



United States Department of Agriculture
Natural Resources Conservation Service

Greenhouse Gases, Environmental Market Concepts and the Emerging California Cap and Trade Program

April 17, 2013

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Air Quality and Atmospheric Change Team

NRCS - West National Technology Support Center

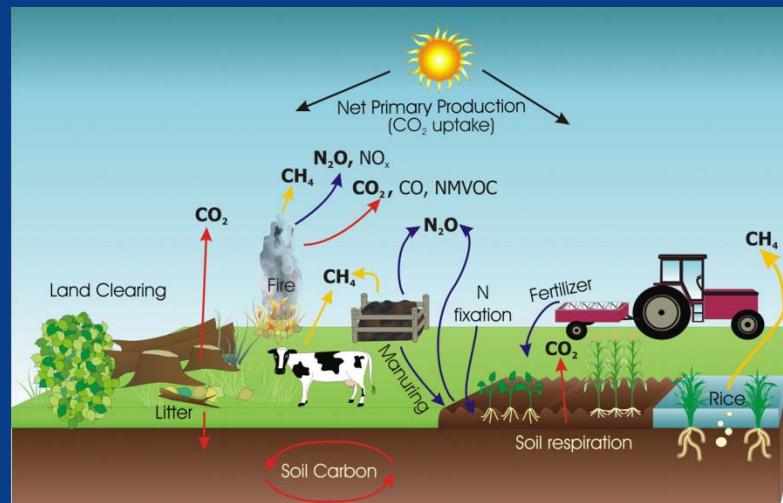
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Agenda

- Agricultural Greenhouse Gases (GHGs)
- Emerging Environmental Markets for GHGs
- NRCS Environmental Market Activities and California's Cap and Trade Program



Climate Change

Science Refresher

The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

Solar radiation powers the climate system.



Some solar radiation is reflected by the Earth and the atmosphere.

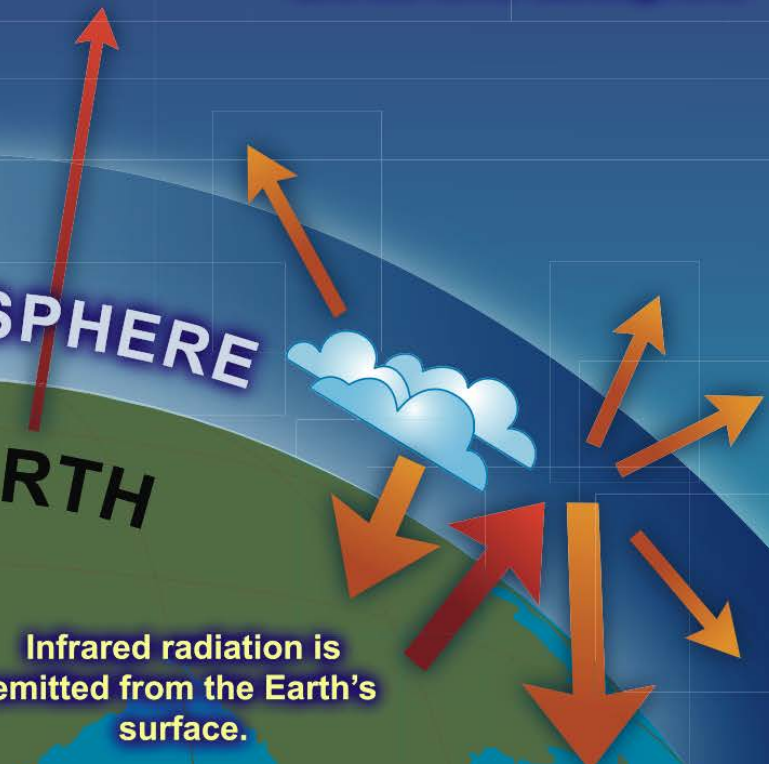


About half the solar radiation is absorbed by the Earth's surface and warms it.

ATMOSPHERE

EARTH

Infrared radiation is emitted from the Earth's surface.



