Nicholas Institute for Environmental Policy Solutions
Duke University

Energy and Climate Policy and the Economics of U.S. Agriculture

Brian C. Murray

Director for Economic Analysis, Nicholas Institute for Environmental Policy Solutions;
Research Professor, Nicholas School of the Environment
Duke University

USDA Agricultural Outlook Forum 2010
Arlington, VA
February 19, 2010

Nicholas Institute for Environmental Policy Solutions
Duke University

Acknowledgments

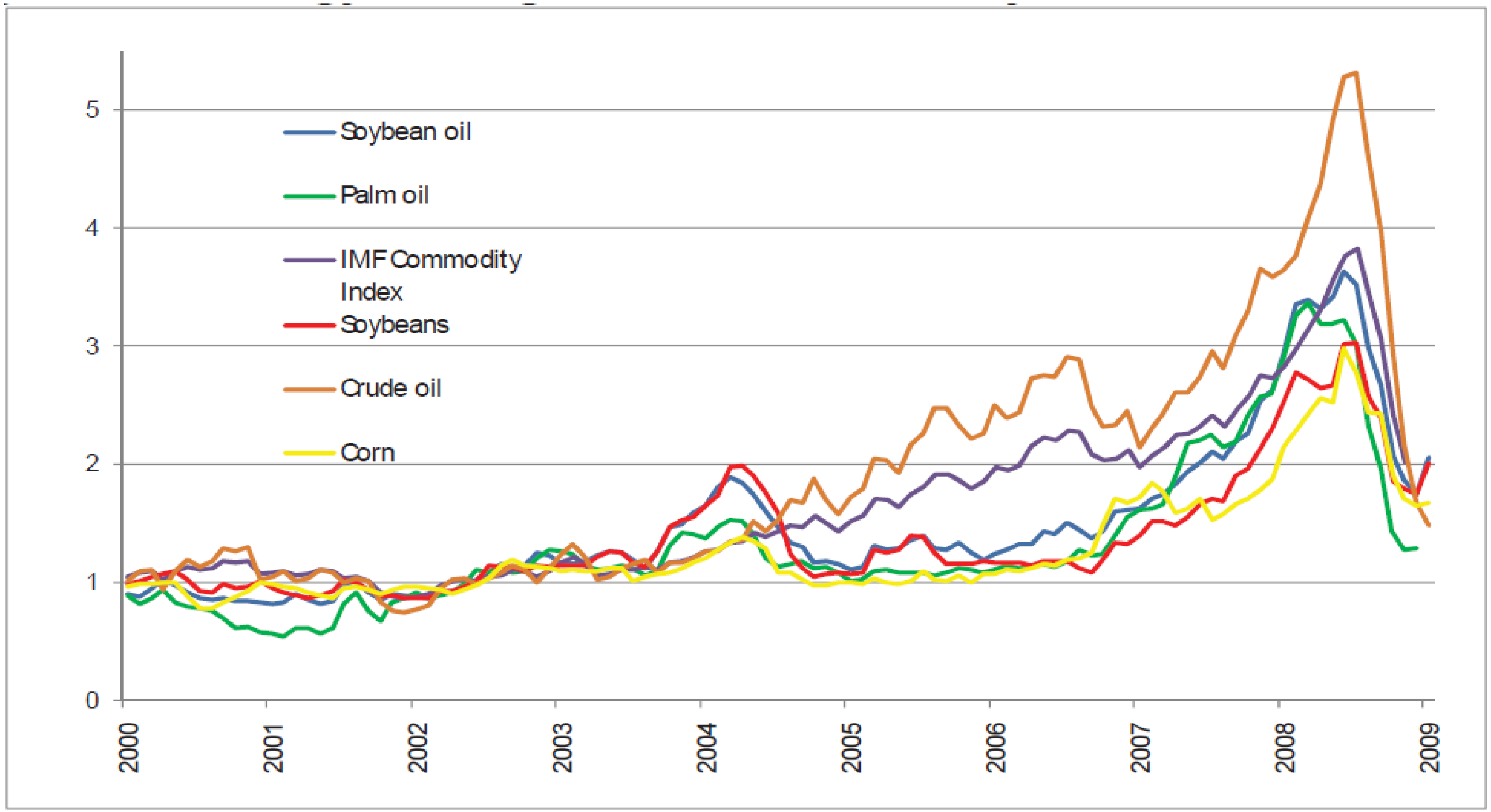
- Justin Baker, Duke and Texas A&M
- Bruce McCarl, Texas A&M
- Rest of FASOMGHG modeling team (Oregon State, EPRI, USDA, EPA)
- USDA Office of Chief Economist/Global Change Program

