Overview

- Communicating to (with) policymakers
- Example in dealing with comprehensiveness and uncertainty
  - Emissions from Forestry & Agriculture and the panorama of policy choices
Perspective # 1

2000 Global Net GHG Emissions

Total 11,000 MMTCE

Source: EMF21, USEPA
## Perspective # 2: Process based mitigation policies

### Global GHG Emissions for 2000 in MMTCE

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Sub-sectors</th>
<th>CO2</th>
<th>Methane</th>
<th>N2O</th>
<th>F-gases</th>
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<tbody>
<tr>
<td>ENERGY 6843</td>
<td>Coal</td>
<td>2,218</td>
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<td></td>
<td>Nat Gas</td>
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<td></td>
<td>Petroleum Syst</td>
<td>2,857</td>
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<td></td>
<td>Stationary/Mobile Sources</td>
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<tr>
<td>LUCF (net)</td>
<td>Soils</td>
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<td>656</td>
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<td>AGRICULTURE 3691</td>
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<td>Enteric Fermentation</td>
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<td>Manure Management</td>
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<td>Rice</td>
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<td>INDUSTRY 408</td>
<td>Cement</td>
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<td>226</td>
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<tr>
<td></td>
<td>Adipic &amp; Nitric Acid Prd</td>
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<tr>
<td></td>
<td>HFCs</td>
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<td>PFCs</td>
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<td>SF6</td>
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<td>Substitution of ODS</td>
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<td>WASTE 388</td>
<td>Landfills</td>
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<td>Wastewater</td>
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<td></td>
<td>154</td>
<td>21</td>
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<tr>
<td><strong>TOTAL GHG</strong></td>
<td></td>
<td>11,330</td>
<td>8,691</td>
<td>1,615</td>
<td>902</td>
</tr>
</tbody>
</table>

Sources: EPA, EMF21, CDIAC
Perspective # 2: Radiative Forcing by Species/Process

Climate Forcings (W/m$^2$): 1850-2000

- **CO$_2$**: 1.4±0.2 (indirect via $O_3$ & H$_2$O)
- **CH$_4$**: 0.7±0.2 (indirect via stratospheric ozone)
- **CFCs**: 0.35±0.05
- **N$_2$O**: 0.15±0.05
- **Tropospheric Ozone**: 0.5±0.2 (semi-direct, dirty cloud & snow effects)
- **Black Carbon**: 0.8±0.4
- **Reflective Aerosols**: -1.3±0.5
- **Soil Dust**: -0.1±0.2
- **Sulfate Organic**: -0.2±0.2
- **Nitrate**: -1.1
- **Forced Cloud Changes**: 0.2±0.2
- **Land Cover Alter.**: 0.4±0.2
- **Sun**: (0.2,-0.5)

Greenhouse Gases

Other Anthropogenic Forcings

Natural Forcings

Hansen (2001)
Global Carbon Emissions in Reference Scenario (GtC)
Global CO$_2$ Emissions

Range of model results ≠ uncertainty

Source: J. Reilly, MIT
“If integrated assessment were perfect, would policymakers listen?”

*Maybe*

Figure 4. Typical Probability Distribution Function (pdf)

$f(x) dx = \text{probability that the r.v. } x' \text{ is in } dx \text{ about } x$
Economic Potential for Agricultural Non-CO2 Greenhouse Gas Mitigation: An Investigation in the United States

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Departments of Geosciences and Economics  
Hamburg University

Dhazn Gillig  
Department of Agricultural Economics  
Texas A&M University

Hengchi Lee  
Department of Economics  
Western Ontario University

Francisco de la Chesnaye  
U.S. Environment Protection Agency
ROLES OF U.S. AG & FORESTRY

- A carbon or GHG sequestering sink
- Offsetting net GHG emissions
- Operating in a mitigating world
- EMISSION REDUCERS
  - Ag and forestry emit 70% of N2O
  - Ag and forestry emit 50% of CH4
  - Ag and forestry emit 20% of CO2
100 year forest and agriculture model - FASOMGHG

Covers GHG mitigation activities in U.S. regions (across 11 regions and 63 U.S. Sub-State regions), 28 foreign regions for 8 commodities, plus world market for other commodities.

Simulates 100 years in decade time steps.

Depicts sector linkage mainly through land transfers.
FASOMGHG REGIONS
### FASOMGHG MITIGATION OPTIONS

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Basic Nature</th>
<th>CO2</th>
<th>CH4</th>
<th>N2O</th>
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<td>Crop Mix Alteration</td>
<td>Emis, Seq</td>
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<tr>
<td>Crop Fertilization Alteration</td>
<td>Emis, Seq</td>
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<td>Crop Input Alteration</td>
<td>Emission</td>
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<tr>
<td>Crop Tillage Alteration</td>
<td>Emission</td>
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<tr>
<td>Grassland Conversion</td>
<td>Sequestration</td>
<td>X</td>
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<tr>
<td>Irrigated /Dry land Mix</td>
<td>Emission</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Biofuel Production</td>
<td>Offset</td>
<td>X</td>
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<tr>
<td>Afforestation</td>
<td>Sequestration</td>
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<td>X</td>
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<tr>
<td>Existing timberland</td>
<td>Sequestration</td>
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<td>X</td>
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<tr>
<td>Deforestation</td>
<td>Emission</td>
<td>X</td>
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<tr>
<td>Stocker/Feedlot mix</td>
<td>Emission</td>
<td>X</td>
<td></td>
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<td>Enteric fermentation</td>
<td>Emission</td>
<td>X</td>
<td></td>
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<tr>
<td>Livestock Herd Size</td>
<td>Emission</td>
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<tr>
<td>Livestock System Change</td>
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<td>Manure Management</td>
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<tr>
<td>Rice Acreage</td>
<td>Emission</td>
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</tbody>
</table>
ECONOMIC POTENTIAL

**Economic potential:** Mitigation potential when crediting each gas separately
ECONOMIC POTENTIAL

Economic potential: Mitigation potential based on combination strategies
Results do not add up due to competition and complementarity
INDIVIDUAL vs. MULTIGAS IMPLEMENTATION

- Joint implementation achieves more quantity reduction at the same price => interaction effects

(a) N2O and CH4

(b) AllGas

- Individual implementation overstates reduction => land competition
Agricultural and Forest Carbon Equivalent GHG Mitigation by Strategy (Annual Avg. - 2000-2030) **old results**

Analyses by Bruce McCarl & Brian Murray
DYNAMICS OF GHG MITIGATION

Multi-Gas

(a) at $5/ton of CO2

(b) at $15/ton of CO2
Sequestration saturates
Biofuels and non CO2 grow in long run
Biofuel dominates at high price

(c) at $50/ton of CO2
(d) $80/ton of CO2
ENVIROMENTAL IMPACTS

(a) NPK Nutrient

(b) Erosion

Carbon Price ($/metric ton of CO2)
WELFARE IMPACT

- U.S. Consumers lose
- U.S. Producers gain
- ROW lose
ECONOMIC INDICATORS

- Trade-off between emission reduction and agricultural price and production

Carbon Price ($/metric ton of CO2)
Contact Information

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