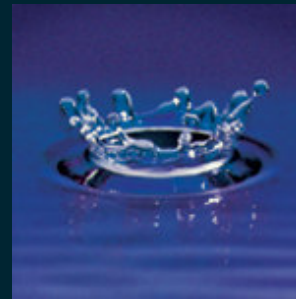
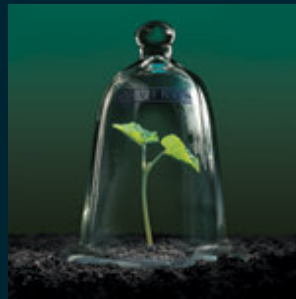
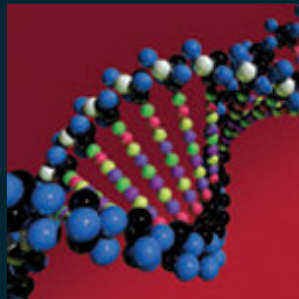


# Strategies for an Environmentally Sustainable Future –the Big Picture



Julia Lester, ENVIRON

Western Dairy Air Quality Symposium 2009

April 15, 2009



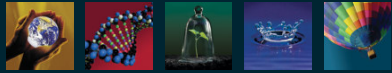
# What is Sustainability?

- One of the first (1987 Brundtland Report):
  - *“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”*
- **Sustainable agriculture**
  - Integrates three main goals: environmental stewardship, farm profitability, and prosperous farming communities
  - The application of husbandry experience and scientific knowledge ... to create integrated, resource conserving farming systems, based on respect for the people and animals ... reduce environmental degradation ... promote agricultural productivity and economic viability ...
  - And many, many more

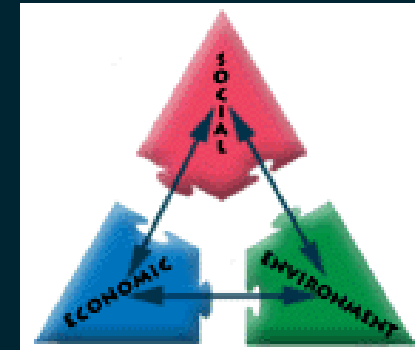


# What Does It Mean To You?

- Does sustainability mean:
  - I can stay in dairy farming, even with
    - challenges to making a profit
    - changing environmental regulations
    - social changes (urban/suburban/rural)
  - My children and their children will be able to choose dairy farming to support their families
  - The farming community will continue and strengthen
  - Other things?
- How will the sustainability movement affect you?



# A Sustainability Paradigm



Economic	Environmental	Social
Economic value created	GHG Management	Labor Practices
Indirect impacts	Other Air Emissions	Diversity
Climate change financial impacts	Water	Human Rights
Government assistance	Energy	Indigenous Peoples
Local suppliers/staff	Ecosystems/Biodiversity	Cultural Heritage
Public benefits	Natural Resources	Community E,H&S
	Solid Waste	Product Responsibility
	Hazardous Waste	Wellness
	Product Impacts	



# Economic and Social

- Economic Value Created and Agricultural Growth
- Government Assistance – changes related to sustainability?
- Cultural
  - The role of dairies in their communities
  - Challenges to rural communities
    - Economic shifts (international, national, local)
    - Urbanization
    - Environmental regulatory changes
- Product Responsibility, Wellness



# Environment

- Ecosystems/Biodiversity
- Natural Resources
- Clean Air and Water
- Greenhouse gas impacts, regulations/policies, management, and strategies



# Biodiversity and Ecosystems

- Can dairies and other agricultural operations coexist with biodiversity and ecosystem concerns?
- What are the barriers?
- What are the opportunities?
  - USDA Office of Ecosystem Services and Markets
  - Wildlife habitat, including migratory bird stopovers
  - Carbon storage
  - Scenic landscapes
  - Proactive engagement before regulatory processes begin in earnest



# Natural Resources

- Opportunities for the dairy industry?
  - Biogas
  - Ethanol
  - Biodiesel from grasses, etc. on agricultural lands
  - Economies of scale for more modern dairies
  - Integrated renewable energy systems?
    - Biofuels from crops/crop residue; feed for dairies; dairy manure for crop fertilizer, soil amendments, and biogas
    - On-dairy solar?
  - Sustainable mixed communities (urban, suburban, rural)
- Other ideas?



