Climate Change and KS : Mitigation

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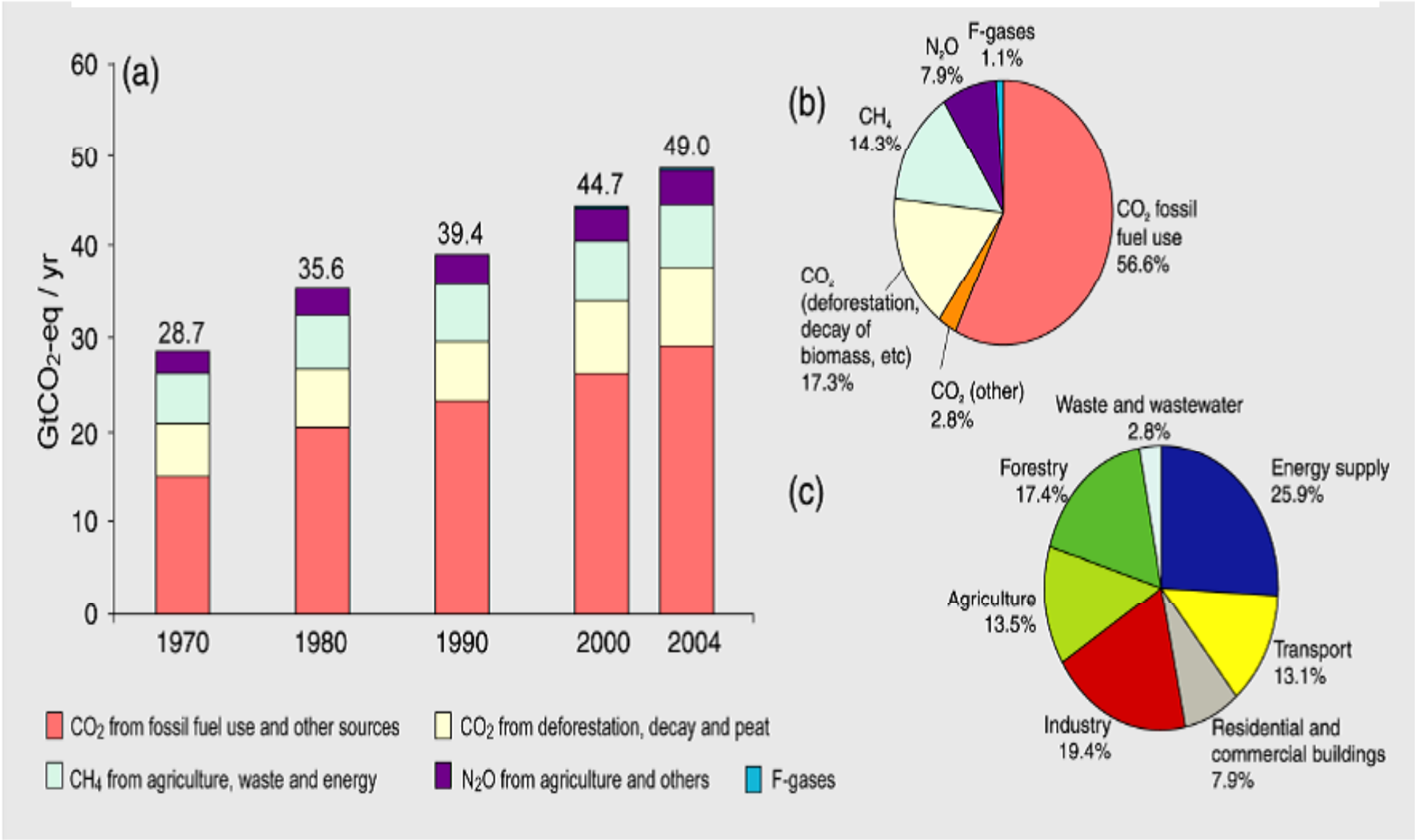