Earth and the Atmosphere – A Tangible Example

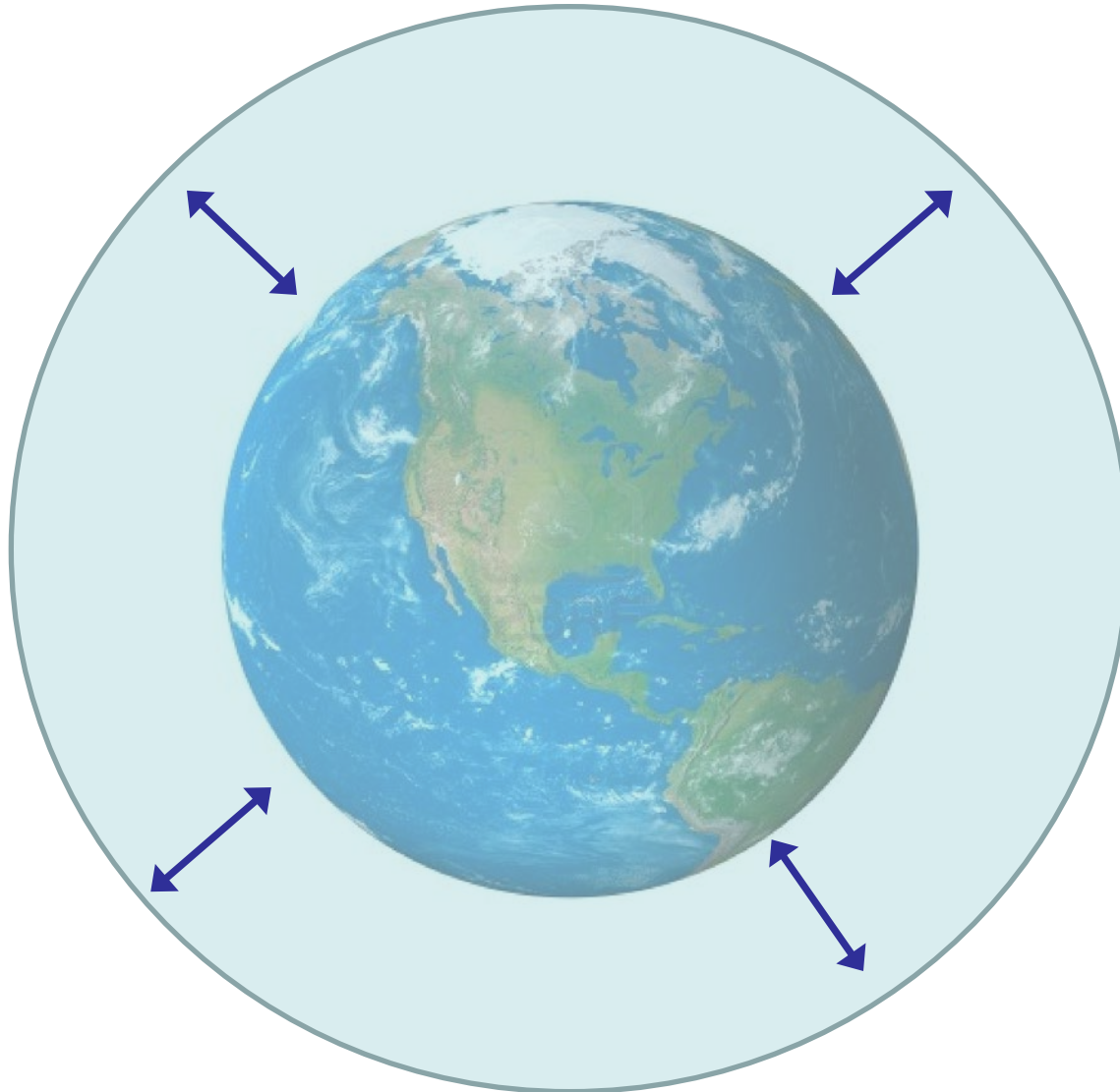


Earth Diameter – 7,900 miles



Earth Atmosphere – 60 miles

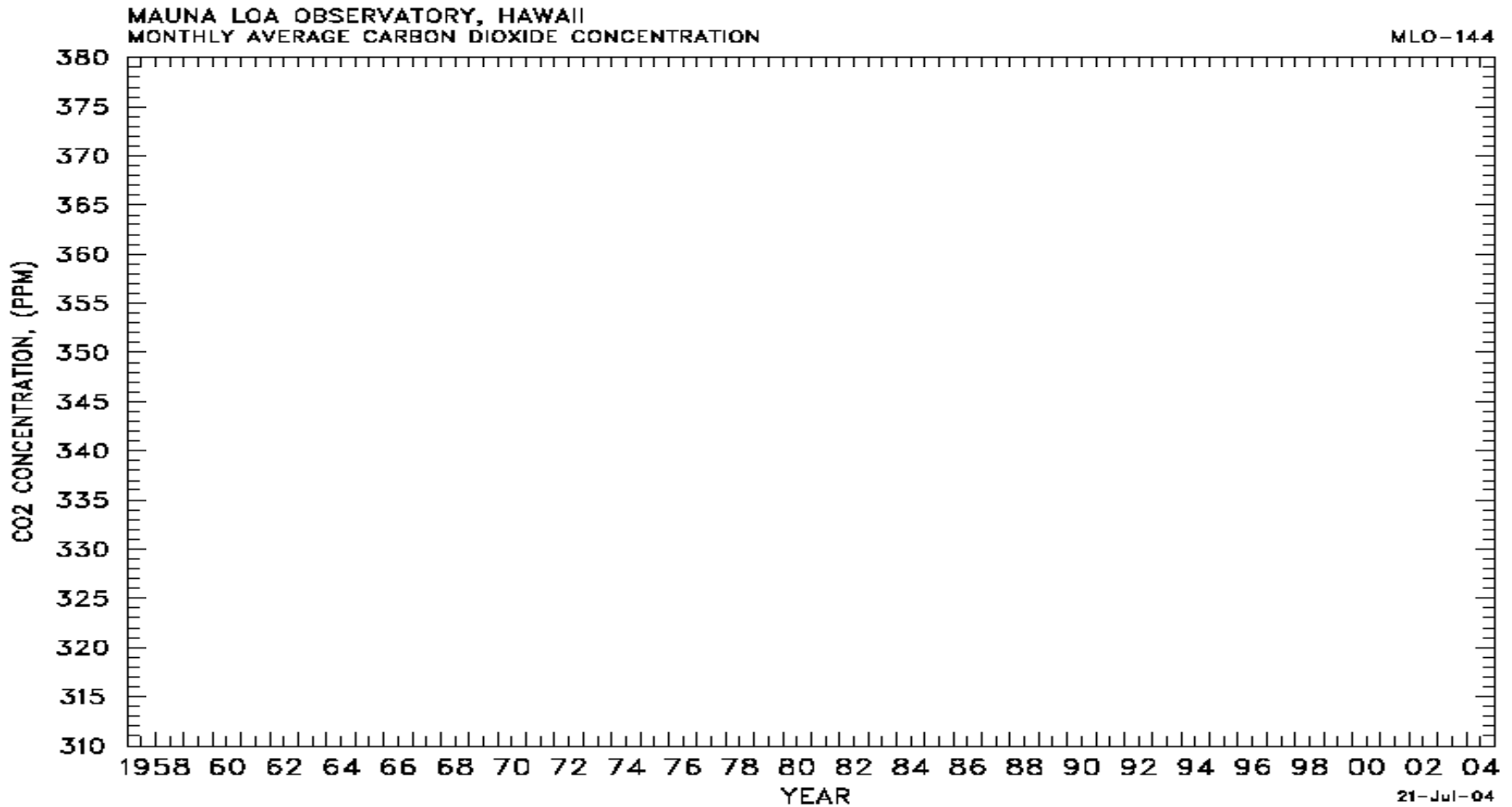
Earth and the Atmosphere – Exaggerated Atmosphere Example



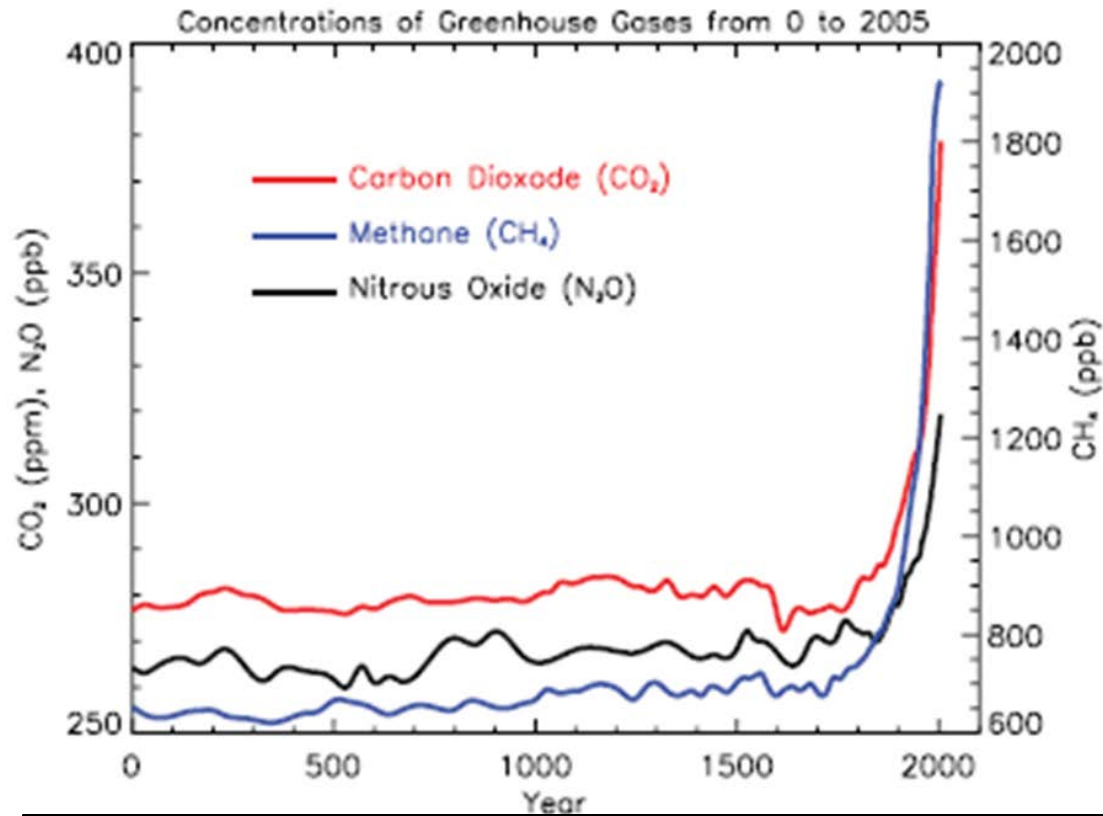
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Atmospheric CO2 Concentrations (Monthly Averages)



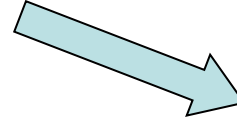
Greenhouse Gas Concentrations are Increasing in the Atmosphere



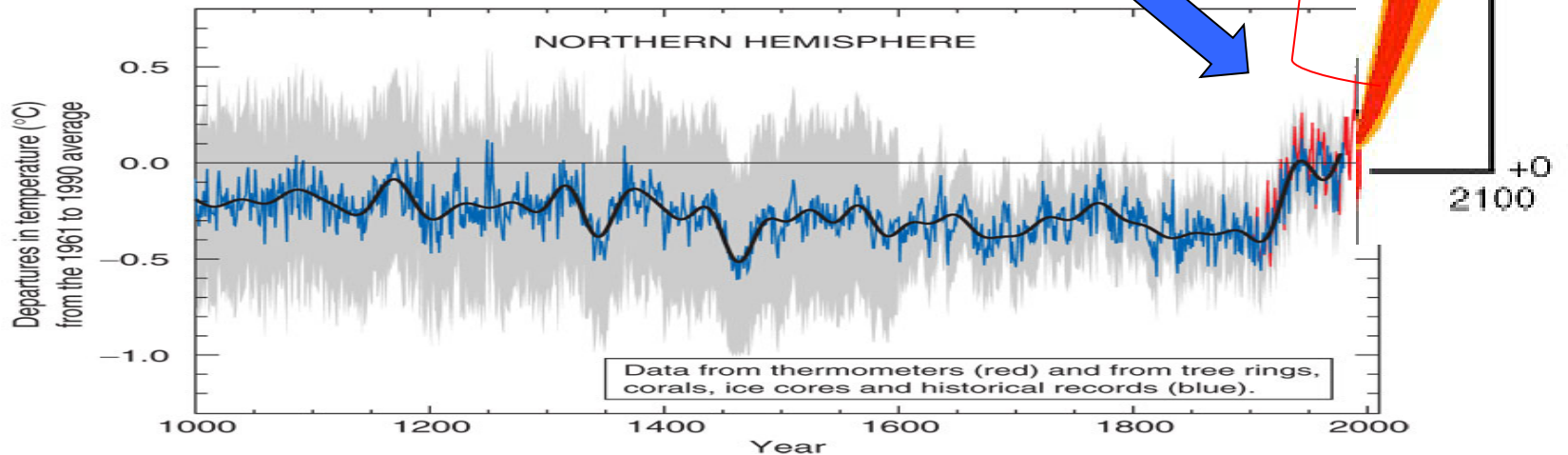
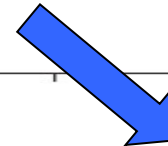
**Source: IPCC, AR4, WG1 Chapter 2

