
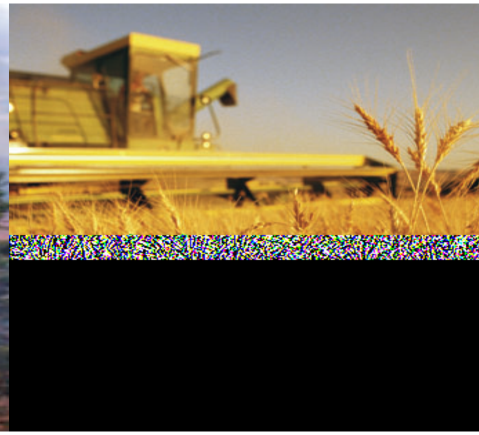


# US Climate Change and Renewable Energy Policies: An "Inside The Beltway" View

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**Thank you:**
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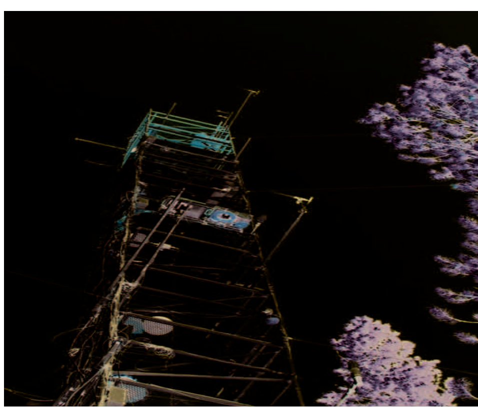
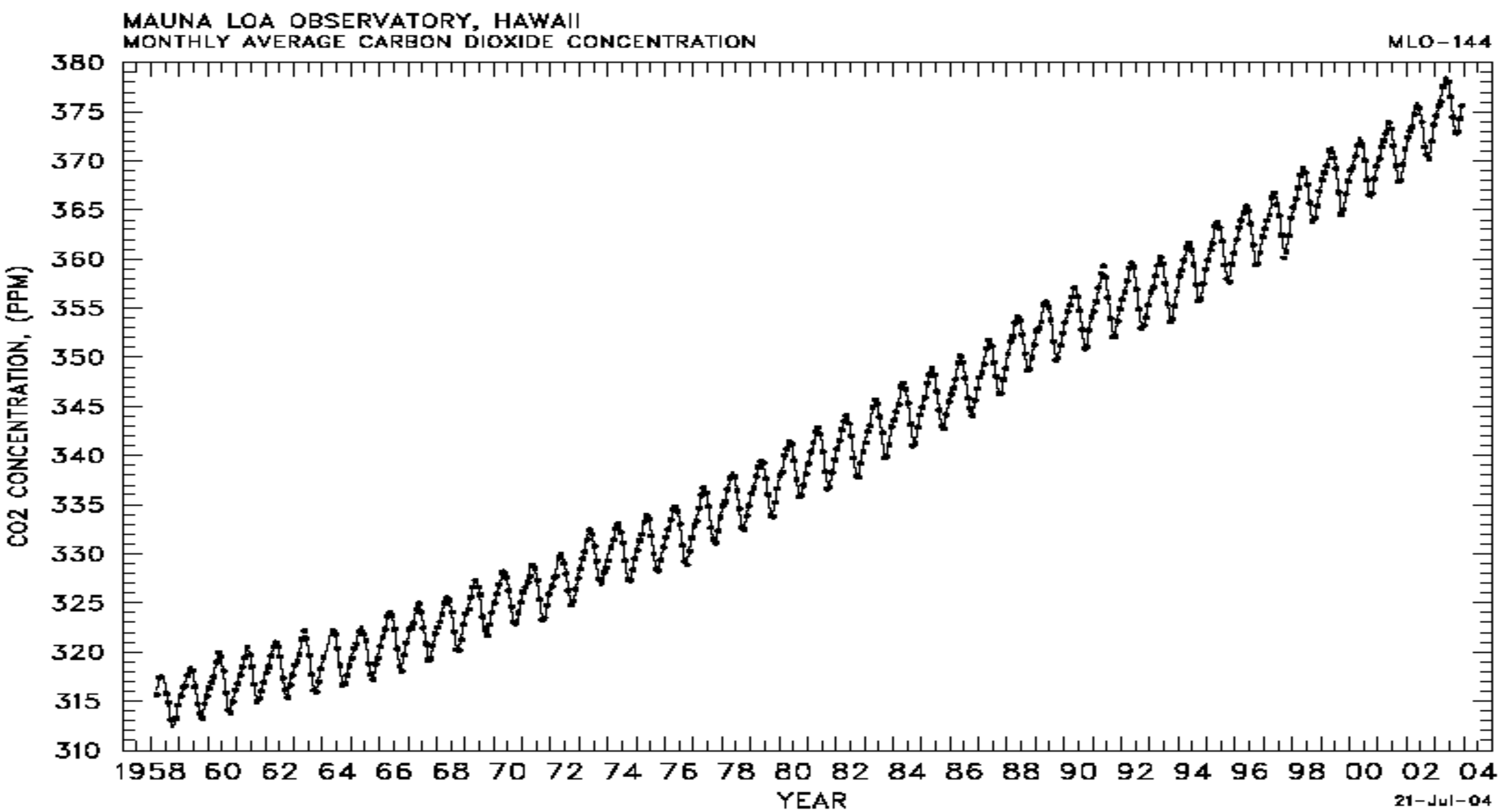



# Presentation Overview

- **The science of climate change - current consensus - likely impacts on US agriculture**.
  - GHG profile of US agriculture and forestry
  - Responding to climate change – Approaches and cost implications
  - HR 2454
  - Funding Opportunities

- **Energy and the Bioeconomy**
  - Challenges
  - Knowledge Gaps
  - Moving Forward

# Atmospheric $CO_2$ Concentrations (Monthly Averages)



# Climate changes observed over the last 50 years in the United States

US Climate Change Science Program
www.climatescience.gov

## Synthesis and Assessment Products: Summary Findings

### *Temperature*

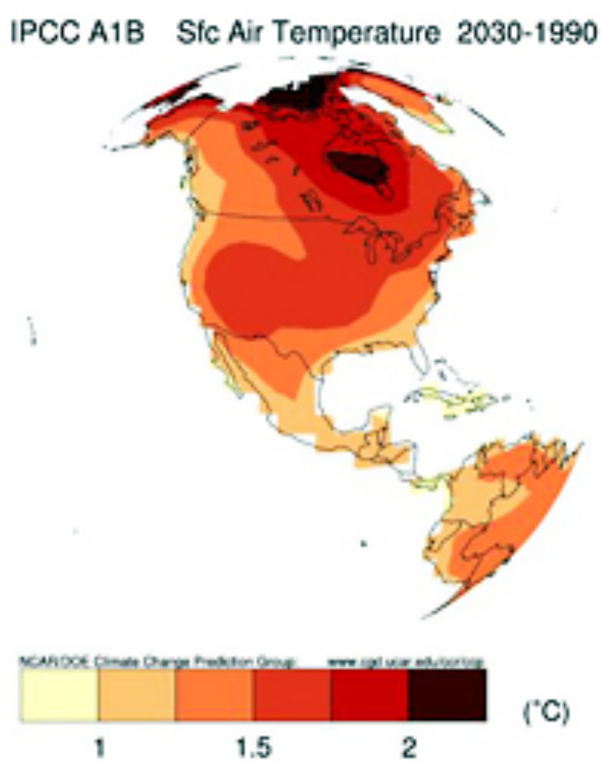
- **Increase in US average temperatures**
- Increased frequency of heat waves.
- Decreased frequencies of unusually cold days and severe cold waves

