Markets, Taxes, Biofuels and Agriculture
All living in the Greenhouse:
An Economic Perspective

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Topics of the day

Markets versus taxes
  Generalities
  Arguments for and against
  What might a tax hit and miss

Market rules and GHGs
  Carbon/GHG pitfalls
  Fungibility
  Biofuels and GHGs
    Effects
    Can we sell biofuels – effects of energy price and GHG incentives

Sector effects
  Will a tax mean money for producers
  Tax
  Market
Markets versus taxes – Generalities
Why either?

Generally GHG (carbon) emissions are pollution. They have a perceived negative cost
Markets versus taxes - Generalities

In general pollution costs are typically not fully considered by the emitting decision maker.

Thus often too much pollution is being emitted and it is judged desirable to reduce emissions.

Three approaches have evolved to fix this

1. Limit maximum allowable pollution by individual
2. Tax emissions by individuals
3. Cap total emissions and allocate emission permits to individuals allowing them to trade.
Markets versus taxes - Generalities

The latter two (tax and cap/trade) are generally preferred in the US as they provide incentives for and rewards to reduce pollution.

Basically both aim to reduce pollution,

– the tax by placing the pollution cost as a burden on the producer

– the cap and trade by limiting total emissions and then passing the burden through the market.

So let us explore these two forms
Markets versus taxes
Program characteristics
Tax characteristics

First the tax

– Levied against emissions
– Money to the government can redistribute but transactions costs
– Reduce pollution if reduction cost < than tax
– Keep emitting if reduction cost > tax but incentive to reduce
– Will not stimulate sequestration in absence of credit
– If cost of emissions reduction < tax may do nothing but could get a tax credit if defined
– May need emissions grandfathering and tax above that
– Magnitude of emissions reduction is uncertain
Cap and Trade Market characteristics

Now cap and trade
  – Total cap on emissions
  – Would need development of a credit for sequestration
  – Firms with expensive emission reduction costs could buy from firms with cheap cost and have incentive to reduce
  – Would create least cost reductions for emission cap level
  – Money stays in private hands
  – Incentive to reduce if cost < market price and firm gains a valuable salable commodity
  – Emission reduction is certain cost/unit is uncertain
  – Place of emission reductions uncertain
  – SO2 example – power plants
  – Chosen Kyoto mechanism
What might be covered and how
Some generalities and cases
Markets versus taxes – Some Cases

Manure lagoon that could be covered with methane recovery system

- Carbon/GHGs arises
  - Methane emissions that are destroyed (revenue source)
  - Carbon emissions when methane burned, capital cost (cost source)
  - A possible offset of fossil fuel (revenue source)

- Under tax
  - Without grandfathering methane emissions would be taxed.
  - Reduce if covering is cheaper than tax.
  - Money to government
  - If covering cost < tax might reduce too much but only gain tax
  - Could increase operation size but would have to pay for emissions

- Under cap and trade
  - Would have rights to emit
  - Could do nothing and have business as usual
  - Could cover lagoon reducing emissions and sell permits if cost of covering was cheaper than cap and trade market price
  - If covering a lot less might reduce too much but only gain tax savings
  - Could increase operation size but would have to buy permits
Markets versus taxes – Some Cases

Farmer producing switchgrass as a biofuel feedstock

– Carbon/GHG's arises
  • As sequestration in soil (revenue source)
  • As emissions from N application (N2O), equipment (cost source)
  • As offset of fossil fuel (revenue source)

– Under tax
  • Without grandfathering pay for fuel and N emissions when buying
    Might experience reductions from prior land use and this is a savings
  • Sequestration revenue would require a credit provision
  • Money to government
  • Biofuels not a credit but added revenue through higher switchgrass price if
    switchgrass combustion/fuel emissions are exempted from tax