Overview

- Current Landscape
  - Agriculture and Energy Markets
  - Climate and Energy Policy
- Overview: Agriculture under Cap-and-Trade
  - Potential costs and benefits of mitigation
  - Review of recent studies
- Focus: Duke/TAMU/OSU study
- Conclusions and caveats

Nicholas Institute for Environmental Policy Solutions
Duke University

Energy and Agricultural Prices Run Together



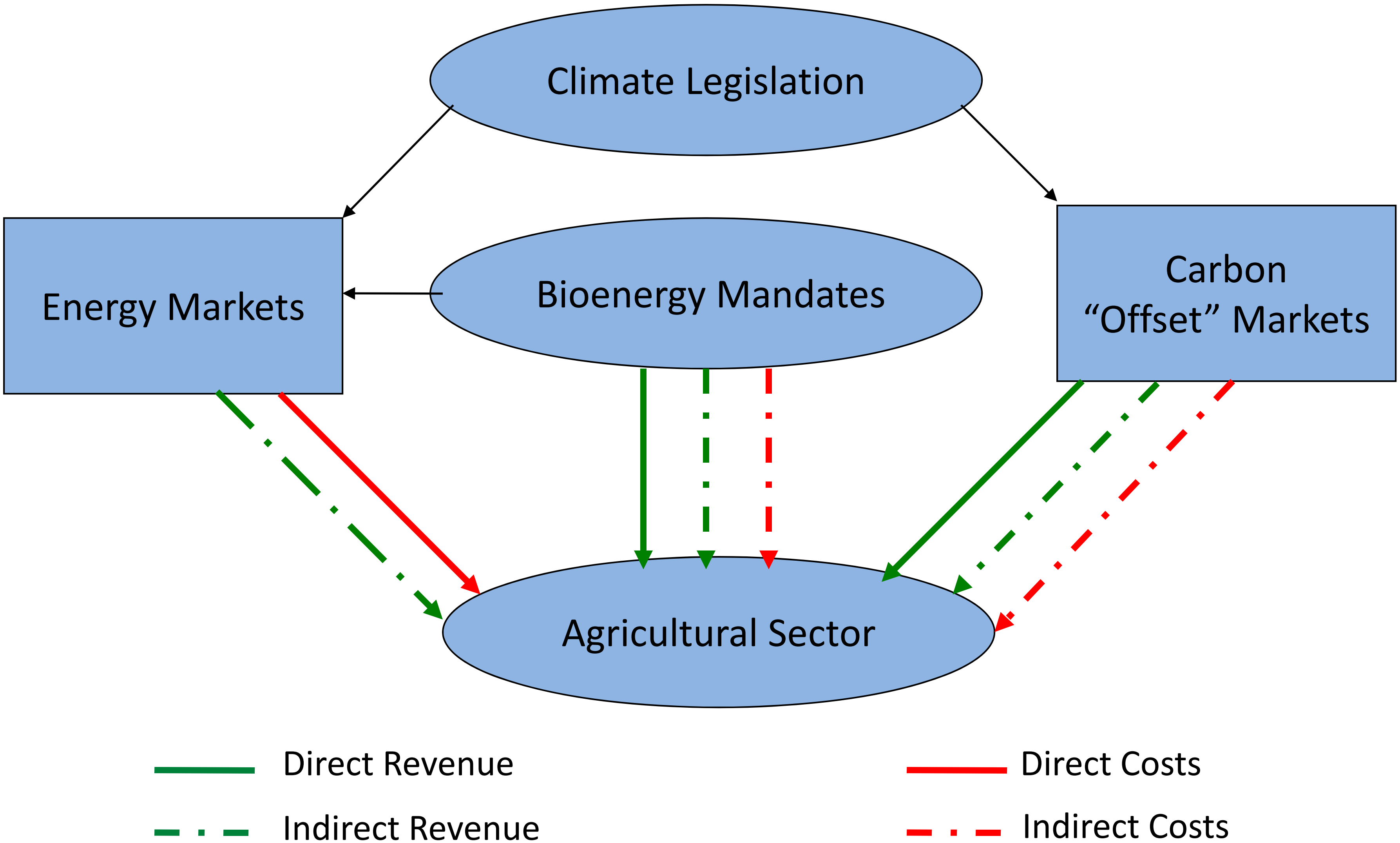
Source: International Monetary Fund, *International Financial Statistics.*
* Commodity prices and indices are normalized to equal 1.0, on average, for 2002.

