

# Public Health and Climate Change Mitigation

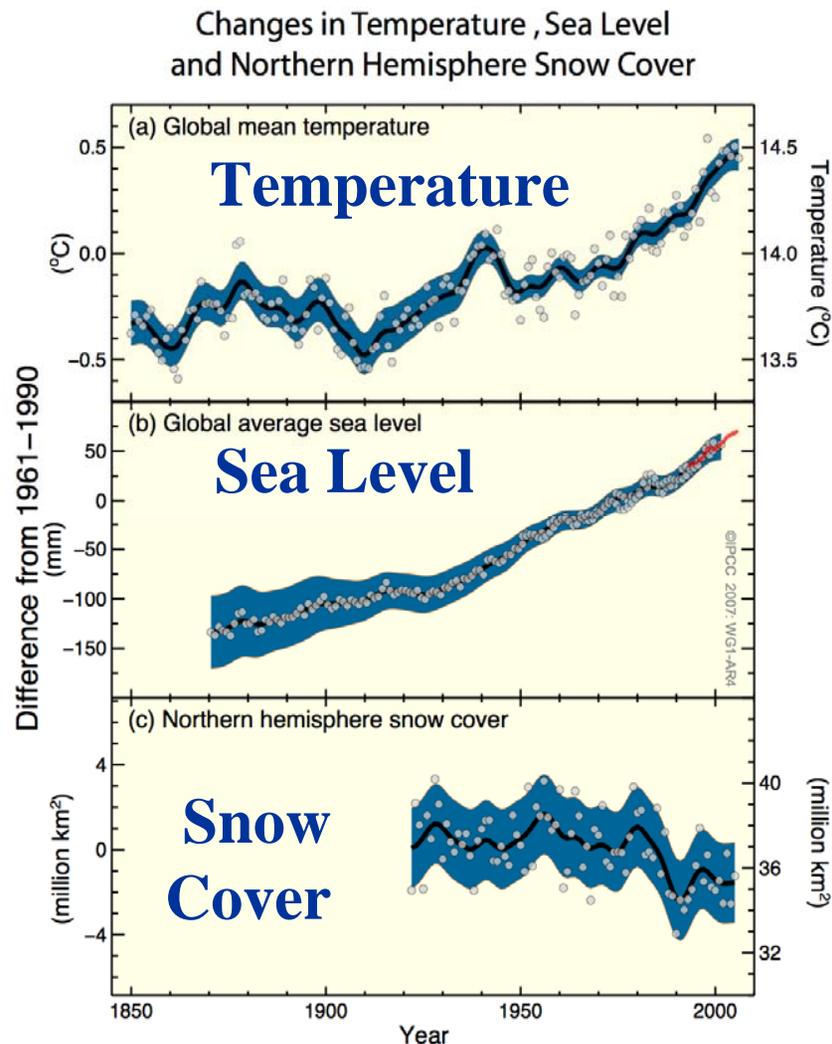


Linda Rudolph, MD, MPH  
City of Berkeley  
CCLHO – May, 2008

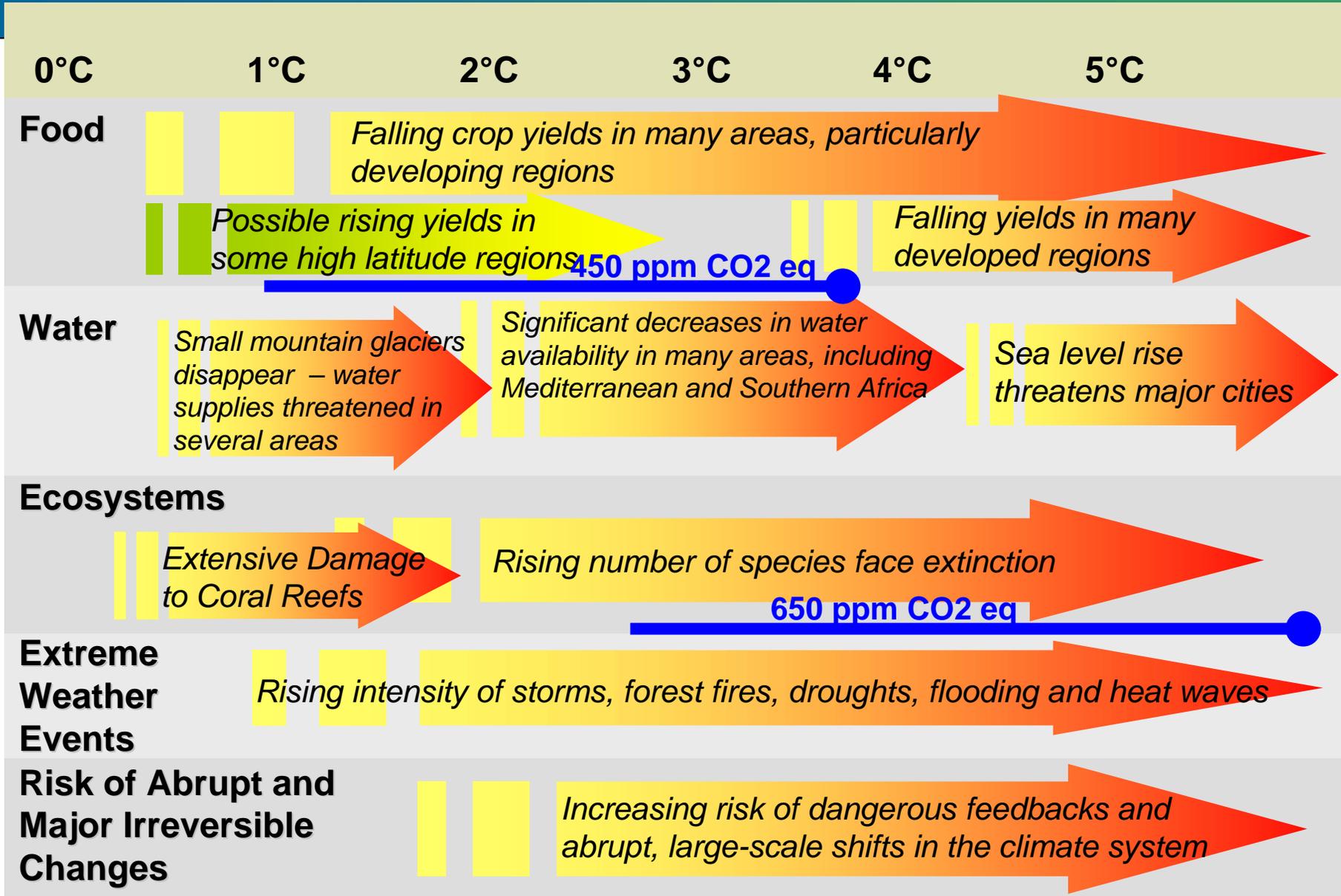
# Climate Change is Happening Now

- Warming is unequivocal; most of the warming of the past 50 years is very likely (90%) due to increases in greenhouse gases.
- Warming *plus*: heat waves, wind patterns, drought, & more
- Physical and biological systems on all continents and in most oceans already affected by recent climate changes.
- Greenhouse gases at unprecedented levels, forcing the climate to change.
- Already committed to more warming (next few decades); choices about emissions affect the longer term more and more.

(IPCC2007)



# Projected Impacts of Global Temperature Change



# We are Sitting on a Ticking Bomb

- Scale of threat: global; touches all, everywhere
- Intensity of the threat: threatens all of our basic survival mechanisms -- food, water, shelter, and health.
- Scale of response: must engage every sector of society
- Timeframe for response: "...we have at most 10 years -- not 10 years to decide upon action, but 10 years to alter fundamentally the trajectory of global greenhouse emissions."
- "There is still time, but just barely."