# Clean Water

- Rising awareness on the part of the public on watershed function = more stringent requirements
- Good time for dairies to take a proactive approach to engaging in watershed management
  - Water balance: what dairies use and what they release to better understand their role in the watersheds where they are located
  - Investigate possible adaption of wastewater utility systems and technologies



# Clean Air

- Current air regulations
  - Driven by federal and state laws
  - Driven by new health effects studies
  - Regulations from most polluted areas (central and southern California) are being increasingly considered for other areas
  - Driving new emission and mitigation studies
- Pesticide regulations (now related to air and water quality issues also)



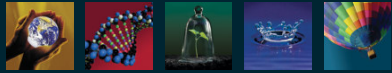
# New Air Regulatory Drivers

- Even though old annual PM10 (dust) standard was revoked
  - New PM2.5 standards
  - New ozone standard
- New ozone health-effects research
  - EPA will immediately re-consider standards
- All proposed revisions include lower concentration standards
  - Precursor to more stringent controls



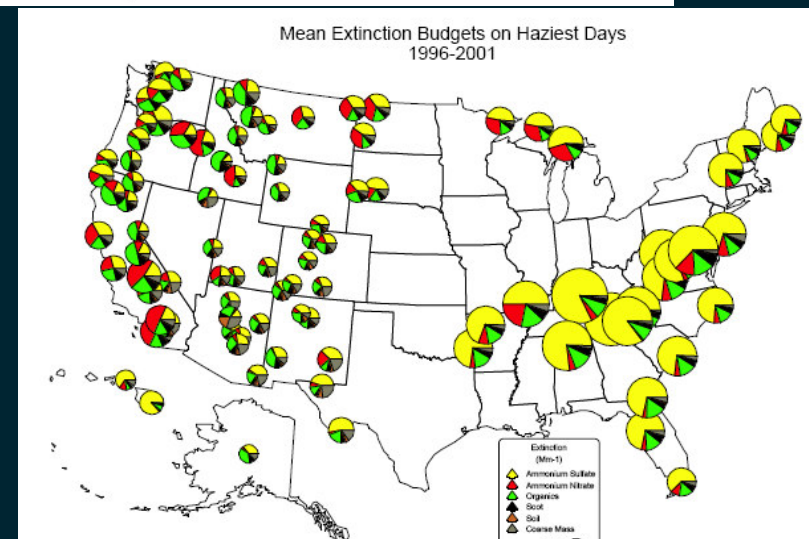
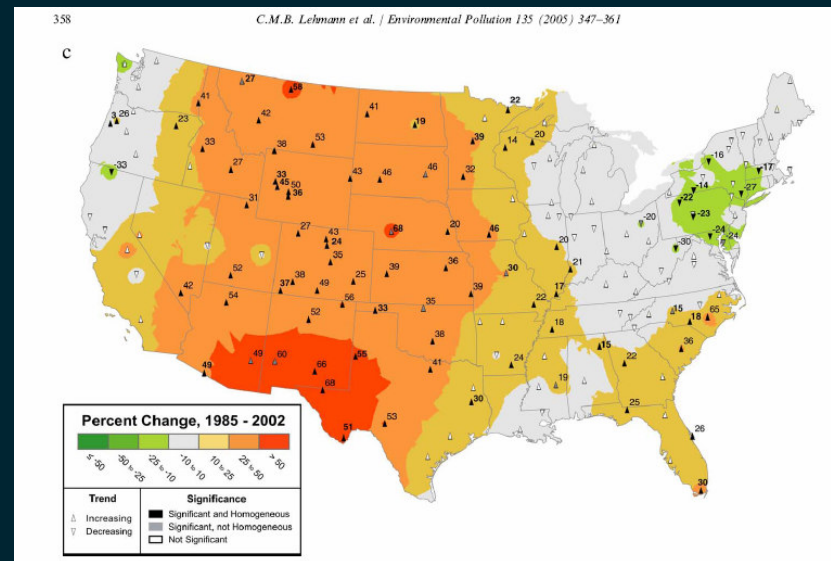
# New Issues

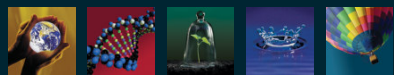
- Global nitrogen cycle
  - Growing scientific and policy concern
  - Comparison to carbon cycle
  - Role of agriculture
- Wet and dry ammonia deposition on surface waters – interrelationship of air/water issues
- Visibility – role of aerosol ammonium particulates
- Aerosols and climate



# Other Regulatory Drivers

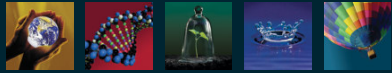
- Ammonia and ammonium aerosol deposition
- Visibility Impairment
  - Light scattering of aerosol particulate and associated water
- Aerosols and climate



