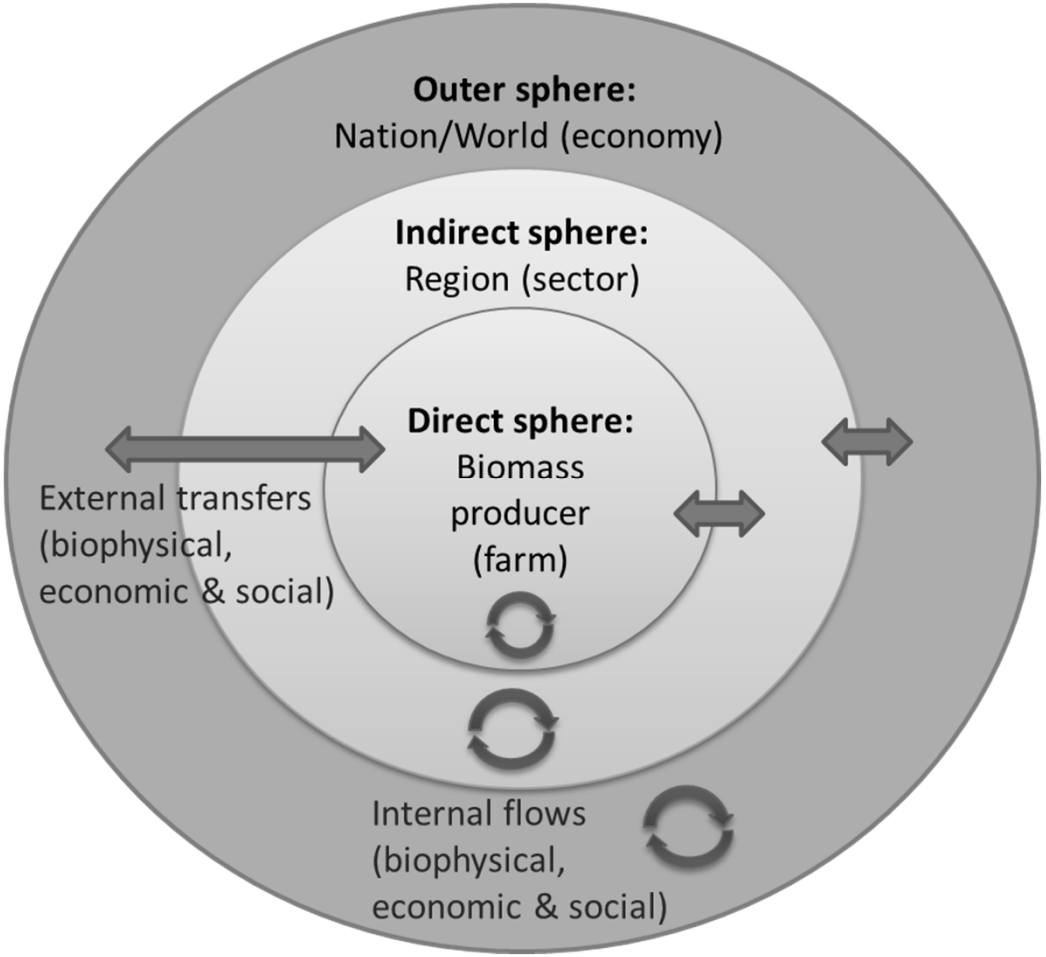
Objectives

- To develop a conceptual framework for measuring direct and indirect impacts of biomass and bioenergy development