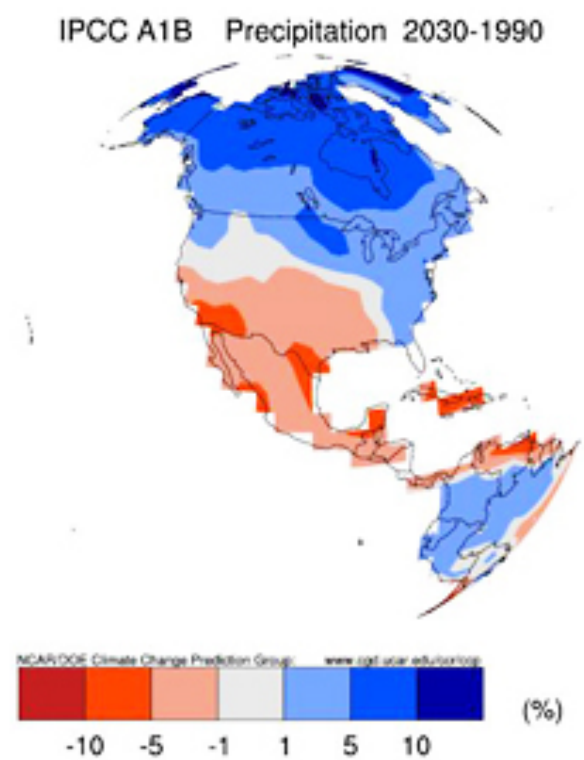
### *Precipitation and drought:*

- Overall increase in annual precipitation but with significant regional variability.
- Increase in heavy precipitation events
- Increase share of annual precipitation falling as rain (rather than snow).
- Tendency toward decrease in severity and duration of droughts

# Projected Temperature and Precipitation Changes

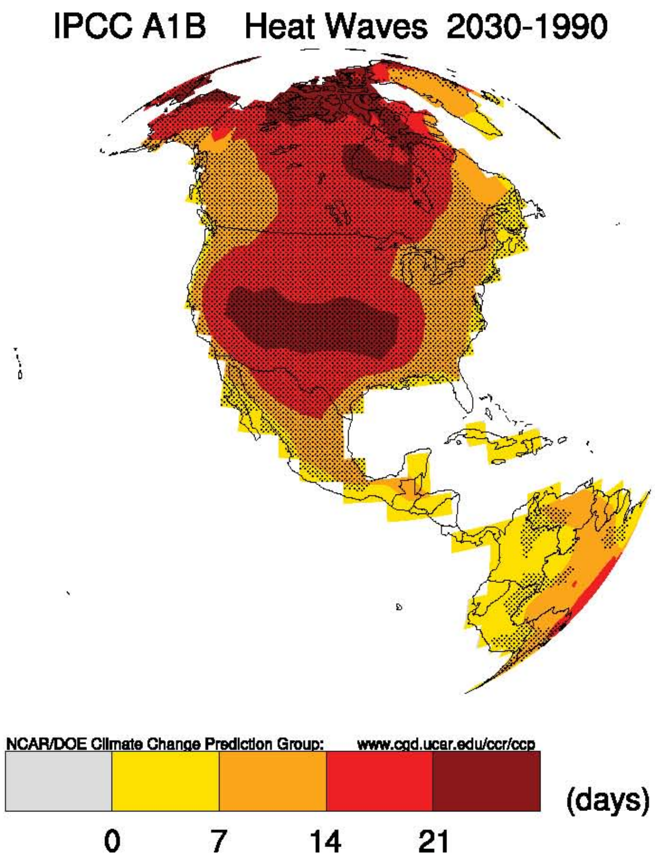
*(Intergovernmental Panel on Climate Change, IPCC, http://www.ipcc.ch)*

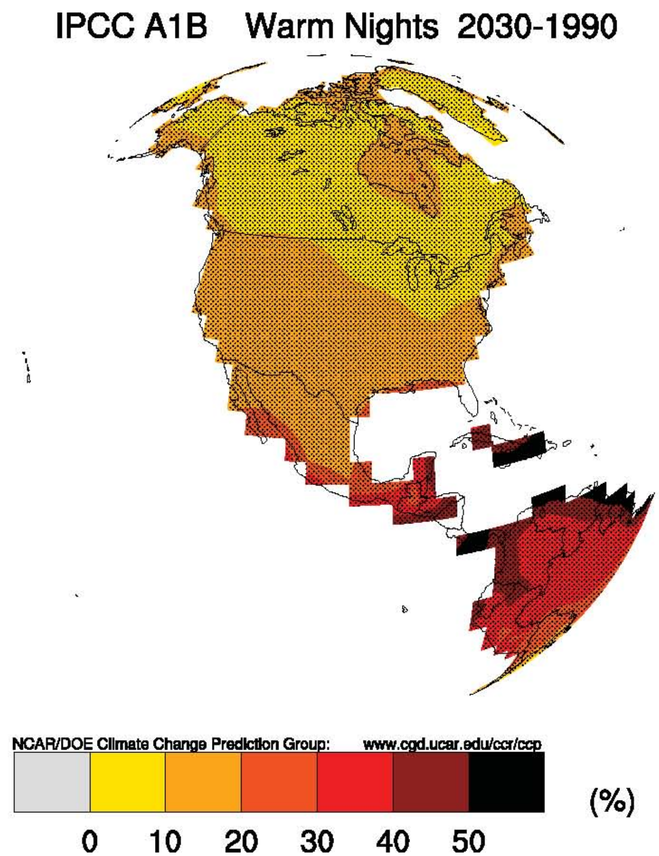


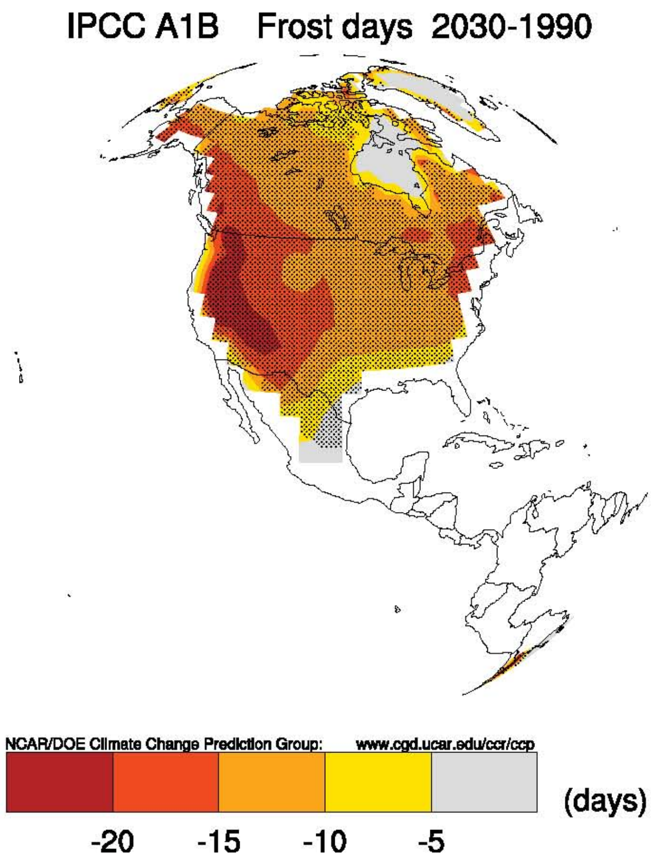

U.S. Temperature and Precipitation Changes by 2030.