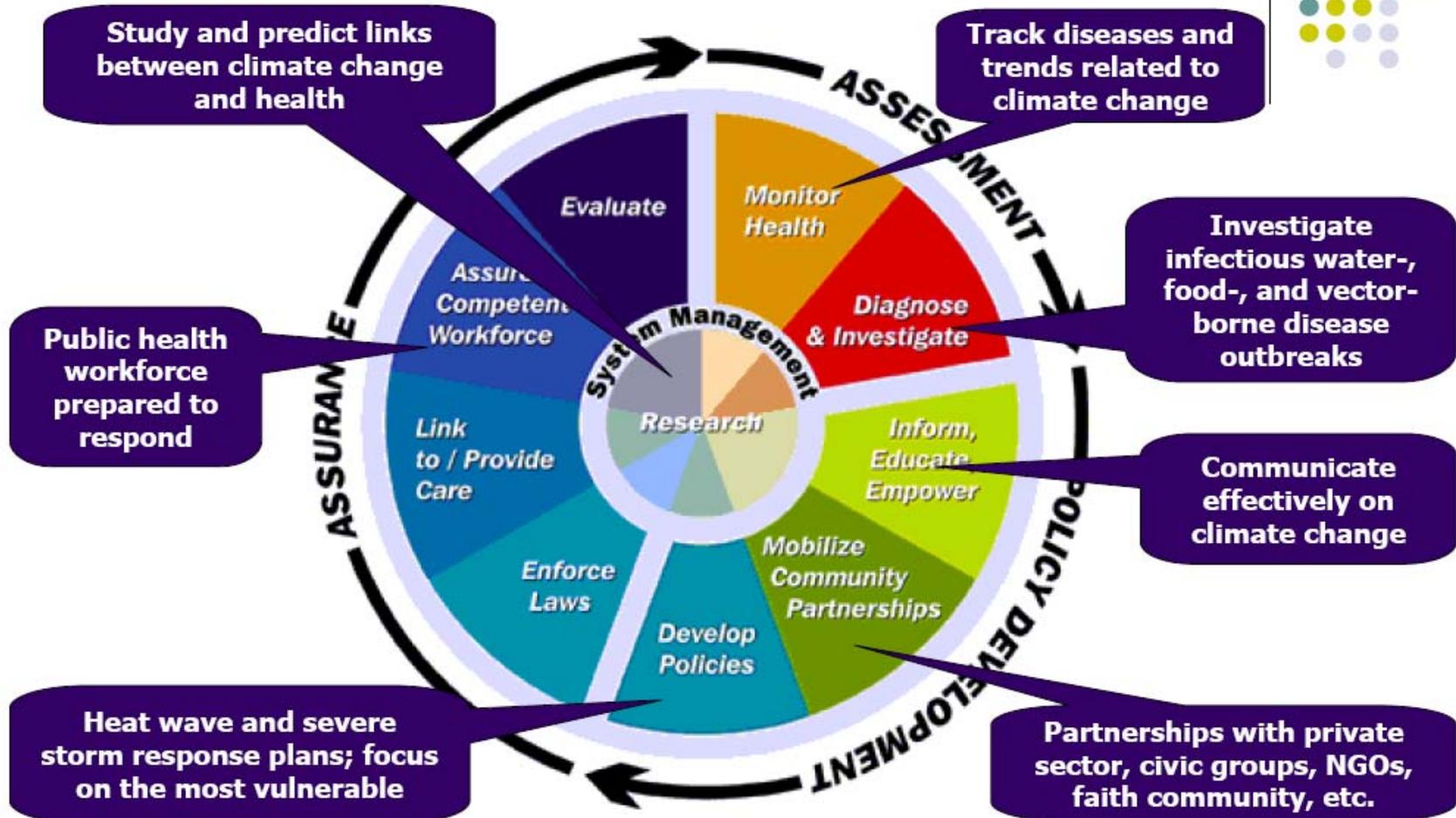
(James Hansen)

# Adaptation and Mitigation

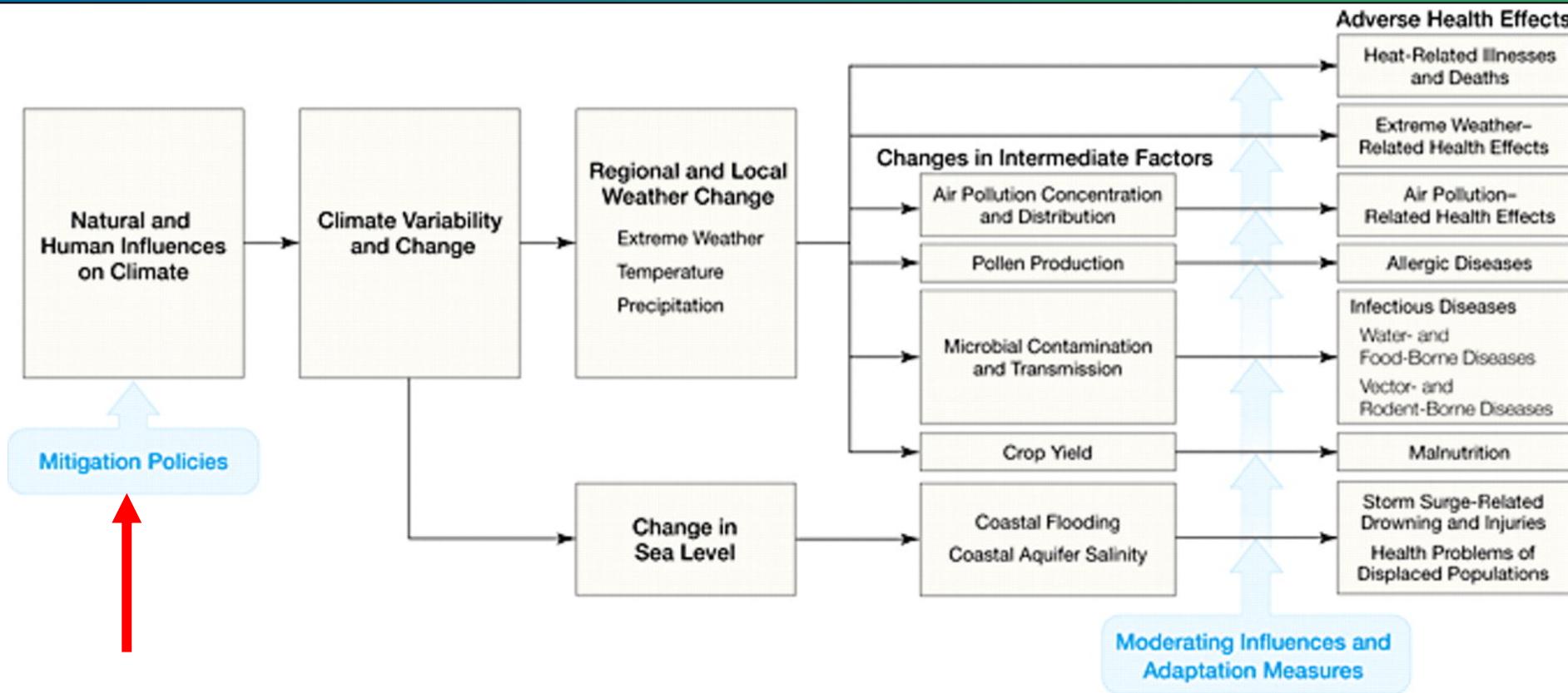
- Adaptation involves developing ways to protect people and places by reducing their vulnerability to and lessen the impact of climate change
  - Public health preparedness & response, tertiary prevention
  
