Demand for Small Scale Bio-Energy Technology: Opportunities for Agricultural & Energy Policy Integration

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Big Sky Carbon Sequestration Partnership

Overview

- Terrestrial Carbon Sequestration
- Small Scale Bio-Energy Production Technologies
- Benefits of Biodiesel
- Modeling the Small Scale Producer's Decision
- Agricultural Policies
- Energy Policies
- Opportunities for Future Policy Integration

Terrestrial Carbon Sequestration

MONTANA STATE UNIVERSITY

Mountains & Minds

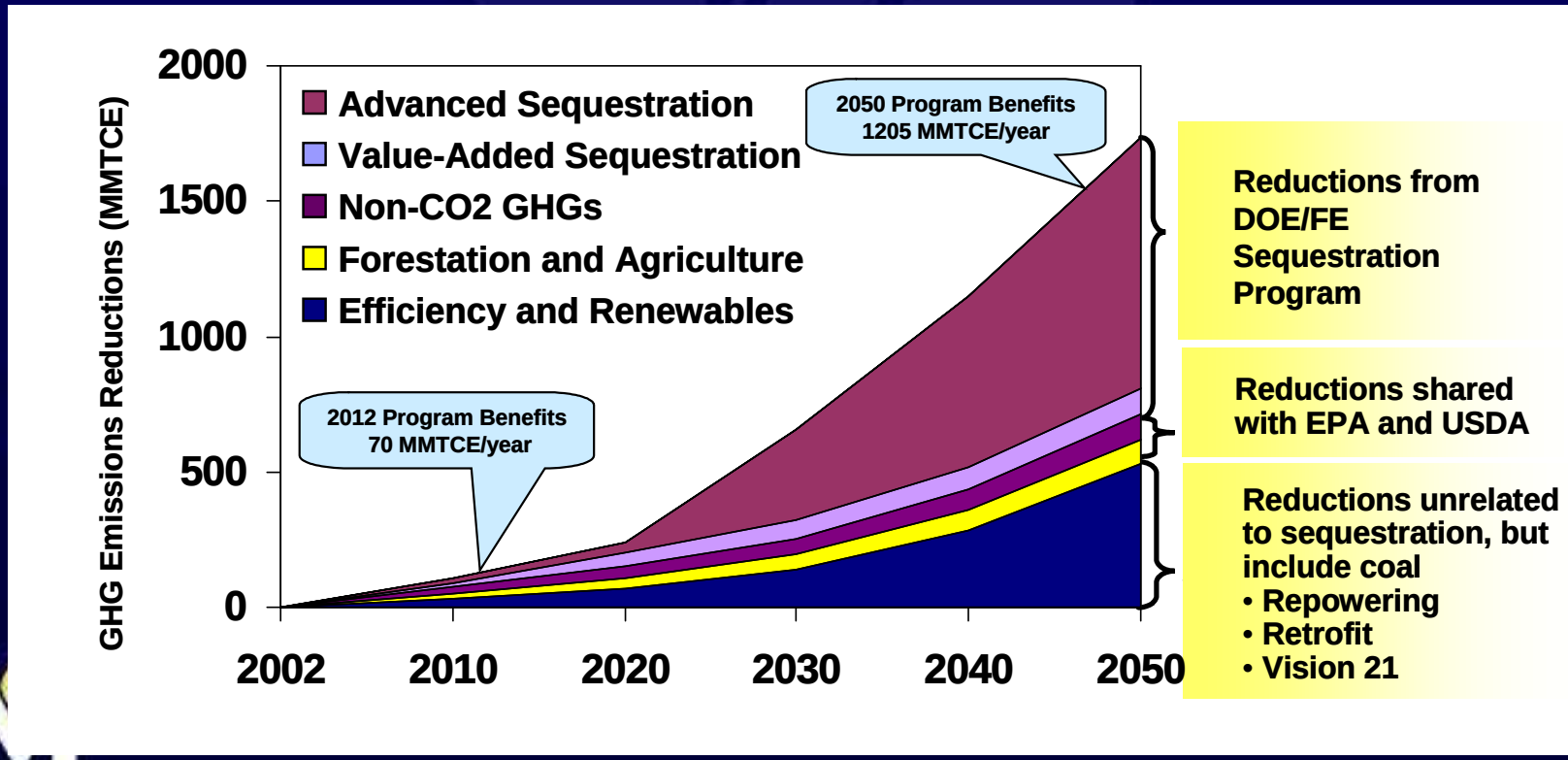
A Growing Case for Carbon Sequestration