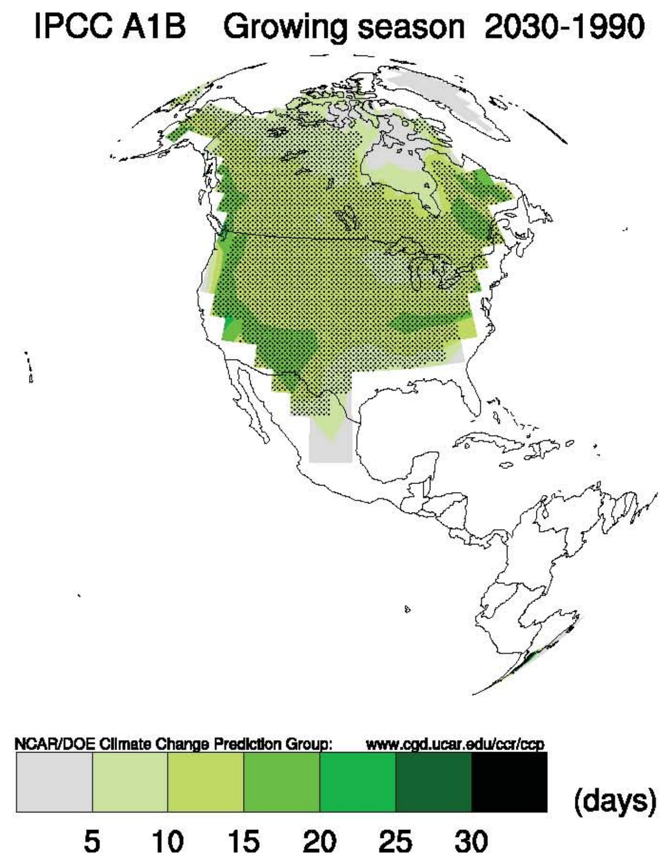
# Projected Changes in Heat Waves and Warm Nights *(IPCC)*



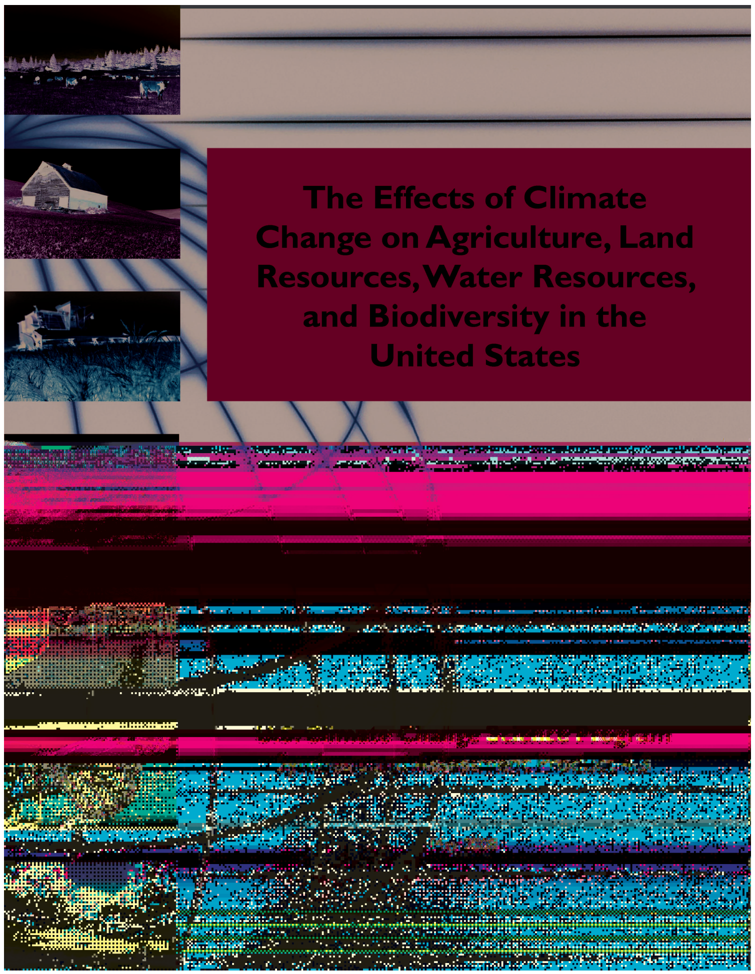



# Projected Changes in Frost Days and Growing Season *(IPCC)*



# US Climate Change Science Program: Synthesis and Assessment Report 4.3

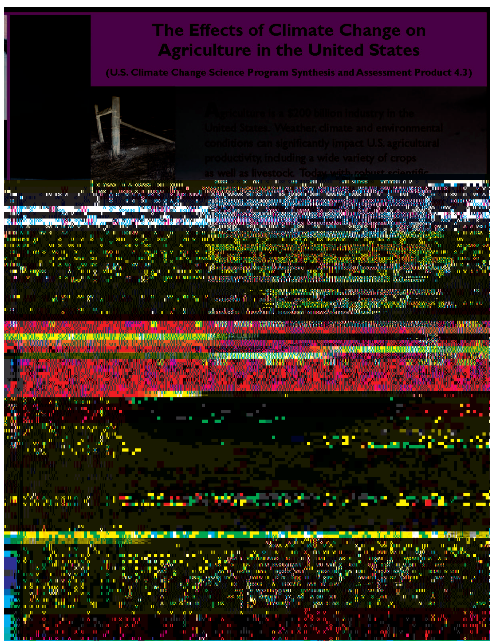



Assesses the current state of our scientific knowledge regarding the likely effects of climate change on:

- Agriculture
- Land Resources
- Water Resources
- Biodiversity

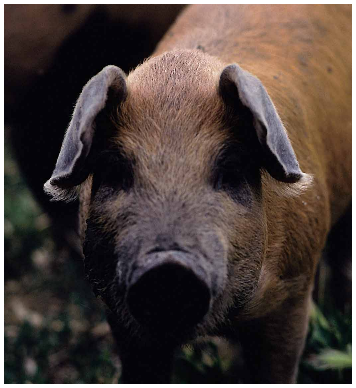
Available at: http:// http://www.usda.gov/oce/climate_change/index.htm

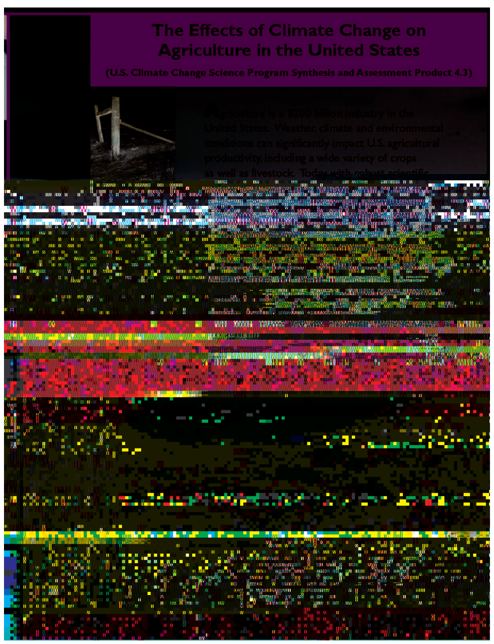
# SAP 4.3: Climate Change Implications for U.S. Crop Agriculture




- With increased CO2 and temperature, the life cycle of grain and oilseed crops will likely progress more rapidly.
- As temperature rises, these crops will increasingly begin to experience failure, especially if climate variability increases and precipitation lessens or becomes more variable.
- The marketable yield of many horticultural crops is very likely to be more sensitive to climate change than grain and oilseed crops.
- Climate change is likely to lead to a northern migration of weeds (particularly C3 weeds).
- Disease pressure on crops and livestock will likely increase with earlier springs and warmer winters, which will allow proliferation and higher survival rates of pathogens and parasites.