– Under cap and trade
  • Would probably pay for permits when buying diesel and fertilizer
    Might experience reductions from prior land use and this may be a savings
  • Sequestration would be salable if rules allow
  • Money to permit seller or from buyer
  • Not saleable as credits, higher switchgrass price if use exempted from cap
Markets versus taxes – Some Cases

Farmer changing tillage to less intensive

– Carbon/GHGs arises
  • As sequestration In soil (revenue source)
  • As emissions from equipment and N use (cost source)
  • As reduced emissions from equipment (revenue source)

– Under tax
  • Without grandfathering would pay for equipment and N application emissions probably when buying diesel and fertilizer
    Might experience reductions from prior land use - a savings
  • Sequestration revenue would require a credit provision
  • Money to government but savings to farmer

– Under cap and trade
  • Would probably pay for permits when buying diesel and fertilizer
    Might experience reductions from prior tillage - a savings
  • Sequestration credits would be salable if rules allow
  • Money to farmer as permit seller
Arguments from Advocates
For an incentive
Whether it be a tax or Cap/trade

– Need price to provide a strong incentive for emission reduction

– Voluntary does not get us there

– Stabilization takes 20 times Kyoto volume – time to get on with it

– Irreversibilities
For a tax

(from Mankiew, New York Times – Harvard and former CEA chair)
– Government needs tax revenue can do good with it by redistributing to reduce tax burden
– Car standards too expensive, efficient cars stimulates driving
– Cap and trade depends on how permits allocated, would mainly go to energy/power companies
– Energy cost would rise, no revenue to compensate
– Tax could be better internationally as China et al could be included, not exempted (Kyoto failure), easier to negotiate
– May be politically acceptable and implementable
For cap and trade plus market

(from House committee on Energy and Commerce)

- Point of regulation can be set where appropriate (refiners, power plants), may allow coverage of small sectors
- Certainty in level of emission reductions
- Produces emissions at lowest cost
- Rewards innovation
- Comprehensive, avoids leakage
- Can be complemented with R&D and other programs
- Ag too small with too many emitters to include
- Money stays in private hands, more efficient (added)
What might hit or miss

**Sequestration**
- Measurement and monitoring takes effort
- Unlikely under tax
- ?? Under cap and trade

**Manure lagoons and enteric ("too small?")**
- Per head tax?
- Need rules for Cap and trade

**Biofuels**
- Need exemption under both
- Value passed through

**Fertilizer ("too small?")**
- N2O is uncertain
- Emission rating per unit N acquired

**Fossil fuel**
- Tax at pump
- Emissions cap at refiner/distributor – cost passed through
Rules for implementing a tax or market
Market rules and GHGs

A lot of issues have arisen in the international dialogue over cap and trade that have affected ag prospects

Namely to date no ag has been traded except hog manure lagoons and possibly some large forest offsets

Why not?

- Permanence
- Additionality
- Leakage
- Uncertainty
- Verification, Measurement and monitoring
- Transactions cost and brokers
Results – C accumulation vs. time with change from conventional till to no-till

Income source for no more than 20 years, 0.8 tons CO2 per year value $4/ton in US, $30 in Europe.
But then must be retained or subject to discount

Income source for 80 years, 4.5 tons CO2 per year value $4 in US, $30 in Europe.
But then must be retained or subject to discount
Permanence and its friends
Saturation and Volatility

Consider 2 actions
  Hog lagoon, capture and burn methane
  Plant trees, possible future cutting or fire

First is gone forever methane destroyed

Second is stored in a volatile fashion as are most sequestration options

Which would you as a power plant pay more for?

Will we see grading standards?

Property rights/future options issues also here
Market rules - Additionality

Kyoto rules say should only pay for new carbon not consequences of prior acts

Land use history under CCX does not consider this (as I recall must stay with reduced till for 4 years, 0.5 tonnes per year – no land use history)

Kyoto would only pay for new adoption

Prior good acts not to be rewarded

May see concept of partial additionality and a discount/grading standard
Market rules - Leakage

One big concern in Kyoto was whether actions created reactions outside of region

Today our corn actions are seeing more planting in Brazil and Argentina offsetting GHG gains here with losses in grassland and rain forest
How much corn will you produce next year – obviously quite variable.