- Mitigation involves attempts to slow, stabilize, or reverse the process of global climate change by lowering the level of greenhouse gases in the atmosphere
  - Public health primary and secondary prevention
  
- **BOTH ARE NECESSARY.**

# Public Health has Needed Skills

## Public Health Actions: For Climate Change



# What Does This Mean for Public Health?



## Mitigation Policies for Reduction of Greenhouse Gas Emissions

Energy Efficiency  
Use of Renewable Energy Sources  
Forest Preservation

## Moderating Influences

Population Density and Growth  
Level of Technological Development  
Standard of Living and Local Environmental Condition  
Preexisting Health Status  
Quality and Access to Health Care  
Public Health Infrastructure

## Adaptation Measures

Vaccination Programs  
Disease Surveillance  
Protective Technologies  
Weather Forecasting and Warning Systems  
Emergency Management and Disaster Preparedness  
Public Health Education and Prevention  
Legislation and Administration

Haines, A. et al. JAMA 2004;291:99-103

# Key Mitigation Technologies & Practices

## ■ Transport

- Fuel efficiency
- Hybrids
- Road to rail
- **Public transport**
- **Non-motorized transport**
- **Land-use planning**

## ■ Buildings

- **Daylighting**
- Energy efficiency
- **Improved cook stoves**
- Solar heating & cooling

## ■ Agriculture

- Crop & land management
- **Livestock & manure management**
- **Improved N fertilizer use**

## ■ Industry

- Energy efficiency
- Heat & power recovery

## ■ Energy supply

- Coal to gas
- Nuclear power
- Renewable energy

# What are Co-Benefits?

- Primary benefits
  - reductions in the expected long-term consequences of global warming; avoided damages of climate change
  
- Co-benefits (or ancillary benefits)
  - economic, social, environmental, public health and other benefits independent of any direct benefits from mitigating climate change
  
- Health co-benefits
  - Benefits of climate change mitigation strategies that have a positive effect on health