# SAP 4.3: Climate Change Implications for U.S. Animal Agriculture






- Projected increases in temperature and a lengthening of the growing season will likely extend forage production into late fall and early spring, thereby decreasing need for winter season forage reserves.
- Forage benefits will very likely be affected by regional variations in water availability.
- Climate change-induced shifts in plant species are already under way in rangelands. Establishment of perennial herbaceous species is reducing soil water availability early in the growing season. Shifts in plant productivity and type will likely also have significant impact on livestock operations.
- Higher temperatures will very likely reduce livestock production during the summer season.
- For ruminants, current management systems generally do not provide shelter to buffer the adverse effects of changing climate; such protection is more available for non-ruminants (e.g., swine and poultry).

# SAP 4.3: Climate Change Implications for U.S. Water Resources


- For US generally, more precipitation.

- Drier conditions in the western states – (due to decreases in precipitation and mountain snowpack, and, earlier snowmelt). Some indications suggest droughts in the West and Southwest will increase in duration and severity.

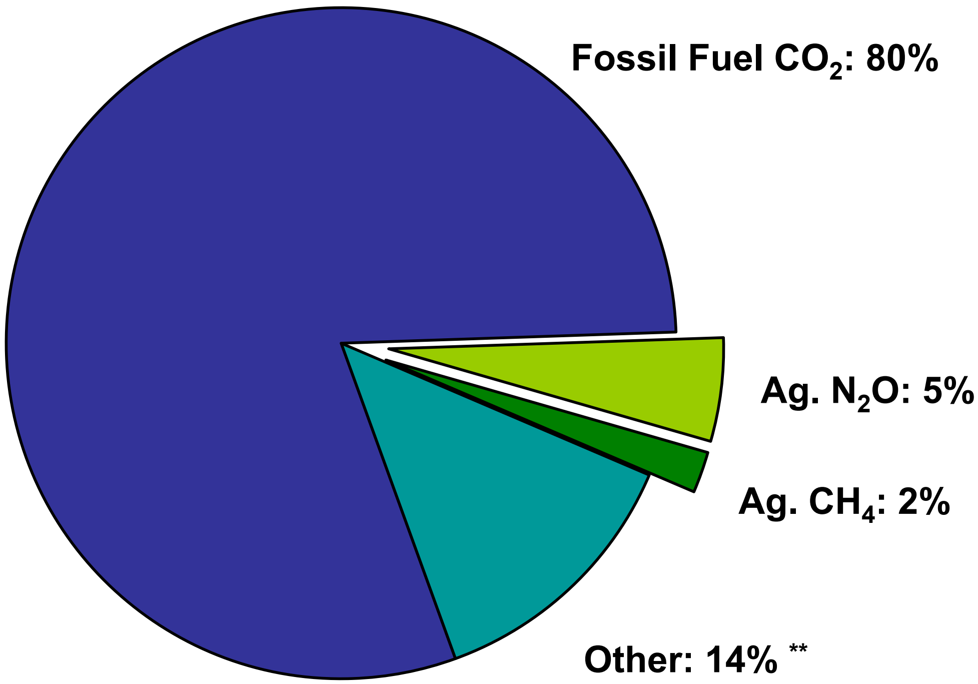
- Stream temperatures are likely to increase as the climate warms (some such increases have already been detected). Stream temperature changes will be most evident in low-flow periods.

- Changes in water quality likely due to higher temperatures and changes in precipitation.

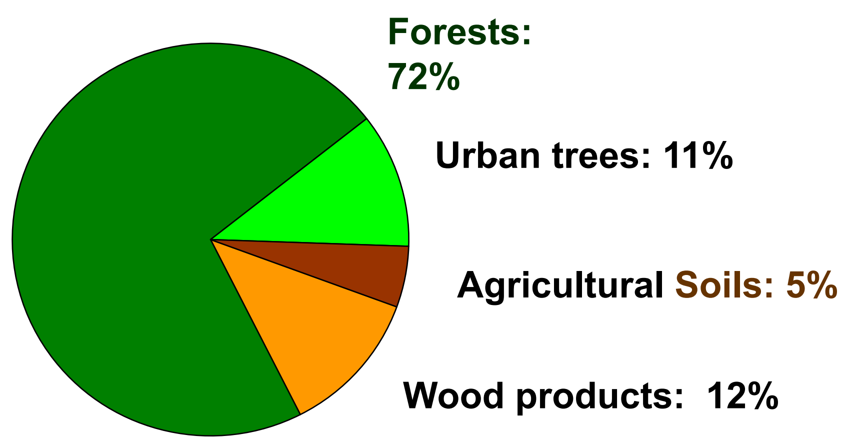
# Within the US:

## *Agriculture accounts for 7 % of GHG emissions*
## *Carbon sequestration offsets 11 % of U.S. emissions*

**U.S. GHG Emissions:**
**7,260 million metric tons $CO_2$e**



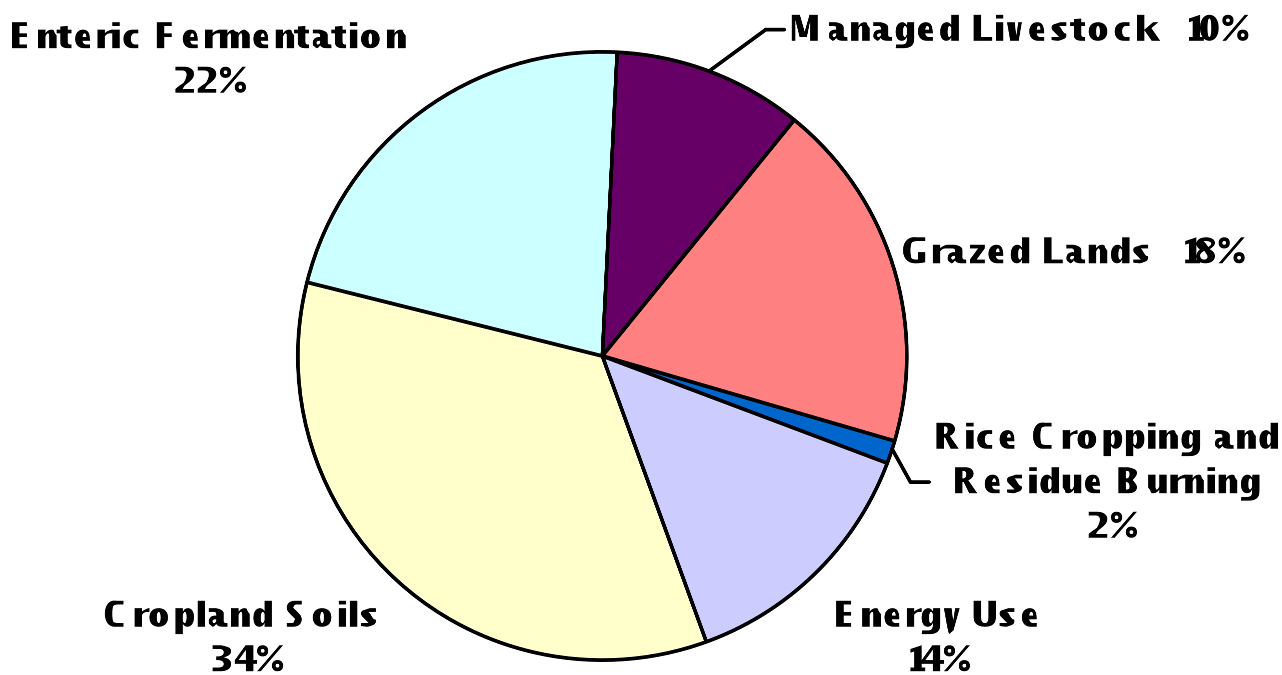

**U.S. Carbon Sequestration:**
**828.5 million metric tons $CO_2$e**




**Source: US EPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2005**

# Within Agriculture:

***Half of emissions are from livestock and grazing,***
***A third are from cropland nitrogen, and***
***The remainder from energy use and small sources***




U.S. Agriculture and Forestry Greenhouse Gas Inventory: 2005

# Responding to Climate Change


At Point **A** :

Benefits are front loaded
Costs are back loaded

At Point **B**:

Benefits are back loaded
Costs are front loaded

From an economics perspective points A and B are likely the two most costly responses society could chose.

