

# NACWA's 2007 Summer Conference Sustainable Infrastructure Choices... Gray, Green & Everything in Between

**Renaissance Cleveland, Cleveland, OH  
June 20, 2007**

**Climate Change...  
What Does it mean for Wastewater Treatment?**

**Glen T. Daigger, Ph.D., Ph.D., BCEE, NAE  
Senior Vice President and Chief Technology Officer**



**CH2MHILL**



# Climate Change... What Does it Mean for Wastewater Treatment?

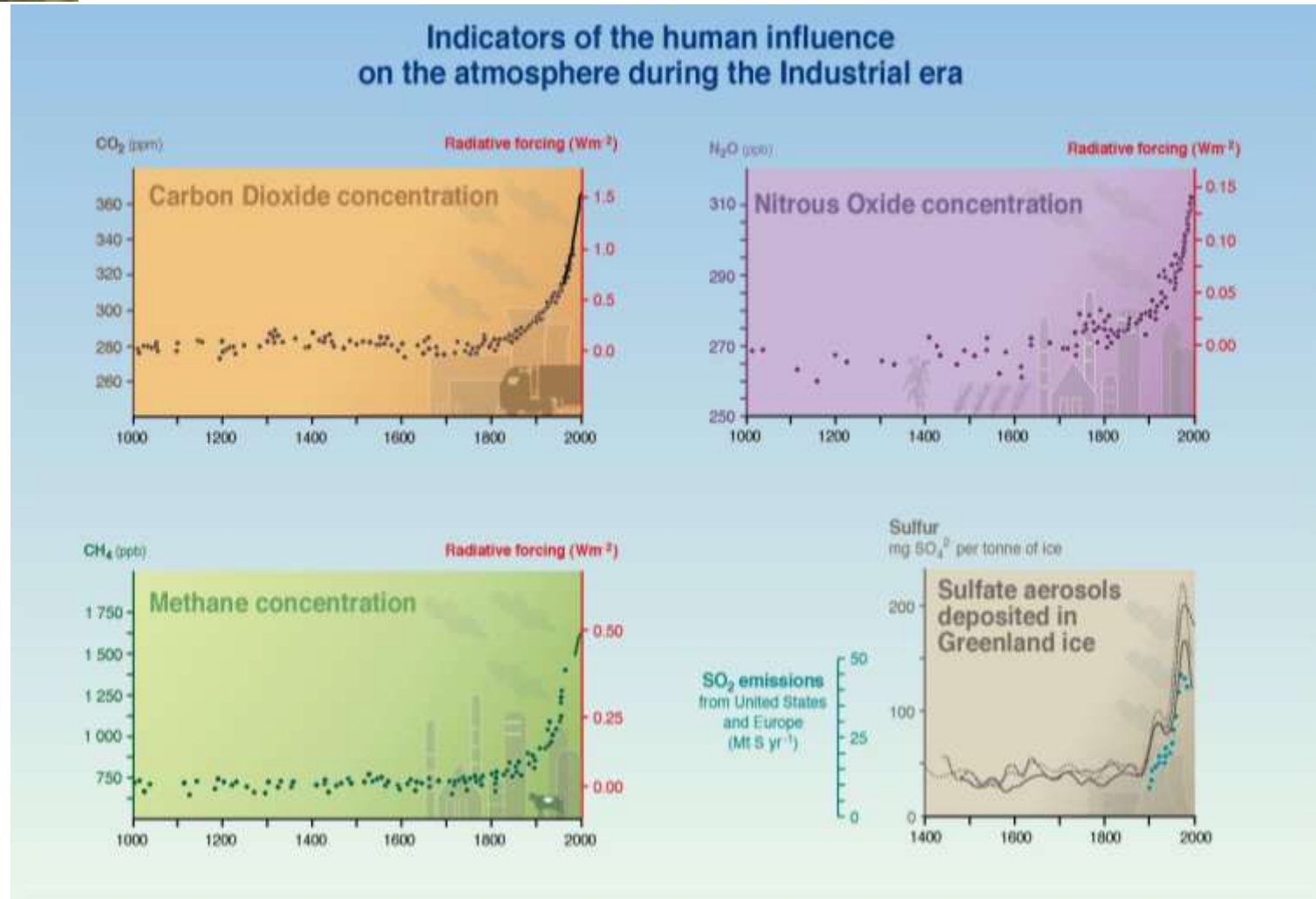
- With Due Respect to “An Inconvenient Truth”:  
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# Human Impacts on Atmosphere Increased Dramatically Since 1800