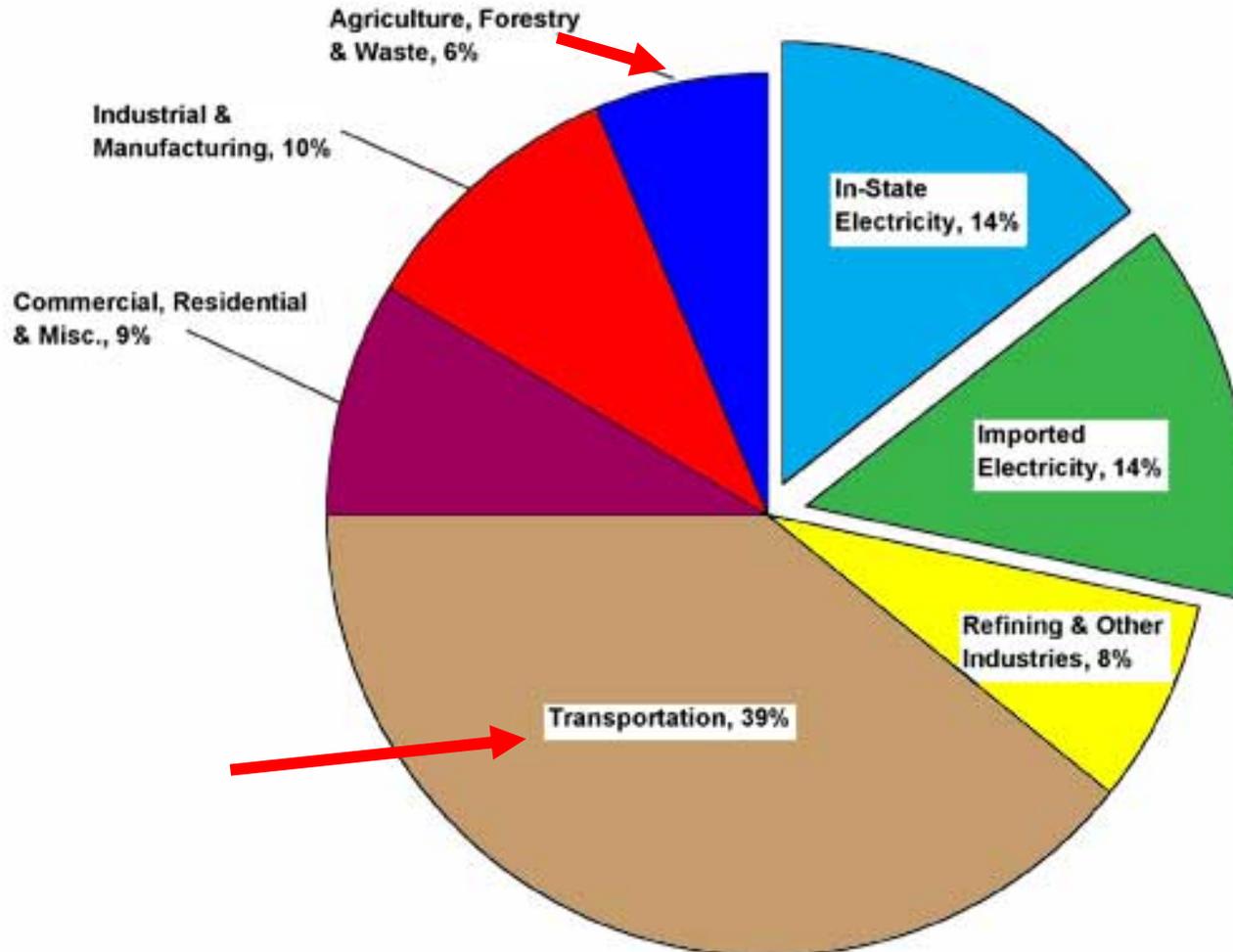
# Health Co-benefits

- Relatively *short-term* relative to primary benefits of climate change mitigation which occur over decades or longer
- *Local* - greater effect on communities relatively close to the source vs at a global level
- Lower net costs of mitigation

# California Greenhouse Gas Emissions

## California's Gross GHG Emissions in 2004

(Based Upon 8-13-07 Draft of ARB GHG Emissions Inventory)



[http://www.energy.ca.gov/global\\_climate\\_change/inventory/index.html](http://www.energy.ca.gov/global_climate_change/inventory/index.html)

# Transportation & Climate Change

- **Contributes nearly 40% of California GHG emissions**
  - Passenger cars 35%
  - Light trucks 27%
  - Heavy duty vehicles 19%
  - Air travel 9%
- **Globally, fastest growing sector for GHG emissions**
- **Indirect contributions**
  - Infrastructure construction and maintenance
  - Enabling of land use changes
    - Deforestation
    - Sprawl

# Climate Change and Air Pollution

- Fossil fuel combustion - large contributor to both GHG emissions ( $\text{CO}_2$ ) and common air pollutants ( $\text{PM}_{10}$ ,  $\text{SO}_x$ ,  $\text{NO}_x$ )
- California has worst air quality in US
  - Ozone and PM above air quality standards
- Climate change and air quality linked through chemistry of atmosphere
  - Warmer temperatures are known to speed formation of smog – mainly ozone
  - Air pollutants influence the life times of GHGs
- Warming will increase days with likely high ozone 25%-80%

# Air Pollution and Health

- Estimated current 8,800 deaths/year in California
- Ozone: respiratory irritation, asthma and chronic lung disease aggravation, decreased lung function, immune effects
  - for strokes, congestive, heart failure, heart attacks, COPD, asthma, other respiratory problems; reduced lung function in children
- PM : attaining Ca. standards would annually prevent
  - about 6,500 premature deaths, or 3% of all deaths
  - 1.3 million school absence days Particulate matter (PM<sub>2.5</sub>)
- Vulnerable: children, elderly, pre-existing disease
- Estimate 1,000 more US deaths for each degree (C) temperature rise

# Transportation and Physical Activity

- Motorized transport creates disincentives for active transport
  - Drivers' perceived time savings/convenience
  - Non-drivers' risks due to speed/traffic
  - Community severance by large roadways
- Transportation and land-use infrastructure interact
  - Low-density land use increases trip distances
  - Auto-oriented infrastructure vs bike/walk/transit infrastructure
- U.S. ranked last for active transport
  - Only 10% trips walking/biking vs near 40% many EU

# Health Benefits of Physical Activity

- Reduced risk of
  - premature mortality
  - coronary heart disease
  - hypertension
  - colon cancer
  - diabetes mellitus
  - depression and anxiety
- Improve mood
- Enhance ability to perform daily tasks throughout the life span