•Biofuel expansion, renewable energy policies reinforce this link

Reported in Abbott et al 2009

Nicholas Institute for Environmental Policy Solutions
Duke University

Policy Interactions and U.S. Agriculture



"Cap and Trade"

- **Cap:** An absolute limit on GHG emissions allowed during a period
  - Regulated sectors are capped; others are not
  - The cap creates a new currency: emission allowances
- **Trade:** Capped parties are allowed to bid among themselves for the "allowances"
- **Bidding**
  - Auctioned by the government
  - Allocated for free ("grandfathered") and traded in a market
- **Advantages**
  - Efficiency
    - Price on GHGs: economic incentive for continued reductions
    - Least cost way to achieve a given emission target
      - Those who can reduce emissions more cheaply will trade their allowances to those for whom it is more expensive
  - Equity: Polluter Pays

Cap-and-Trade:
How it Affects U.S. Agriculture

- **Direct Positive (or neutral)**
  - Agriculture/forestry is ***exempt from the cap***
    - No direct limits put on farms or livestock
  - Can supply offsets to capped sectors if it is profitable to do so
    - Ag soil management, manure management, afforestation, …
  - A successful climate policy (globally) avoids potentially severe threats to agriculture
- **Direct Negative**
  - Input supply sectors ***are*** capped
    - Fuels
    - Electric power
    - Ag chemicals
  - This raises input costs

Other Impacts to Consider

- **Indirect: Behavioral/market responses**
  - Modify production/practice decisions in response to input price changes driven by carbon price
  - Engage in offsets to receive carbon payments
  - Increased output prices
  - Costs pass down through the value chain (feed -> livestock -> processed goods -> consumers)

What are the Net Economic Impacts of Federal Cap-and-Trade on Agriculture?

- Initial studies emphasize cost impacts…

1. Doane Advisory Services (2008)
   - Cost side only
   - Input costs impacts of C&T would cause a loss of $8 billion by 2020
2. FAPRI
   - Analysis for Missouri production
     - 4-10%/acre increased production costs
3. USDA (2009) initial study
   - Projects cost increases
     - 2%, 4%, and 10%/acre for short, medium and long term
4. Texas A&M (Outlaw et al)*
   - Output price effects are measured
   - Farm-level analysis
   - Out of 98 farms:
     - 71 see decreased returns, 27 gain

* Different study than the one discussed below, which also has Texas A&M collaborators

More recent studies incorporate offset suite and output price effects

- UTENN-25x25 Study
  - Net returns to agriculture are positive and exceed baseline projections for 8 of 9 crops analyzed
  - No afforestation of major shifts in cropland use for carbon prices up to $27/tCO$_2$
- Updated USDA (2009b)
  - Net returns positive for agriculture
    - Annualized gains of ~$20 billion
    - Offset potential in excess of $30 billion by 2050

Nicholas Institute for Environmental Policy Solutions
Duke University

“The Effects of Low-Carbon Policies on Net Farm Income”

NI/TAMU et al Modeling Effort
WORKING PAPER*

Justin S. Baker
Bruce A. McCarl
Brian C. Murray
Steven K. Rose
Ralph J. Alig
Darius Adams
Greg Latta
Robert Beach
Adam Daigneault

*Results under review, please do not cite at this time.