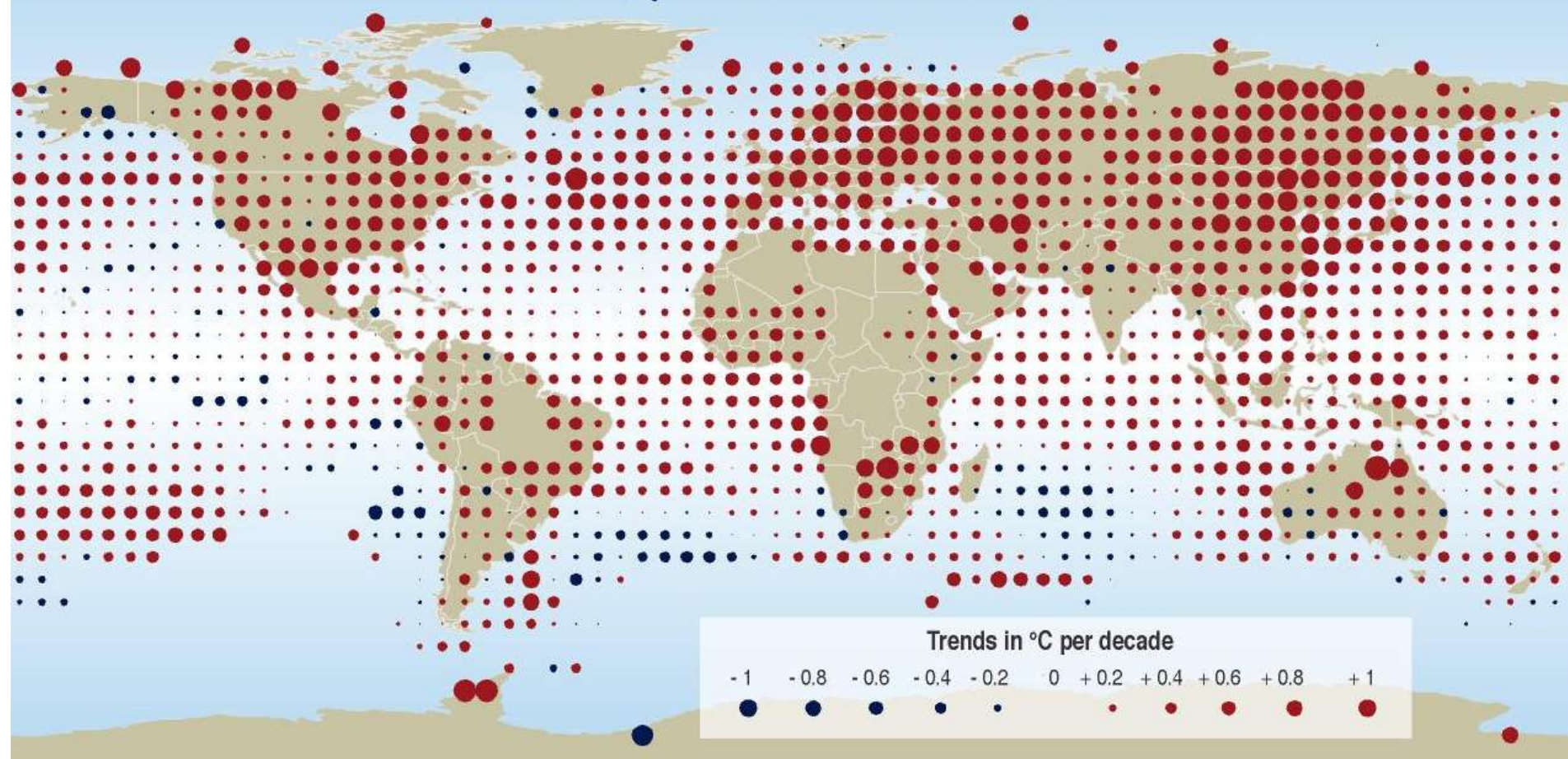






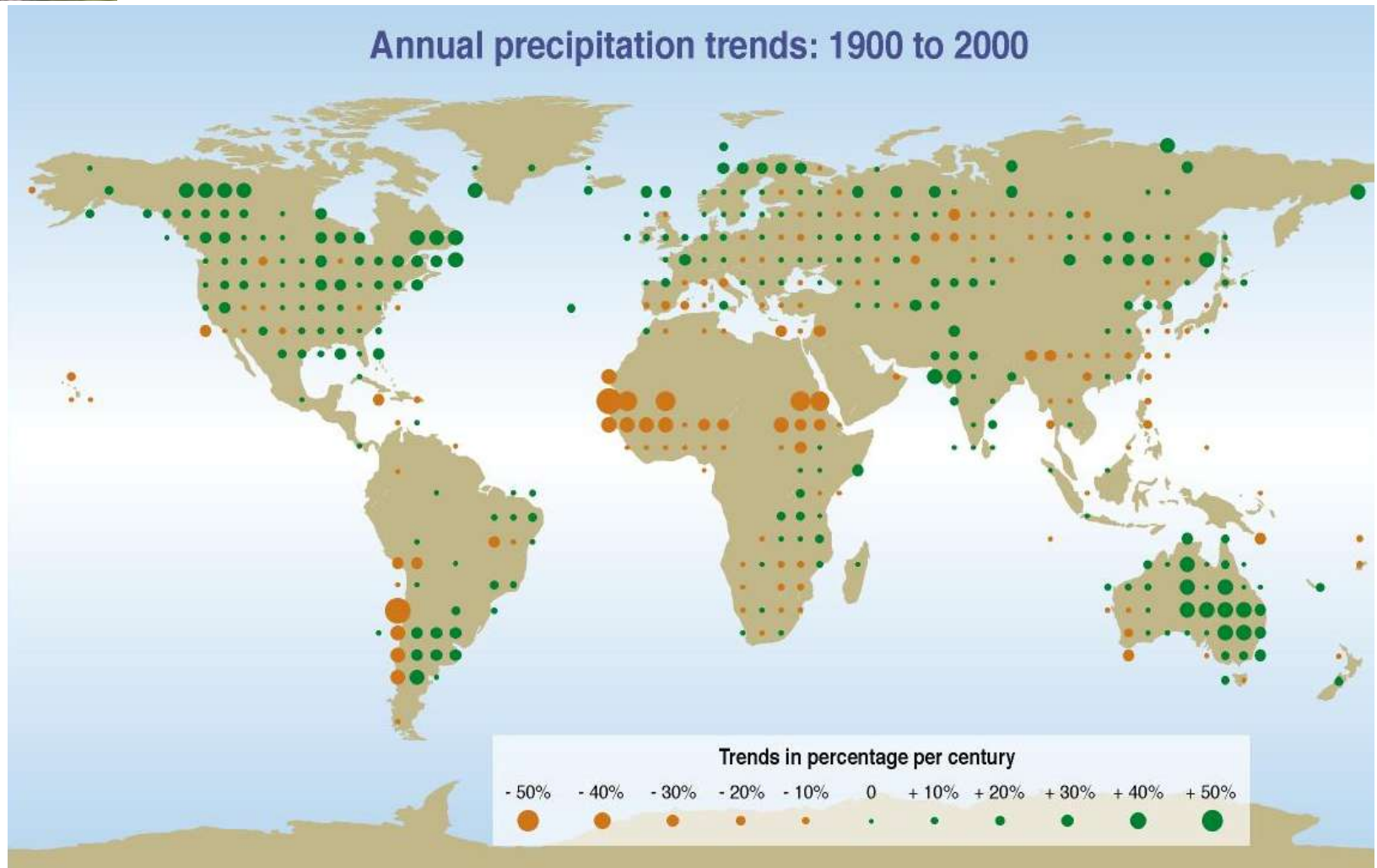
# Annual Temperature Trends Have Changed Over Similar Period.....