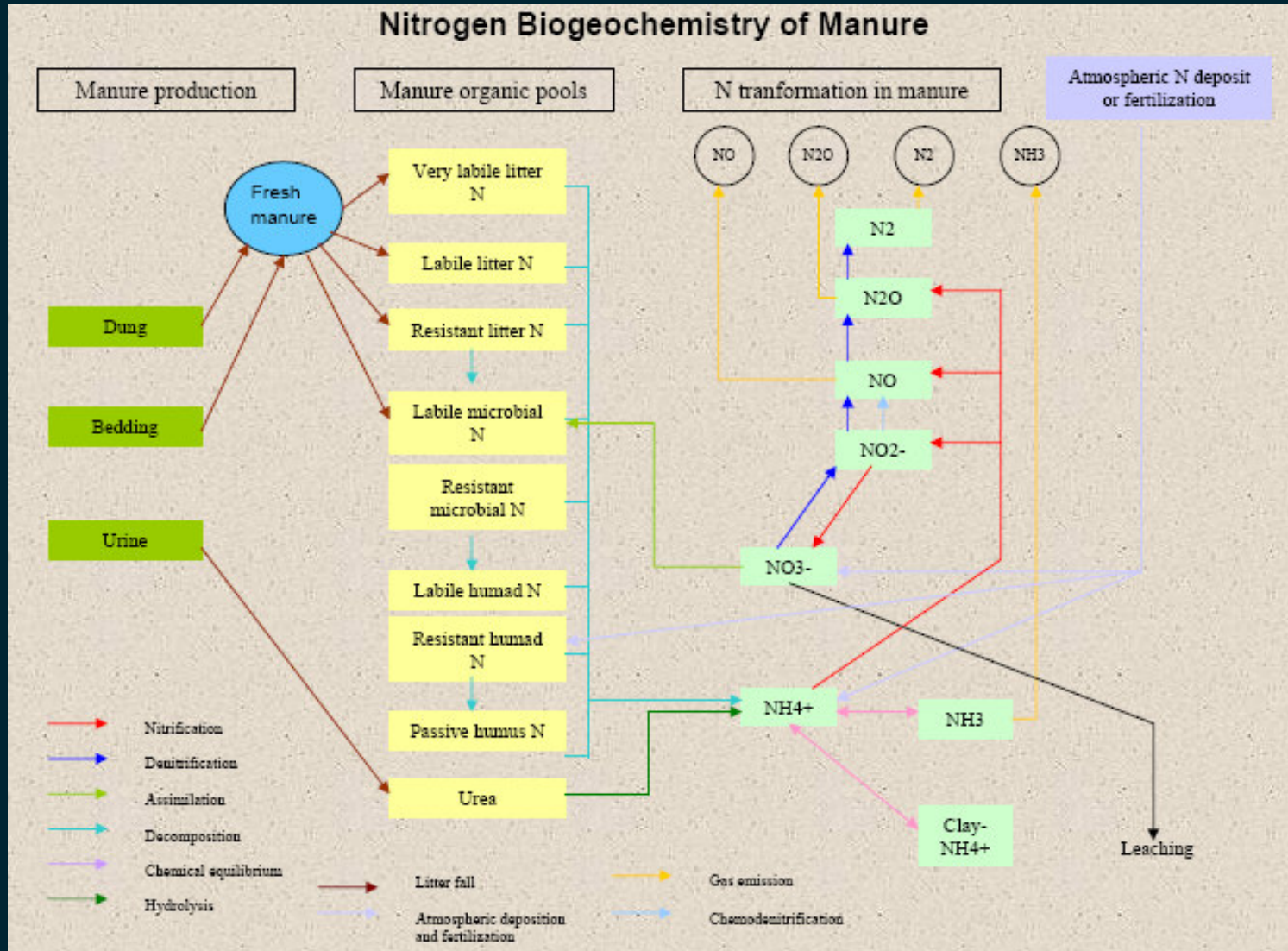


# Evolving Science, New Tools

- Regulations often based on early science and technical work
- Regulatory timelines not necessarily consistent with science/technical timelines
- New resources are being committed
  - Are they going to the right areas?
    - Emissions vs. mitigations; model development vs. model validation data; integrated systems vs. specific processes?
    - How are research needs assessed and balanced?
  - How are farm groups being involved?
    - Study design, protocol development, draft data review, final data review, final regulations?