Carbon is highly associated with yield

Canadian in Kyoto proposed you get paid not for average carbon but rather a discounted amount

My work shows 5% or so below the average for a large contract
Market Rules - Verification

Cannot truly Verify, Measure and fully monitor. Why not every square inch has carbon and is part of soil.

But need to sample and this has been a major obstacle that has stopped soil carbon in its tracks internationally.

Not expensive but requires new infrastructure

Also long term retention is an issue
Contracts have a minimum size, CCX is 10,000 tons CO2, others are 100,000 tons. This implies at CCX rate procurement of 20,000-200,000 acres or at 500 acres per farm 40-400 farmers.

Brokers needed as in Iowa Farm Bureau case and they will take part of price.

For crop insurance 25%, for a house 7% for carbon ??
Effects of such a tax or market on agriculture
Will a tax or market mean money for producers

Cost sources
- Fossil fuel use, fertilizer use, enteric fermentation, rice, manure, deforestation, break out land

Revenue sources
- Sequestration, biofuel offsets

Results show for moderate tax offset revenue exceeds cost given grandfathering
What will this do to agriculture

Conventional Production Lower by 1/6

Livestock Production Lower by 1/4

Exports lower by ½

Prices higher by ½

Farm incomes double

Consumers pay

Trading partners pay

Biofuels big opportunity
Energy prices increases with CO2 price
Ag soil goes up fast then plateaus and even comes down
Why – Congruence and partial low cost
    Lower per acre rates than higher cost alternatives
Biofuel takes higher price but takes off
Electricity gives big numbers due to plant expansion
Other small and slowly increasing
A Possibly Needed Elaboration
Biofuels and GHGs
Rewards in the market
Feedstocks take up CO2 when they grow then CO2 is emitted when feedstocks burned or when energy derivatives burned

But Starred areas also emit

In total they increase emissions but recycled on net

Source of underlying graphic: Smith, C.T., L. Biles, D. Cassidy, C.D. Foster, J. Gan, W.G. Hubbard, B.D. Jackson, C. Mayfield and H.M. Rauscher, “Knowledge Products to Inform Rural Communities about Sustainable Forestry for Bioenergy and Biobased Products”, IUFRO Conference on Transfer of Forest Science Knowledge and Technology, Troutdale, Oregon, 10-13 May 2005
An Aside

From a GHG perspective

Biofuels $\neq$ Ethanol

Particularly corn or sugar ethanol

GHG offset = $a_1 \times$ crop ethanol
+ $a_2 \times$ cell ethanol
+ $a_3 \times$ biodiesel
+ $a_4 \times$ bio fueled electricity
Offset Rates Computed Through Lifecycle Analysis

<table>
<thead>
<tr>
<th></th>
<th>Ethanol</th>
<th>BioDiesel</th>
<th>Electricity</th>
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<tr>
<td>Corn</td>
<td>25%</td>
<td>50%</td>
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<tr>
<td>Soybeans</td>
<td></td>
<td></td>
<td>71%</td>
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<tr>
<td>Sugarcane</td>
<td>65%</td>
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<tr>
<td>Switchgrass</td>
<td>50%</td>
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<tr>
<td>Bagasse</td>
<td>85%</td>
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<td>95%</td>
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<tr>
<td>Corn Residue</td>
<td>70%</td>
<td></td>
<td>85-90%</td>
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<tr>
<td>Manure</td>
<td></td>
<td></td>
<td>95-99%</td>
</tr>
<tr>
<td>Lignin</td>
<td></td>
<td></td>
<td>85-95%</td>
</tr>
</tbody>
</table>

Ethanol offsets are in comparison to gasoline

Power plants offsets are in comparison to coal.