Annual temperature trends: 1976 to 2000



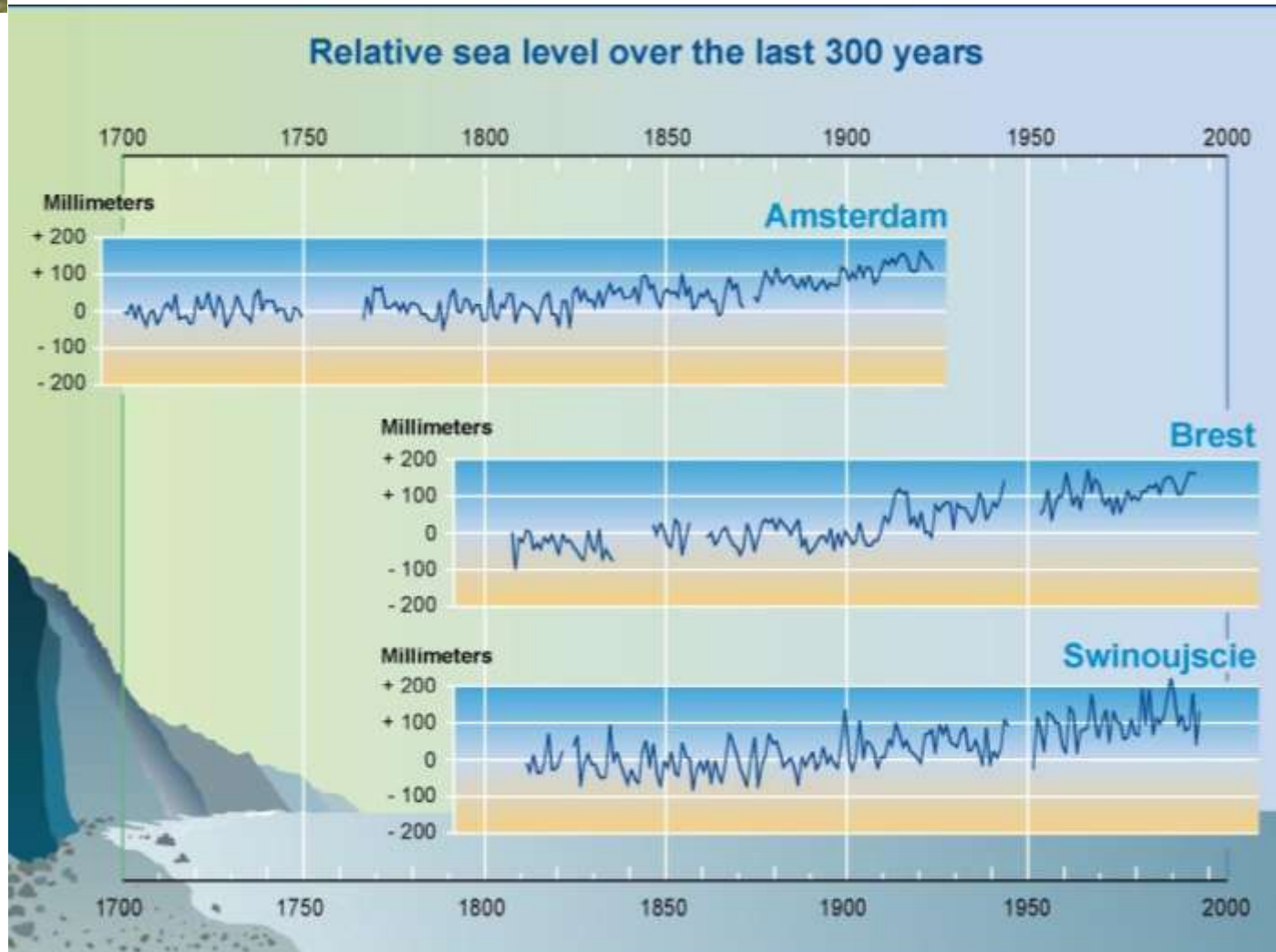


## ...And So Has Annual Precipitation



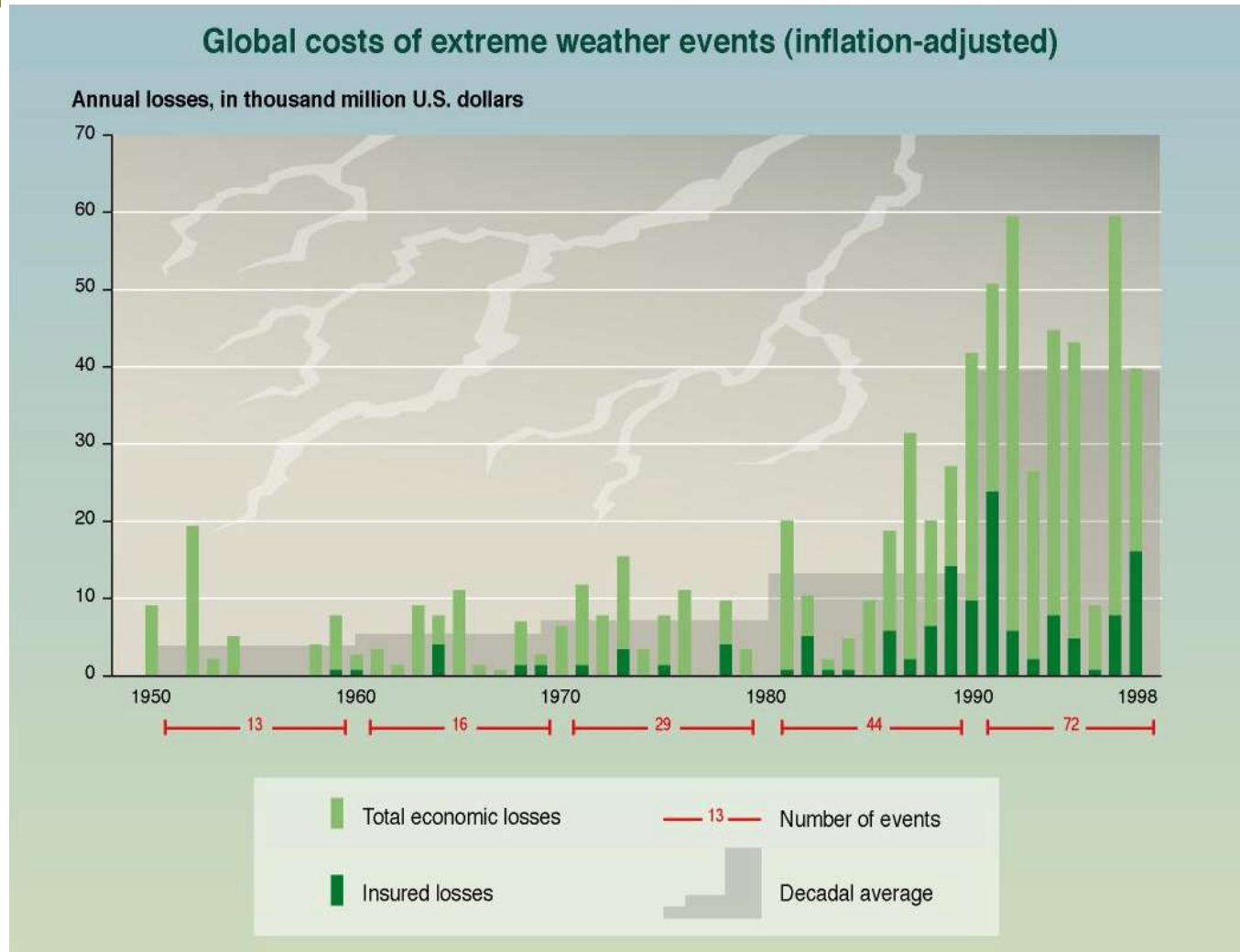


# Sea Level is Rising....





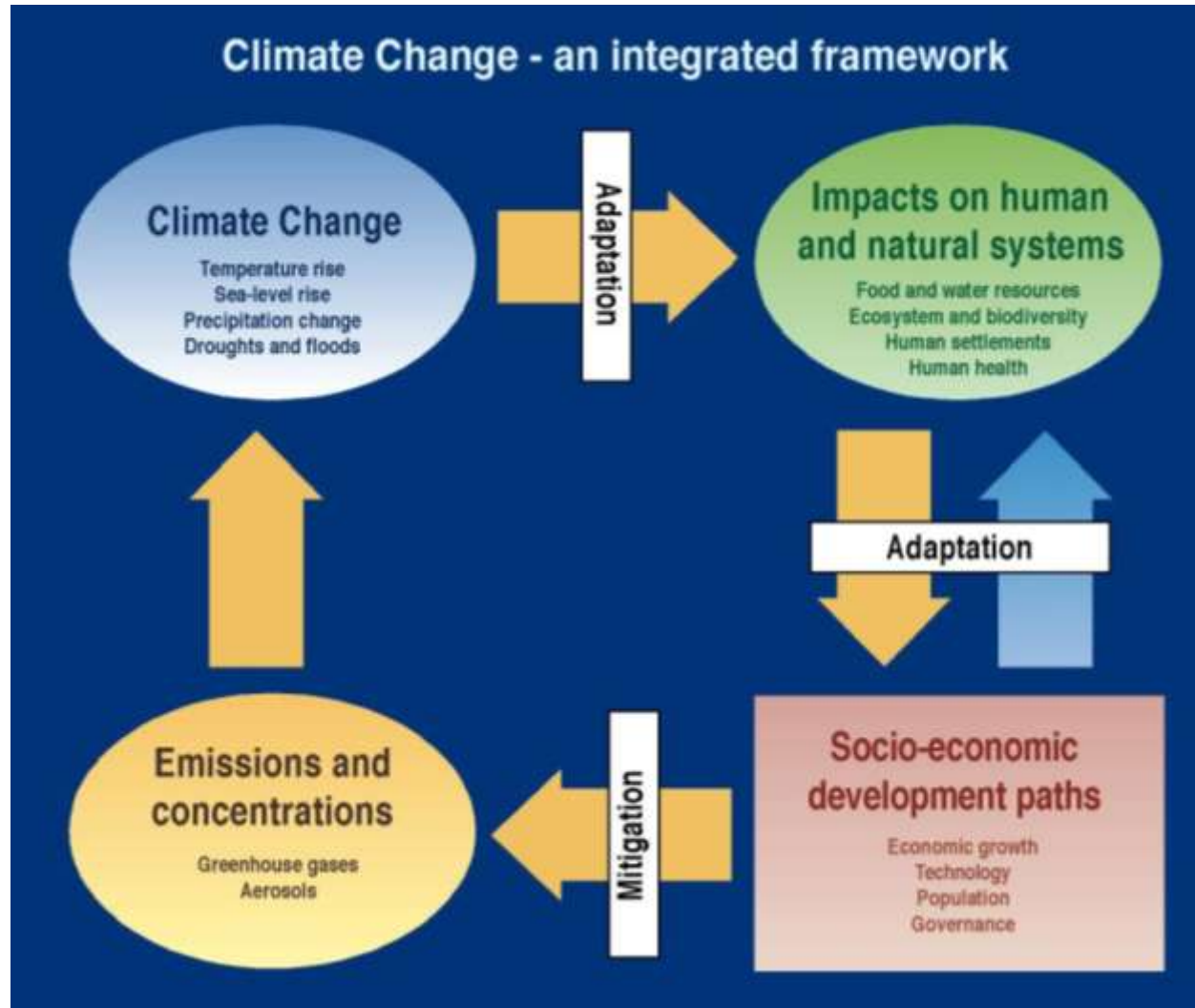