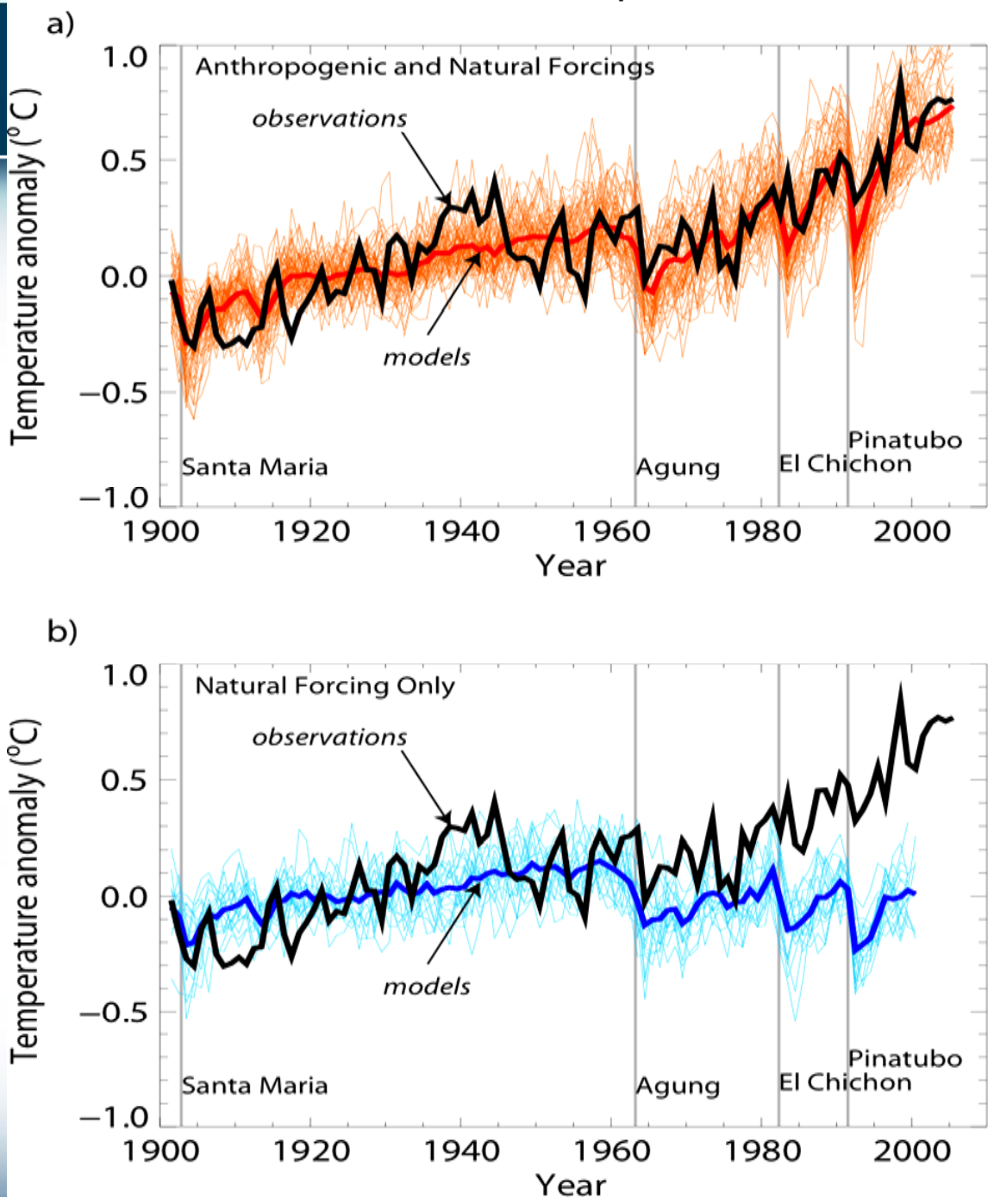
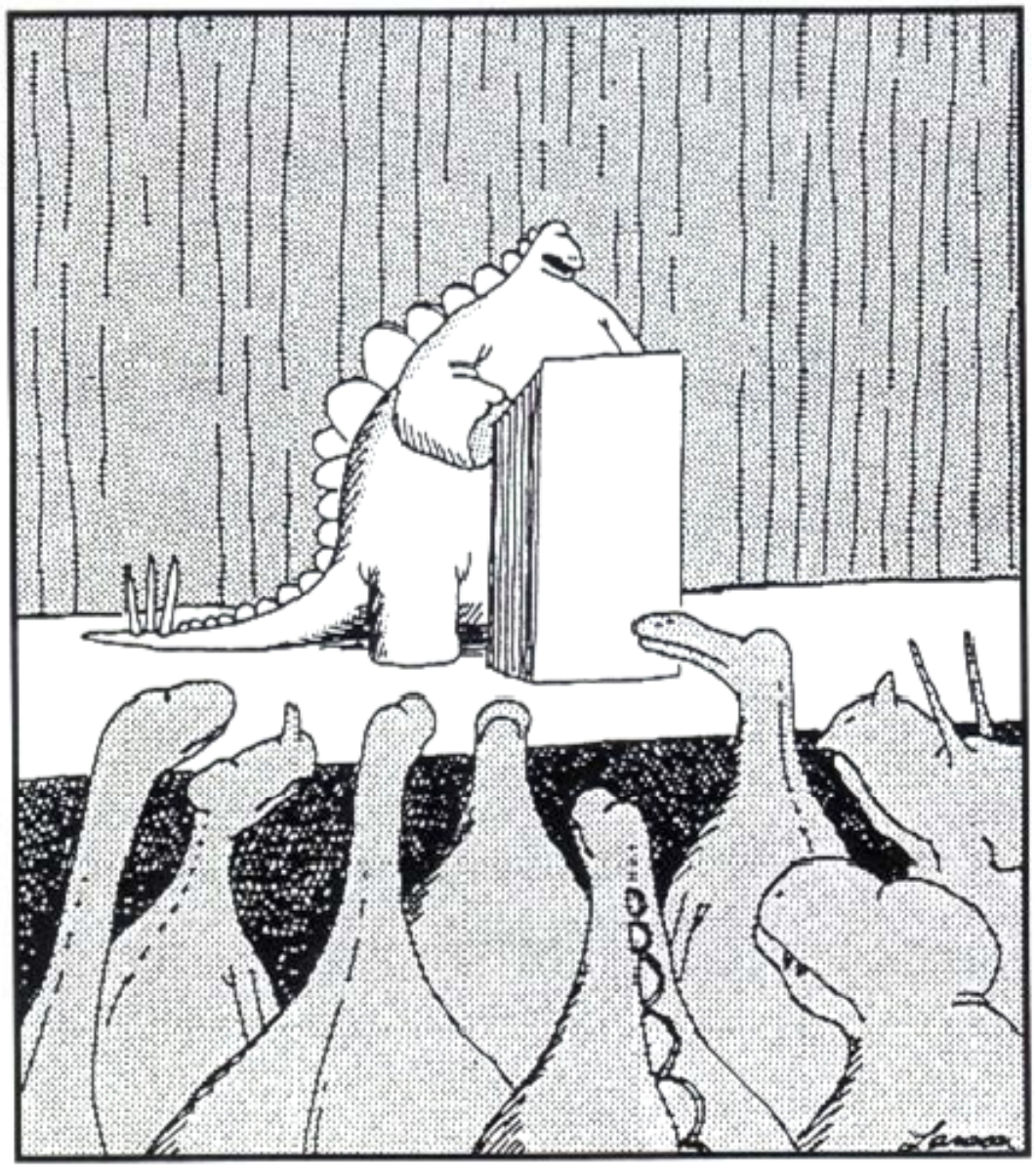
K-State Research and Extension