Temperature

Expected range of temperature rise is concerning



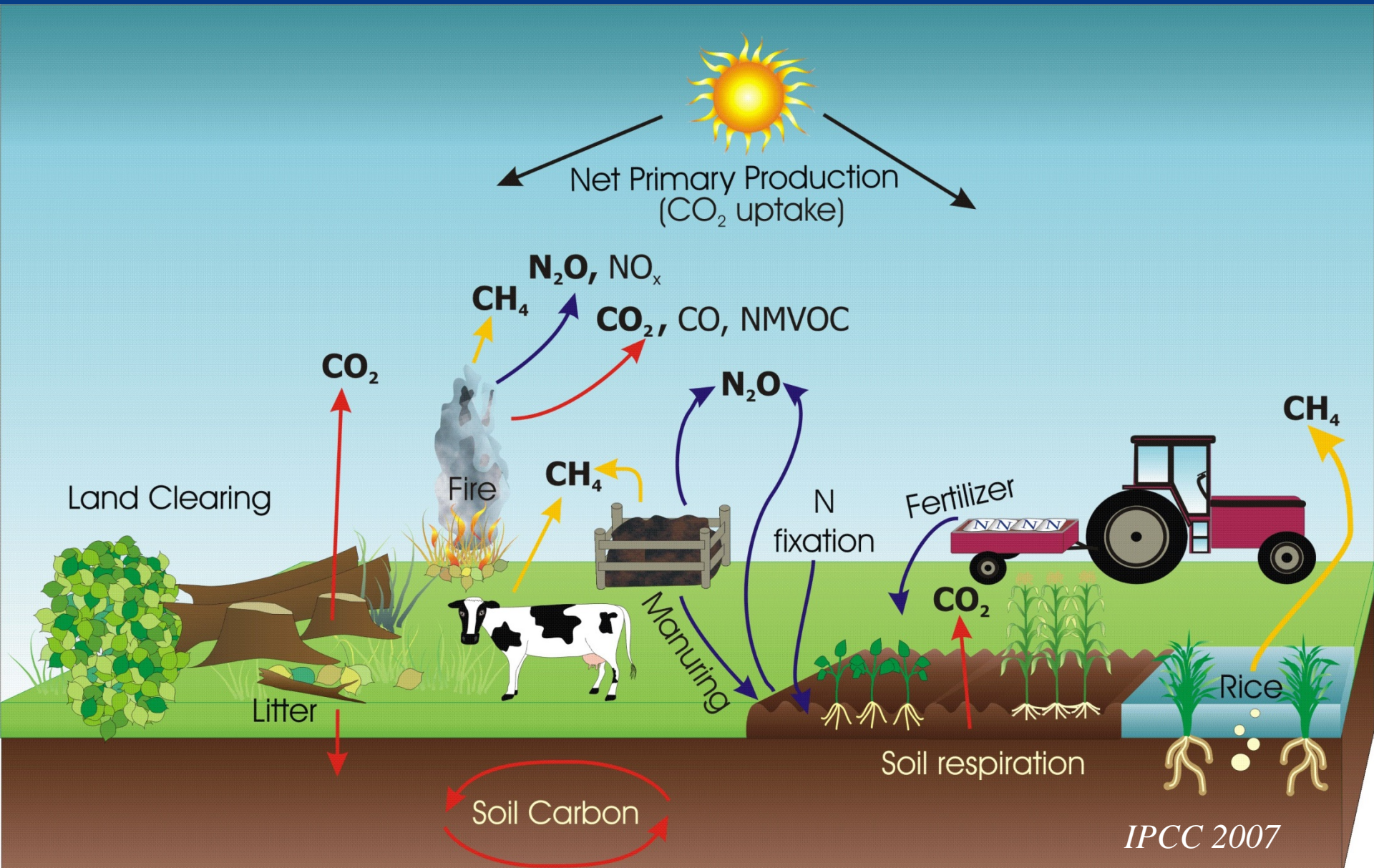
This temperature rise has us concerned



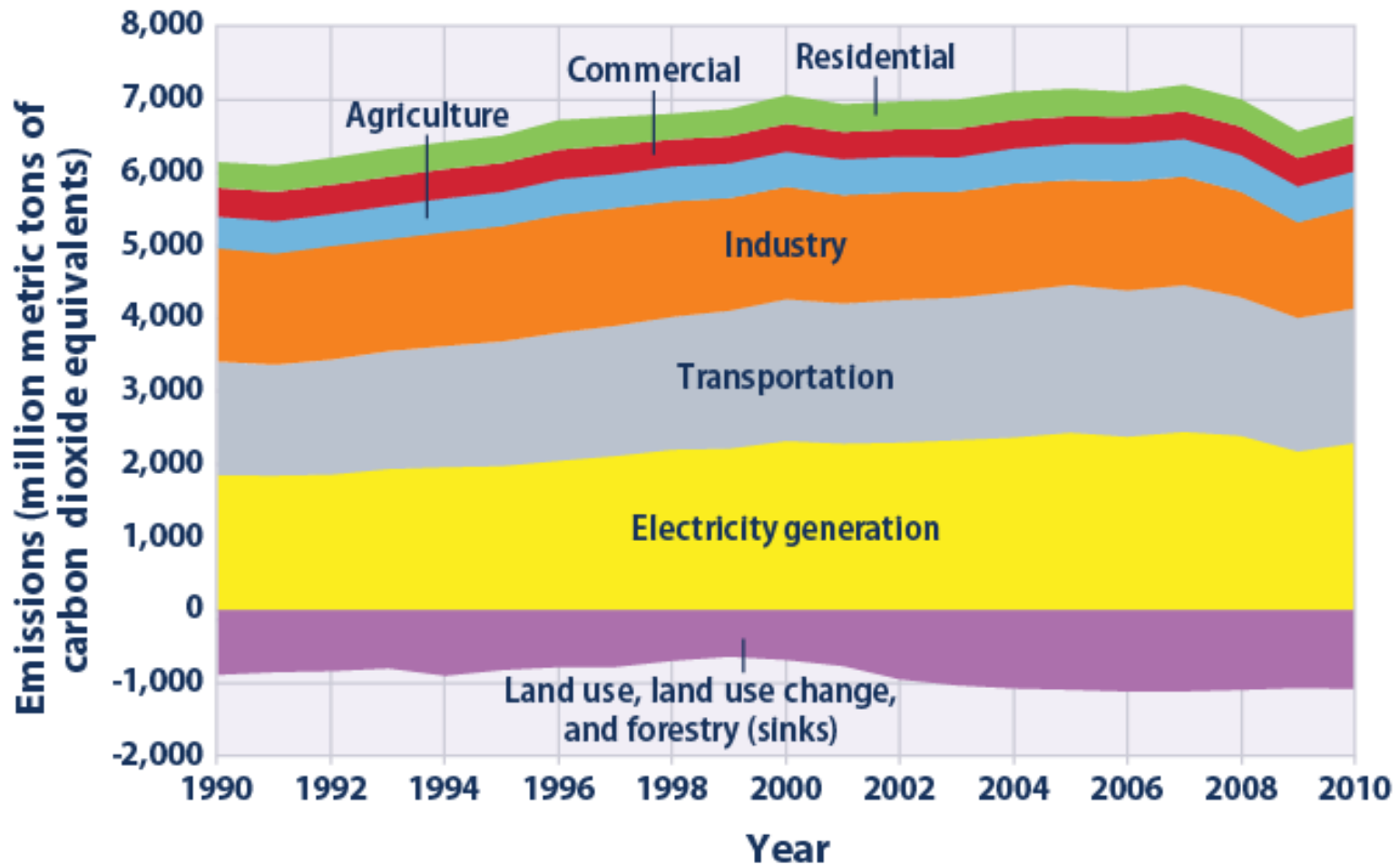
Climate Change

***U.S. Agricultural GHG
Emissions***

Agricultural sources and sinks of greenhouse gases



U.S. Greenhouse Gas Emissions and Sinks by Economic Sector, 1990–2010



Data source: U.S. EPA (U.S. Environmental Protection Agency). 2012. Inventory of U.S. greenhouse gas emissions and sinks: 1990–2010. USEPA #EPA 430-R-12-001. www.epa.gov/climatechange/ghgemissions/usinventoryreport.html.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climatechange/indicators.