The least-cost response strategy will include some mitigation and some adaptation. The key question is, how much of each?

# Possible Approaches to GHG Mitigation

- Encourage Voluntary Actions
- Regulation (mandate  compliance: use specific technologies, meet minimum performance standards or emissions reduction levels)
- Carbon Taxes
- Government Payments to reduce emissions and/or increase sequestration
- Cap-and-Trade:  Approach in HR 2454 (and S1733)
  - Government sets overall allowable emissions level (the cap)
    - Distributes emissions allowances equal to the cap
    - Covers firms must have allowances and/or offsets equal to their emissions
      - Firms can receive allowances, purchase allowances, or reduce emissions
      - Capped firms can purchase offsets from uncapped firms who have reduced emissions or increased sequestration
  - Capped
    - Electric and natural gas utilities
    - Oil refiners
    - Most “heavy” industry
  - Not capped
    - Farms (although input industries are)
    - Various small emitters of greenhouse gases

# Agriculture and Forestry in HR 2454

Specified schedule of annual GHG emissions caps for covered sectors from 2012 to 2050.

- Covered sectors account for 85% of current US GHG emissions
- Cap would reduce emissions from covered sectors: 17% by 2020, 42% by 2030, 83% by 2050

Provides for agriculture and forestry to supply Offsets:

- USDA would administer the offsets program;
- Capped the use of domestic offsets at 1 billion tons of $CO_2$e per year;
- Required offsets would account for: Leakage, Permanence, Additionally, and Uncertainties

Provides support for expanded use and production of renewable energy

## Costs and Benefits of HR 2454 to Agriculture

- Main costs
  - Higher prices for energy and energy intensive inputs (including fertilizer)
  - Fertilizer and fuel costs account for 50-60 percent of variable costs of production for corn;
  - Rural households have higher personal transportation expenditures than urban households. Would be more negatively impacted by increased gas prices.

- Main benefits: Potential revenue from supplying
  - Offsets to covered industries,
  - Clean energy and clean energy feed stocks

# Wildcard: Offsets in HR 2454 are Largely To-Be-Defined

- Not clear which practices will be eligible to generate offsets
- Need to develop metrics to quantify GHG benefits including dealing with additionally, permanence, and leakage
- Establish requirements and systems for reporting, monitoring, certification, recordkeeping;

***How these (and other) issues are resolved will critically affect the economics of offsets***

For a detailed analysis of the economic effect of HR2454 as it now stands on US agriculture, please see USDA OCE report to Congress dated 12/18/2009 at

http://www.usda.gov/oce/newsroom/archives/releases/2009files/ImpactsofHR%202454.pdf

## Other Wildcards that Could Affect the Economics of Climate Change for US Agriculture:

- International Processes
  - United Nations Framework Convention on Climate Change (UNFCCC, Kyoto Protocol) and Major Economies Process on Energy Security and Climate Change

- Federal
  - 2007 EISA (Renewable Fuels Standard)
  - Farm Bill (Environmental services markets)
  - In December 2009 EPA issued a finding that GHG contributes to air pollution and poses a danger to public health

- States and Regional GHG Mitigation Initiatives
  - California, Western Climate Initiative, Regional Greenhouse Gas Initiative, and Midwestern Regional Greenhouse Gas Reduction Accord

***(note: little chance for either House or Senate version as is as of 2/27/2010)***

# Funding Opportunities: Climate Change

- NOAA Climate Program Office

  *http://www.climate.noaa.gov/index.jsp?pg=./opportunities/opp_index.jsp&opp=grants*

- USDA NIFA (formerly CSREES)

  *http://www/csrees.usda.gov/fo/funding.cfm*

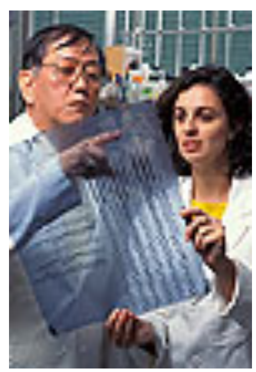
- DOE Office of Biological and Environmental Research

  *http://www.er.doe.gov/ober/Opp.html*

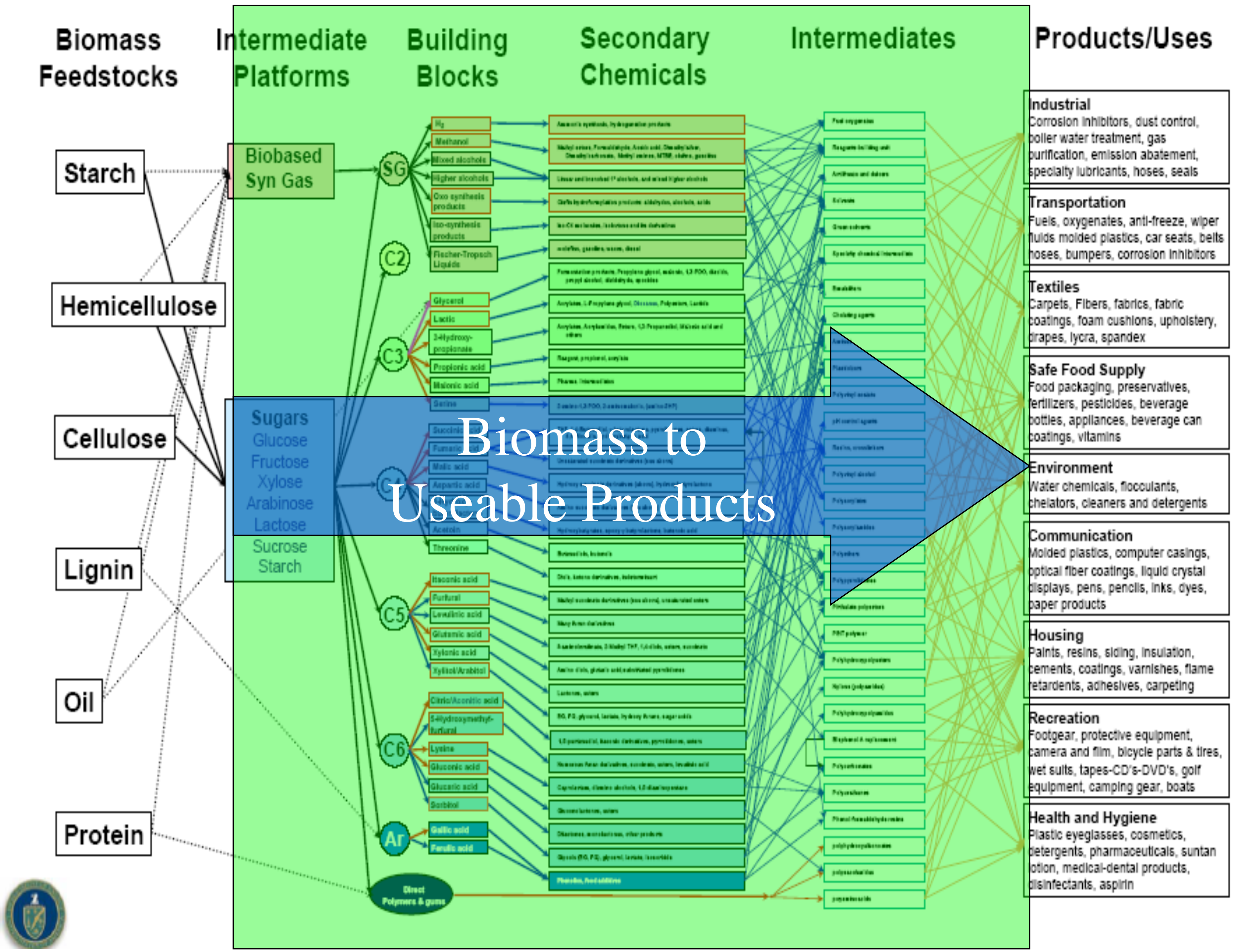
# Energy for the Bioeconomy Yesterday, Today and Tomorrow