# ...And the Weather is Becoming More Unpredictable







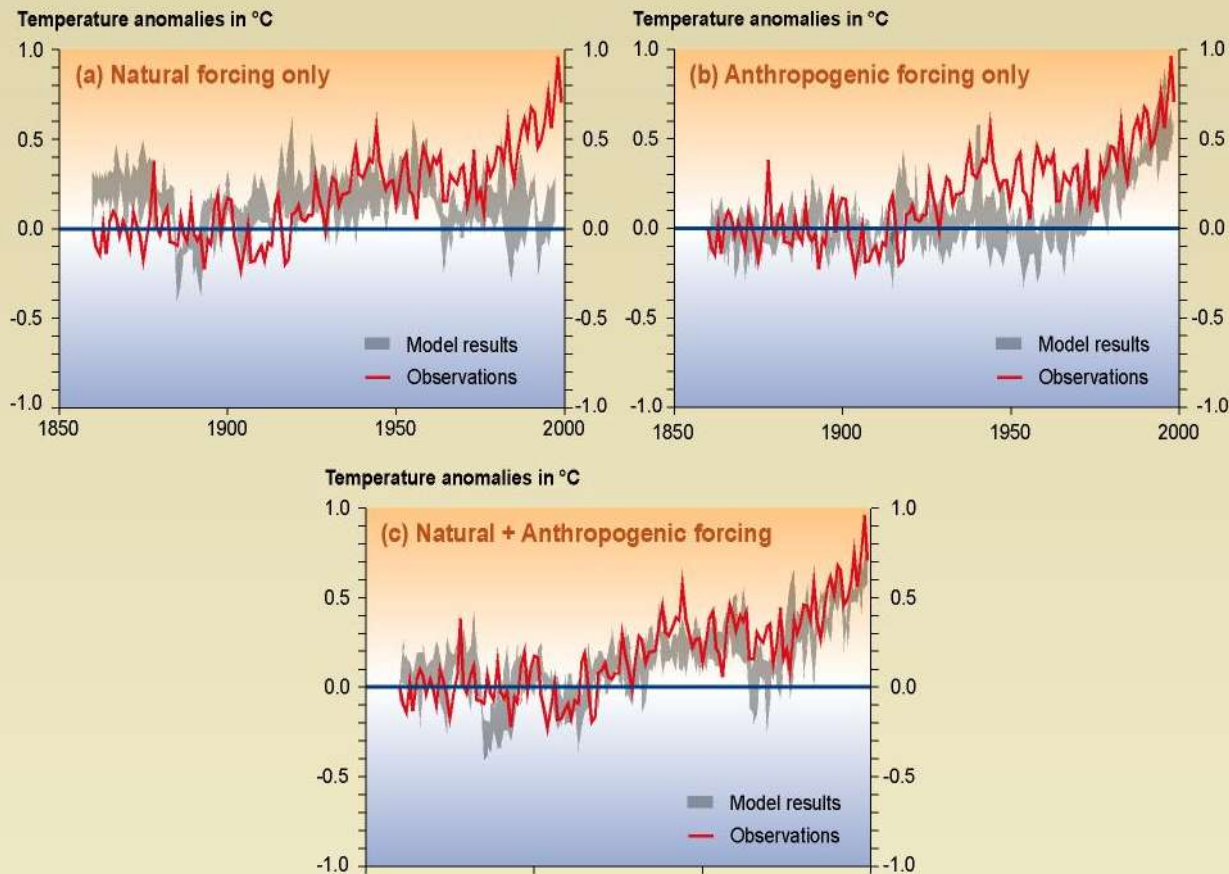
# Two Aspects of Climate Change are Important: (1) Mitigation and (2) Adaptation