<u>Rank</u>	<u>Country</u>	<u>CO₂e emissions in megatonnes</u>	<u>Percentage of global total</u>
1	China	7,225.4	16.38%
2	United States of America	6,933.8	15.72%
3	European Union (27) ^[2]	5,331.5	12.09%
4	Brazil	2,854.8	6.47%
5	Indonesia	2,038.9	4.62%
6	Russian Federation	2,012.8	4.56%
7	India ^[2]	1,875.5	4.25%
8	Japan ^[2]	1,390.3	3.15%
9	Germany ^[2]	1,005.0	2.28%
10	Canada	810.8	1.84%
11	United Kingdom ^[2]	684.2	1.55%
12	Mexico	682.3	1.55%
13	Korea (South) ^[2]	608.3	1.38%
14	Italy ^[2]	581.5	1.30%
15	France ^[2]	575.0	1.30%
16	Iran ^[2]	572.5	1.30%
17	Australia ^[2]	571.6	1.30%
18	Ukraine ^[2]	494.7	1.12%
19	Spain ^[2]	470.9	1.07%
20	Venezuela	457.2	1.04%
21	Nigeria	454.4	1.03%
22	South Africa ^[2]	433.3	0.98%
23	Turkey	431.1	0.98%
24	Saudi Arabia ^[2]	387.6	0.88%
25	Malaysia ^[3]	374.5	0.85%

Increase This

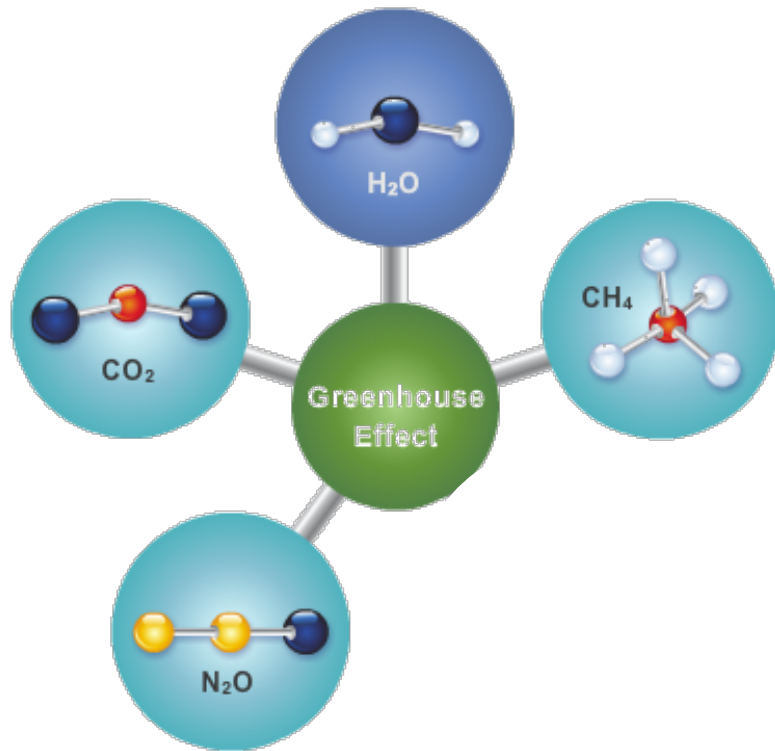
Decrease This

Carbon Sequestration from Land Use, Land Use Change, and Forestry (Sinks) – 958.3 (2011)

US Ag Sector 591.6 (2011)



Common Greenhouse Gases

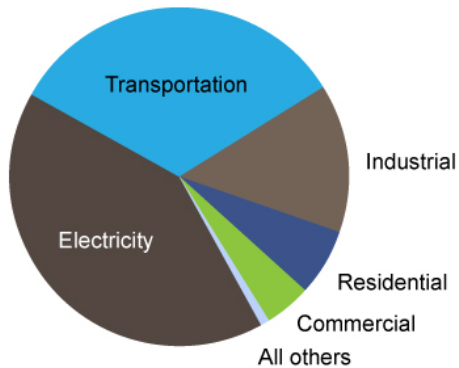


- **Carbon dioxide** is recycled through the atmosphere by the process of photosynthesis, microbial decomposition, and oxidation.
- **Methane** is a product of anaerobic decomposition of an organic material. It is the only greenhouse gas that when burned, creates another similar gas.
- **Nitrous oxide** is a clear gas with slight odor and can be removed from the atmosphere by photolysis or a process that involves its breakdown using sunlight. It is also reactive in the soil and atmosphere.

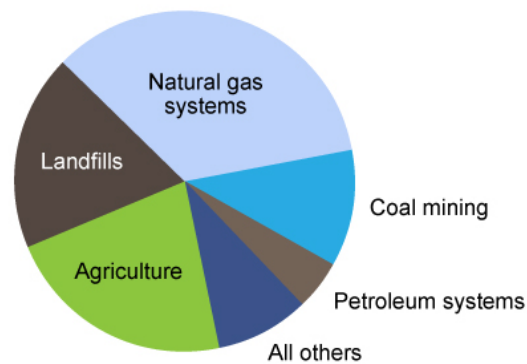
Source of Greenhouse Gas Emissions

Fossil fuel combustion alone contributed 95% of all carbon dioxide emitted in the US in 2009.

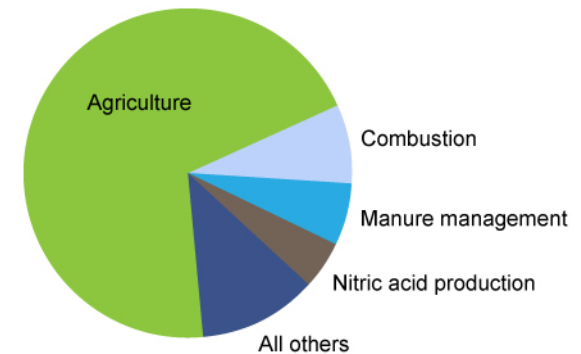
Carbon Dioxide (CO₂) Emission by Sector



Methane (CH₄) Emission by Sector



Nitrous Oxide (N₂O) Emission by Sector

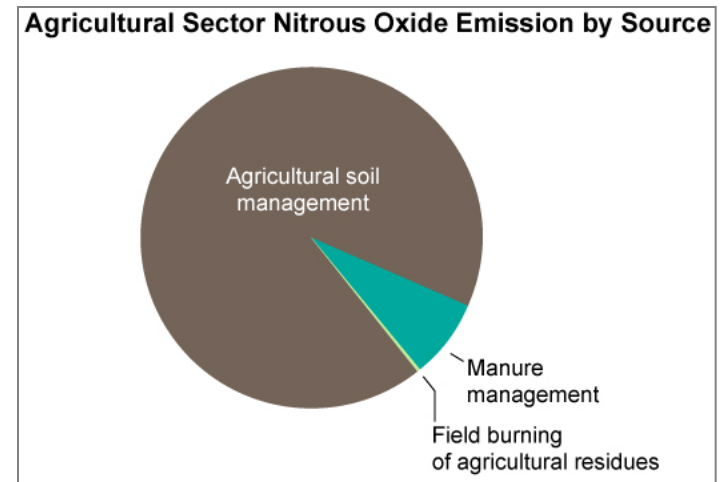
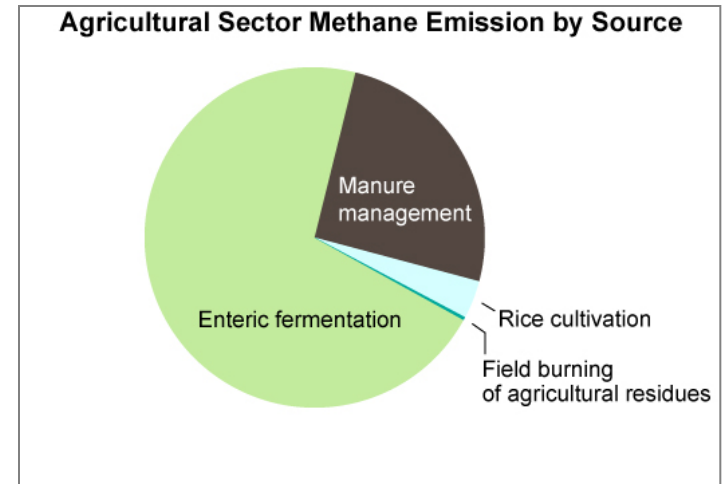


Percentage of GHG Emissions in 2009. EPA, 2011

GHGs Contributed from Agriculture

Agricultural sector is responsible for about 6% of total U.S. greenhouse gas emissions.