- **Agriculture has a long history of utilizing research to develop new agricultural products to enhance farm income and improve the national economy**

- **The dynamics of our present day energy situation has significantly increased interest in utilization of agricultural products and residues as energy and bio product feed stocks**



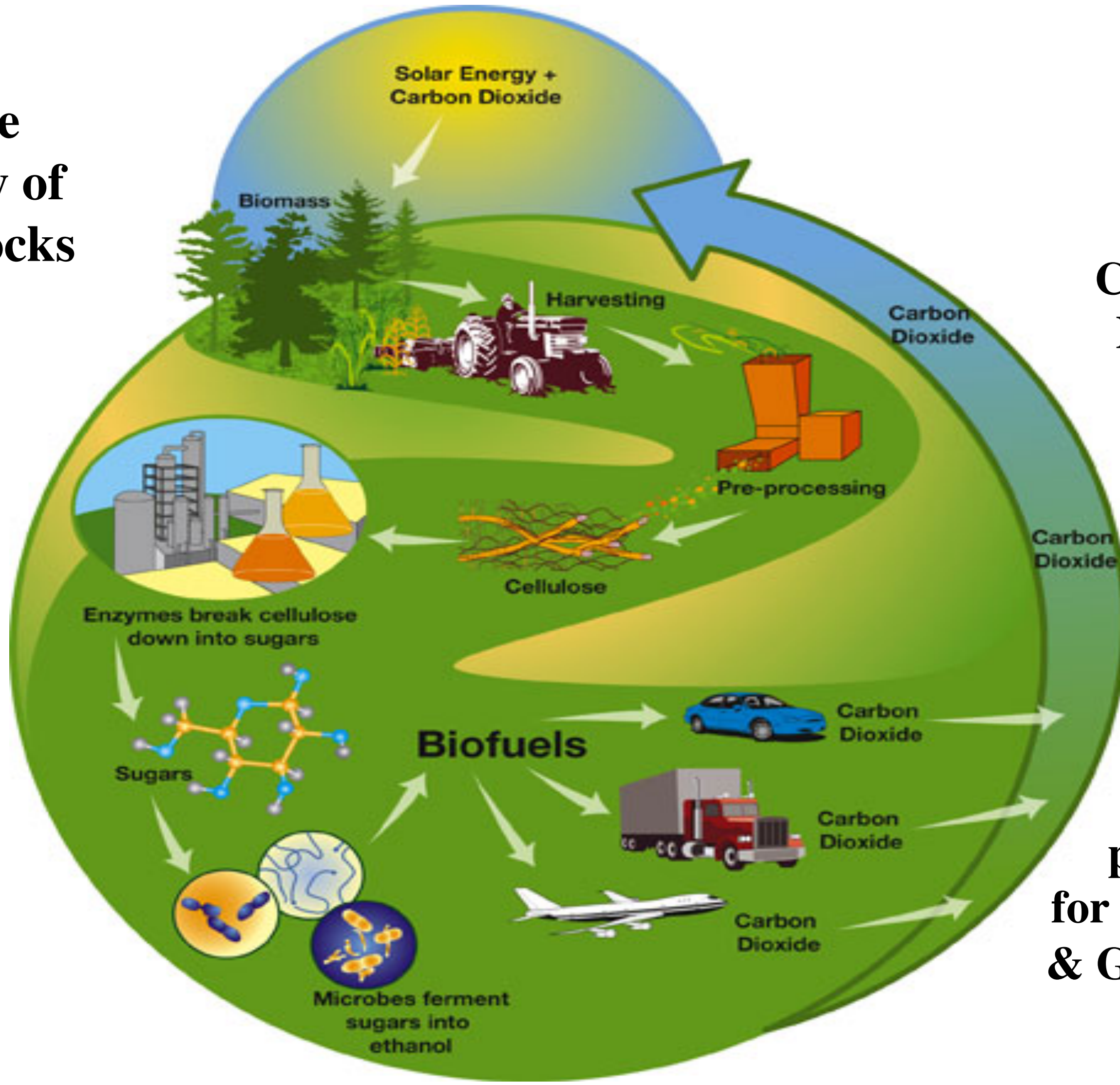
# Petroleum to Useable Products


Biomass Feedstocks
Intermediate Platforms
Building Blocks
Secondary Chemicals
Intermediates
Products/Uses
Starch
Hemicellulose
Cellulose
Lignin
Oil
Protein
Biobased Syn Gas
Sugars
Glucose
Fructose
Xylose
Arabinose
Lactose
Sucrose
Starch
SG
C2
C3
C4
C5
C6
Ar
Methanol
Mixed alcohols
Higher alcohols
Oxo synthesis products
Iso-synthesis products
Fischer-Tropsch Liquids
Glycerol
Lactic
3-Hydroxy-propionate
Propionic acid
Malonic acid
Serine
Threonine
Itaconic acid
Furfural
Levulinic acid
Glutamic acid
Xylonic acid
Xylitol/Arabitol
Citric/Aconitic acid
5-Hydroxymethyl-furfural
Lysine
Gluconic acid
Glucaric acid
Sorbitol
Gallic acid
Ferulic acid
Direct Polymers & gums
Biomass to Useable Products
Industrial
Corrosion inhibitors, dust control, boiler water treatment, gas purification, emission abatement, specialty lubricants, hoses, seals
Transportation
Fuels, oxygenates, anti-freeze, wiper fluids molded plastics, car seats, belts hoses, bumpers, corrosion inhibitors
Textiles
Carpets, Fibers, fabrics, fabric coatings, foam cushions, upholstery, drapes, lycra, spandex
Safe Food Supply
Food packaging, preservatives, fertilizers, pesticides, beverage bottles, appliances, beverage can coatings, vitamins
Environment
Water chemicals, flocculants, chelators, cleaners and detergents
Communication
Molded plastics, computer casings, optical fiber coatings, liquid crystal displays, pens, pencils, inks, dyes, paper products
Housing
Paints, resins, siding, insulation, cements, coatings, varnishes, flame retardents, adhesives, carpeting
Recreation
Footgear, protective equipment, camera and film, bicycle parts & tires, wet suits, tapes-CD's-DVD's, golf equipment, camping gear, boats
Health and Hygiene
Plastic eyeglasses, cosmetics, detergents, pharmaceuticals, suntan lotion, medical-dental products, disinfectants, aspirin