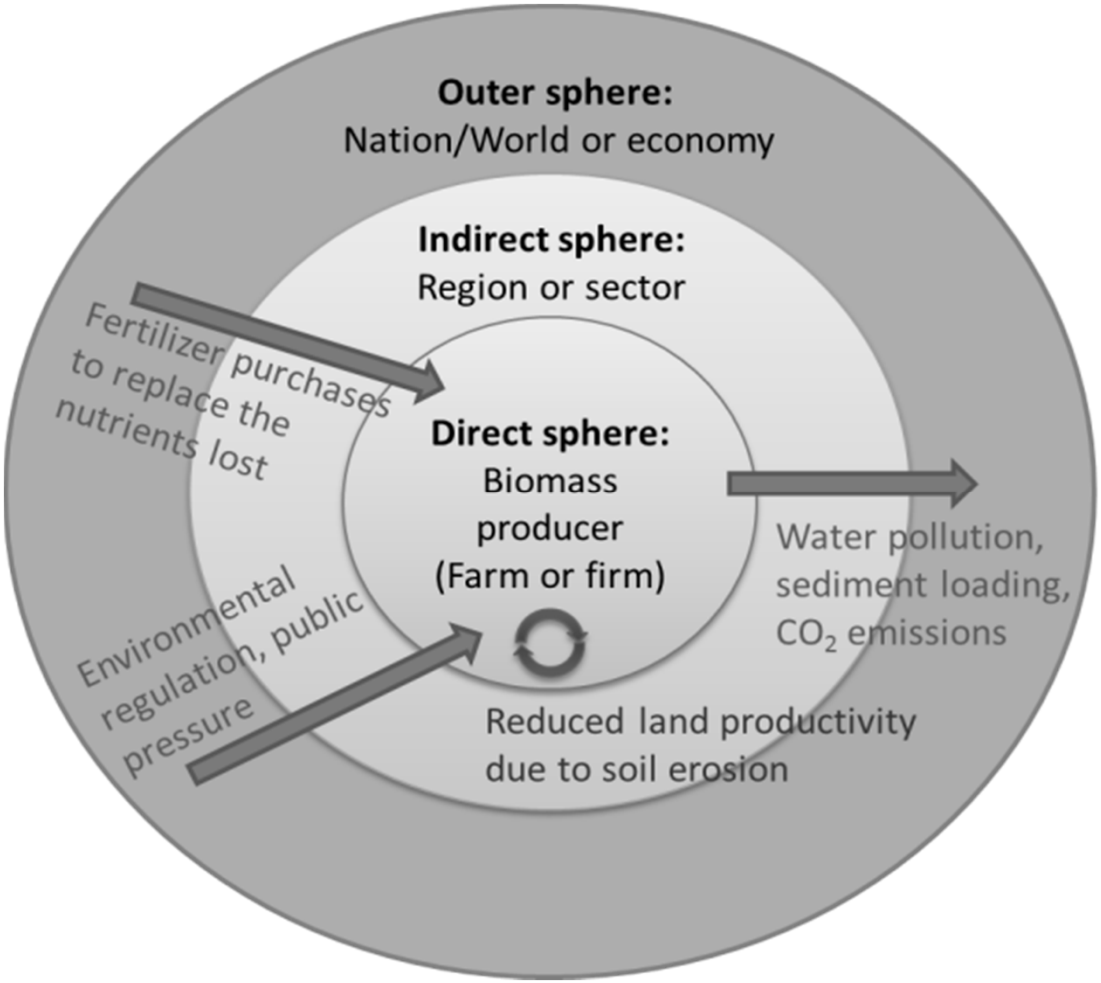
- To apply the framework to a case study to illustrate its applicability and identify ways for improvement