# Transportation and Injuries

## ■ Injuries

- 1.2 million deaths and 50 million injuries worldwide
- 4300 deaths and nearly 300,000 injuries in California annual
- Low income & children at highest risk

# Mitigation Strategies for Transportation

Mitigation Options	Strategies	Supporting Policies
Vehicle Efficiency	<ul style="list-style-type: none"> <li>• Incremental improvements</li> <li>• Eco-driving</li> <li>• Speed reduction</li> <li>• (Electrification)</li> <li>• (Fuel cells)</li> </ul>	<ul style="list-style-type: none"> <li>• Performance standards</li> <li>• Purchasing incentives (fuel and vehicle)</li> <li>• Gov't &amp; company fleet purchasing</li> </ul>
Low carbon fuels	<ul style="list-style-type: none"> <li>• Bio-fuels</li> <li>• Diesel, Compressed gas</li> <li>• (Hydrogen)</li> <li>• (Electricity)</li> </ul>	<ul style="list-style-type: none"> <li>• Fuel standards</li> <li>• Carbon tax</li> <li>• Fleet use alternative fuel</li> </ul>
Motorized travel & vehicle demand reduction	<ul style="list-style-type: none"> <li>• Land use planning</li> <li>• Incentives, rules to reduce car use</li> <li>• Incentives for non-motorized travel</li> <li>• Intelligent transport &amp; mobility management systems</li> </ul>	<ul style="list-style-type: none"> <li>• Road, parking, congesting pricing</li> <li>• Public transit investment</li> <li>• Zoning, land use, driving, building rules</li> <li>• Public education &amp; outreach</li> </ul>

# GHG Mitigation Strategies, Air Pollution, & Health

- Globally ancillary benefits may be 30% – 100% abatement costs
- Public health improvement and “knock-on” effect to health services from reductions in air pollutants account for approximately 80% total value ancillary benefits in US
- Canada proposed GHG emissions reductions would also reduce
  - SO<sub>2</sub> by 9%, NO<sub>x</sub> by 7% of annual emissions
  - 3,300 premature deaths per year avoided in Canada w/15% GHG reduction (based on PM reduction only)
- GHG reductions in 4 cities would avoid (through 2020)
  - 64,000 premature deaths :
  - 65,000 chronic bronchitis cases
  - 37 million person-days of restricted activity or work loss

IPCC (2001); Caton (2000); Blomqvist (2000); Cifuentes (2001)

# Active transport, GHG, and Weight

- Bicycling 1 hour
  - Reduce Carbon emissions by 15 lbs vs auto
  - Burns average 450 calories; saves \$0.52/mile;
  - 3 days per week = > 1 ton reduction C emissions
  - 3 days per week = 67,500 calories/year
  - Converts to 19 pounds of body fat
- Low-carbon London with 53% trips by active transport (Woodcock)
  - 72% reduction in GHG emissions
  - Health benefits: increased fitness, decreased adiposity, increased muscle mass, increased bone density, decrease of 20–40% in risk of premature mortality, increase of 1–2 years in life expectancy, decrease of 25% in breast cancer risk, decrease of >20% all cancer risk, decrease of >30% diabetes mellitus

# Speed, GHG emissions, and health

- Speed and emissions
  - Texas: (55 mph to 70 mph limit)
    - Emissions increase: 23% CO, 13% NO<sub>x</sub>, 5% VOC
  - Enforcement of the 70 mph speed limit in the UK could save around 1 MtC (million tons of carbon) a year
    - Reducing the limit to 60 mph would almost double to 1.88 MtC
- Highway fatalities and speed
  - 9000 fewer U.S. MVA fatalities in 1<sup>st</sup> year after 55 mph speed limit
  - restriction 65 mph or less will save almost 3,000 lives per year U.S.
- But: what about light-weighting

# Transportation Mitigation & Co-Benefits

- London congestion pricing
  - 16% reduction in CO2 emission
  - 13-15% reduction NOx, 7% reduction PM<sub>10</sub>
  - reduced congestion by 26 % (less stress & road-rage)
  - 40 - 70 fewer accidents resulting in personal injury (1 yr)
  
- Rotterdam Speed Control
  - Emissions reduced: CO2 15%, NOx 15-25%; PM 25-35%
  - Health co-benefits:
    - air pollution reduction
    - decrease in accidents (60 %) and casualties (90 %)
    - decreases in noise from traffic (50 %)
  
- Finnish Eco-driving
  - average fuel consumption reduced by 10-16 %
  - decreased accidents
  
- Teleconferencing (British Telecom)
  - each conference call saved  $\geq$  40 kg of travel CO2 emissions
  - total avoided CO2 : 103,174 tons one year
  - improved work–life balance, reduce family stress