Approach

- **Full structural economic model of the forest and agriculture sectors**
  - **FASOMGHG**
- **Integrated Top-down/Bottom-up look at:**
  - **Land use decisions**
  - **Commodity markets**
  - **Economic “welfare” (producer and consumer surplus)**
  - **Available at: http://www.nicholas.duke.edu/institute/ni.wp.09.04.pdf**

Scenarios Analyzed

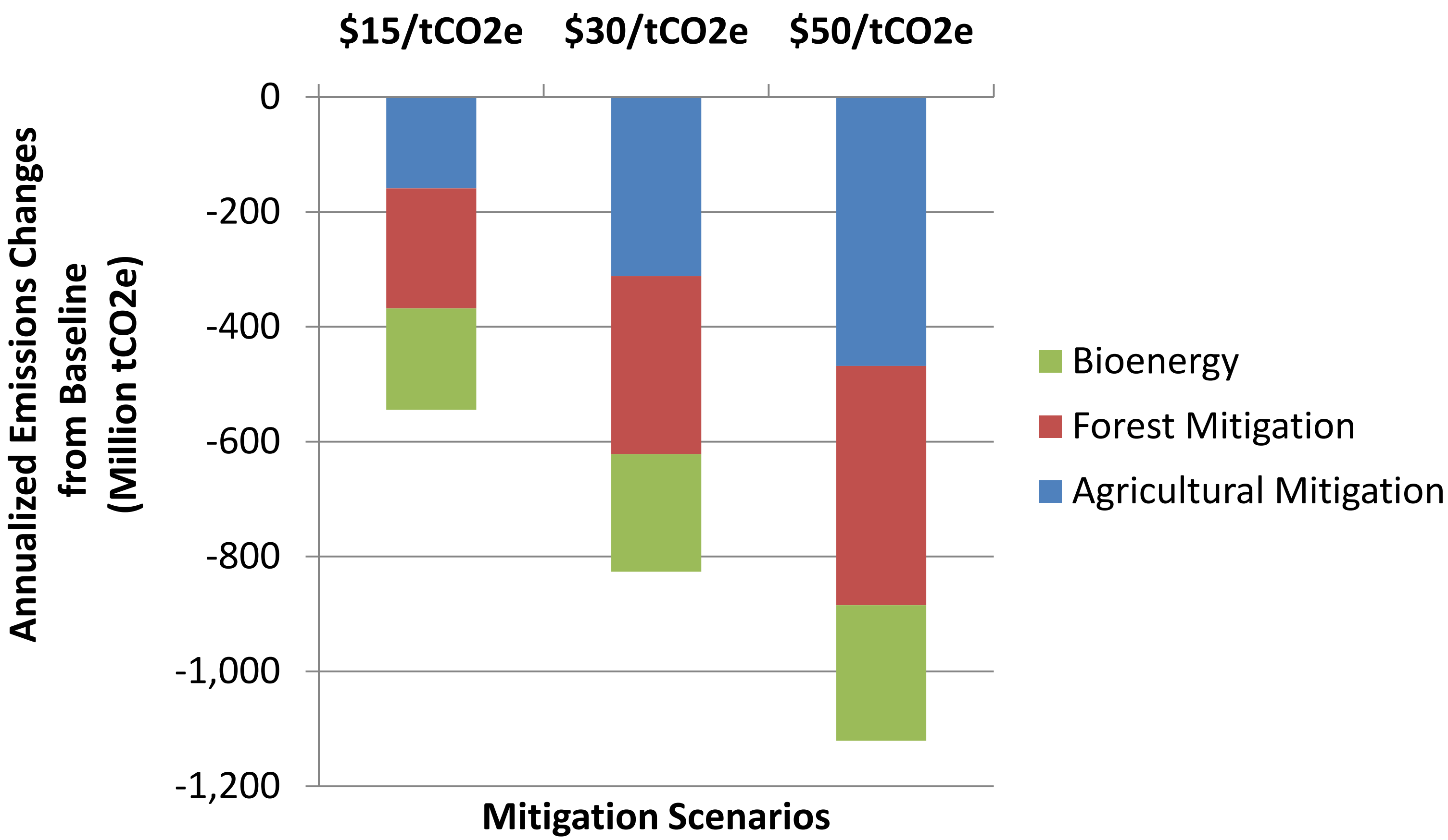
- ***EISA-RFS biofuel mandates included***
  - 30 Billion Gallons/year from Ag and Forest biomass by 2022
  - Biofuel production locked in at mandated levels beyond 2022
- ***To simulate GHG mitigation, CO_2e prices are imposed on emissions/sequestration sources***
  - \$15/tCO_2e
  - \$30/tCO_2e
  - \$50/tCO_2e

Cost Implications?