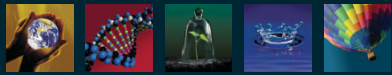


# Could It Get Any More Complicated?



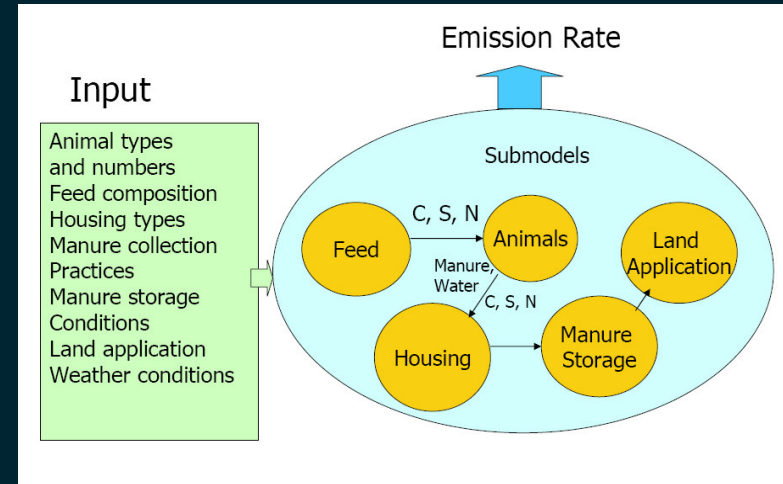
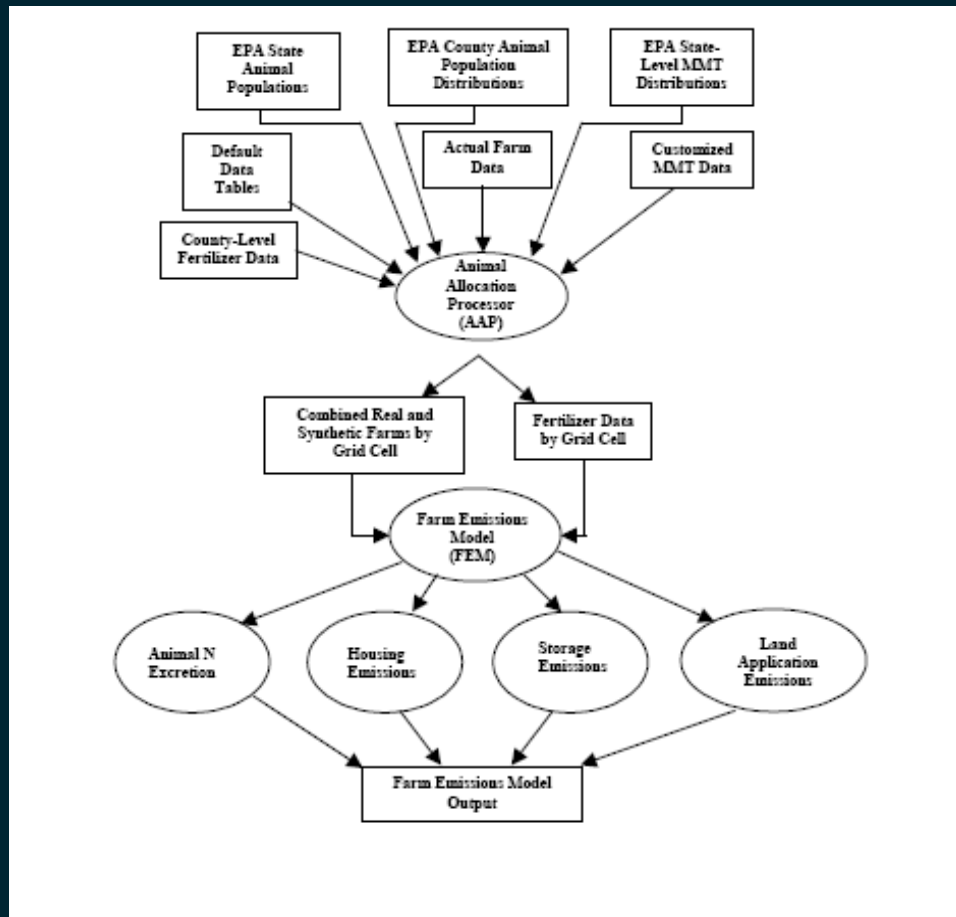
Source: William Salas, CARB Dairy Symposium 2006