# *Bio-Energy Systems Can Provide a Significant and Sustainable Replacement for Fossil Energy*

**Wide variety of feedstocks**

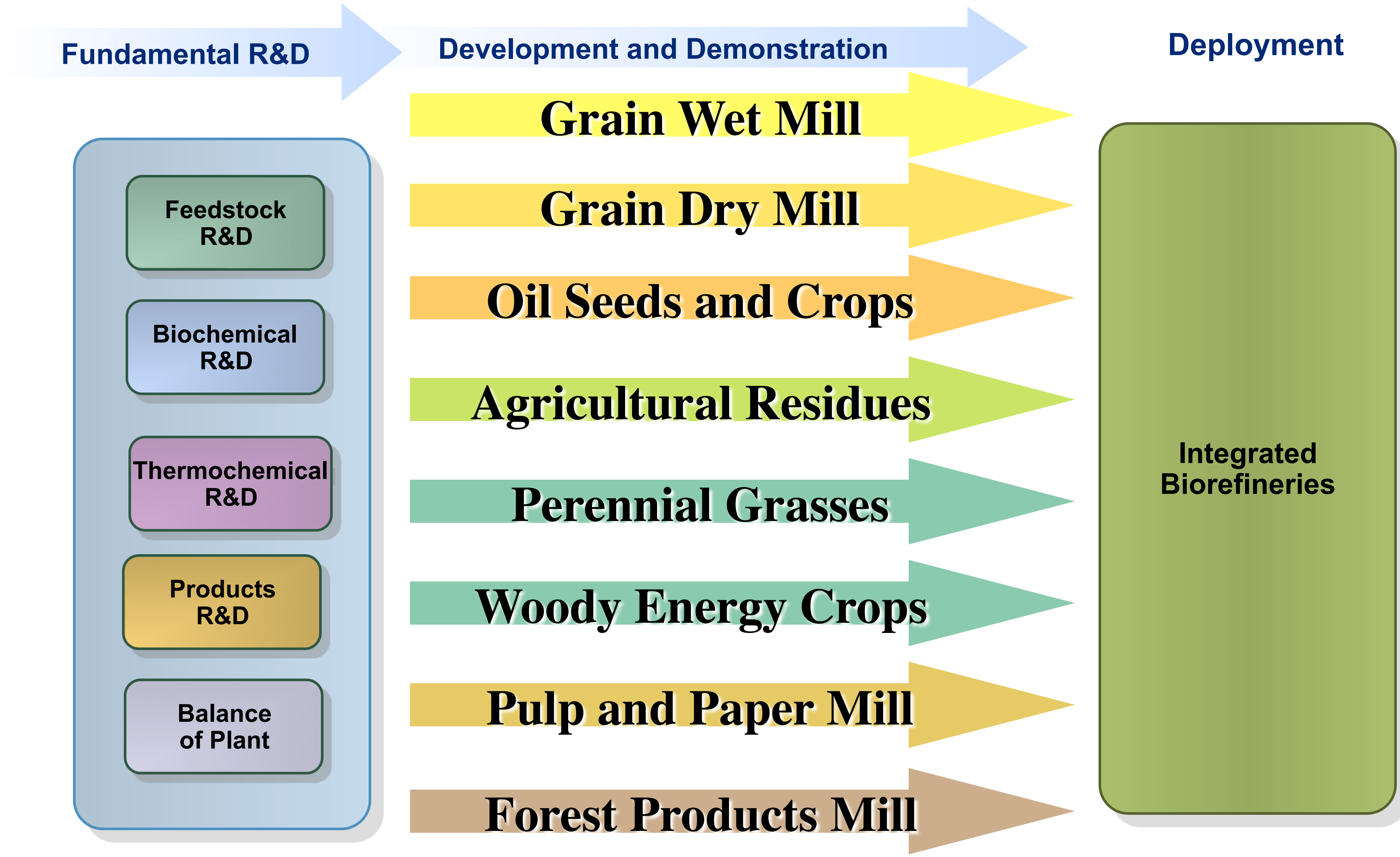
**Multiple Conversion Processes and Products**




**Participation across all U.S. regions**

**Higher performance for energy balance & GHG reductions**

# Where will Engineers & Scientists Lead Us?



# R&D Challenges/Opportunities

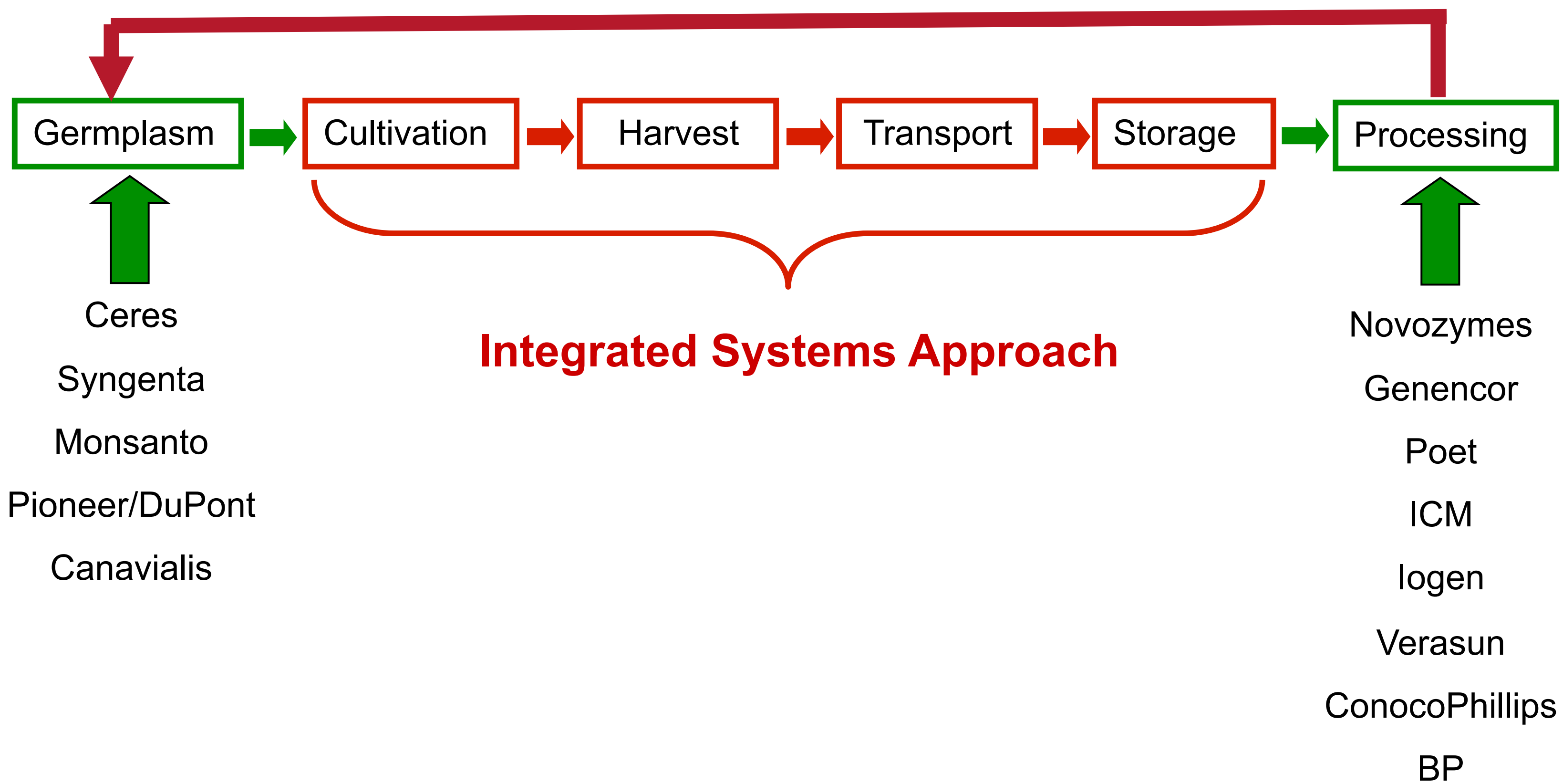
- Can we produce enough feedstocks?
  - Enhance productivity
  - Not disrupt markets
  - Avoid land-use competition
- Can we produce feedstocks sustainably?
  - Maintain ecological integrity
  - Enhance environmental values
- Can we make biofuels competitive?
  - Optimize agronomic and silvicultural systems
  - Innovative conversion and delivery technology deployment
  - Bioproducts and coproducts
- Can we enable a "Rural Renaissance?"
  - Transition to a bioeconomy – education, training, and outreach
  - Provide economic opportunities
  - Provide assistance