Among all non-carbon-dioxide emissions, methane (CH₄) and nitrous oxide (N₂O) are the primary greenhouse gases emitted by agricultural activities.



Percentage of GHG Emissions in 2009. EPA, 2011

Methane

Main anthropogenic sources of methane emissions are:

- a) Fossil fuel mining / distribution
- b) Rice Cultivation
- c) Livestock and manure management:
 - emitted through a digestive process
 - called enteric fermentation that is
 - unique to ruminant animals
 - produced by the anaerobic
 - decomposition of the organic waste
- d) Landfills:
 - produced by the anaerobic
 - decomposition of the organic matter



Photos courtesy of USDA-NRCS

Nitrous Oxide



Photos courtesy of USDA-NRCS

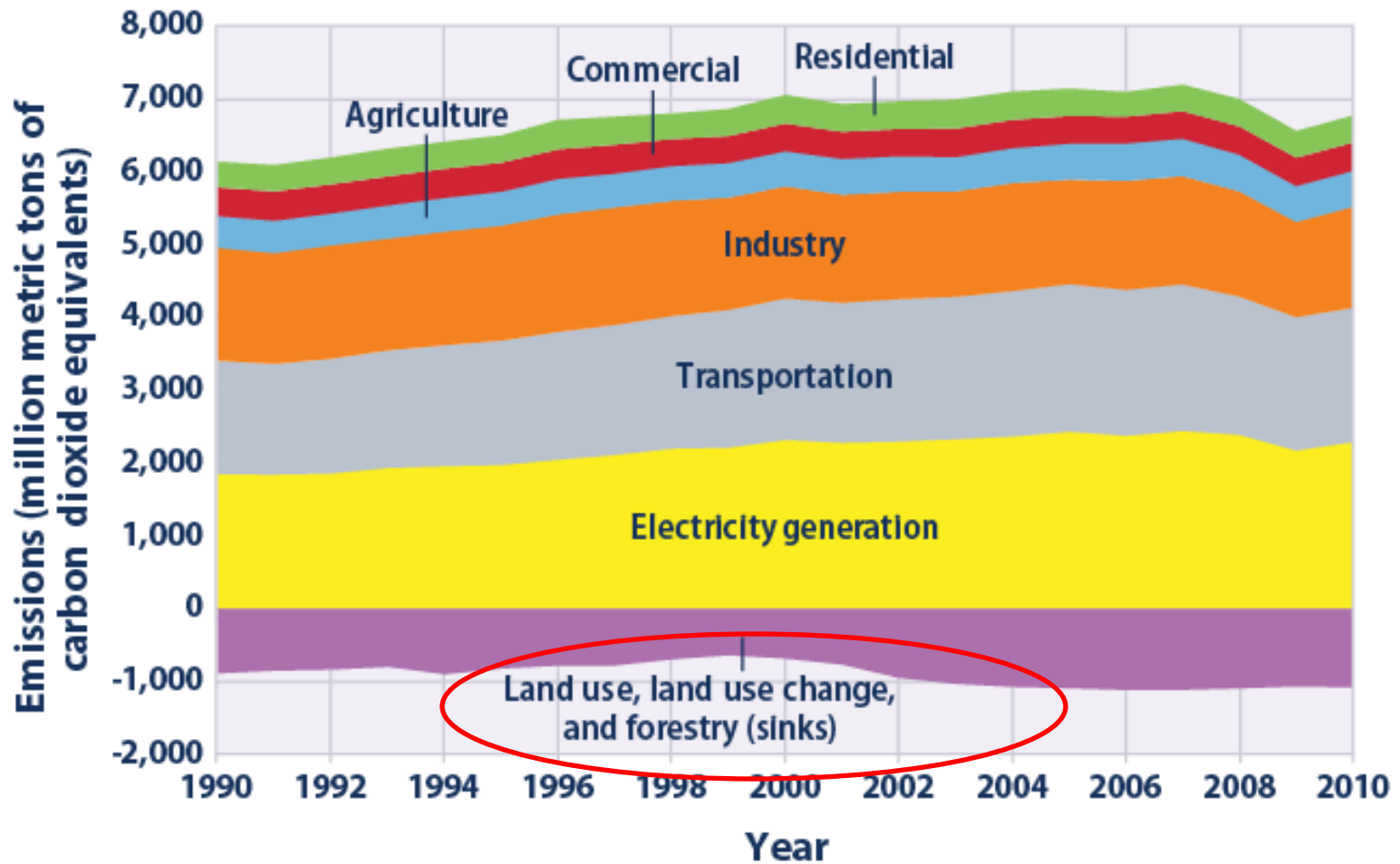
Main anthropogenic sources of nitrous oxide emissions are:

- a) Agricultural soil management
- b) Manure management
- c) Field burning of agricultural residues

Most nitrous oxide in the U.S. is a product of the processes related to the management of agricultural soils. These processes include fertilizer application, tillage and cropping systems.

Nitrous oxide is emitted during microbially-driven processes of [nitrification](#) and [denitrification](#).

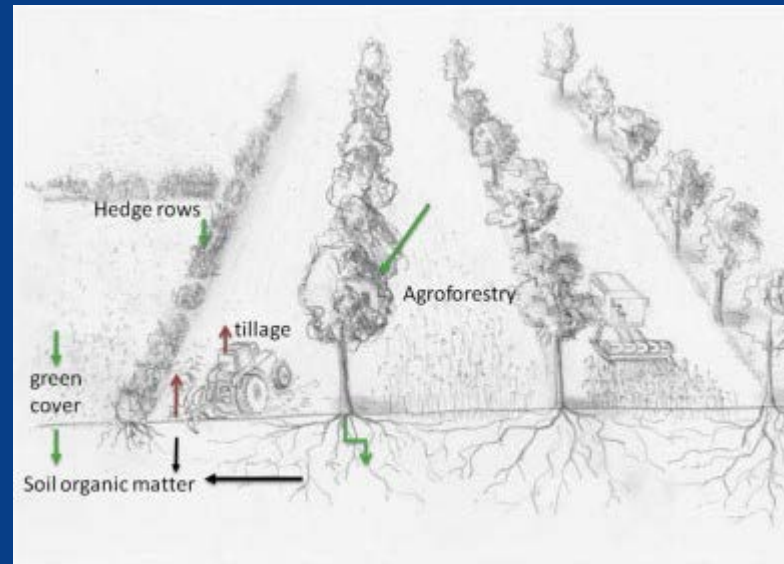
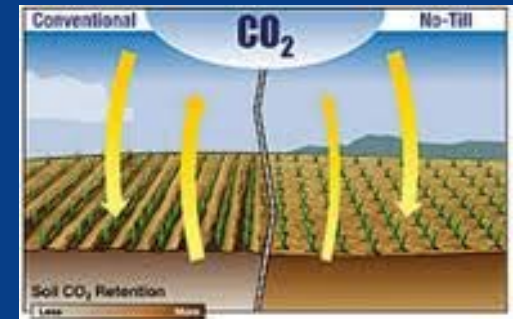
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NRCS Conservation Management Provides Emission Reduction and Carbon Sequestration Opportunities



Improved Agricultural Practices

Conservation buffers



Conservation tillage



Soil organic matter

CRP

Cover crops



Improved rotations

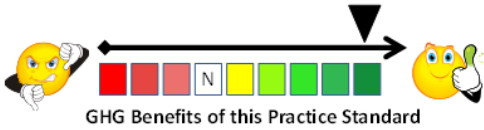


Sequestration - Soil and Biomass Storage of Carbon

****Numerous Co-Benefits**



NRCS Practice Standards for Greenhouse Gas Emission Reduction and Carbon Sequestration

