farmdoc
UNIVERSITY OF ILLINOIS

Climate Change Policy & Agriculture

A. Bryan Endres
bendres@illinois.edu
University of Illinois

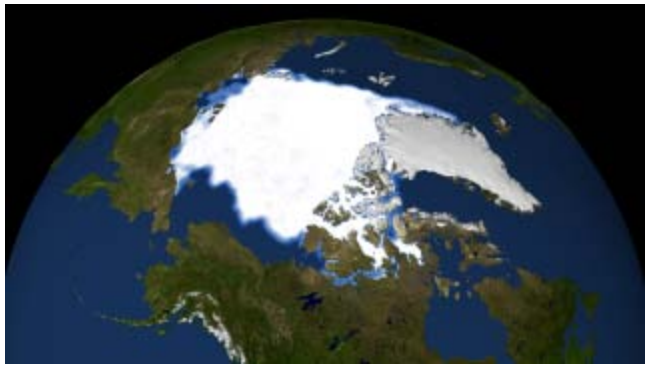


Agricultural and Consumer Economics

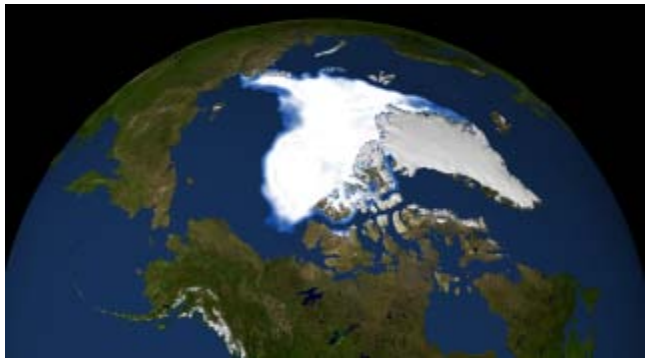
2009 Illinois Farm Economics Summit

The Profitability of Illinois Agriculture: Profitability at a Crossroads

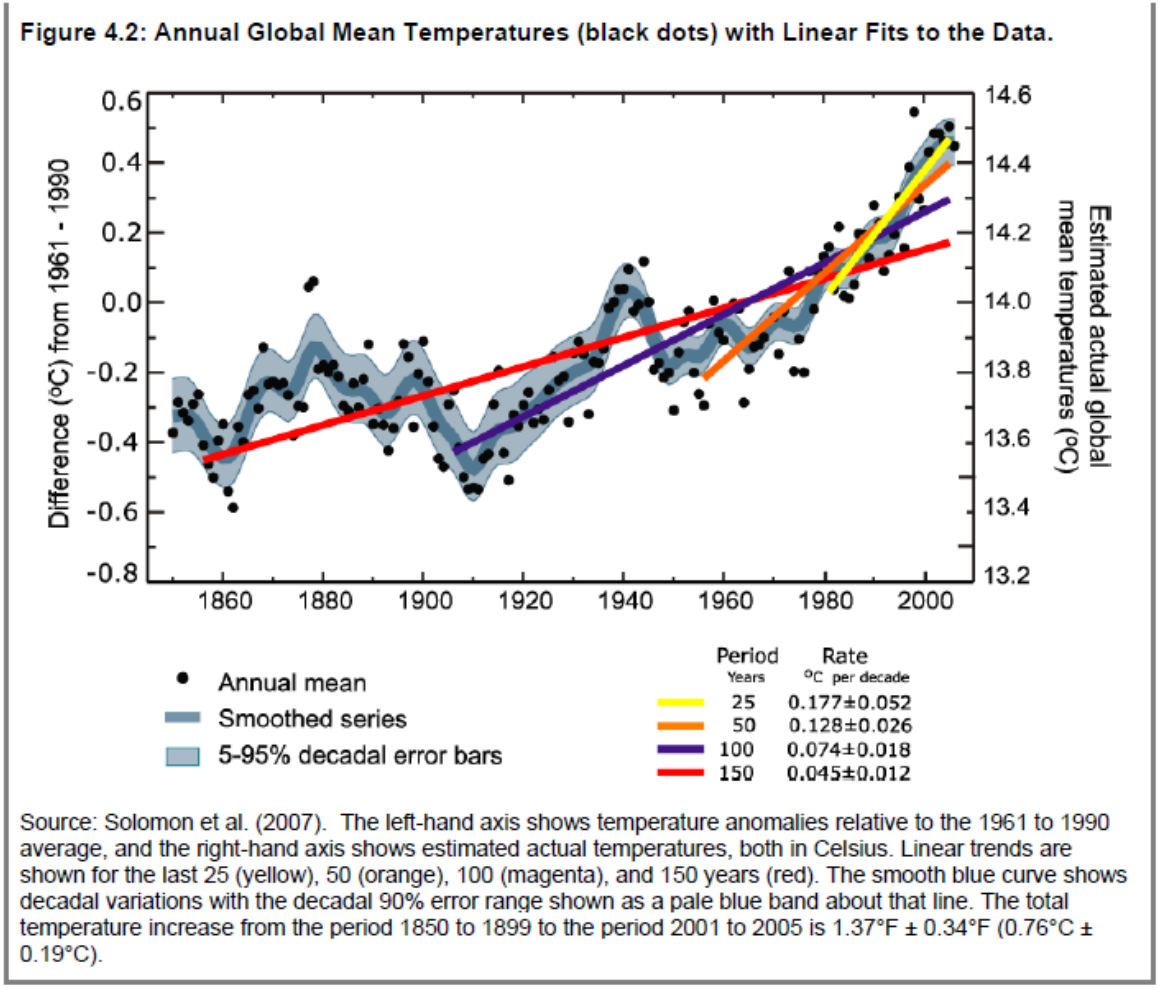
Sea Ice & Temperature



September 1979



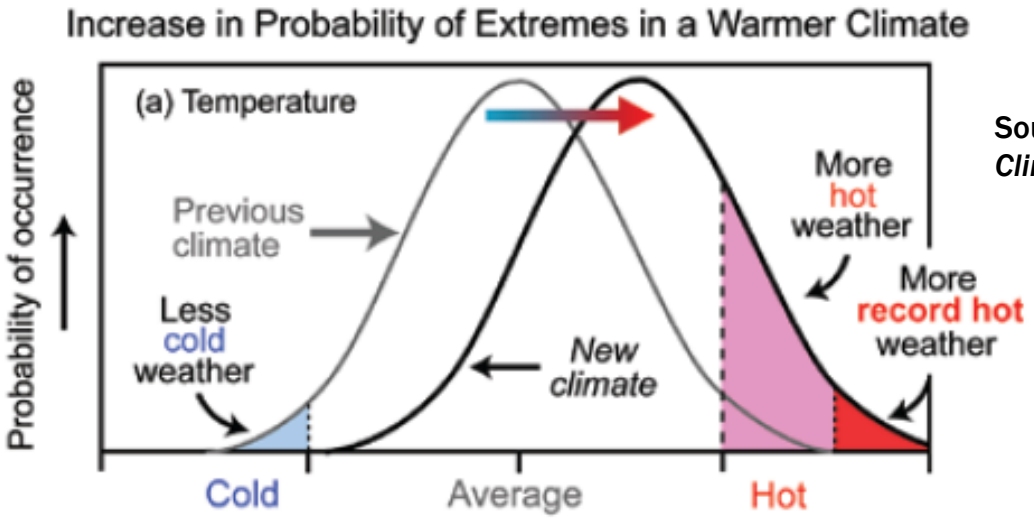
September 2007



Source: Solomon et al. (2007). The left-hand axis shows temperature anomalies relative to the 1961 to 1990 average, and the right-hand axis shows estimated