- Energy input cost increases
  - $15/t$CO_2$e: 2.20%/acre
  - $30/t$CO_2$e: 2.94%/acre
  - $50/t$CO_2$e: 5.50%/acre
- Why are our estimates different than USDA and others?
  - Producers can respond to higher energy prices through altered production practices, crop mix strategies

GHG Mitigation Across Scenarios

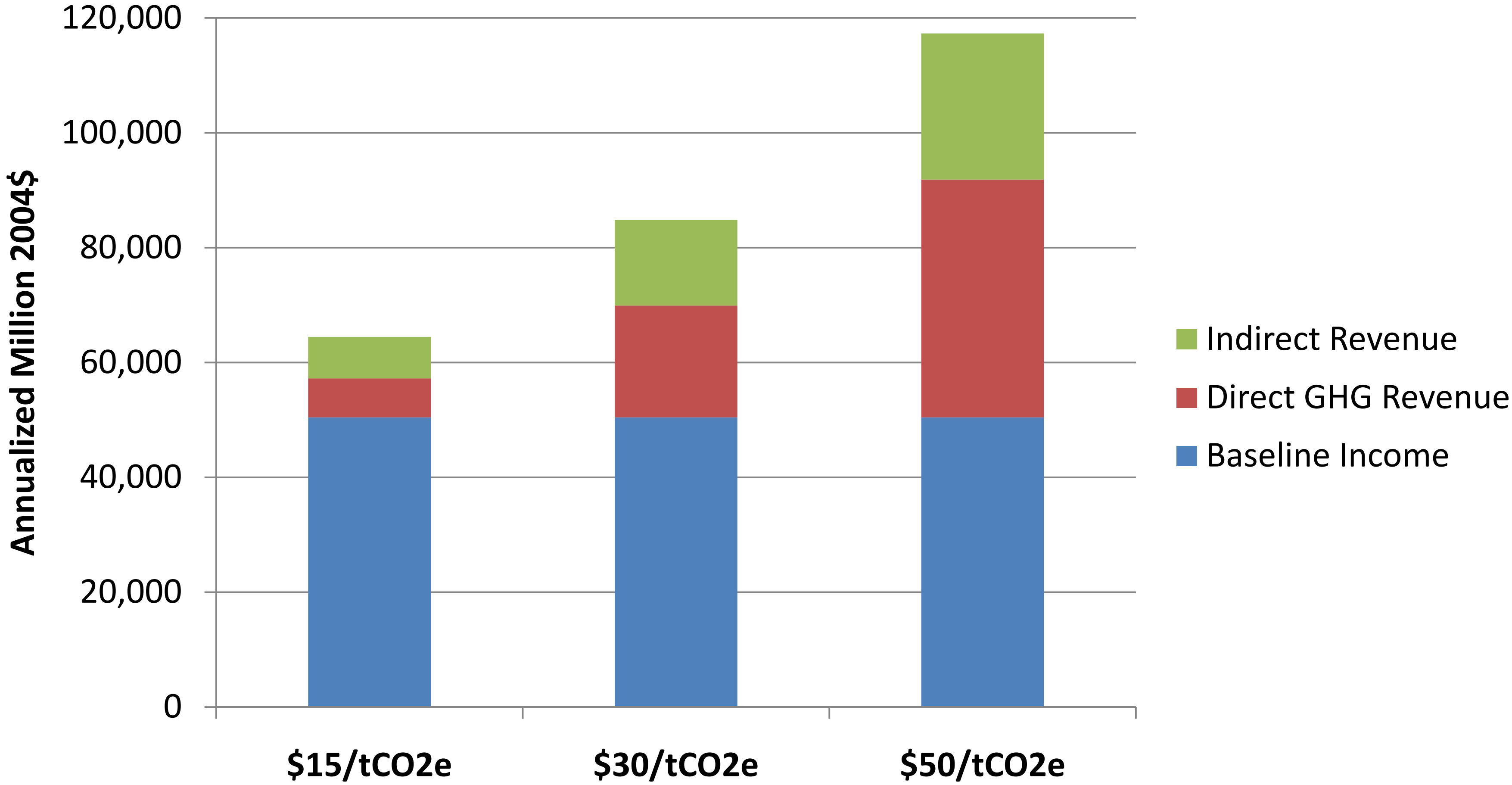