**Electricity offsets higher when cofired due to Efficiency and less hauling**

**Opportunities have different potentials**
Concerns the Farm Sector
 Might Have
 Or
 Items to Possibly
 Work on
Concerns as Market/Tax Evolves

Will tax policy or market have provisions for sequestration or manure lagoon covering?

Will biofuels use have emissions or use exempted?

If a tax is defined will there be a given level of deduction or a compensation scheme for historic energy use?

Should N2O from fertilizer be included? Enteric fermentation? Rice?

Is ag too small to be a player?

If ag is too small will it still face elevated energy prices?

If permits are upstream will ag get credits or grandfathering?

If we sell sequestration what happens to property rights, long run land use options and ability to cut down trees or breakout land?
For more information


http://agecon2.tamu.edu/people/faculty/mccarl-bruce/biomass.html
Remaining Slides included in case of questions require more data for responses
Liquid Portfolio Composition

Graph of NPV GHG

GHG Price per ton CO2

Biodiesel
Cell Ethanol
Grain/Sug Ethanol
Portfolio Composition

Graph of NPV GHG Mitigation in Million tons for Gas 1.42 and Coal 24.68

Graph of NPV GHG Mitigation in Million tons for Gas 0.94 and Coal 24.68
<table>
<thead>
<tr>
<th></th>
<th>Gas price 0.94</th>
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<tr>
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<td>-1 10 30 50</td>
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<td>10 30 50 5000</td>
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<tr>
<td>Lower carbon dioxide price</td>
<td></td>
<td>Upper carbon dioxide price</td>
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<tr>
<td></td>
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<tr>
<td>Corn into ethanol wet milling</td>
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<td>Corn into ethanol dry milling</td>
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<tr>
<td>Make wheat into ethanol</td>
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<td>Make sorghum into ethanol</td>
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<td>Make sorghum Bagasse into ethanol</td>
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<td>Make corn residues into ethanol</td>
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<td>Make wheat residues into ethanol</td>
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<td>Make sorghum residues into ethanol</td>
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<tr>
<td>Make rice residues into ethanol</td>
<td>xx</td>
<td>Make soybean oil into biodiesel</td>
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<tr>
<td>Make corn oil into biodiesel</td>
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<td>Make corn oil into biodiesel</td>
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GHG offset and energy price send similar signals
Cellulosic at higher prices, switchgrass and residue
## Electricity Portfolio Composition

<table>
<thead>
<tr>
<th>Residue Type</th>
<th>Cofiring</th>
<th>Coal Price 24.68</th>
<th>Coal Price 49.36</th>
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<td>Make barley residues into electricity</td>
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<td>10 30 50</td>
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<tr>
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<td>xx</td>
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<td>10 30 50</td>
</tr>
<tr>
<td>Make corn residues into electricity</td>
<td>xx</td>
<td>10 30 50</td>
<td>10 30 50</td>
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<tr>
<td>Make wheat residues into electricity</td>
<td>xx</td>
<td>10 30 50</td>
<td>10 30 50</td>
</tr>
<tr>
<td>Make sugarcane bagasse into electricity</td>
<td>xx</td>
<td>10 30 50</td>
<td>10 30 50</td>
</tr>
<tr>
<td>Make manure into electricity</td>
<td>xx</td>
<td>10 30 50</td>
<td>10 30 50</td>
</tr>
<tr>
<td>Make lignin into electricity</td>
<td>xx</td>
<td>10 30 50</td>
<td>10 30 50</td>
</tr>
<tr>
<td>Make switchgrass into electricity</td>
<td>xx</td>
<td>10 30 50</td>
<td>10 30 50</td>
</tr>
<tr>
<td>Make willow into electricity</td>
<td>xx</td>
<td>10 30 50</td>
<td>10 30 50</td>
</tr>
</tbody>
</table>

**Cofiring ratio increases with price**

**Residues Show at higher prices**

**Sugarcane bagasse at all prices**