actual temperatures, both in Celsius. Linear trends are shown for the last 25 (yellow), 50 (orange), 100 (magenta), and 150 years (red). The smooth blue curve shows decadal variations with the decadal 90% error range shown as a pale blue band about that line. The total temperature increase from the period 1850 to 1899 to the period 2001 to 2005 is 1.37°F ± 0.34°F (0.76°C ± 0.19°C).

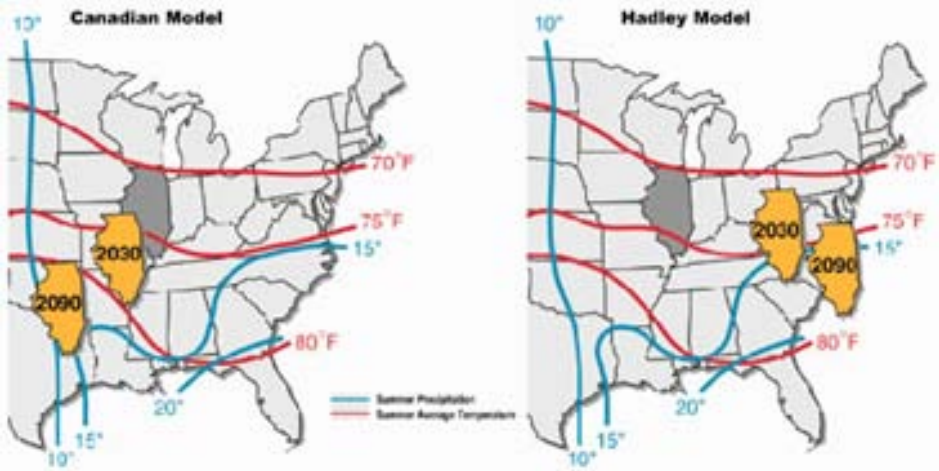
Source: NASA (2007), Sea Ice Yearly Minimum 1979-2007. Available at: http://svs.gsfc.nasa.gov/vis/a000000/a003400/a003464/index.html.
Temperature data source: EPA, Technical Support Document for Endangerment Finding (2009).