The more negative, the more mitigation



Preliminary Results: Subject to Change

Nichols Institute for Environmental Policy Solutions
Duke University

Direct and Indirect Revenue Benefits



Preliminary Results: Subject to Change

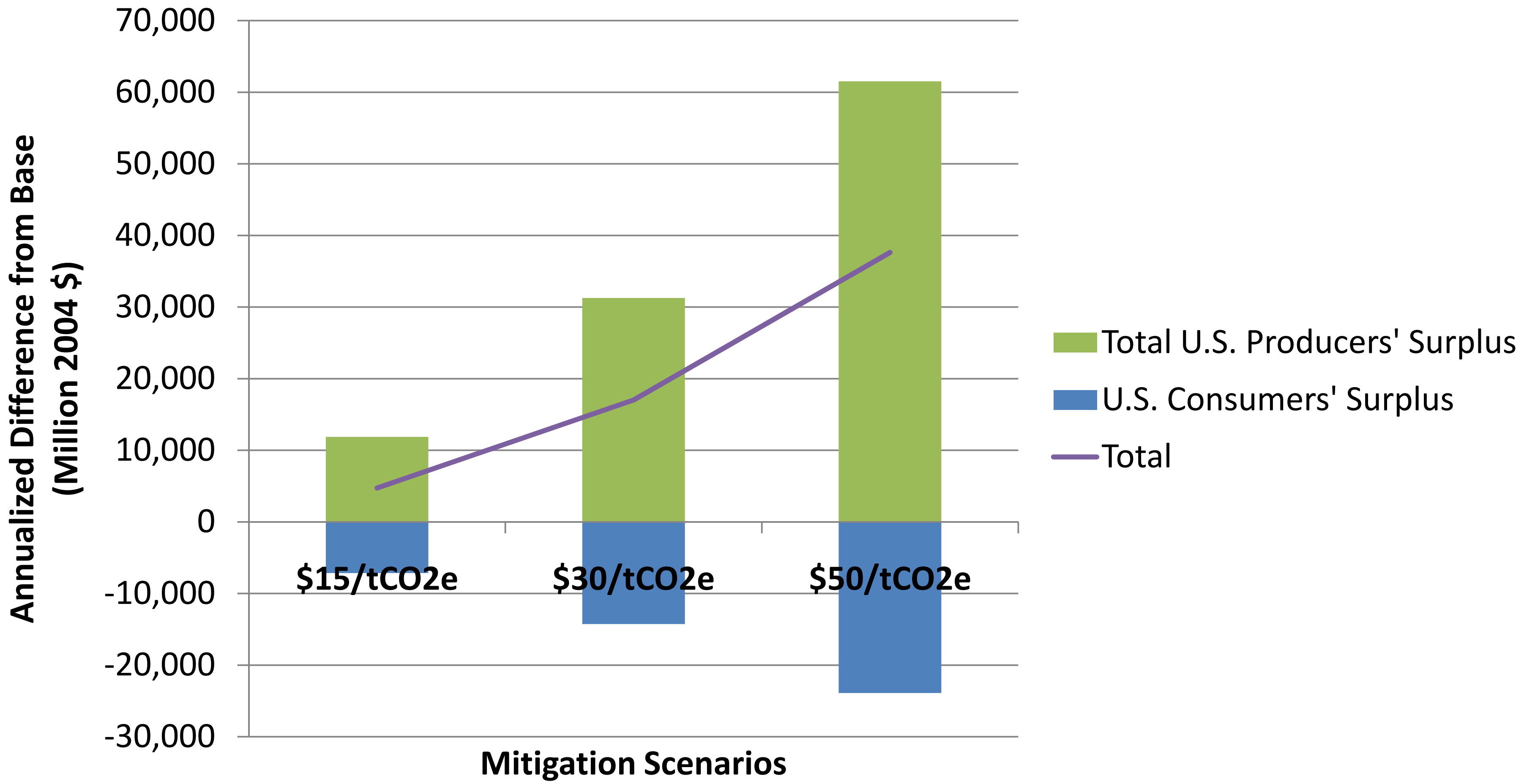
Nicholas Institute for Environmental Policy Solutions
Duke University