Figure SPM.3. (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004.[a] (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO_2-eq. (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2-eq. (Forestry includes deforestation). {Figure 2.1}



Global Mean Surface Temperature Anomalies





"The picture's pretty bleak, gentlemen. ... The world's climates are changing, the mammals are taking over, and we all have a brain about the size of a walnut."

The Far Side®

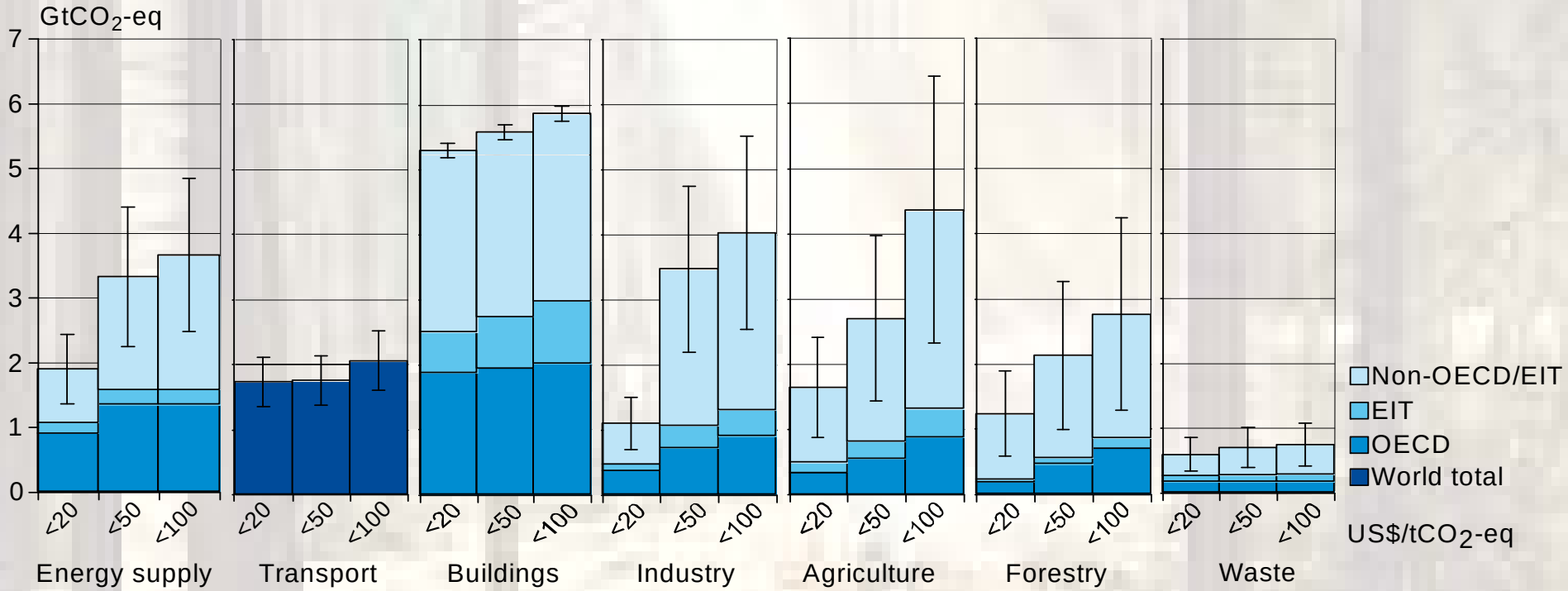
LAST IMPRESSIONS

2002

March

Saturday 23

Global economic mitigation potential for different sectors at different carbon prices



IPCC, 2007

How can emissions be reduced?
Energy Supply

IPCC
Intergovernmental Panel on Climate Change

Key mitigation technologies and practices currently commercially available

- **Efficiency**
- **Fuel switching**
- **Nuclear power**
- **Renewable (solar, wind, geothermal and bioenergy)**
- **Combined heat and power**
- **Early applications of CO_2 capture and storage (CCS)**

Key mitigation technologies and practices projected to be commercialized before 2030

- **CCS for gas**
- **Biomass and coal-fired electricity generating facilities**
- **Advanced renewables (tidal and wave energy, concentrating solar, solar PV)**