Climate Change & Weather



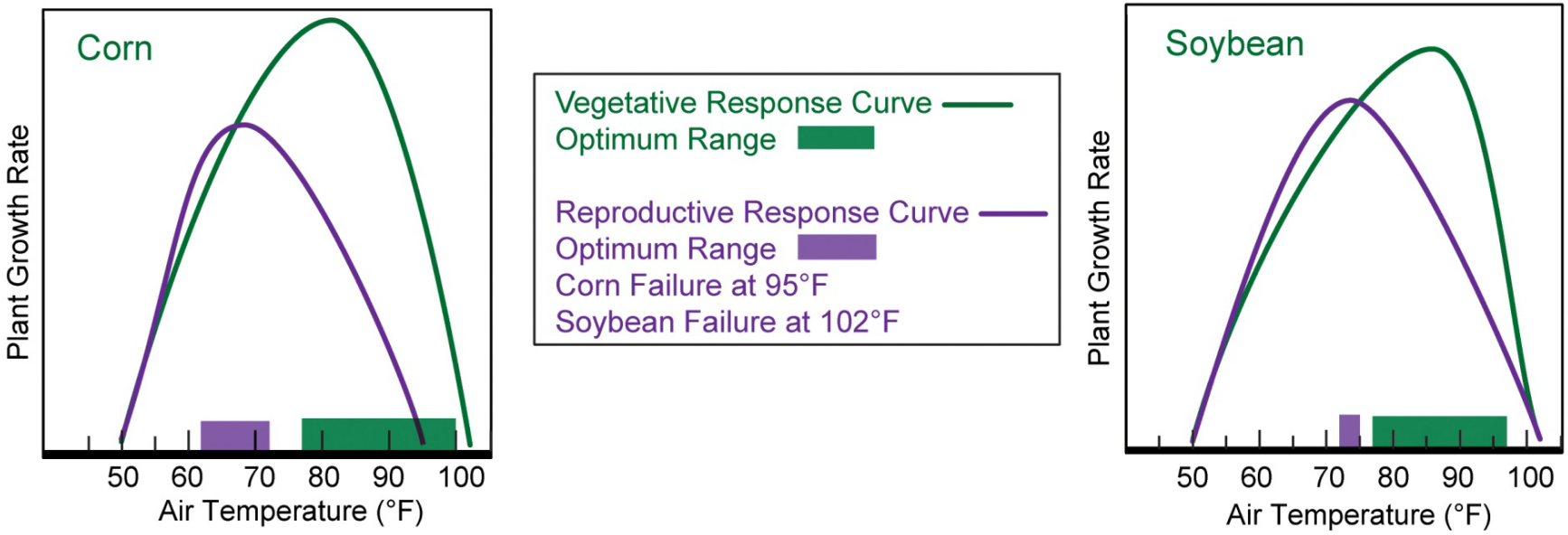
Source: U.S. Climate Change Science Program, *Weather and Climate Extremes in a Changing Climate* (June 2008), p.19.

Source: United States Global Change Research Program, *First U.S. National Assessment,* p. *55*.



Plant Growth & Temperature

farmdoc
Harness the Power of the Internet



ARS USDA

For each plant variety, there is an optimal temperature for vegetative growth, with growth dropping off as temperatures increase or decrease. Similarly, there is a range of temperatures at which a plant will produce seed. Outside of this range, the plant will not reproduce. As the graphs show, corn will fail to reproduce at temperatures above 95°F and soybean above 102°F.