GHG Mitigation Payments
(Offsets and Bioenergy– annualized million $)

	$15/tCO2e	$30/tCO2e	$50/tCO2e
Afforestation	2,279	8,048	19,522
Forest Management	2,355	6,761	14,919
Forest Bioelectricity	351	1,021	2,338
Agricultural Bioelectricity	4,521	10,523	19,096
Manure Management	48	166	357
Enteric Fermentation	294	958	1,856
N Fertilizer Reductions	6	144	501
Ag Soil Carbon	100	561	1,367
Reduced Rice Cultivation	25	80	195

Nicholas Institute for Environmental Policy Solutions
Duke University

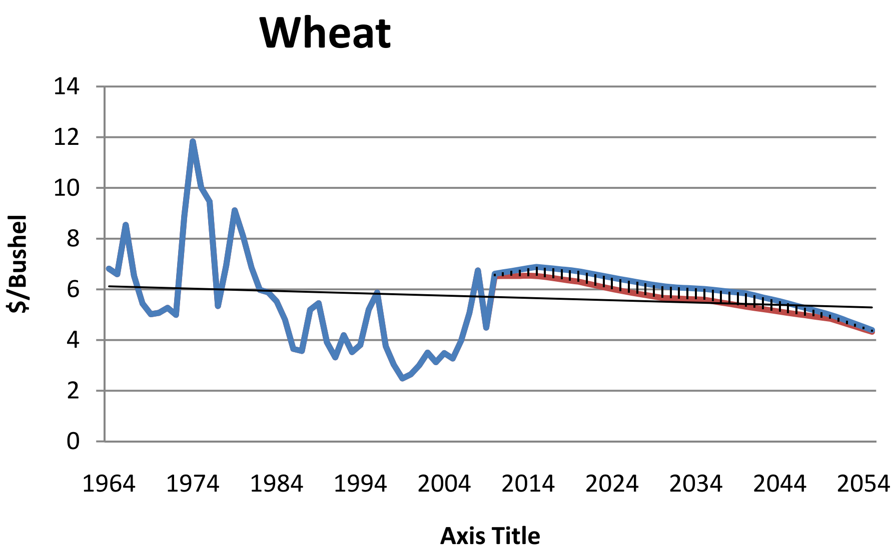
Total Economic Welfare?