Qualitative Ranking N=Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
 <p style="text-align: center;">GHG Benefits of this Practice Standard</p>	327	Conservation Cover (Information Sheet)	Establishing perennial vegetation on land retired from agriculture production increases soil carbon and increases biomass carbon stocks.
	329	Residue and Tillage Management, No Till/Strip Till/Direct Seed (Information Sheet)	Limiting soil-disturbing activities improves soil carbon retention and minimizes carbon emissions from soils.
	366	Anaerobic Digester (Information Sheet)	Biogas capture reduces CH ₄ emissions to the atmosphere and provides a viable gas stream that is used for electricity generation or as a natural gas energy stream.
	367	Roofs and Covers	Capture of biogas from waste management facilities reduces CH ₄ emissions to the atmosphere and captures biogas for energy production. CH ₄ management reduces direct greenhouse gas emissions.
	372	Combustion System Improvement	Energy efficiency improvements reduce on-farm fossil fuel consumption and directly reduce CO ₂ emissions.
	379	Multi-Story Cropping	Establishing trees and shrubs that are managed as an overstory to crops increases net carbon storage in woody biomass and soils. Harvested biomass can serve as a renewable fuel and feedstock.
	380	Windbreak/Shelterbelt Establishment (Information Sheet)	Establishing linear plantings of woody plants increases biomass carbon stocks and enhances soil carbon.
	381	Silvopasture Establishment	Establishment of trees, shrubs, and compatible forages on the same acreage increases biomass carbon stocks and enhances soil carbon.

Climate Change

*Environmental Markets
and Greenhouse Gases*

Policy Mechanisms for Reducing GHG Emissions

NRCS is engaged in the three most widely recognized and supported policy options that aim to reduce carbon and other greenhouse gas emissions are:

- 1) Non-regulatory market mechanisms (voluntary markets) and regulations (EPA and ARB)
- 2) An economy-wide greenhouse tax or simply a carbon tax (regional)
- 3) Cap-and-trade system (California)



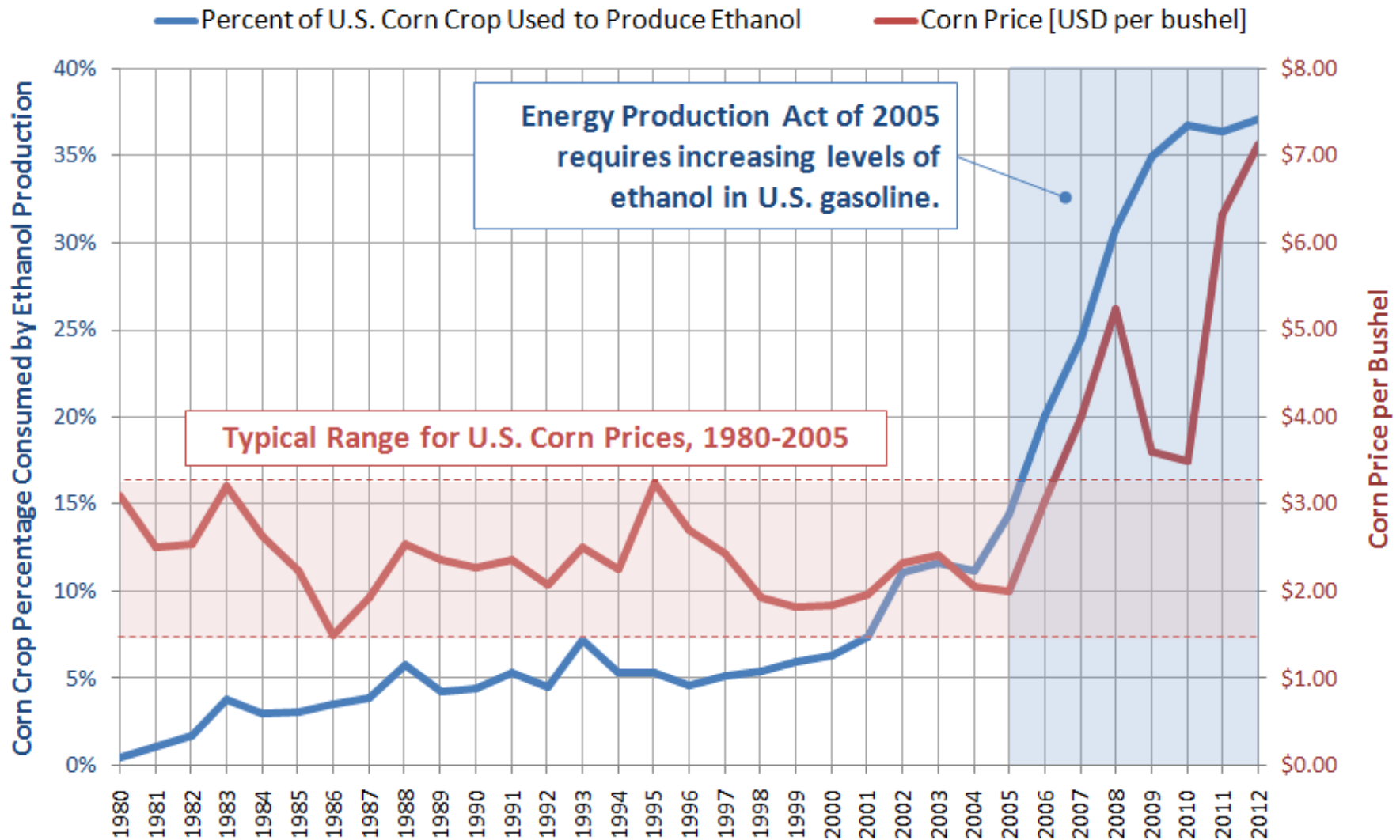
“The Financial Market”

- Dow Jones Industrial Average
- Kraft Foods Price

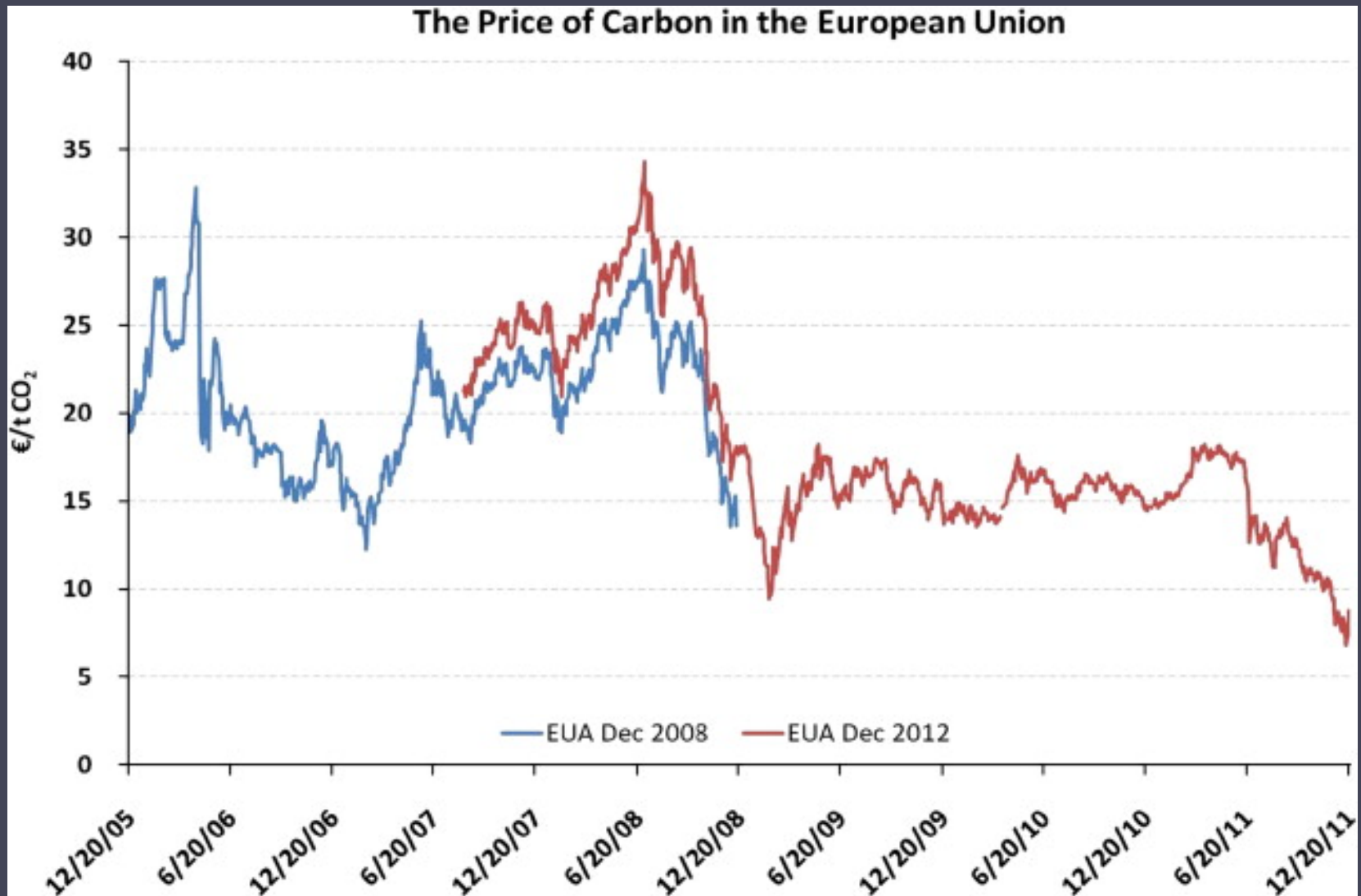


Food and Fuel Market - Commodities

Percentage of U.S. Corn Crop Consumed by Ethanol Production and Corn Price per Bushel, 1980-2012