Approaches

Conceptual framework

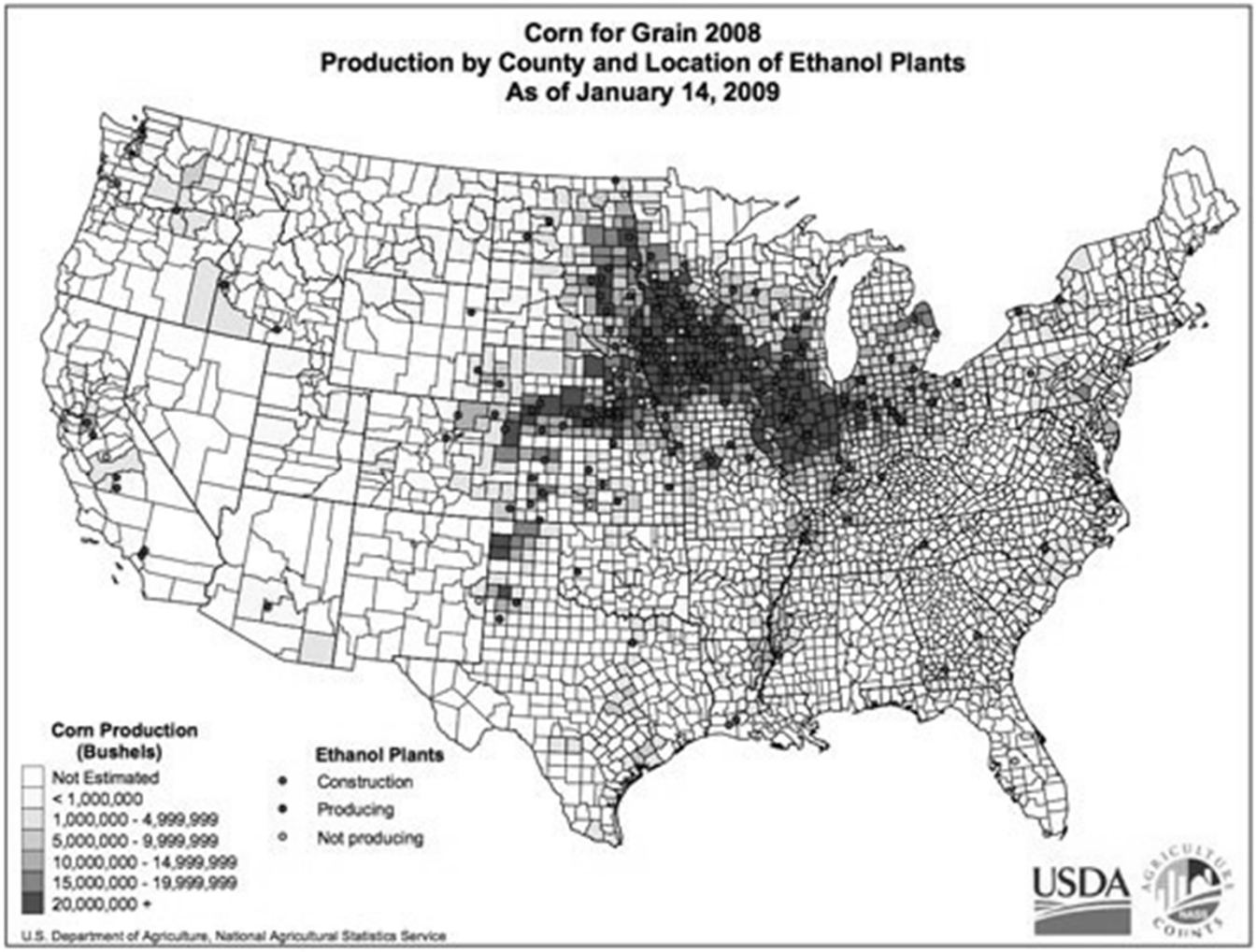


Example: Soil erosion caused by residue removals

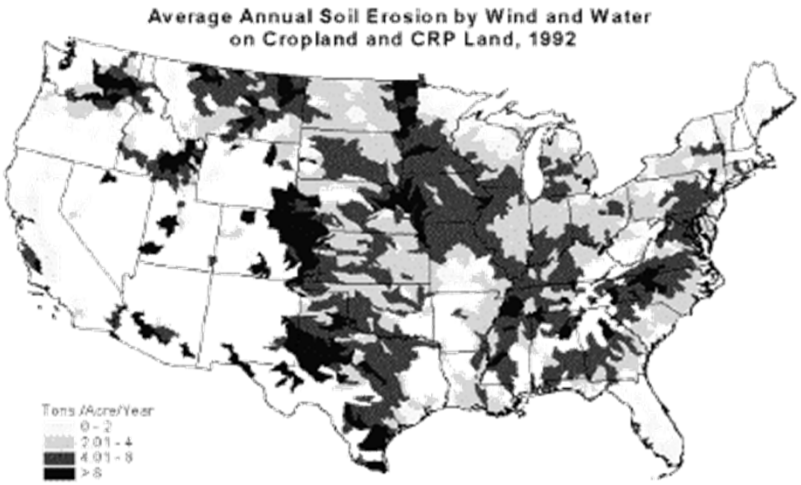