# Climate & health co-benefits of decreased auto use

## Reductions

- Greenhouse gas emissions
- Air pollution
- Noise
- Infrastructure costs
- Community Severance

## Increases

- Physical Activity
- Social Capital

## Reductions

- Respiratory disease
- Traffic injuries
- Heart disease
- Depression
- Osteoporosis
- Diabetes
- Cancer
- Stress

# Are Bio-fuels the Answer?

- Developed nations setting bio-fuel targets
  - EU: 10% by 2020; UK: 5% by 2010
  - US (Bush): 17% by 2017 – 35 billion gallons
- Ca. Executive Order S-1-07, the Low Carbon Fuel Standard:
- Corn ethanol only currently available bio-fuel
  - E85 (85% ethanol) would increase ozone-related mortality & asthma in LA by 9%
  - 15 billion gallons corn ethanol: increase ag GHG emissions by 8%
  - Corn ethanol increases total life cycle emissions 6x gasoline (deforestation)
  - Food insecurity: diversion of corn to biofuels causes increased corn prices
    - Mexican corn tortilla crisis
    - Asian rice price inflation

# Agriculture & GHG Emissions

- Agricultural activity contributes one fifth (22%) total GHGs
- Agriculture produces GHG through NO<sub>x</sub> (fertilizers), methane, burning, transport, deforestation
- Energy used for food production = 17% all fossil fuel used in U.S. in 2002 for food production
  - 3 kcals of fossil fuel energy to produce 1kcal food energy
- Average food miles: 1500
  - Conventional food transport uses 4 to 17 times more fuel with 5 to 17 times more CO<sub>2</sub> than local systems
- Up to 40% energy used in food system goes to production of artificial fertilizers and pesticides

# Livestock and GHG Emissions

- Nearly 80% agricultural emissions caused by livestock production
- World meat consumption is expected to double by 2050
- Livestock production: major source of methane and nitrous oxide, both with greater warming potential than CO<sub>2</sub>
  - Animal agriculture produces more than 100 million tons of methane a year.
  - Stored liquid manure produces >13 million tons methane per year
- Grain-fed beef requires thirty-five calories for every calorie of beef produced.
- Limiting increased greenhouse gas emissions from livestock production could curtail warming fairly rapidly and therefore is a top priority

# Meat Consumption & Climate Change

- Average American diet requires the production of extra 1.5 CO<sub>2</sub>e compared to a strictly vegetarian diet
- 2.2 pounds beef = CO<sub>2</sub>e of 155 miles driving
- Meat consumption reduction of 20% = switch from Camry sedan to Prius
- Average meat consumption = 100 g per person per day
  - 10-fold difference populations with high vs low consumption.

# Meat Consumption and Health

- Animal (saturated) fat diets: increased risks of
  - CV disease, obesity, colorectal cancer, breast cancer, prostate cancer
- High-income countries: decreased meat consumption should improve health
  - Low-intake population: increased meat consumption should improve health through reduced protein and other nutrient deficiencies

# Climate & Health Benefits of Sustainable Agriculture

## Reductions

- Greenhouse gas emissions
- Pesticide use
- Synthetic fertilizer use
- Food miles
- Antibiotic use
- Water pollution (nitrates)
- Air pollution
- Biodiversity loss
- Soil erosion
- Unsustainable H<sub>2</sub>O consumption

## Increases

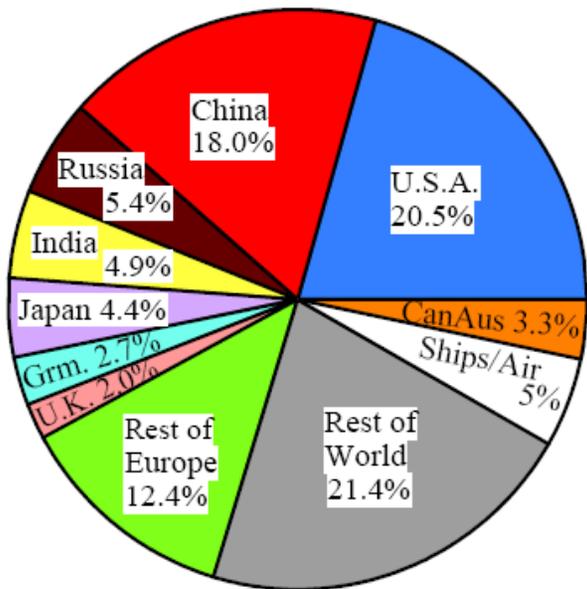
- Local food systems
- Rural community strength