Emerging Market - Carbon Market (Addressing Global Climate Change)



Ecosystem Service Markets are...

- Mechanism for placing value on marketable natural services (assets/benefits)
- Platform where services can be bought, sold or traded
- Financial system through which individuals receiving benefits can compensate the benefits producer

What makes a Market Successful?

- Clear rules/protocols for market transactions and trades
- Credible measurements and reporting
- Relatively low transaction costs
- Ability to accurately define & deliver benefit
- Adequate number of buyers and sellers that are easily located within a “marketplace”

Broad Array of U.S. Environmental Markets and Credits

<u>Type</u>	<u>Regulatory Driver</u>
Wetland	Federal & State
Stream	Federal & State
Buffer	State
Habitat	Federal & State
Forest	State
Carbon/GHG	State & (possibly) Federal
Nutrients	State
Misc. Water Quality	Federal & State
Stormwater	Federal & State
Renewable Energy	State
Water Rights	State
Aquifer Recharge	State
Development Rights	County

**Slide provided via compliments of American Farmland Trust

Why Allow for Trading?

- Cost Effectively Achieves Environmental Objectives
- Co-benefits and Ancillary Environmental Benefits

Why Should Ag Participate?

- Revenue and Payment Stacking Opportunities (EQIP plus Credit Revenue)
- Discussions are influencing land stewardship goals
- Agriculture knows what works best on the farm
- Receive recognition for what it has already done

Agricultural Offsets

- Reduce emission from BAU
- Sequester carbon in the soil
- Reforestation or afforestation of native tree species
- Methane capture and destruction from livestock
- Provide an entire suite of co-benefits
- Concerns: lack of permanence, science unclear on measuring and quantifying reductions


Universal Challenges

- Solid science (unit traded must be definable, measurable and verifiable)
- Appropriate length of contracts to ensure permanence
- Determining baselines and ensuring real changes occur that don't lead to leakage
- Creating transparent, credible, efficient, economical, high confidence markets

Climate Change

*Example of NRCS and
GHG Market
Opportunities*

NRCS Practice Standards for Greenhouse Gas Emission Reduction and Carbon Sequestration

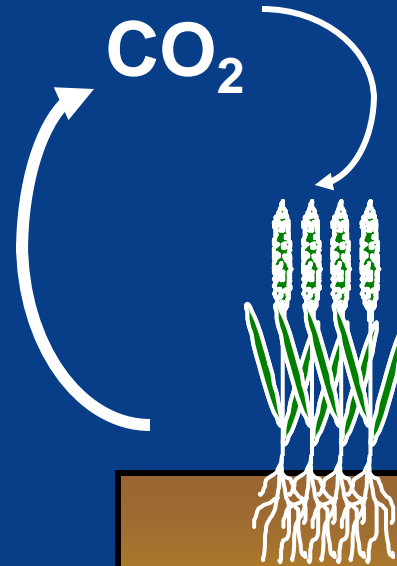
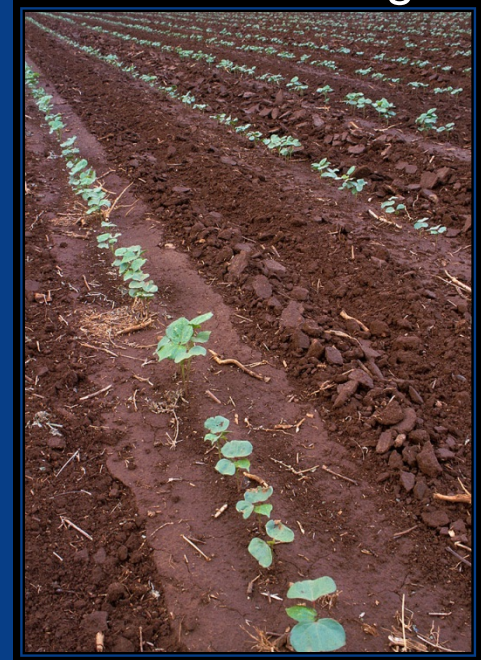
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Past Agricultural Practices

Erosion



Intensive tillage



Soil organic matter

Residue removal



Low Productivity

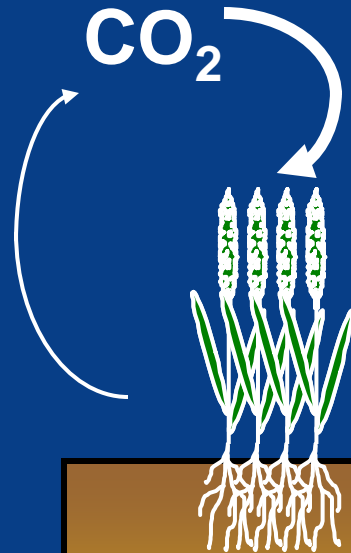


Improved Agricultural Practices

Conservation buffers



Conservation tillage



Soil organic matter

CRP

Cover crops



Improved rotations



Sequestration - Soil and Biomass Storage of C

****Numerous Co-Benefits**



Testing the waters - NRCS Environmental Market Leadership



Fact Sheet: Conservation Innovation Grant Program for Reducing Greenhouse Gas (GHG) Emissions and Promoting Carbon Sequestration

December 2010

NRCS Overview

The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) works with landowners through conservation planning and assistance designed to benefit the soil, water, air, plants, and animals resulting in productive lands and healthy ecosystems.

Science and technology are critical to good conservation. NRCS experts from many disciplines come together to help landowners conserve natural resources in efficient, smart and sustainable ways. Whether developed in a laboratory or on the land, NRCS science and technology helps landowners make the right decisions for every natural resource. NRCS succeeds through partnerships, working closely with individual farmers and ranchers, landowners, local conservation districts, government agencies, Tribes, Earth Team volunteers and many other people and groups that care about the quality of America's natural resources.

NRCS works at the local level – in field offices at USDA Service Centers in nearly every county in the Nation. NRCS employees understand local resource concerns and work to develop conservation solutions that withstand the test of time.

Grants Overview

Conservation Innovation Grants (CIG) is a voluntary program administered by NRCS. The grants are intended to stimulate the development and adoption of innovative conservation approaches and technologies to agricultural production while leveraging the

Federal investment in environmental enhancement and protection. Under CIG, Environmental Quality Incentives Program (EQIP) funds are used to award competitive grants to non-Federal governmental or non-governmental organizations, federally-recognized Tribes, and individuals.