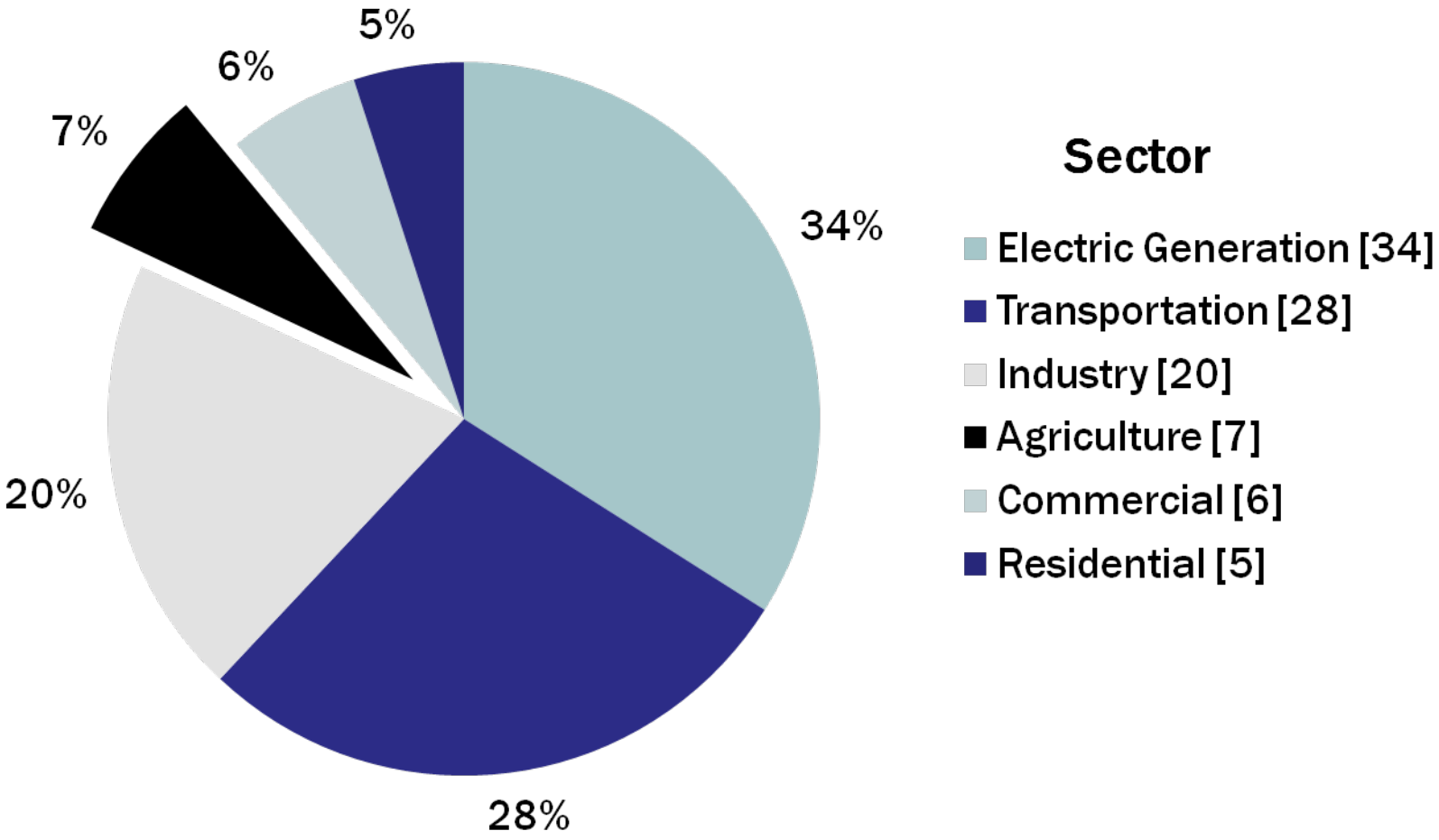
Source: United States Global Change Research Program, *Global Climate Change Impacts in the U.S.*, p. 72.

Potential Impact on Agriculture

- Potential benefit in near term for some grains/oilseeds due to elevated CO_2 levels and warmer temperatures
  - Elevated ozone levels may negate yield benefits
  - Increased risk of "extreme" events—heat, drought
  - Potential for increased pests/weeds
- Potential adverse affect to livestock management and irrigation

Source: EPA Endangerment Finding (Dec. 7, 2009)

U.S. GHG Emissions by Sector



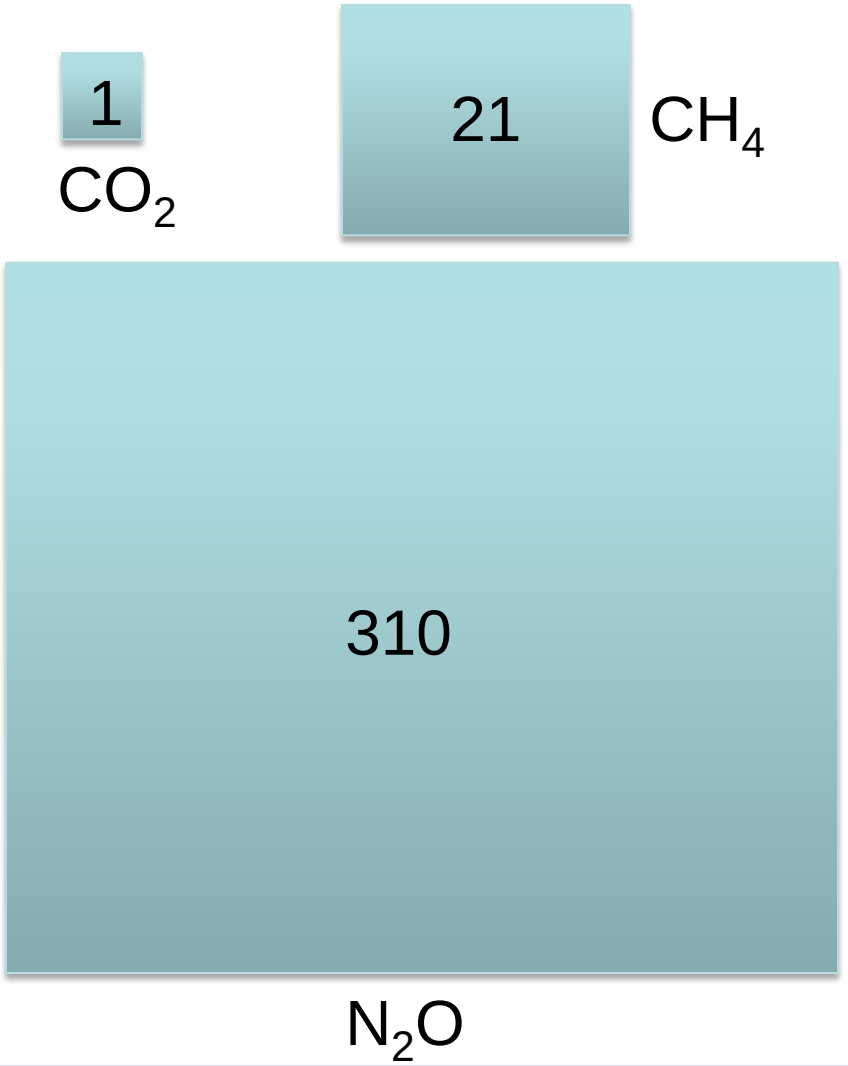
Source: EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007* (data rounded to total 100%).