How can emissions be reduced?
Transport

IPCC
Intergovernmental Panel on Climate Change

Key mitigation technologies and practices currently commercially available

- More fuel efficient vehicles
- Hybrid vehicles
- Biofuels
- Rail and public transport systems
- Cycling, walking
- Land-use planning

Key mitigation technologies and practices projected to be commercialized before 2030

- Second generation biofuels
- Higher efficiency aircraft
- Advanced electric and hybrid vehicles with more powerful and reliable batteries

How can emissions be reduced?
Industry

IPCC
Intergovernmental Panel on Climate Change

Key mitigation technologies and practices currently commercially available

- More efficient electrical equipment
- Heat and power recovery
- Material recycling
- Control of non-CO_2 gas emissions

Key mitigation technologies and practices projected to be commercialized before 2030

- Advanced energy efficiency
- CCS for cement, ammonia, and iron manufacture
- Inert electrodes for aluminum manufacture

How can emissions be reduced?
Buildings

IPCC
Intergovernmental Panel on Climate Change

Key mitigation technologies and practices currently commercially available

- Efficient lighting
- Efficient appliances and air-conditioners
- Improved insulation
- Solar heating and cooling
- Alternatives for fluorinated gases in insulation and appliances

Key mitigation technologies and practices projected to be commercialized before 2030

- Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control
- Solar PV integrated in buildings

Agriculture

IPCC
Intergovernmental Panel on Climate Change

- A large proportion of the mitigation potential of agriculture (excluding bioenergy) arises from soil C sequestration, which has strong synergies with sustainable agriculture and generally reduces vulnerability to climate change.

- Agricultural practices collectively can make a significant contribution at low cost
  - By increasing soil carbon sinks,
  - By reducing GHG emissions,
  - By contributing biomass feedstocks for energy use

IPCC Fourth Assessment Report, Working Group III, 2007

Agriculture

IPCC
Intergovernmental Panel on Climate Change

- **Cropland**
  - Reduced tillage
  - Rotations
  - Cover crops
  - Fertility management
  - Erosion control

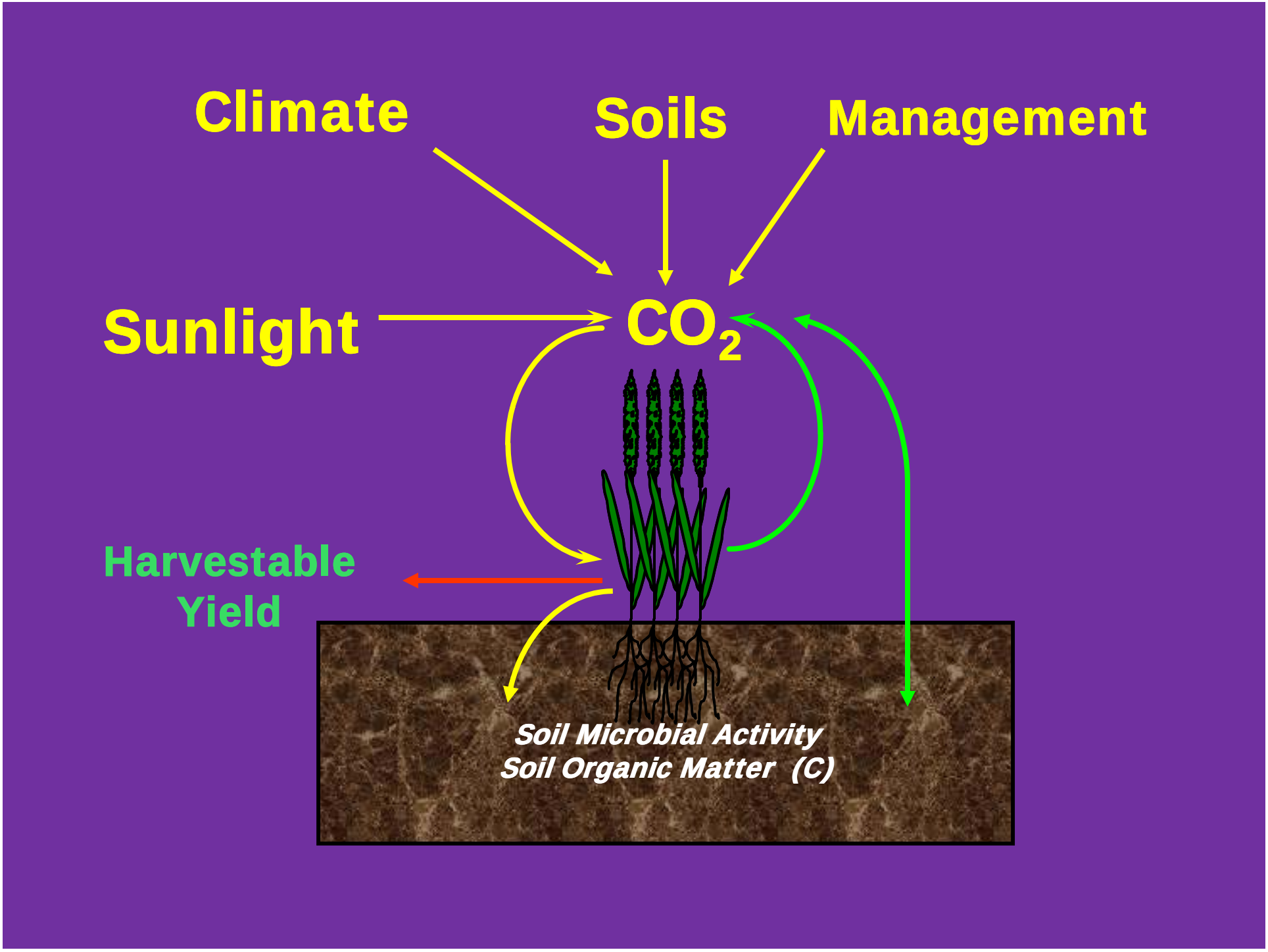
No-till seeding in USA

- **Rice paddies**
  - Irrigation
  - Chemical and organic fertilizer
  - Plant residue management