Greenhouse Gas Grants

In fiscal year 2011, NRCS is making up to \$5 million available to support large-scale demonstration projects that will accelerate adoption of new and innovative approaches to reduce greenhouse gas (GHG) emissions and promote carbon sequestration on private lands. In addition, NRCS will provide up to \$10 million in EQIP funds to support eligible producers who are working with grant recipients as they implement conservation practices associated with the selected GHG projects. NRCS will support projects that meet the following requirements:

- Promote the adoption of conservation systems and practices for reducing greenhouse gas emissions and sequestering carbon;
- Quantify the impacts of conservation practices on GHG emissions and carbon sequestration;
- Demonstrate and further develop opportunities for marketing environmental credits associated with reducing GHG emissions and increasing carbon sequestration;
- Quantify the environmental benefits of these practices and work with GHG trading organizations to assist eligible

Greenhouse Gas Grants

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Helping People Help the Land

An Equal Opportunity Provider and Employer

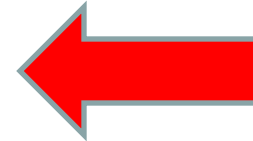


GHG CIG Projects

- More than nine Projects
- > \$7 Million
- Up to or >\$10 Million in FY2013 EQIP funds available – FY2014 dependent on FY2013 rollout
 - Not all CIG projects have been developed to incorporate EQIP-assisted producers

Testing the Markets – Greenhouse Gas / Carbon Sequestration Conservation Innovation Grants

- **Agricultural Soil Carbon in the Palouse Region**
- **Avoided Grassland Conversion Carbon Project**
- **Bovine Innovative Greenhouse Gas Solution**
- **Bringing Greenhouse Gas Benefits to Market: Nutrient Management for Nitrous Oxide Reductions**
- **Demonstrating GHG Emission Reductions in California and Mid-South Rice Production**
- **Development of Protocols and Accounting Methods for Carbon Sequestration on US Rangelands**
- **Estimating Nitrous Oxide Reductions from Nutrient Management in the Chesapeake Watershed**
- **Farm Smart Management System**
- **Improving Nitrogen Use Efficiency and Reducing Nitrous Oxide Emissions in Tomato Systems**
- **Reducing N₂O Losses from Cropping Systems for Environmental Credits with Fertilizer BMPs**



Ducks Unlimited and The Climate Trust CIG Projects (Note: this project will utilize EQIP Funding)



PLUS
Soil Carbon Credits

Preserving Grasslands
And Not Tilling – grazing and
haying permitted

\$\$\$ Return to Producer for Avoided
Grassland Conversion



Policy Mechanisms for Reducing GHG Emissions

NRCS is engaged in the three most widely recognized and supported policy options that aim to reduce carbon and other greenhouse gas emissions are:

- 1) Non-market mandates (voluntary markets) and regulation (EPA)
- 2) An economy-wide greenhouse tax or simply a carbon tax (regional)
- 3) Cap-and-trade system (California)



Assembly Bill 32 – California Global Warming Solutions Act

AB 32 Timeline



- **By Jan 1, 2009** - ARB adopts plan indicating how emission reductions will be achieved from significant sources of GHGs via **regulations, market mechanisms and other actions**.
- **During 2009** - ARB staff drafts rule language to implement its plan and holds a series of public workshop on each measure (including **market mechanisms**).
- **By Jan 1, 2010** - Early action measures take effect.
- **During 2010** - ARB conducts series of rulemakings, after workshops and public hearings, to adopt GHG regulations including rules governing **market mechanisms**.
- **By Jan 1, 2011** - ARB completes major rulemakings for reducing GHGs including **market mechanisms**. ARB may revise the rules and adopt new ones after 1/1/2011 in furtherance of the 2020 cap.
- **By Jan 1, 2012³** - GHG rules and **market mechanisms** adopted by ARB take effect and are legally enforceable.
- **December 31, 2020** - Deadline for achieving 2020 GHG emissions cap.

The Global Warming Solutions Act (AB 32) and GHG Reductions Goals

Background

The AB 32 [Scoping Plan](#) identifies a cap-and-trade program as one of the strategies California will employ to reduce the greenhouse gas (GHG) emissions that cause climate change. This program will help put California on the path to meet its goal of reducing GHG emissions to 1990 levels by the year 2020, and ultimately achieving an 80% reduction from 1990 levels by 2050. Under cap-and-trade, an overall limit on GHG emissions from capped sectors will be established by the cap-and-trade program and facilities subject to the cap will be able to trade permits (allowances) to emit GHGs.

The California Air Resources Board (ARB) has designed a California cap-and-trade program that is enforceable and meets the requirements of AB 32. The development of this program included a multi-year stakeholder process and consideration of potential impacts on disproportionately impacted communities. The program starts on January 1, 2012, with an enforceable compliance obligation beginning with the 2013 GHG emissions.





California is working closely with British Columbia, Ontario, Quebec and Manitoba through the Western Climate Initiative to develop harmonized cap and trade programs that will deliver cost-effective emission reductions. The WCI jurisdictions have formed a non-profit corporation, WCI, Inc. to provide coordinated and cost-effective administrative and technical support for its participating jurisdictions' emissions trading programs. Just as with other voluntary agreements that ARB establishes with local air districts, states, federal government, and contractors, ARB's [agreement](#) with WCI, Inc. does not confer any decision making authority; decisions concerning the ARB's cap-and-trade regulation are made by ARB at the direction of the Board. More details on the organization and operation of WCI, Inc., can be found at: <http://www.wci-inc.org/>.

Goals of Regulation

- Achieve 1990 GHG emission levels by 2020
- Achieve 80% reduction of 1990 levels by 2050

- ▶ [Regulatory Guidance Documents](#)
- ▶ [Auction Information](#)
- ▶ [Compliance Instrument Tracking System Service \(CITSS\)](#)
- ▶ [Compliance Offset Program](#)
- ▶ [List of Covered Entities](#)
- ▶ [Adaptive Management](#)
- ▶ [Voluntary Renewable Electricity Program](#)
- ▶ [Reported Emissions Data](#)
- ▶ [2020 Forecast Inventory](#)
- ▶ [Economic and Allocation Advisory Committee \(EAAC\)](#)
- ▶ [Workshops / Meetings](#)

▶ **Board Resolutions:**

- ▶ [12-51 \(10/18/2012\)](#) 
 - ▶ [Attachment A](#)
- ▶ [12-33 \(9/20/2012\)](#) 
- ▶ [11-32 \(10/20/2011\)](#) 
- ▶ [10-42 \(12/16/2010\)](#) 

▶ **Fact Sheets:**

- ▶ [Implementation FAQ](#) 
- ▶ [Program Overview](#) 
- ▶ [Market Oversight & Enforcement](#) 

▶ **Economics:**

- ▶ [Economic Analysis](#)
- ▶ [Economic Models](#)

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Background

ARB offset credits are greenhouse gas (GHG) emission reductions or GHG removal enhancements that meet regulatory criteria and may be used by an entity to meet up to eight percent of its triennial compliance obligation under the Cap-and-Trade Program. Each ARB offset credit is equal to 1 metric ton of carbon dioxide equivalent (MTCO_{2e}) and can only be quantified using an ARB approved Compliance Offset Protocol. [Subarticle 13](#) of the [Cap-and-Trade Regulation](#) details the legal requirements for Compliance Offset Protocols, implementation and verification of offset projects, and issuance of ARB offset credits. Once an ARB offset credit is issued, it may be used for compliance up to applicable limits with the Cap-and-Trade Program. **Only ARB can issue compliance offset credits for use in the Cap-and-Trade Program.**



Compliance Offset Protocols

ARB has adopted four Compliance Offset Protocols that may be used to generate ARB offset credits.

- [U.S. Forest Projects Compliance Offset Protocol](#)
- [Urban Forest Projects Compliance Offset Protocol](#)
- [Livestock Projects Compliance Offset Protocol](#)
- [ODS Compliance Offset Protocol](#)

Note: *Additional Compliance Offset Protocols will be considered as part of future rulemaking activities.*



Compliance Offset Projects

All compliance offset projects must be developed according to ARB approved Compliance Offset Protocols. [Offset Project Operators](#) must list their offset projects with an approved [Offset Project Registry](#) to be eligible for ARB offset credits. Please see the Compliance Offset Projects web page (**coming soon!**) for more information on proposed compliance offset projects.

Project Types:

- [Forest Projects](#)
- [Urban Forest Projects](#)
- [Livestock Projects](#)
- [Ozone Depleting Substances \(ODS\) Projects](#)

California ARB continues to refine many of the carbon offset program details.

Concluding remarks

- Agriculture has a significant role to play in environmental markets, voluntary GHG emission reductions, and carbon sequestration
- Many technologies are feasible and can be implemented at relatively low cost – but **may** require incentives to farmers
- Barriers exist – a key issue is the cost of quantifying and verifying agricultural environmental benefits

- Emerging systems and recordkeeping (precision ag., etc.) can empower farmers and help generate agricultural carbon credits.
- Land Use, Land Use Change, and Forestry are important carbon sinks (**with plenty of untapped conservation potential**)
- USDA and NRCS are investing in quantification tools to support the accounting of agricultural GHG emissions and sinks



United States Department of Agriculture
Natural Resources Conservation Service

*Planning today...
for a better tomorrow.*



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