CO_2e & Global Warming Potential

Primary Greenhouse Gases

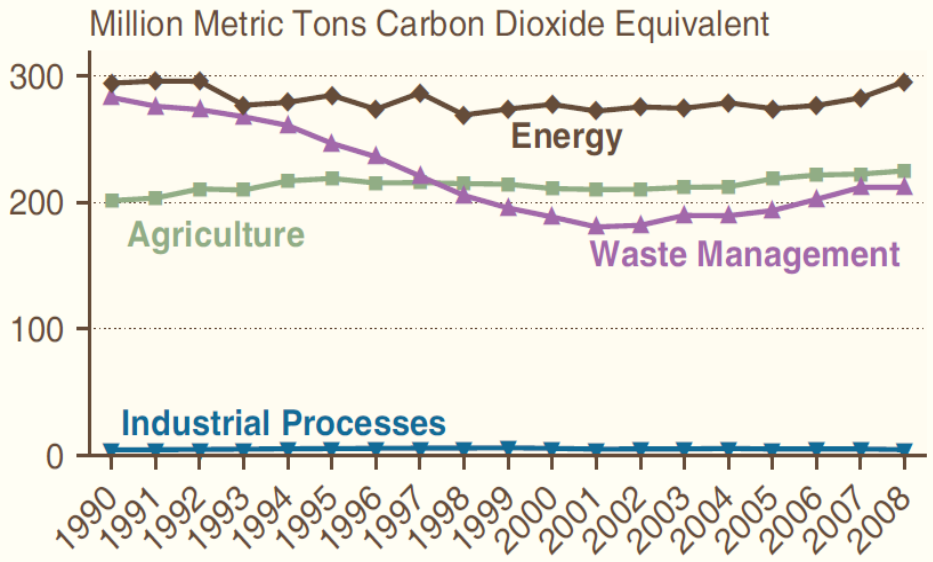
- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6)

1 Kg of CO_2 has a GWP of 1, with all other GHGs measured against the CO_2 baseline to create CO_2e



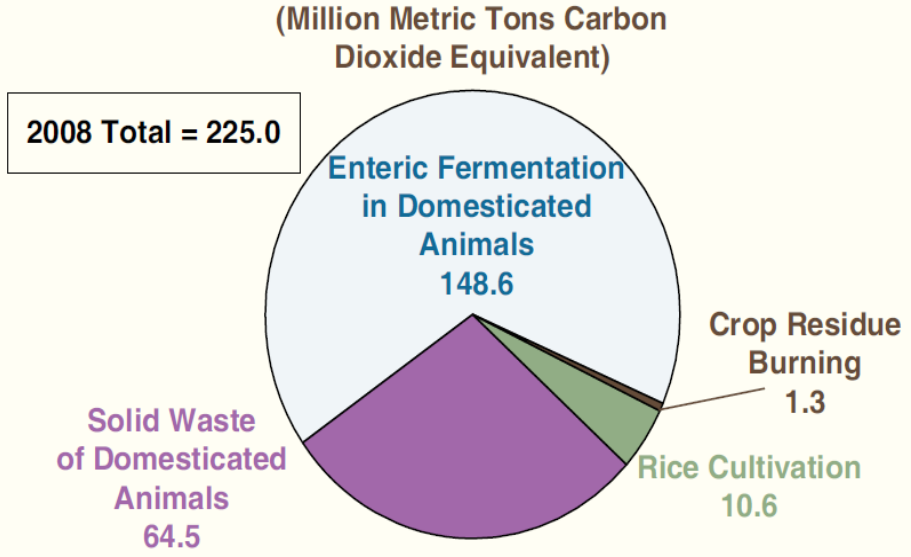
Methane Emissions by Source

Figure 15. U.S. Methane Emissions by Source, 1990-2008



Source: EIA estimates.