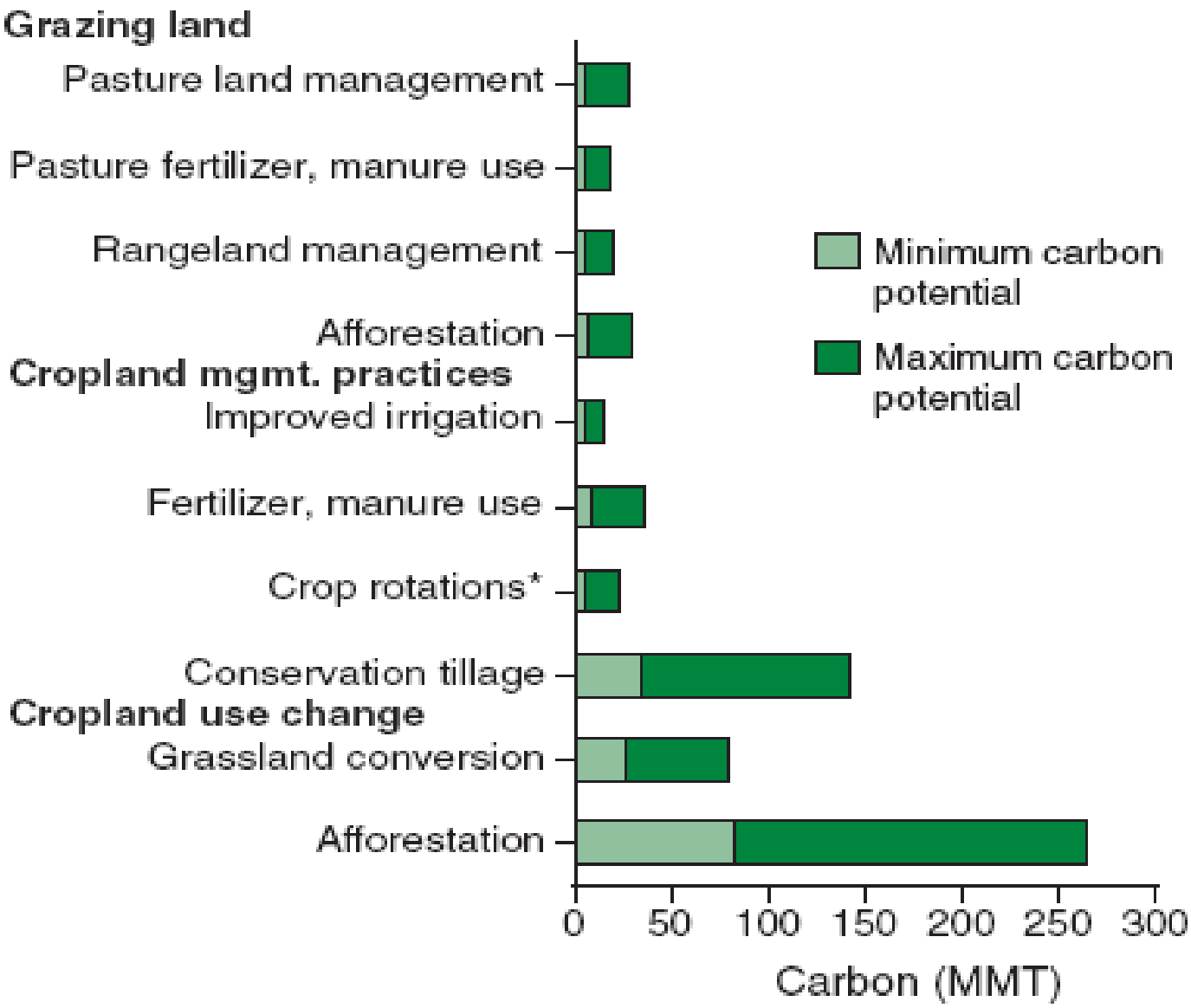
Rice fields in The Philippines

- **Agroforestry**
  - Improved management of trees and cropland

Maize / coffee fields in Mexico


Climate
Soils
Management
Sunlight
CO_2
Harvestable Yield
Soil Microbial Activity
Soil Organic Matter (C)

Estimated potential carbon sequestration



* Includes winter cover crops and elimination of summer fallow.