## Reductions

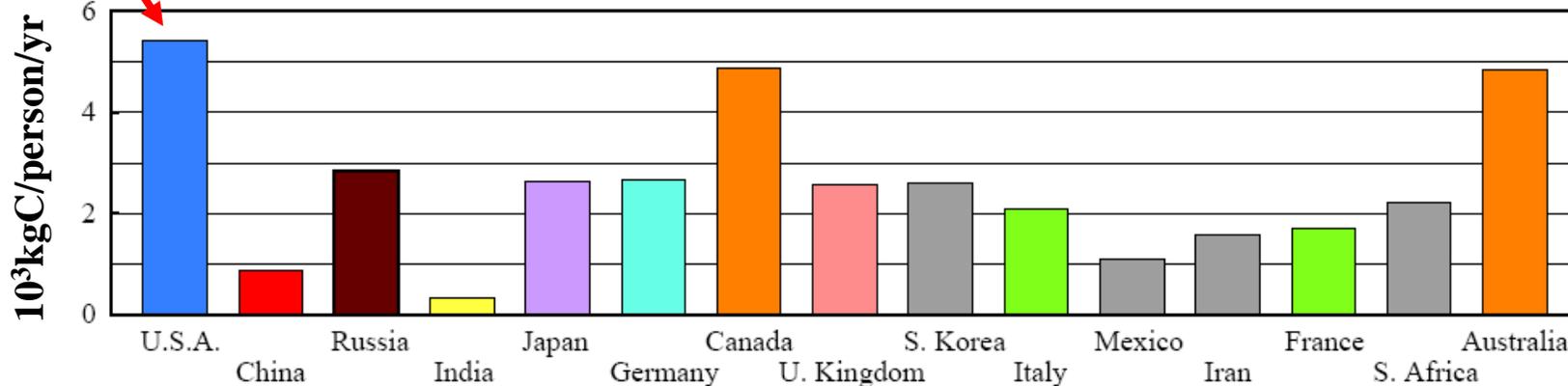
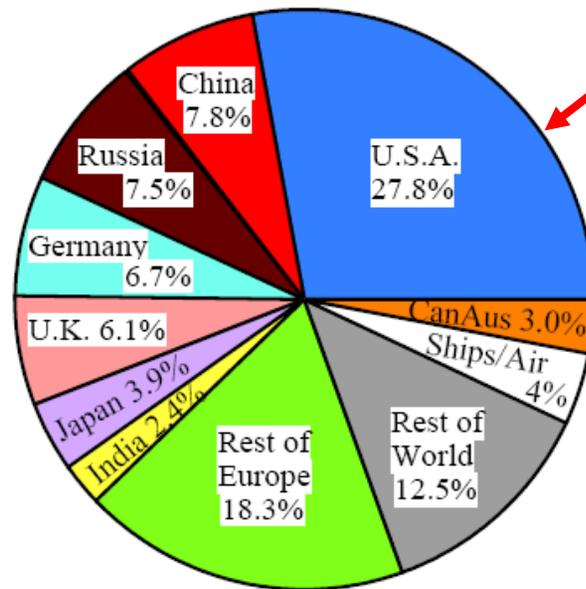
- Ischemic heart disease
- Obesity
- Colorectal cancer
- Breast & prostate cancers
- Type II Diabetes
- Antibiotic resistance
- Respiratory disease
- Pesticide health effects

# US bears responsibility

2005 CO<sub>2</sub> Emissions



Total CO<sub>2</sub> Emissions



Per Capita Fossil Fuel CO<sub>2</sub> Emissions in Order of Total Emissions

# Environmental Justice at Home

First A.G. approved trade in California – September, 2007

- Conoco-Phillips refinery granted permission to expand refinery capacity
  - 500,000 ton CO<sub>2</sub> emissions increase Contra Costa County
- \$10 million to cut GHG
  - \$7 million to fund for financing projects to cut CO<sub>2</sub> in Bay Area
  - \$2.8 M for trees in “mature” forests
  - \$200K restore wetlands in San Pablo Bay
  - Eliminate 70,000 tons CO<sub>2</sub> Santa Maria refinery
- Refinery emissions: CO<sub>2</sub> plus NOx, SOx, PM, aldehydes, benzene, 1-3 butadiene, benzopyrenes, volatile organics, etc.

# What Should We Do?

- Educate – ourselves, public, and policy makers
- Partnerships and collaboration
- Lend PH credibility and experience in driving policy and behavior change
- Advocate for aggressive government and business mitigation policies & strategies that also promote health
- PH leadership in advocating for personal, organizational, local government carbon footprint reduction
- Increase understanding and research re: health co-benefits
- Ensure health co-benefits included in policy and cost assessments (e.g. HIAs)
- Protect vulnerable populations
  - Advocate for equity in mitigation
- Monitor health impacts of climate change
- Preparedness and adaptation

# Action is Urgent!

“Ignorance is no excuse for us. There is overwhelming scientific evidence of global warming, its causes, and many of its implications. Today’s generations will be accountable, and how tall we stand remains to be determined. There is still time, but just barely.”

James Hansen