- GCCI goal to lower GHG intensity
  - 18% improvement by 2012
- CO_2 Regulation at state, regional, National levels
  - Voluntary CO_2 requirements
- Renewed emphasis on U.S. coal
  - Electric power generation
  - Feedstock for hydrogen economy
  - FutureGen
- Carbon Sequestration provides a means to achieve both energy security and environmental goals
- IPCC Feb 2007 report
- Terrestrial sequestration is a bridge and has critical role

Sequestration = Stabilization

Could account for >60% of reduction gap in 2050

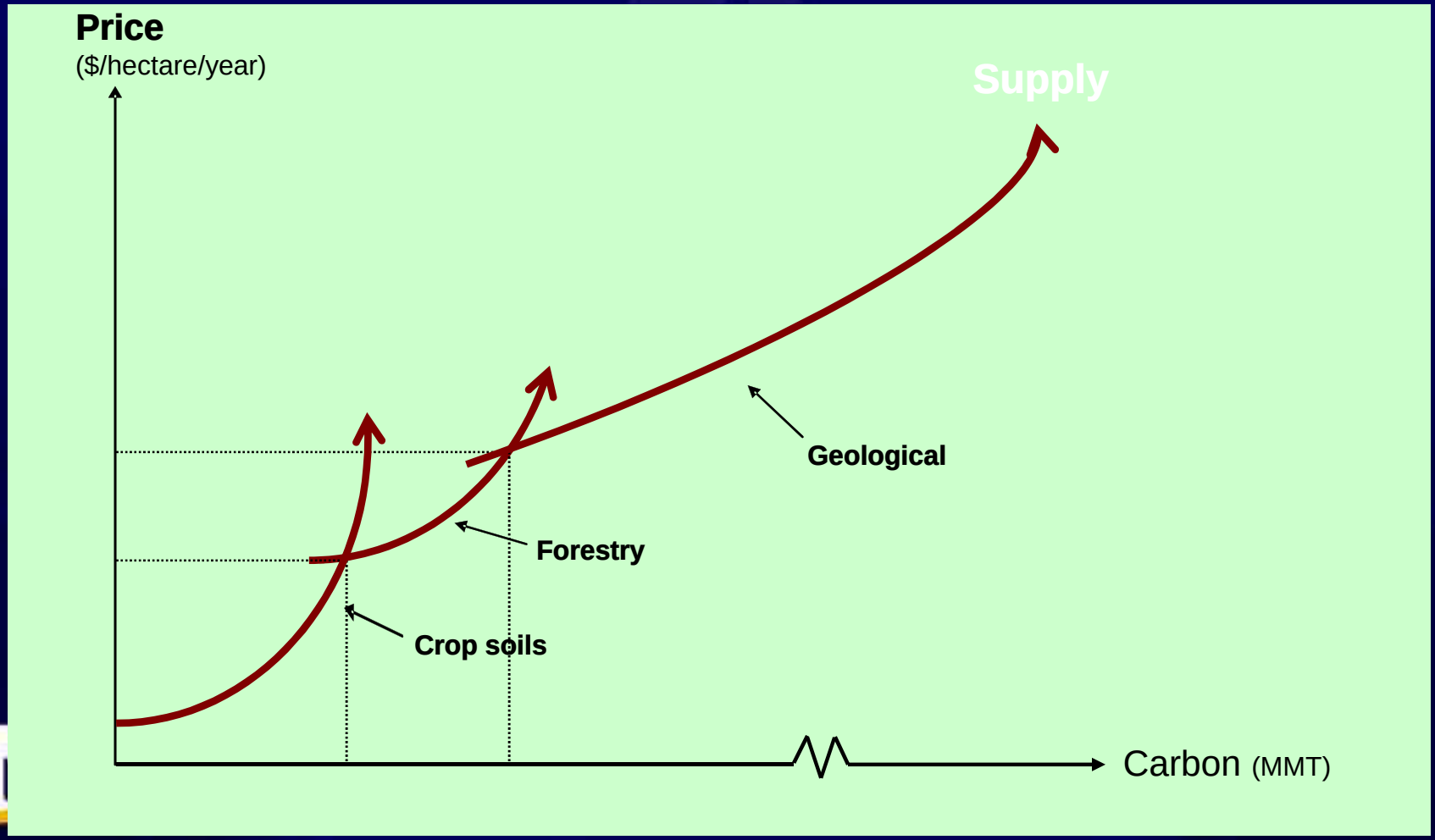
Key point: Forestry and Ag are important, especially in near term