ENVIRON

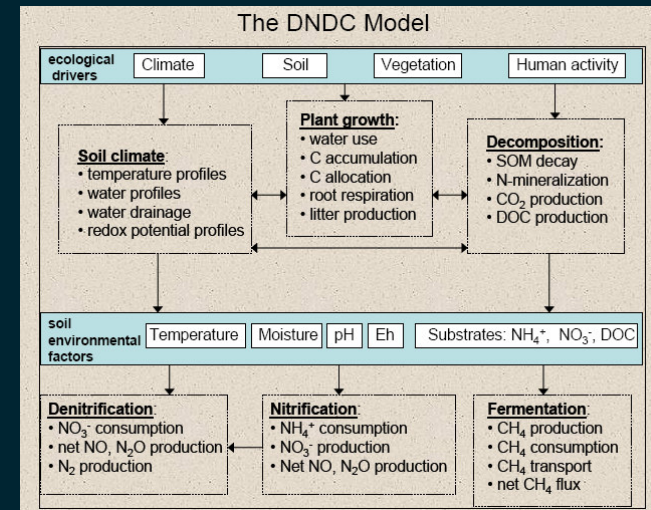


# Emissions Models

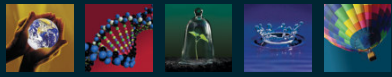
From Regional Inventories  
(e.g., WRAP) . . .



. . . to Single Farm Emissions

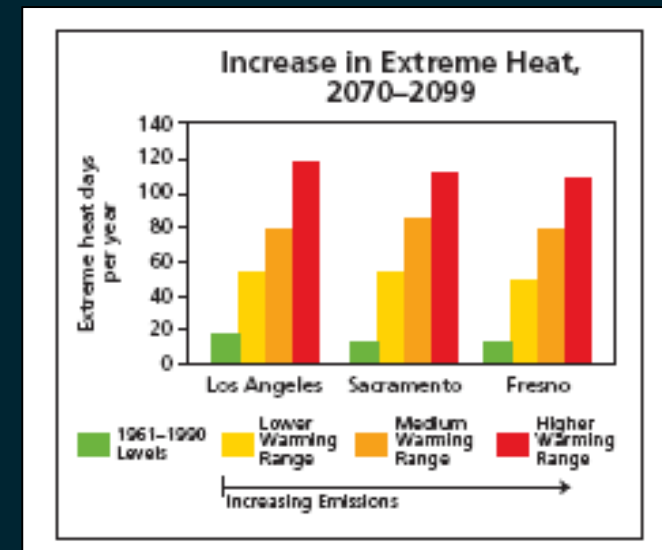


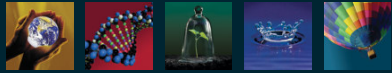
And many more . . .



# Climate Change

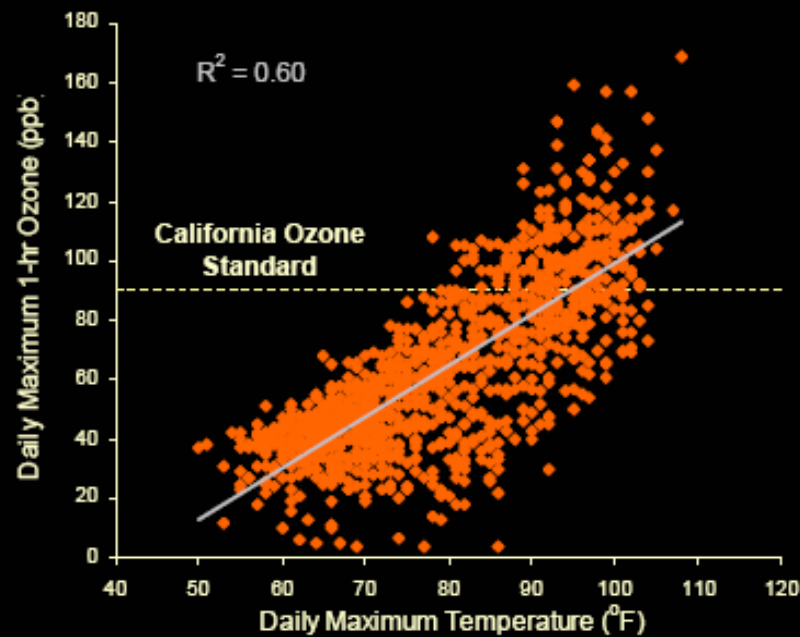
- Scientific consensus on climate change, but continuing discussion on:
  - Range of potential impacts
  - Mitigation strategies
- Effect of climate change on dairies
  - Effect on cow health (temperature, diseases, vectors)
  - Effect on feed crops/commodities