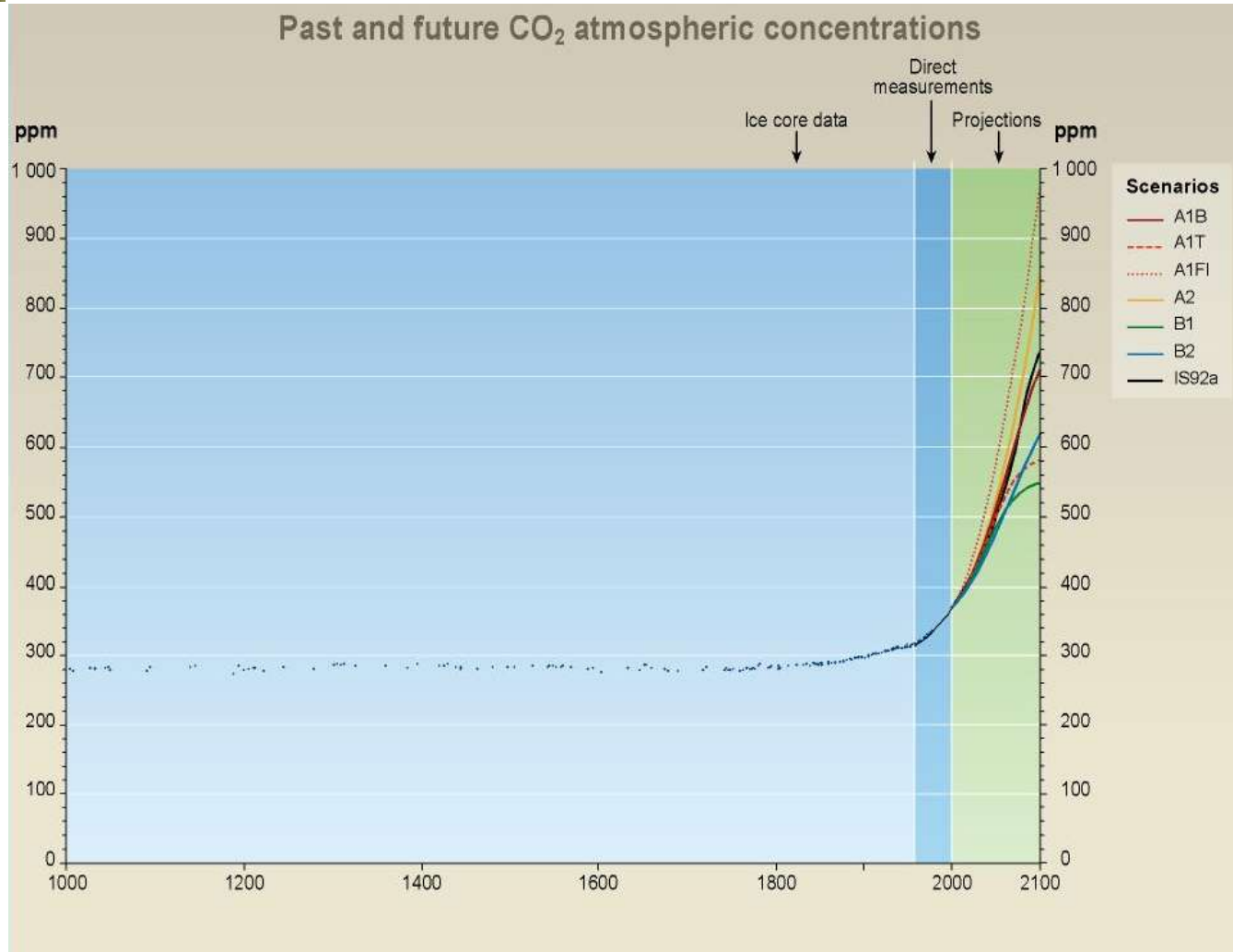


# Global Climate Models Appear to Accurately Characterize Temperature Changes

Comparison between modeled and observations of temperature rise since the year 1860