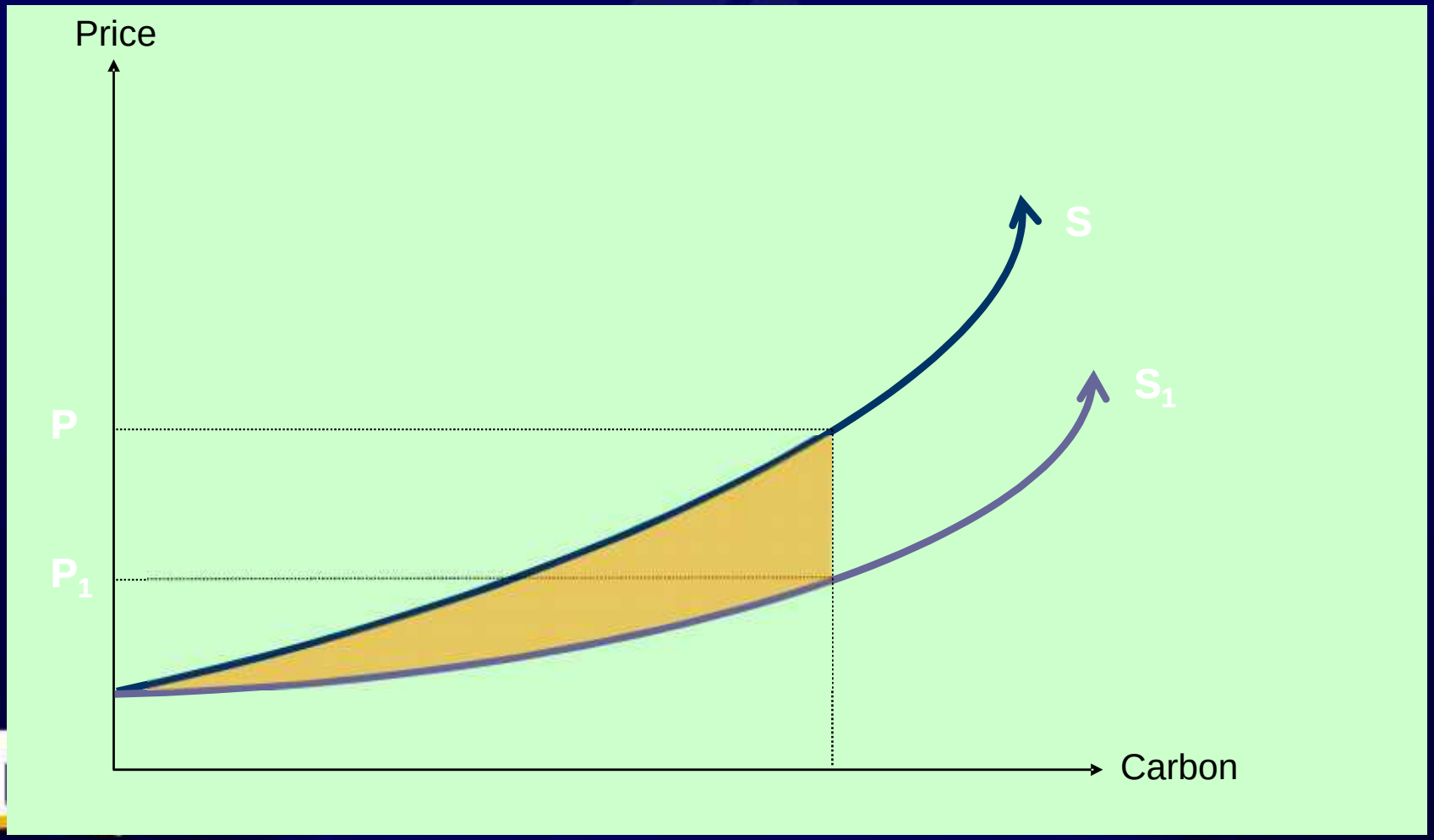
Background on the Big Sky Carbon Sequestration Partnership at Montana State University