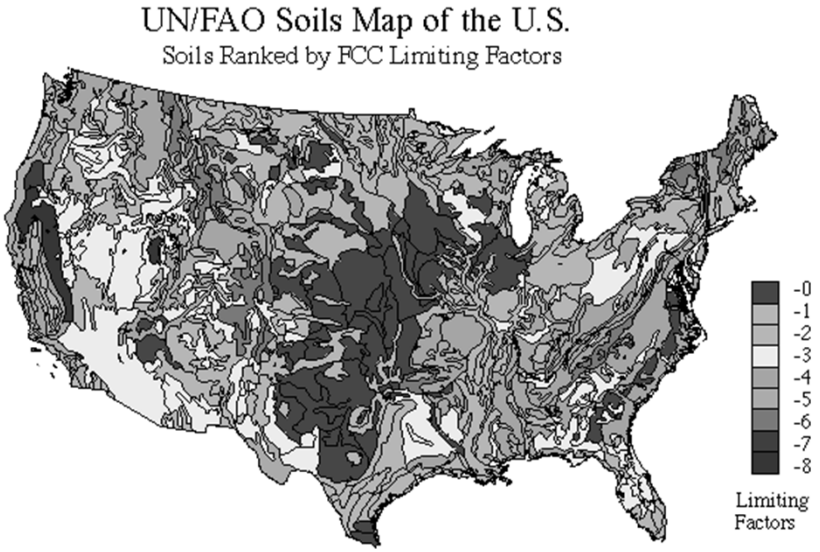
Study case

- LIBERTY project: corn stover ethanol plant in Palo Alto County, located in Northwest Iowa (in the heart of the corn belt), USA.