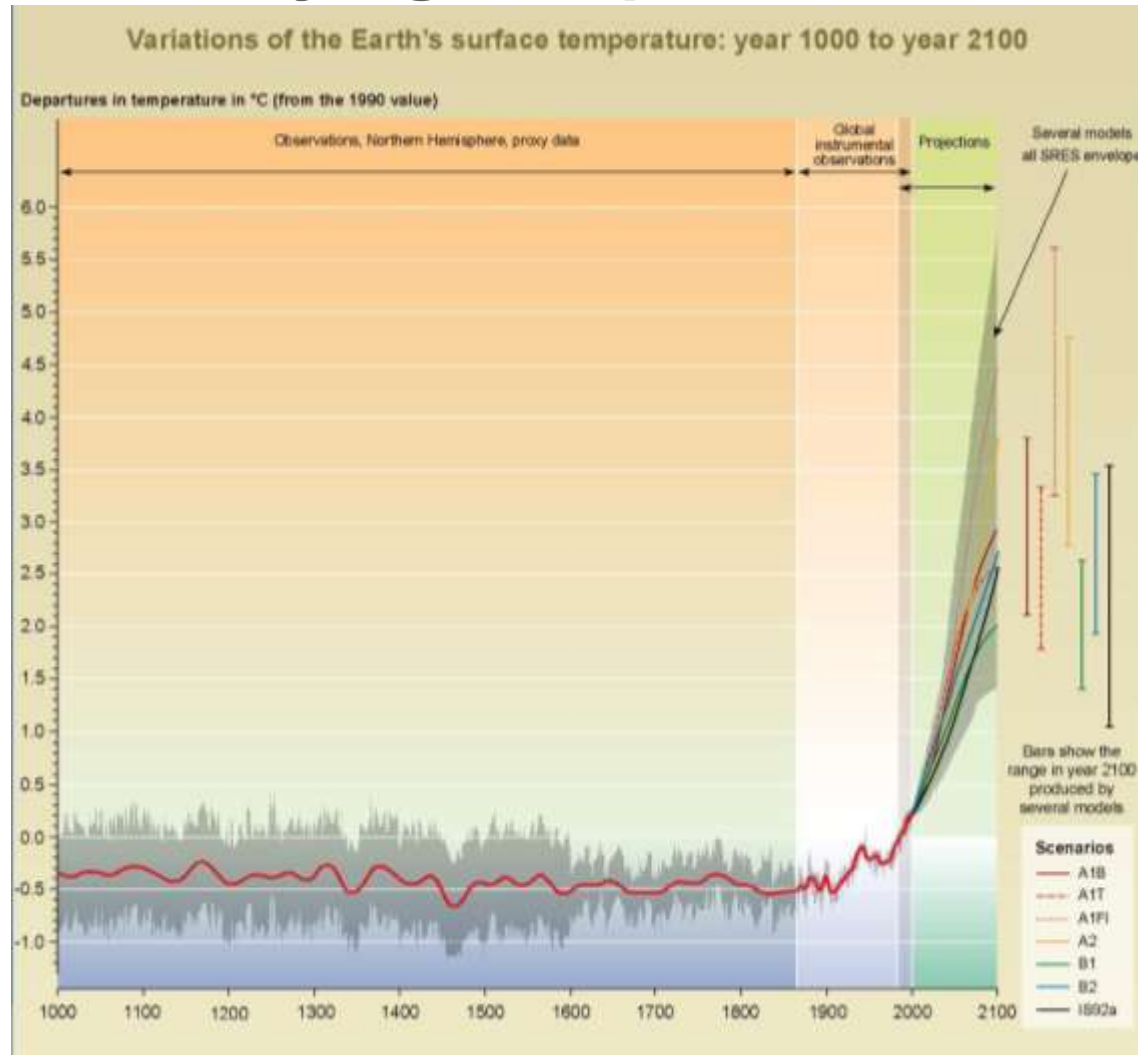


# Various Control Policies Can Result in Differing CO<sub>2</sub> Increases.....





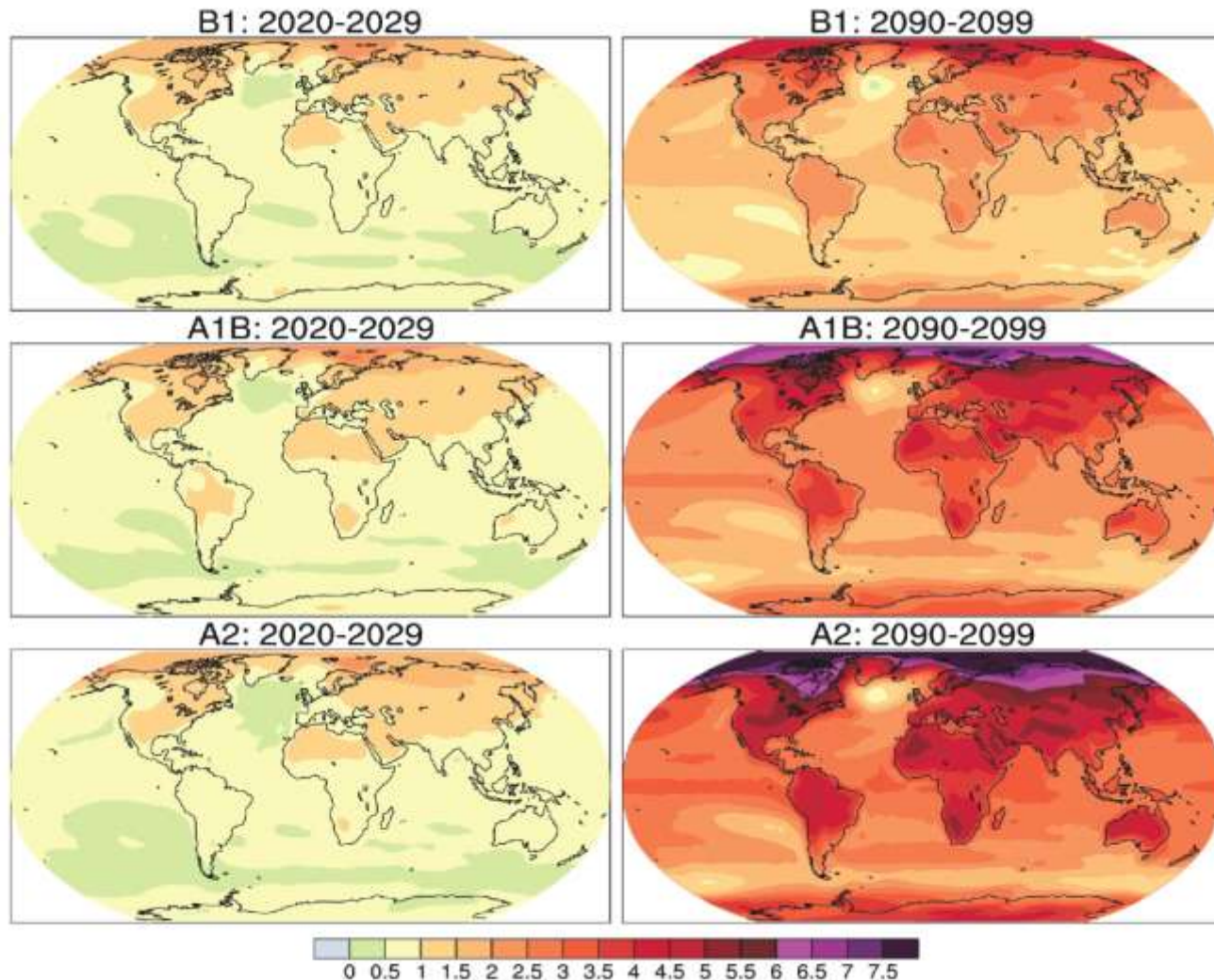
## ...And Varying Temperature Rises