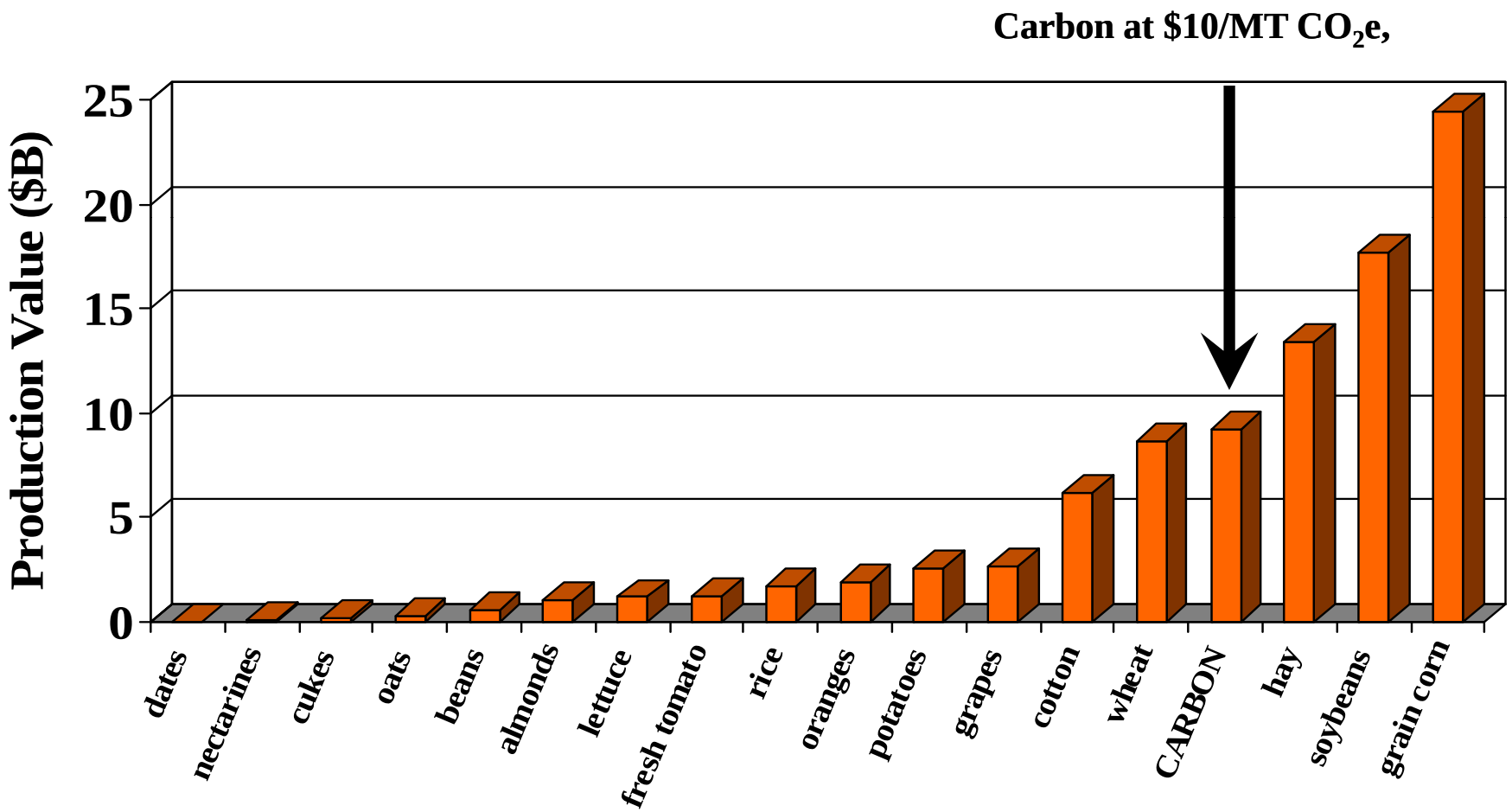
[ERS 2004]

No-Tillage Cropping Systems
Conservation Agriculture

- Restores soil carbon
- Conserves moisture
- Saves fuel
- Saves labor
- Lowers machinery costs
- Reduces erosion
- Improved soil fertility
- Controls weed
- Planting on the best date
- Improves wildlife habitat

Illustrative Ranking of Carbon as a Crop in U.S.