# Can we Produce Enough Feedstocks?
## *(current focus of USDA intramural (ARS) and extramural (NIFA) biofuels research programs)*

- ***Starch Based Feedstocks***
  - Investigate means to increase grain yield
  - Investigate opportunities to expand starch feedstock options to include barley, sorghum, millet, and field peas
- ***Oil Based Feedstocks***
  - Investigate methods to increase oil content
  - Expand biodiesel feedstocks to include rendered animal fats and byproducts, restaurant waste fats/oils, greases, etc.
- ***Cellulose Based Feedstocks***
  - Determining the economic production cost feasibility of perennial herbaceous energy crops
  - Develop new varieties of "Power Plants" such as energy cane and high biomass alfalfa
- ***GMO***
  - Elucidate plant cell wall molecular biology to dramatically improve ease of hydrolysis
  - Germplasm collection screening
- ***Crop Residues***
  - Practical removal of Ag residues for biofuels

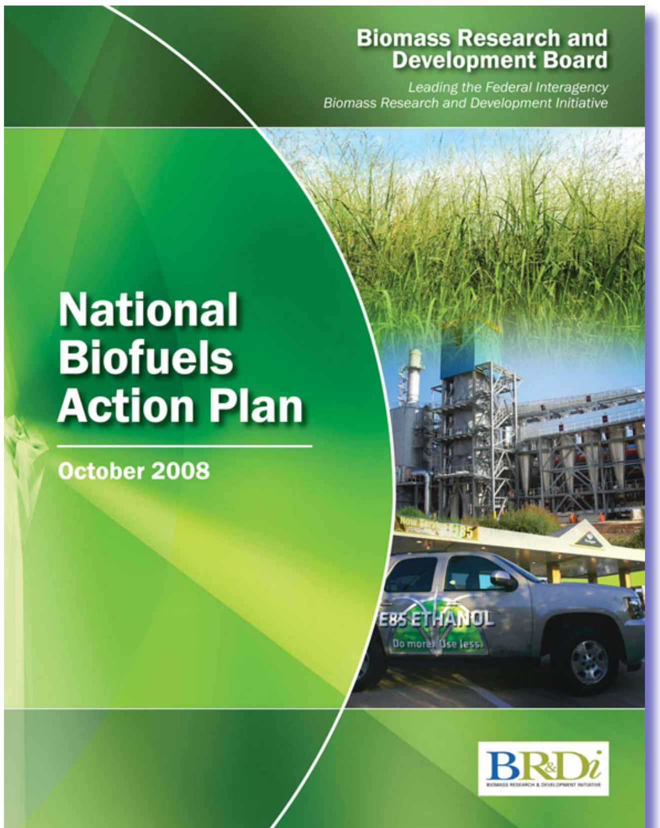
# Knowledge Gaps?

*(Current Intention of USDA's REE Strategic Energy Science and Education Plan)*




http://www.ree.usda.gov/news/bead/USDA_REE_strat_plan.pdf

# Joint DOE/USDA National Biofuels Action Plan




- DOE and USDA released on October 7, 2008 the National Biofuels Action Plan (NBAP)
- This was an interagency plan that details the collaborative efforts of federal agencies to accelerate the development of a sustainable fuel industry.
- The NBAP outlines interagency actions in 7 areas:
  - Sustainability
  - Feedstock production
  - Feedstock logistics
  - Conversion science and technology
  - Distribution infrastructure
  - Blending
  - Environment, health and safety

# Can we use sustainable feedstock production for bioenergy as a means to enable a "Rural Renaissance?"

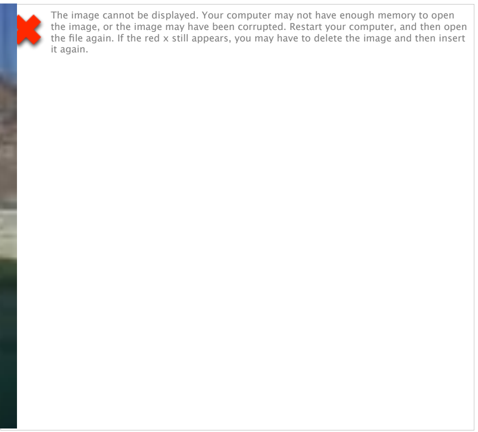
## *Title 9 of the 2008 Farm Bill*

- **Section 9007 (managed by USDA RD) – Rural Energy for America Program *(*expands and renames Renewable Energy Systems and Energy Efficiency Improvements Program in 2002 Farm Bill)**
  - **Continues a grant, loan, and loan guarantee program to assist eligible farmers, ranchers, and rural small businesses in purchasing renewable energy systems and making energy efficiency improvements. Now farm energy audits will be included as eligible costs.**
- **Section 9008 (managed by USDA and DOE) – Biomass Research and Development (R&D) Initiative**
  - **Supports research, development, and demonstration on biobased products, biofuels, and biopower.**
    - **Eligible Recipients: Institutions of Higher Learning; National Laboratory; Federal Research Agency; State Research Agency; Private Sector Entities; and Nonprofit Organizations or a consortium of two or more of entities described above.**

# Can we use sustainable feedstock production for bioenergy as a means to enable a “Rural Renaissance?” An example of other opportunities

– Aviation fuel from renewable resources

  - The US Air Force will have all of its fleet of aircraft certified for 50 percent use of biofuels by the end of 2012;
  - The commercial aviation industry is not far behind the Air Force in certification plans for its fleet of aircraft;
  - The same is true for the Army and the Navy in terms of their efforts to obtain 50 percent alternative fuel certification for their fleets of aircraft;
  - The Air Force is currently certifying Fischer Tropsch (FT) derived fuels for use in all aircraft and tactical systems. FT fuels can be produced from coal, natural gas, oilseeds and cellulosic biomass. Currently blends of percent FT fuels are then blended with petroleum derived fuels to make a “drop in”  fuel.
  - ***The Air Force would like to expand the sources of fuels to include more biomass derived alternatives such as seed crops or cellulosic materials.***
  - To meet the needs of the Military,  NCFAP is working with the Air Force is building its strategic plan where the agricultural community will supply the best feedstocks for use in producing aviation fuel.
  - The commercial airlines are also interested in the use of biomass derived fuels to help provide alternative sources of supply and for reductions in life cycle greenhouse gas emissions.


**Thank You**

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