- One of seven DOE-funded partnerships
- Partnership Goal: Develop infrastructure to support and enable future carbon sequestration field tests and deployment (regional orientation)
- Coalitions of professionals, and industry that represent regional interests and serve as driving force for carbon sequestration projects
- Phase I: 2003-2005 scoping/screening effort – carbon atlas
- Phase II: (i) Deployment of sequestration field validations, terrestrial and geological and (ii) economic assessments of sequestration options and opportunities for CO_2 emission offsets

Regional Carbon Supply Curve



Shaded Area: Benefits of Lowered Costs of Sequestration



Carbon Emissions and Small Scale Bio-Energy Opportunities

- Carbon emissions reductions and carbon sequestration are two methods to reduce green house gases
- They may have complementary elements
- Agricultural operations may contribute in both ways

Small Scale Bio-Energy Production Technologies

- Two General Categories
  - Electrical Energy Production Technologies
    - Wind
    - Solar
    - Bio-based oil fired generators
  - Transportation Energy Production Technologies
    - Strait Vegetable Oil (SVO)
    - Biodiesel

Small Scale Biodiesel Production Technology

- Process Overview
  - Three Inputs:
    - Vegetable Oil
    - Alcohol
    - Catalyst
  - Two Outputs:
    - Biodiesel
    - Glycerin (crude)

Vegetable Oil Sources

- Oilseed Crops Vary by Region

• Soybeans	Midwest
• Cottonseeds	South
• Canola/Rapeseed	Northern Great Plains
• Camelina	Northern Great Plains
• Safflower	Northern Great Plains
• Sunflower	Northern Great Plains
• Mustard	Northern Great Plains

Benefits of Biodiesel

- Potential impact of widespread adoption of small scale biodiesel production:
  - Decrease fuel requirements for transportation
    - Lower production of products with off farm markets
      - Example: Acres shifted from wheat to oilseed production are no longer producing crops that need to be transported to an off farm market.
  - Petroleum diesel fuel is replaced by biodiesel
    - Life cycle analysis of petroleum diesel vs. biodiesel has been completed by the U.S. Departments of Agriculture and Energy

Life Cycle Analysis

- Key assumptions
  - Biodiesel
    - Includes analysis of soybean production, transportation, processing, conversion, transportation and end use
    - Based on industry averages for each process
  - Petroleum diesel
    - Includes crude oil extraction, transportation, refining transportation and end use
    - Bases on industry averages for each process

Life Cycle Analysis

- Replacing Petroleum Diesel with Biodiesel
  - CO_2 emissions: reduced by 78%
  - Particulate matter: reduced by 32%
  - CO emissions: reduced by 35%
  - Nitrogen oxide emissions: increased by 13%

Life Cycle Analysis

- Replacing 1,000 gallons of Petroleum Diesel with Biodiesel
  - CO_2 emissions: reduced by 16,120 lbs.
  - Particulate matter: reduced by 5 lbs.
  - CO emissions: reduced by 55 lbs.
  - Nitrogen oxide emissions: increased by 15 lbs.