Per Proposed GHG Limits in Senate Bill 280 (Lieberman-McCain) 1/12/07



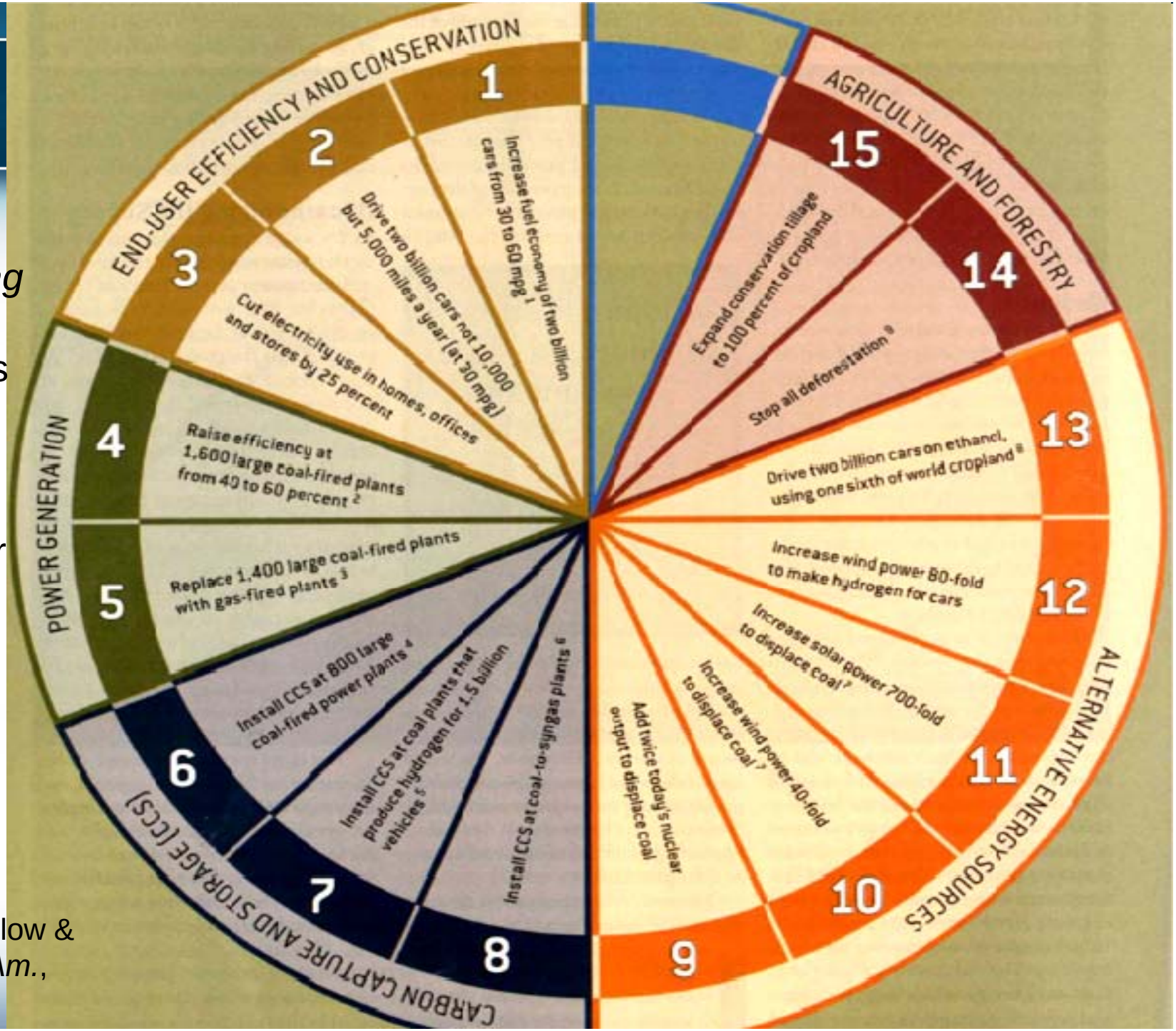
[Crop Source: USDA - National Agricultural Statistics Service – US Crop Rankings - 1997 Production Year Ranking Based on Value of Production]

Conclusions: Agricultural Mitigation

- Agriculture has a significant role to play in climate mitigation
- Agriculture is cost competitive with mitigation options in other sectors
- Bio-energy crops and improved energy efficiency in agriculture can contribute to further climate mitigation
- Agricultural mitigation should be part of a portfolio of mitigation measures to reduce emissions / increase sinks while new, low carbon energy technologies are developed

Each "*De-carbonizing Wedge*" represents 25 billion tons of carbon avoided or reduced.

7 wedges needed to reach stabilize emissions



Source: Socolow & Pacala; *Sci. Am.*, Sept. 2006

- Power Generation
  - Raise efficiency of 1600 large coal-fired power plants from 40-60%
  - Replace 1400 large coal-fired power plants with gas-fired
- Carbon Capture and Storage
  - Install CCS at 800 large coal-fired power plants
  - Install CCS at coal plants the produce H_2 for 1.5 billion vehicles
  - Install CCS at coal to syngas plants

- Alternative Energy Sources
  - Add 2X current nuclear output to replace coal
  - Increase wind power 40 fold to displace coal
  - Increase solar power 700 fold to displace coal
  - Increase wind power 80 fold to make hydrogen for cars
  - Biofuels for 2 billion cars using 16% of the world's cropland
- Energy Efficiency and Conservation
  - Increase fuel economy from 30 -60 mpg (2 billion cars)
  - Reduce annual mileage (2 billion cars @ 30 mpg)
  - Cut electricity use in buildings by 25%