Figure 17. U.S. Methane Emissions from Agriculture by Source, 2008

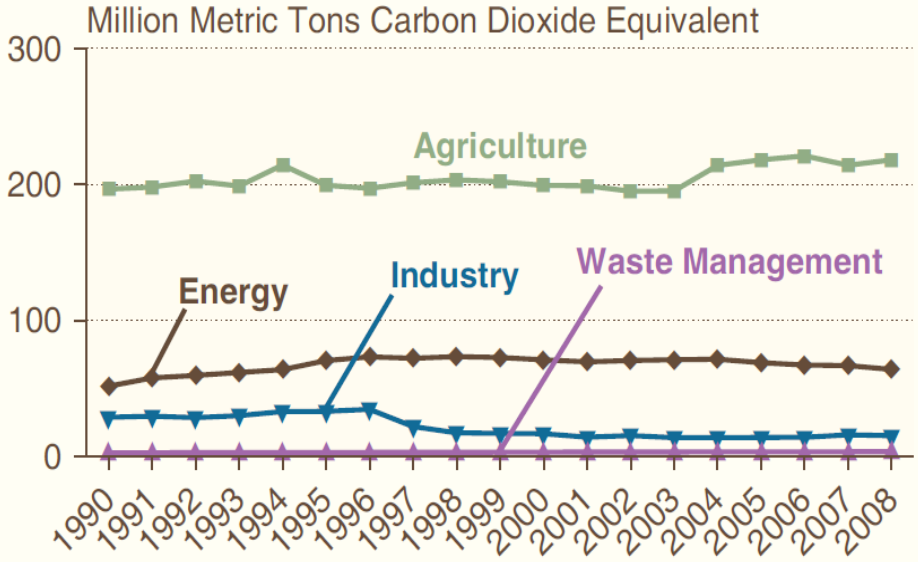


Source: EIA estimates.

Source: U.S. Energy Information Administration, *Emissions of Greenhouse Gasses in the United States 2008*, p. 29, 31.

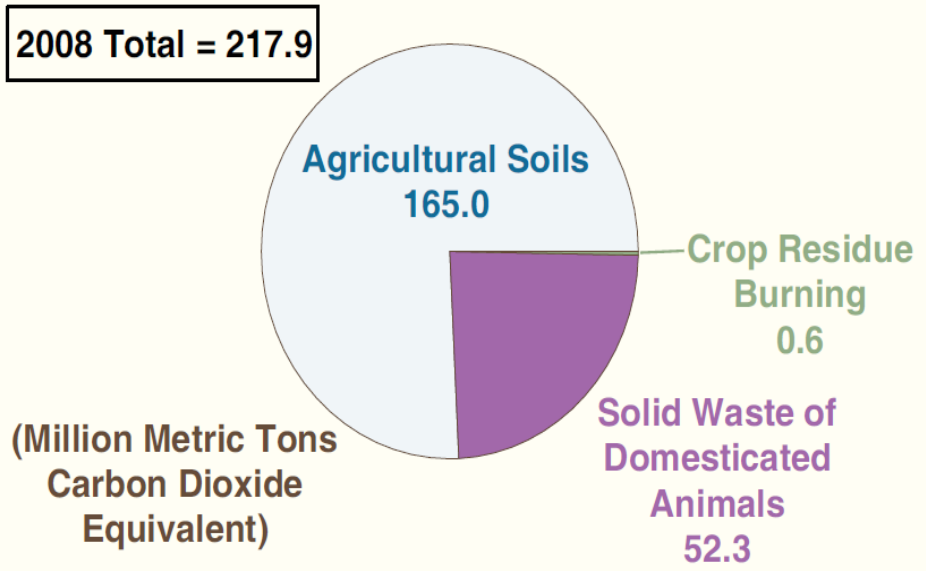
Nitrous Oxide Emissions

Figure 20. U.S. Nitrous Oxide Emissions by Source, 1990-2008



Source: EIA estimates.

Figure 21. U.S. Nitrous Oxide Emissions from Agriculture by Source, 2008



Source: EIA estimates.