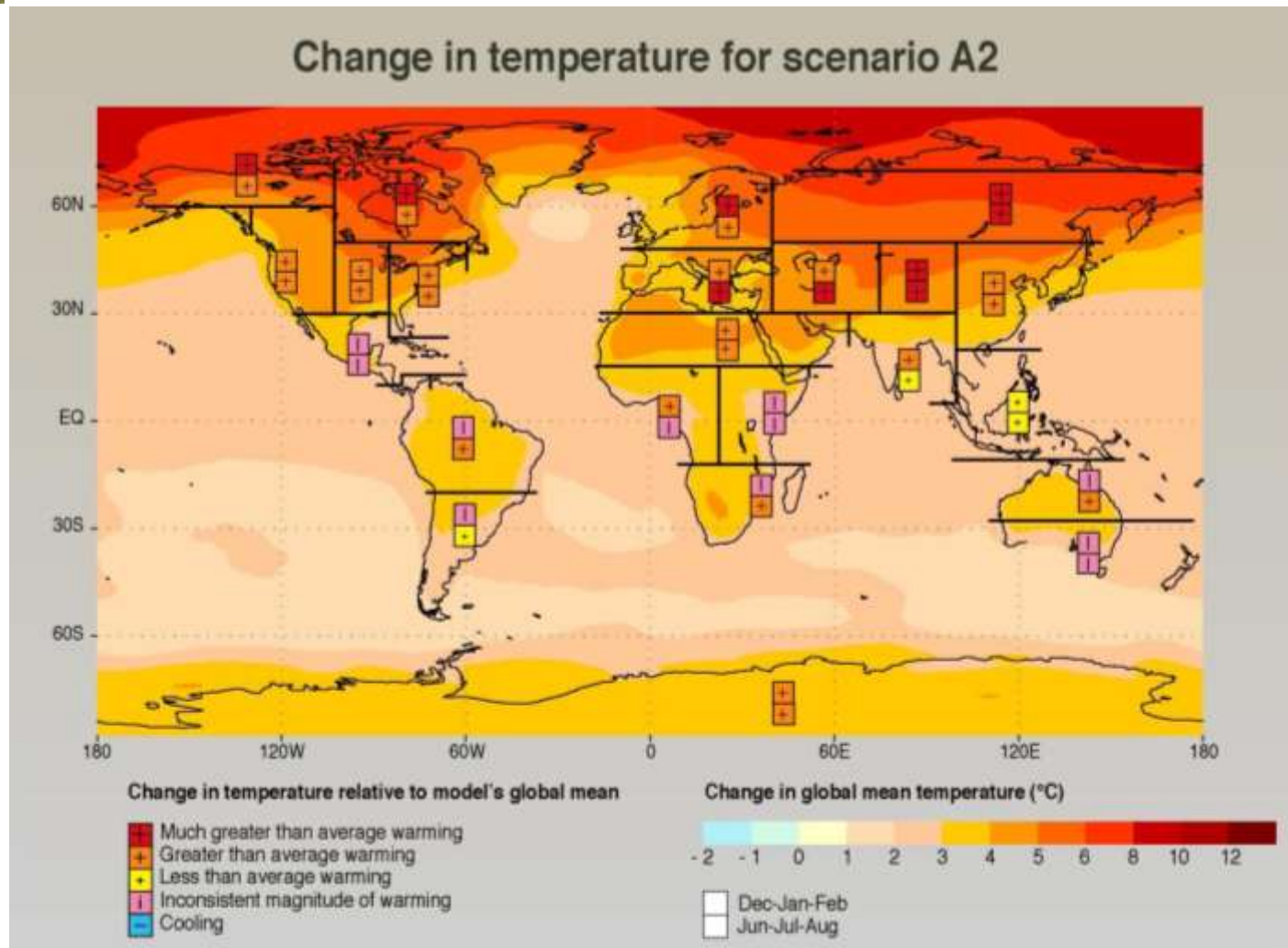


## But None of them are “Pretty”.....



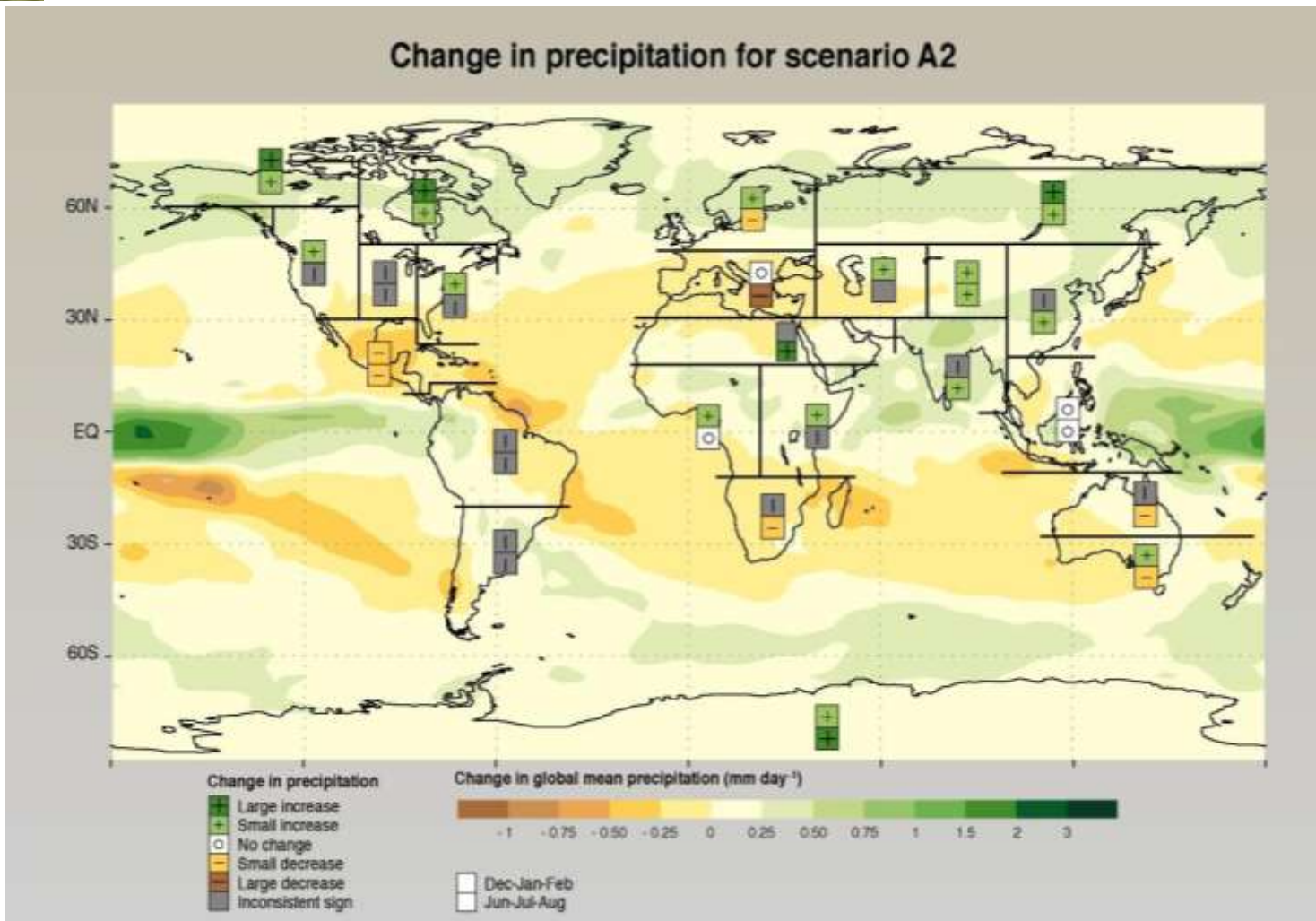


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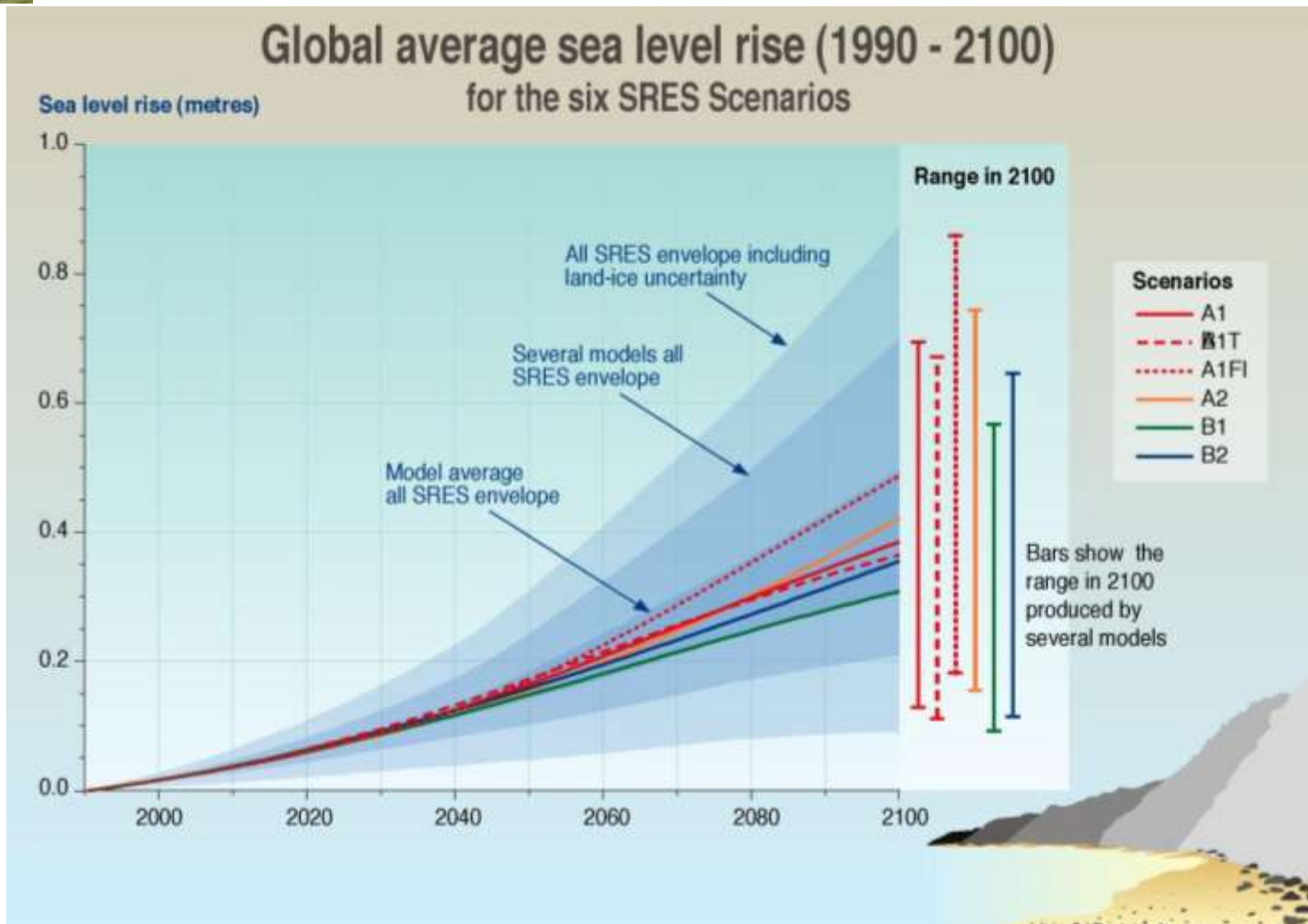