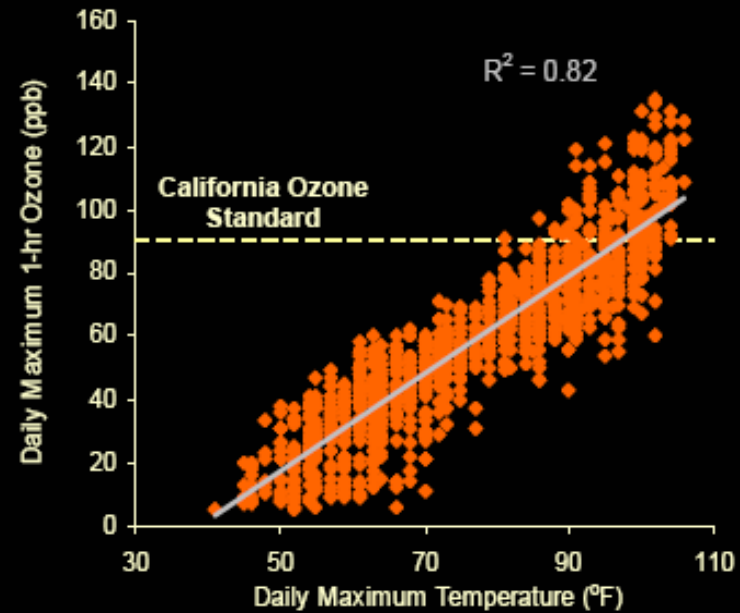


# Effect of Climate Change on Air Quality

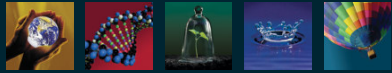
## Ozone versus Temperature



Riverside, 2003-2005

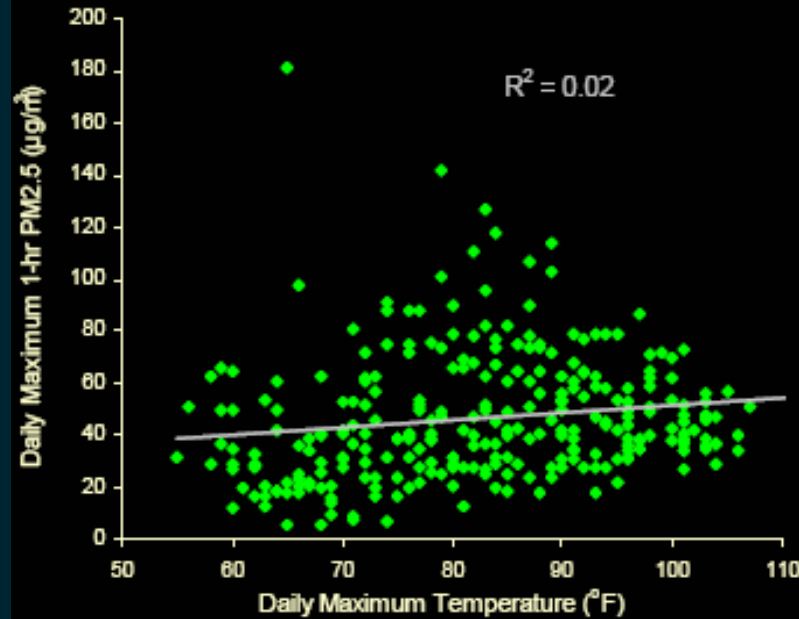


Fresno, 2003-2005

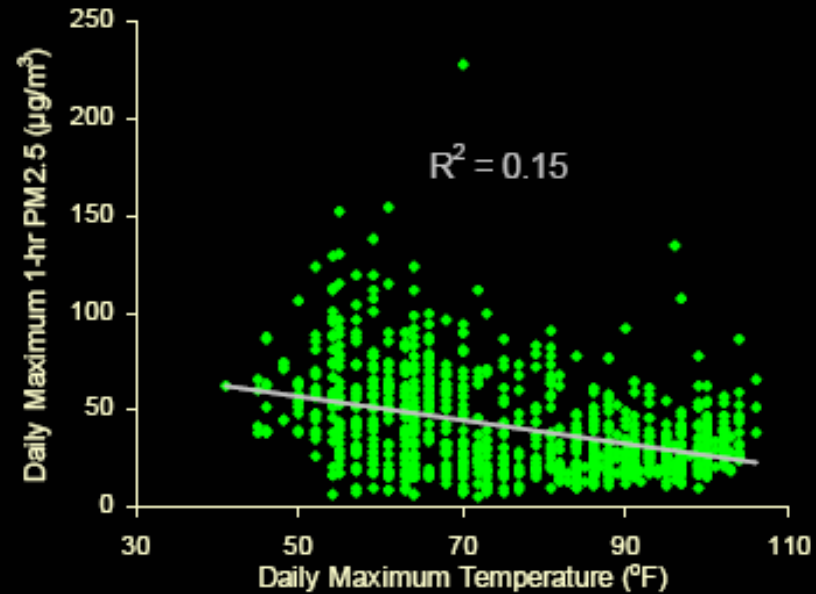


# Effect of Climate Change on Air Quality

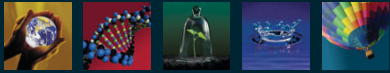
## PM2.5 versus Temperature



Riverside, 2003-2005