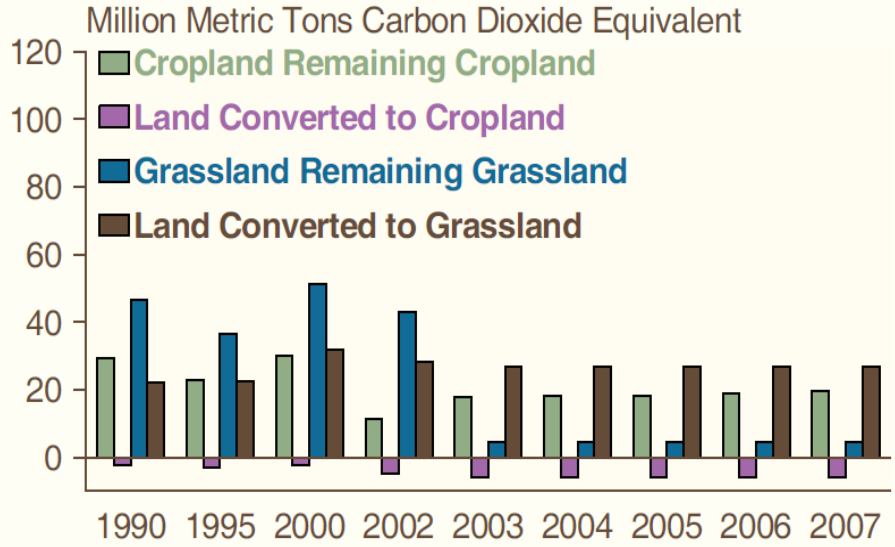
Source: U.S. Energy Information Administration, *Emissions of Greenhouse Gasses in the United States 2008*, p. 35-36.

CO_2 Flux (Sequestration)

Carbon Sequestration in U.S. Croplands and Grasslands, 1990, 2006, and 2007

	1990	2006	2007
Estimated Sequestration (Million Metric Tons CO_2e)	96.3	44.5	45.1
Change from 1990 (Million Metric Tons CO_2e)		-51.8	-51.2
(Percent)		*-53.8%*	*-53.2%*
Average Annual Change from 1990 *(Percent)*		*-4.7%*	*-4.4%*
Change from 2006 (Million Metric Tons CO_2e)			0.6
(Percent)			*1.4%*

Figure 31. Carbon Sequestration in U.S. Croplands and Grasslands, 1990-2007



Source: U.S. EPA estimates.

Source: U.S. Energy Information Administration, *Emissions of Greenhouse Gasses in the United States 2008*, p. 47.

Voluntary Agricultural GHG Emission Reductions

- Trading of carbon credits created outside of a legal mandate based on contractual relationships
  - E.g., Chicago Climate Exchange (CCX)
- Total CCX Offsets (tons CO_2e)
  - Agricultural Methane: 1,406,300
  - Agric. Soil Carbon: 21,679,100
  - Forestry: 11,223,800
- Future of CCX hinges on “cap & trade” rules

Key Legal Developments

- Mandatory GHG Reporting Rule (Oct. '09)
- *Massachusetts v. EPA* (2007) / EPA GHG Rulemaking under Clean Air Act (2009)
  - Proposed GHG permitting requirements for New Source Review (NSR) and Title V operating permits for large facilities (Oct. '09)
  - Prevention of Significant Deterioration (PSD) program reconsideration (Oct. '09)
  - GHG Endangerment Finding (Dec. '09)
- H.R. 2454, American Clean Energy & Security Act (Cap & Trade bill)
- Renewable Fuel Standard (RFS2) Rules (May '09)

Mandatory GHG Reporting Rule

- FY 2008 Consolidated Appropriations Act / 74 Fed. Reg. 56260 (Oct. 30, 2009)
- Purpose
  - Collect accurate emissions data to inform future policy
- Timing
  - Monitor as of Jan. 1, 2010; Report due Mar. 31, 2011
- Scope
  - Facilities with 25,000 metric tons CO_2e/year
    - 85% of U.S. emissions / 10,000 facilities
    - Includes approximately 107 livestock facilities
  - Exempts all other agric. operations & food processing

Massachusetts v. EPA (2007)

- Supreme Court rules that GHGs are "air pollutants" covered by the CAA
  - EPA required to determine if GHGs from new motor vehicles contribute to air pollution, which may endanger public health or welfare (endangerment finding)
  - Domino effect
    - If issue "endangerment" finding, then may regulate GHGs from new motor vehicles
    - Regulation of GHGs from new motor vehicles will trigger additional GHG regulations

Proposed GHG permits for NSR & Title V operating permits

- 74 Fed. Reg. 55292 (Oct. 27, 2009)
- Purpose:
  - Mandate emissions control requirements / best available control technologies at large industrial facilities
- Scope:
  - New / modified facilities with 25,000 metric tons CO2e/year
  - EPA could later lower permit thresholds
  - No explicit agricultural exemption
- Issued in conjunction with proposal to revise PSD regulations to include GHGs (74 Fed. Reg. 51535)