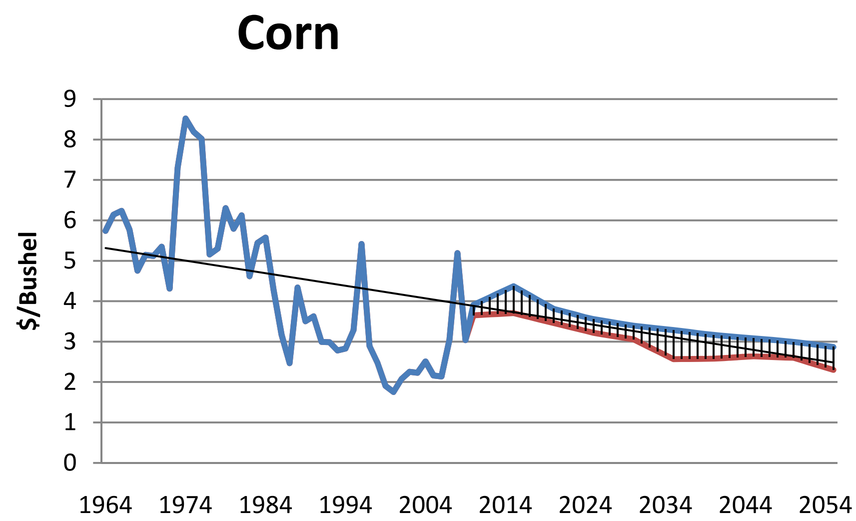


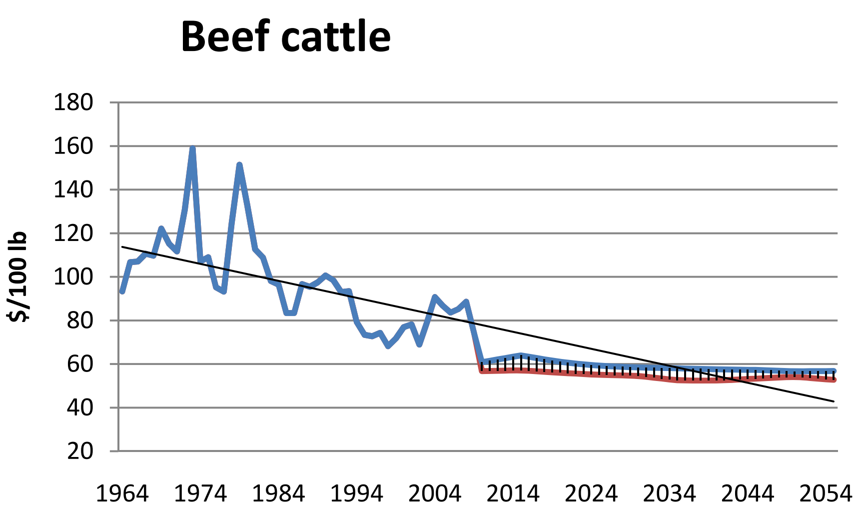
Preliminary Results: Subject to Change

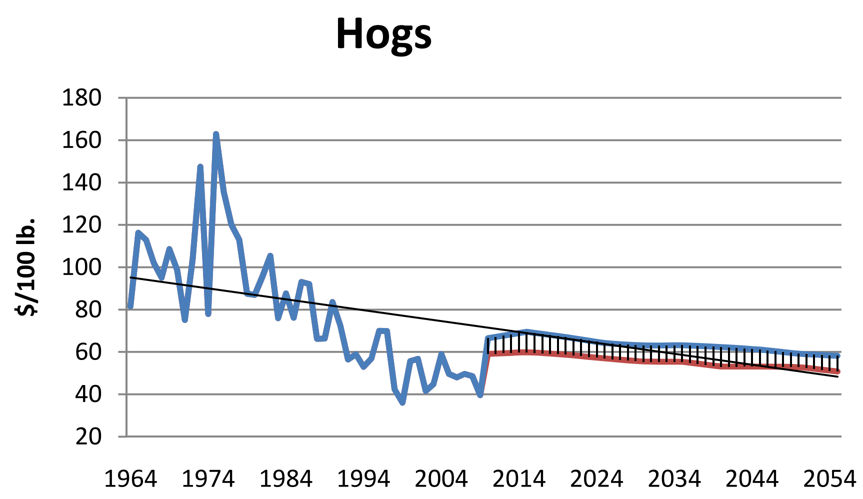
Nicholas Institute for Environmental Policy Solutions
Duke University

Prices in Context:
Historic, Projected with and w/o $30 carbon price









Implications for Land Use?

- Markets for bioenergy and carbon offsets can shift land use patterns
  1. Less deforestation for agriculture
  2. Afforestation incentives for cropland/pasture
  3. Forest management incentives signal longer harvest periods
  4. Some land moving out of conventional production

General Conclusions

- We model multiple low-carbon futures:
  1. Offsets Dominate
  2. Bioenergy dominates
- Producers/landowners benefit substantially
- Land use competition is important; shifts from agriculture to forestry, or from conventional to bioenergy production are likely
  – Not shown: CRP lands can play an important role
- Price affects can decrease consumer economic welfare

Caveats

- This is an aggregated view
  - Does not consider distributional impacts between small and large operations
  - Regional impacts also important
- We do not model a specific cap-and-trade bill, just a general form of climate policy
  - Offset provisions/protocols might be more stringent
  - Transaction costs matter
- FASOMGHG dynamic optimization procedure provides insight– not predictions
- Risk and uncertainty not accounted for

Thank You!

- Further questions?
  - Brian Murray (bcmurray@duke.edu)
  - Justin Baker (justin.baker@duke.edu)