- Source: National Biodiesel Board

Modeling the Producer's Biodiesel Production Decision

A producer maximizes expected utility of profits from their operation:

p_i = expected price or value of the crop

q_i = per acre yield

L_i = land allocated to the i'th crop

Gross "revenues" for the i'th crop = $L_i\ p_i\ q_i$

$c_i = c(q_i)$ = total cost of producing the i'th crop

s_i = subsidy per unit of output

$$\text{Maximize } E\ U\{\ \sum\{L_i\ (p_i + s_i)\ q_i - c\ (q_i)\}\}$$

subject to $L = \sum L_i$, and other relevant constraints

Modeling the Producer's Biodiesel Production Decision

- Examining: Expected Return of Crop N
  - Quantity Produced is a function of Land Area, Weather, Variety, Soil Quality, Fertilizer, Pesticides, and other Inputs
  - Value per Unit is assumed to be the higher of the market price or value of the unit further processed on farm
  - Cost of Production is a function of Capital Costs (land, equipment) and Variable Input Costs (seed, fertilizer, fuel, labor)
  - Impact of future production represents possible benefits (break disease cycle, improved soil quality) or costs (decreased soil quality, adverse effects on yields of other crops in the rotation)

Modeling the Producer's Biodiesel Production Decision

- Government Subsidies that Matter are Subsidies Linked to Current Production:
  - Crop Insurance Subsidies
  - Loan Deficiency Payments
  - Tax credits for Bio-Fuel Production and Use
- Government Subsidies that Don't Matter (a lot) are Subsidies based on Historical Production:
  - Direct Payments
  - Counter cyclical payments
- Conservation Reserve Program Payments are payments for another "crop"

Modeling the Producer's Biodiesel Production Decision

- If the expected utility of profits is increased by including a crop for biodiesel production:
  - Development of a large number of small scale biodiesel producers is feasible
  - Acres of crop production for non-biodiesel crops will be shifted to crops suitable for biodiesel production
- An expected utility framework is one approach to accounting for risk in the farmer's production decision

Current Agricultural Policy

- Output Related Commodity Programs
  - Loan rate programs (wheat, corn, soybeans, barley, oats, grain sorghum, cotton, rice, peas, oilseeds, lentils, small chickpeas, honey, wool)
  - Federal Crop Insurance
  - Not all of these programs are available for all oilseeds (e.g., camelina)
- Other USDA Policy Programs (Examples)
  - USDA NRCS Conservation Innovation Grant Program
  - USDA Renewable Energy Systems & Energy Efficiency Improvements Program
  - USDA Valued-Added Producer Grant Program

Current Energy Policy

- Policy Examples
  - Biodiesel Blenders Tax Credit ($1.00/gallon)
  - Small Producer Tax Credit ($0.10/gallon)
  - Renewable Fuels Standard
  - Alternative Fuel Infrastructure Tax Credit

Future Policy Issues

- Some policies overlap; some don't (for example, CRP)
- Some policies are targeted to processors and stimulate demand for bio-energy crops but do not provide direct incentives for crop production
- Some agricultural interest groups are opposed to further demand-oriented subsidies for bio-energy production (i.e., livestock producers and processors)
- Future carbon policies (for example, carbon reduction subsidies and/or taxes) may increase expected returns from bio-energy crops

QUESTIONS?