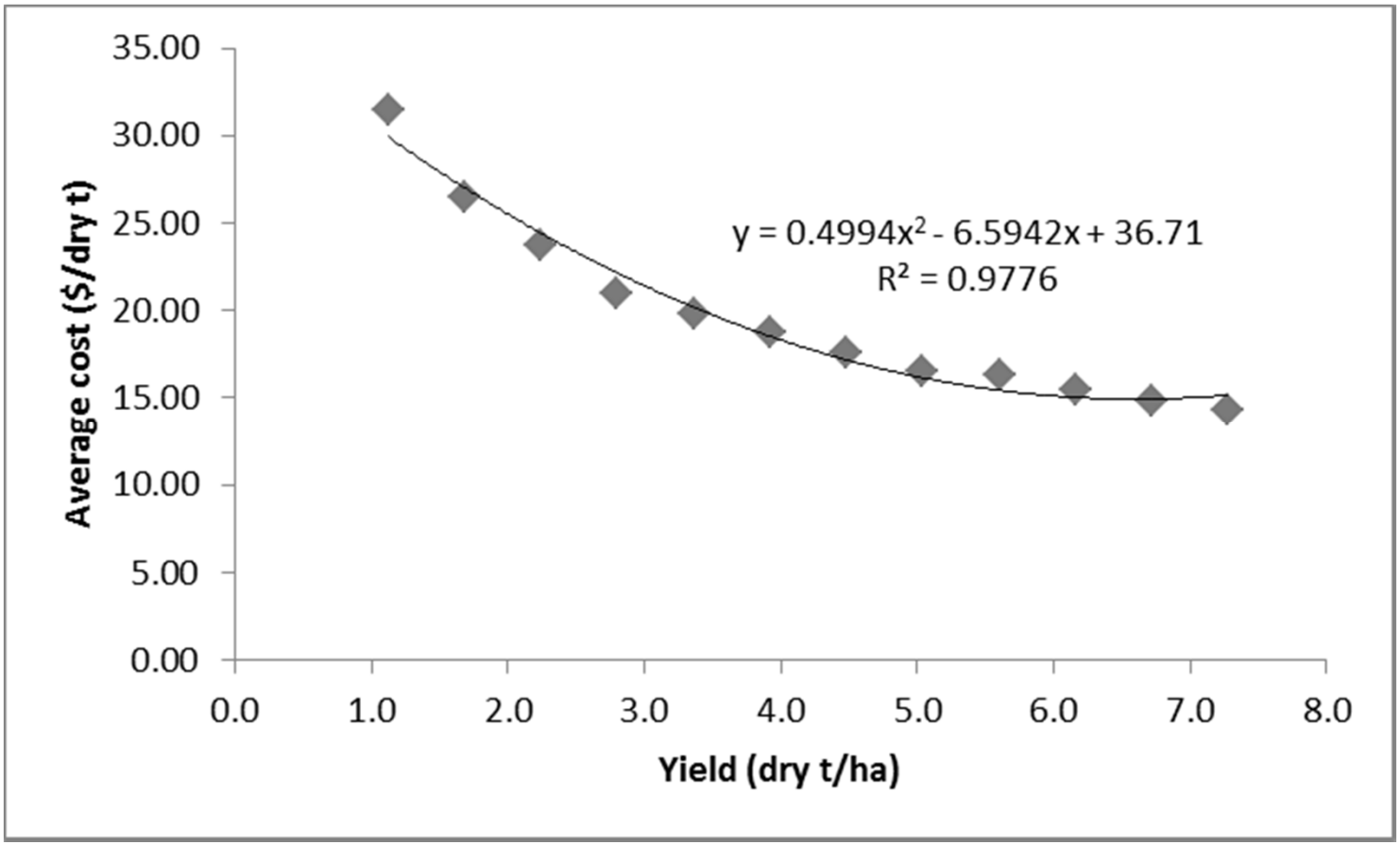
Soil erosion risk and limiting factors





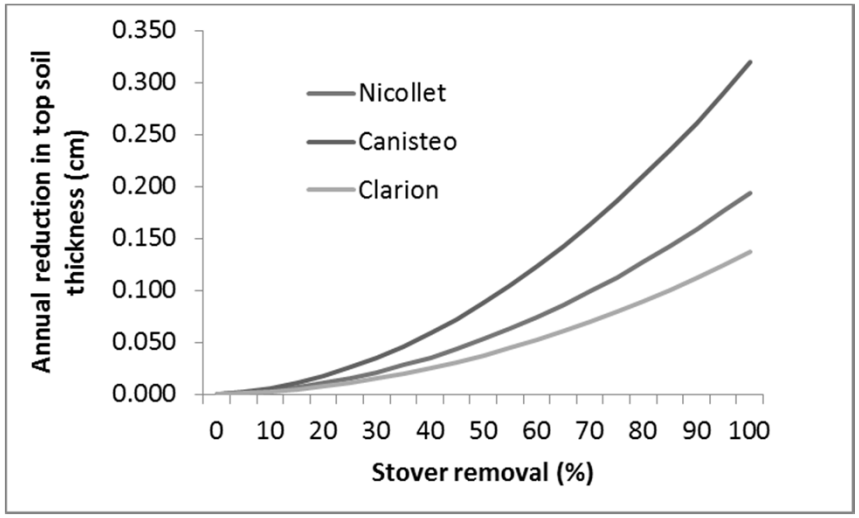
Key findings

Stover harvesting cost

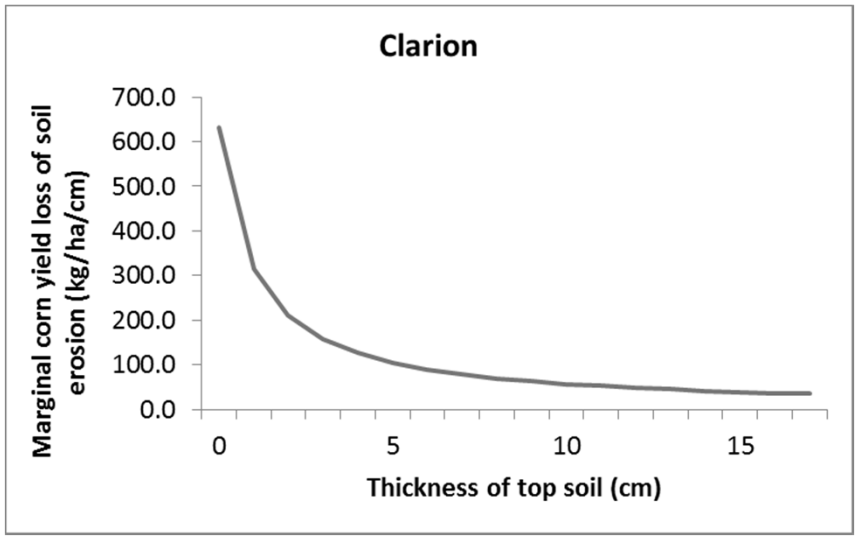


Stover removal, top soil loss, & crop yield

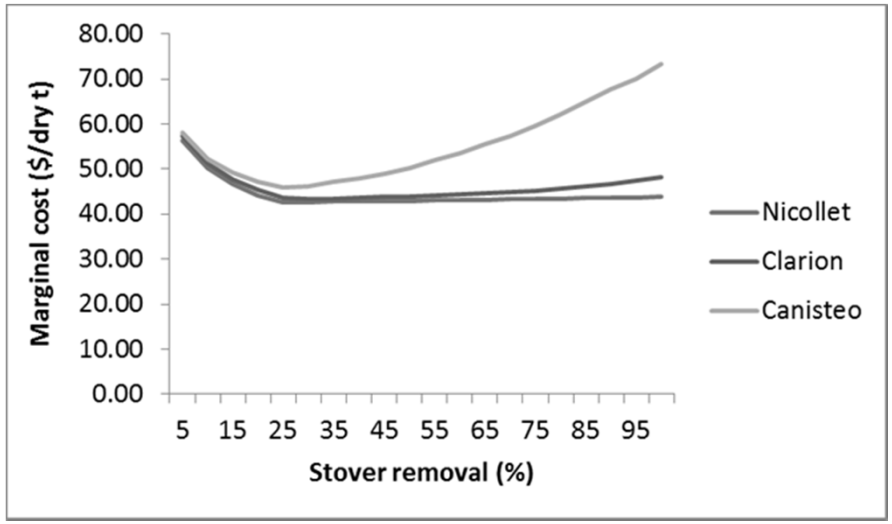
Top soil loss vs. stover removal intensity



Crop yield vs. top soil thickness



Total marginal cost of stover removal



- Marginal cost decreases first and then increases as more stover is removed.
- Soil conditions are a critical factor for determining stover removal intensity.
- For the study case, stover removals from Nicollet and Clarion soil series do not seem to be a problem, yet stover removals from Canisteo should be cautious or prevented.

GHG offsets & energy security premium

GHG offsets:

2.17 kg CO_2-e L^{-1} ethanol

National energy security premium:

US$0.13 L^{-1} ethanol

Multipliers of producing ethanol from corn stover in Palo Alto County, Iowa, USA

Sphere	Value ($ L^{-1})	Multiplier I	Multiplier II
Direct sphere (Farm)	0.19		
Indirect sphere (Region)	0.42	3.23	
Public sphere (Nation)			
Energy security premium	0.13		
GHG offset value @ following CO_2 price (US$ t^{-1})			
5	0.01		3.99
10	0.02		4.05
15	0.03		4.11
20	0.04		4.16
25	0.05		4.22

Summary

Summary

- An increase in stover removal intensity reduces biomass procurement cost, yet increases soil erosion risk.
- Distributional effects of producing biofuels from corn stover vary across stakeholders.
- High multipliers suggest that producing ethanol from corn stover in the study region would benefit stakeholders in the indirect and outer spheres more than corn farmers.
- Multiplier II is sensitive to energy security premium and GHG price.

Implications

- The amount of stover actually supplied could differ significantly from the amount physically available given the indirect costs/benefits considered by stover producers.

- Incentives to stover producers are recommended given the benefits accrued to the indirect and outer spheres.

- Availability of other energy sources (e.g. shale gas) could affect GHG emissions and energy security concerns, thus changing the multiplier values.

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