The Global Warming Survival Guide

51 Things You Can Do To Make A Difference

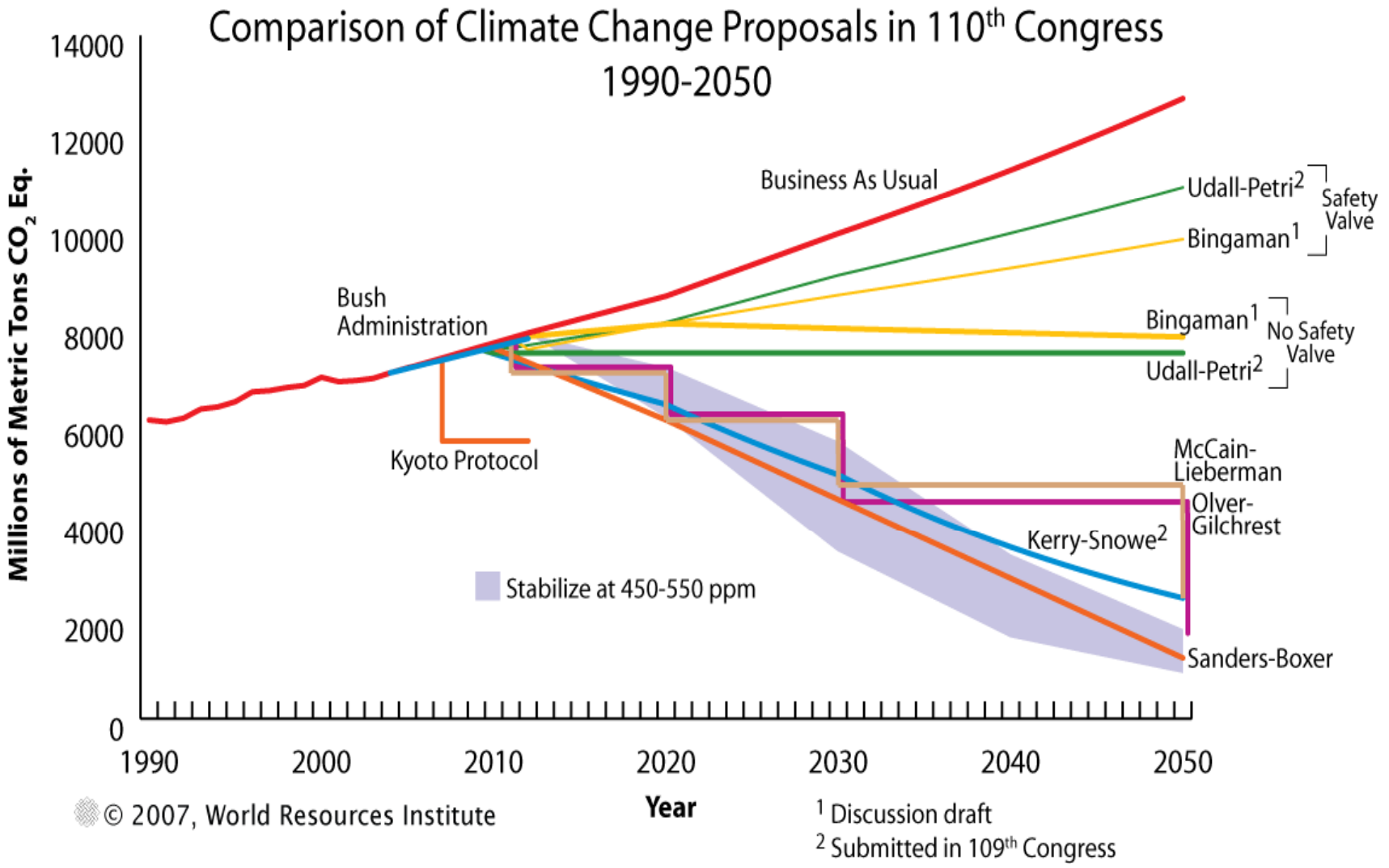
(Reference: Time Magazine, April 09, 2007)

1. Turn food into fuel. Cellulosic ethanol.
2. "Green" homes, increase efficiency by 40%
   - Larger overhangs
   - Double pane windows
   - Insulation
3. Change your light bulbs
4. Light up your city with LEDS
5. Hang up a clothesline
6. Geothermal heat, wind energy, solar
7. Carbon capture
8. Pay bills online
9. Open a window instead of air conditioning
10. Home energy audit

10. Energy Star rating for appliances
11. Insulate the water heater
12. Say no to plastic bags. Use recycled grocery bags.
13. Turn off the lights
14. Turn off the computer
15. Use recycled paper
16. Check tire pressure
17. Hybrid or electric car
18. Walk or bike
19. Recycle
20. Consume less

There are also co-benefits of mitigation

- Many climate change mitigation measures lead to less air pollution.
- Mitigation can also be positive for:
  - Energy security
  - Improve the balance of trade
  - Rural economic development
  - Sustainable agriculture
  - Employment
  - Human health and well-being


Comparison of Climate Change Proposals in 110th Congress
1990-2050
Millions of Metric Tons CO_2 Eq.
14000
12000
10000
8000
6000
4000
2000
0
1990
2000
2010
2020
2030
2040
2050
Year
Business As Usual
Udall-Petri[2]
Safety Valve
Bingaman[1]
Bush Administration
Bingaman[1]
No Safety Valve
Udall-Petri[2]
Kyoto Protocol
McCain-Lieberman
Olver-Gilchrest
Kerry-Snowe[2]
Stabilize at 450-550 ppm
Sanders-Boxer
© 2007, World Resources Institute
[1] Discussion draft
[2] Submitted in 109th Congress


AN OBSERVANT SCOUT CAN LEARN A LOT ON A HIKE...
HE CAN LEARN ABOUT THE "WEB OF NATURE"
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ALL WORKING TOGETHER TO MAKE A BETTER LIFE FOR BEAGLES!

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- Websites

  www.soilcarboncenter.k-state.edu/

  www.casmgs.colostate.edu/

- Energy Efficiency and Conservation
  - Increase fuel economy from 30 - 60 mpg (2 billion cars)
  - Reduce annual mileage (2 billion cars @ 30 mpg)
  - Cut electricity use in buildings by 25%

- Agriculture and Forestry
  - Stop all deforestation
  - Expand conservation tillage to 100 % of the cropland