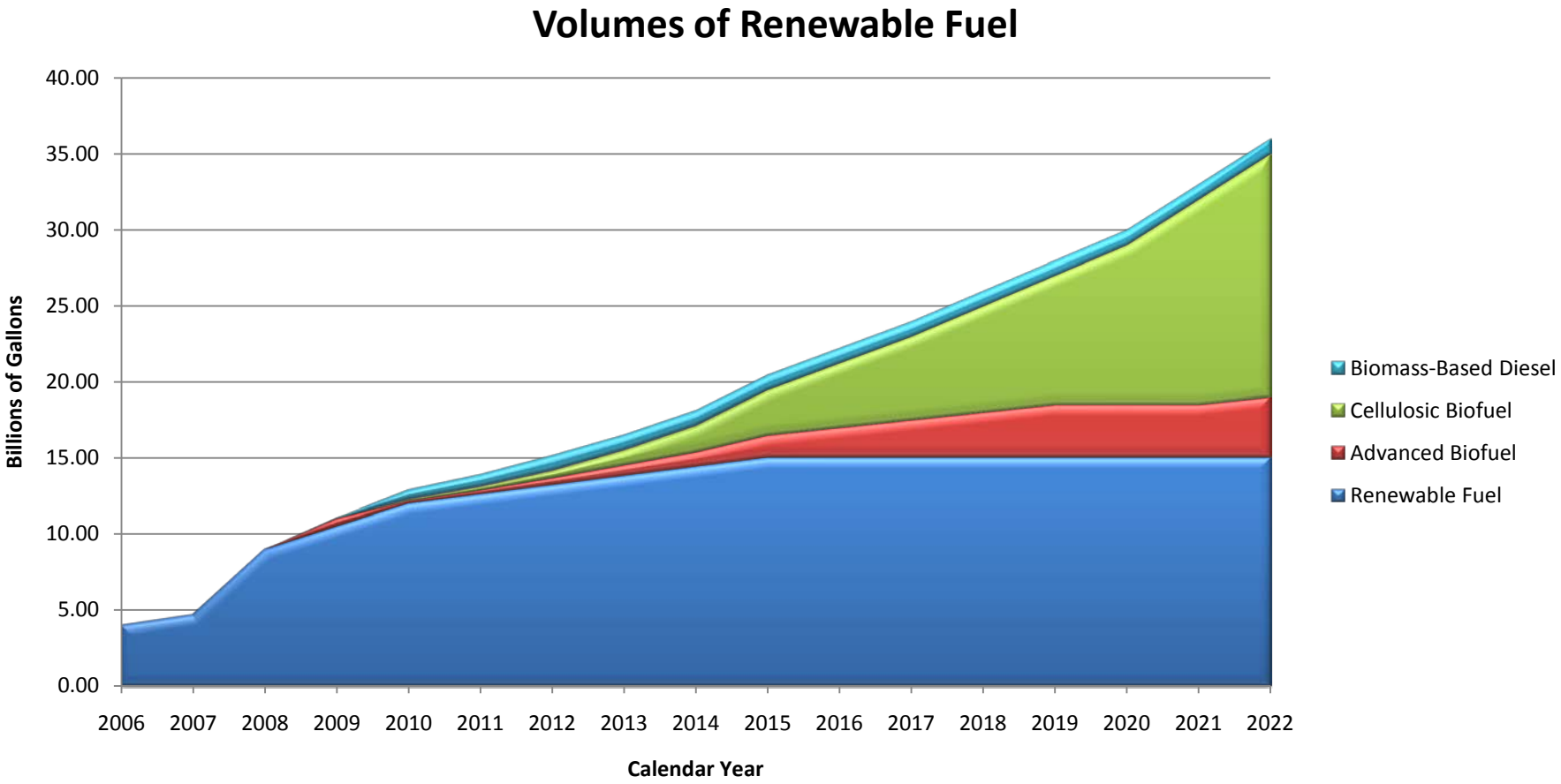
GHG Endangerment Finding

- Issued Dec. 7, 2009
- Finding:
  - Six GHGs endanger both the public health and public welfare of future generations
  - New motor vehicles contribute to GHG air pollution
- Rule effective 30 days after publication in Federal Register
- Supports the Sept. 15, 2009 proposed rule to limit GHGs / improve fuel economy to 35.5 mpg

H.R. 2454, American Clean Energy & Security Act

- Title I & II: Clean Energy & Efficiency Incentives
- Title III: "Caps" certain GHG emissions
  - 17% reduction from 2005 levels by 2020
  - 83% reduction from 2005 levels by 2050
  - Rules and allowances set by EPA
  - Ability to "trade" emission allowances/offset credits
- Title V: Exempts all agricultural activities from "cap"
  - Rules for offsets set by USDA (not EPA)
    - USDA projects a net annualized annuity benefit of $22 billion to agriculture industry; 30% of benefit to Corn Belt
- Preempt EPA Clean Air Act GHG regulations

Renewable Fuel Standard



Energy Independence; Support Rural Economics; Reduce GHG Emissions

Concluding Thoughts

- Federal government likely to take significant steps to regulate GHG emissions in 2010
- Medium to long term potential input price increases from GHG regulation under “cap & trade” or Clean Air Act rules
- Agriculture may have significant opportunities to diversify farm income via GHG offset trading under “cap & trade” regime
- Bioenergy mandates unlikely to change and low carbon fuel requirements will support diversified agricultural operations