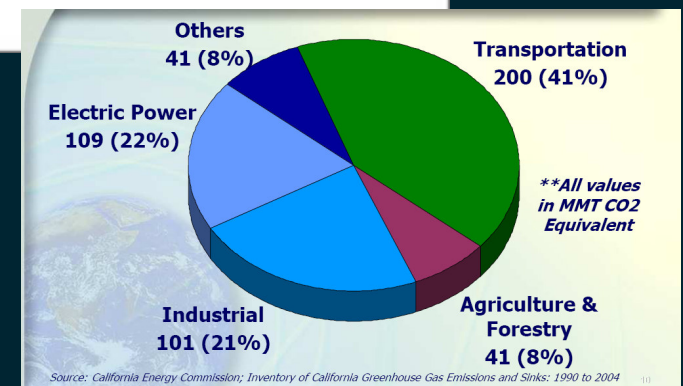
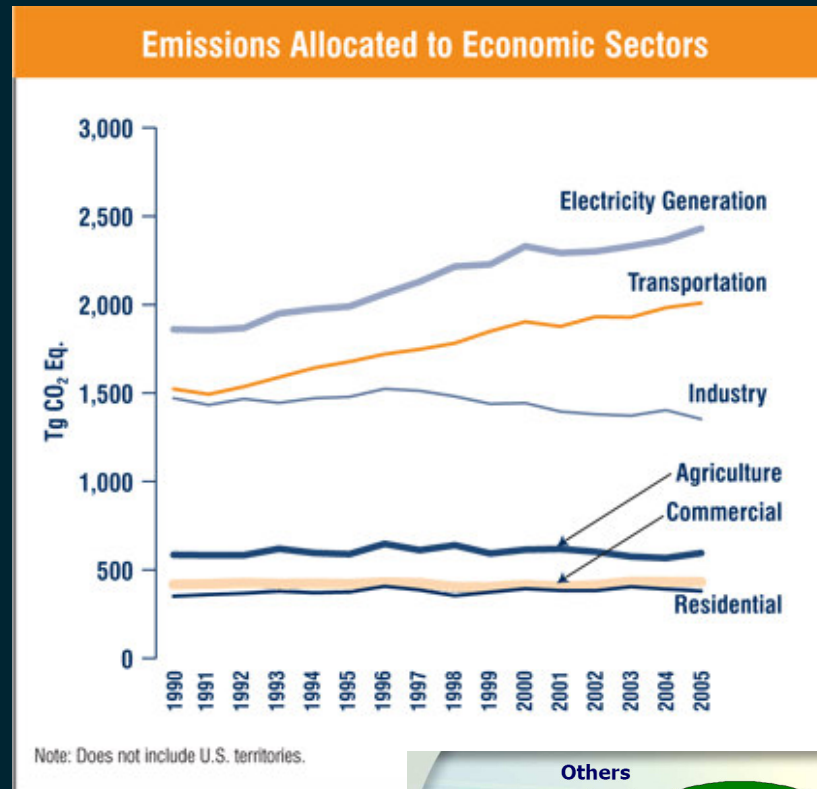


Fresno, 2003-2005



# Greenhouse Gas Emissions

- Agriculture
  - 5% California
  - 7% U.S.
  - 13% globally
- Second largest contributor of methane (CH<sub>4</sub>)
  - GWP = 21
- Largest contributor of nitrous oxide (N<sub>2</sub>O)
  - GWP = 310

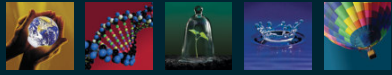


Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005 (EPA, 2007).



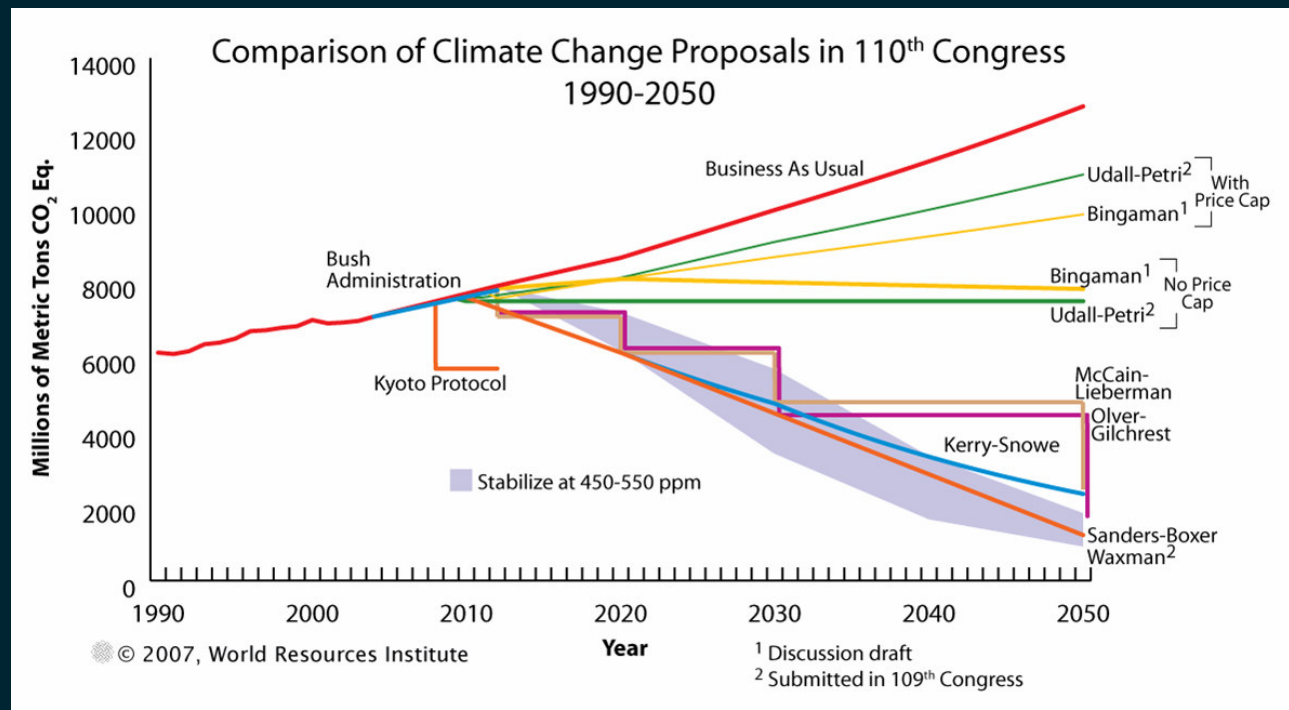
# Dairies and GHGs

- Major sources: enteric and manure management
  - Consider also direct and indirect energy uses, etc.
- GHG “efficiency” – how you measure matters!
  - Emissions per head (1990 to 2005)
    - U.S. = 398 to 357 lb CH<sub>4</sub>/head-year
    - CA = 662 to 602 lb CH<sub>4</sub>/head-year
  - Emissions per unit of milk produced (1990 to 2005)
    - U.S. = 0.018 to 0.014 lb CH<sub>4</sub>/lb milk
    - CA = 0.015 to 0.011 lb CH<sub>4</sub>/lb milk
- New studies can change the “playing field”



# GHG Initiatives and Regulations

- GHG regulations are here and more are coming
  - State
  - Regional (WCI, RGGI)
  - National (new proposed EPA rule, new legislation)





# What is Your Plan?

- Many industries and facilities are developing sustainability and/or GHG plans to respond to proposed GHG regulations and/or markets
  - And many other longer-term reasons
- Potential sustainability plan elements
  - GHG reductions
  - Carbon markets
  - Energy technology
  - GHG strategy
- The first step in any plan is deciding that you need one



# The Big Picture

- Sustainability issues are here to stay
  - Many industries and groups are planning already
- There is an opportunity to be proactive, not just reactive
  - Farming’s historical role as “stewards of the land”
  - Multi-generational nature of US dairy farming
  - Reducing “food-miles” of air pollutants and GHGs, increasing GHG efficiency
  - Support more holistic environmental regulations that account for multi-media impacts and benefits
- Sustainability will require new scientific tools or new applications of older ones



# The Big Picture (continued)

- Sustainability provides an opportunity for engagement and discussion
  - Within the dairy community
  - With old and new neighbors (e.g., green-belt, slower-growth initiatives)
  - With old allies and a chance to make new ones (e.g., waste-to-energy, renewable fuels, rural ecosystems, agricultural fields as air pollutant and carbon sinks)
- And it starts with: “What does sustainability mean to you?”