# ...And They Will Result in Significant Changes in Precipitation!





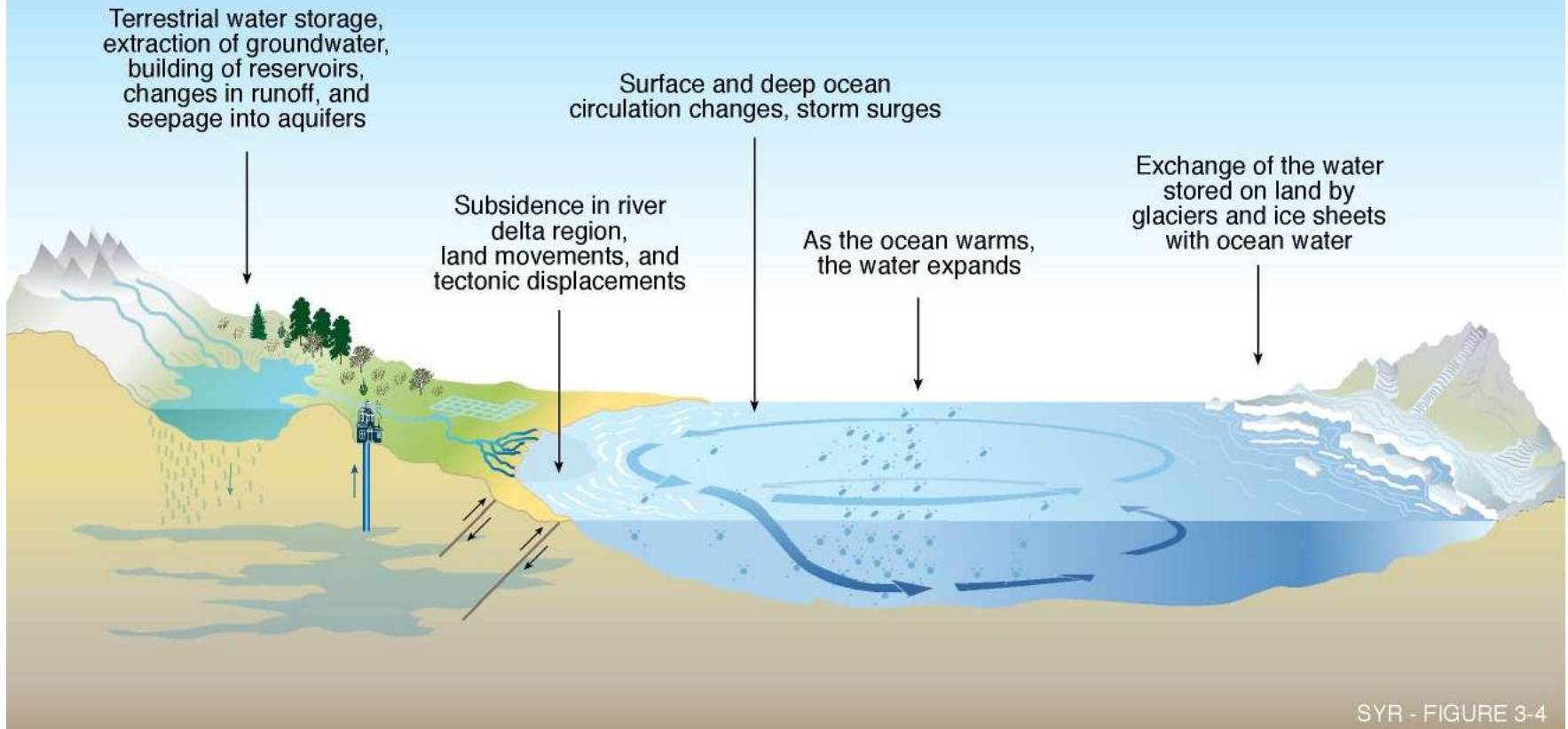
# Sea Level Will Continue to Rise.....





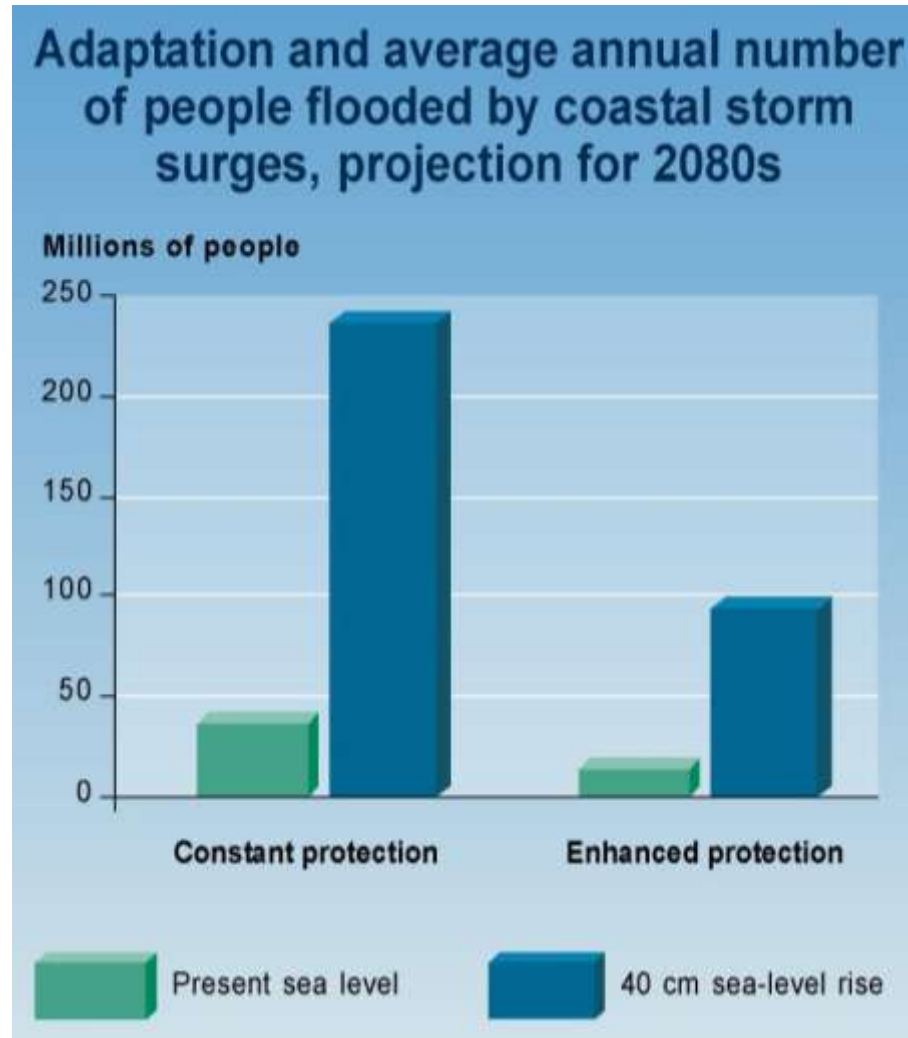
# ...Causing Significant Impacts on Coastal Areas....

## What causes the sea level to change?





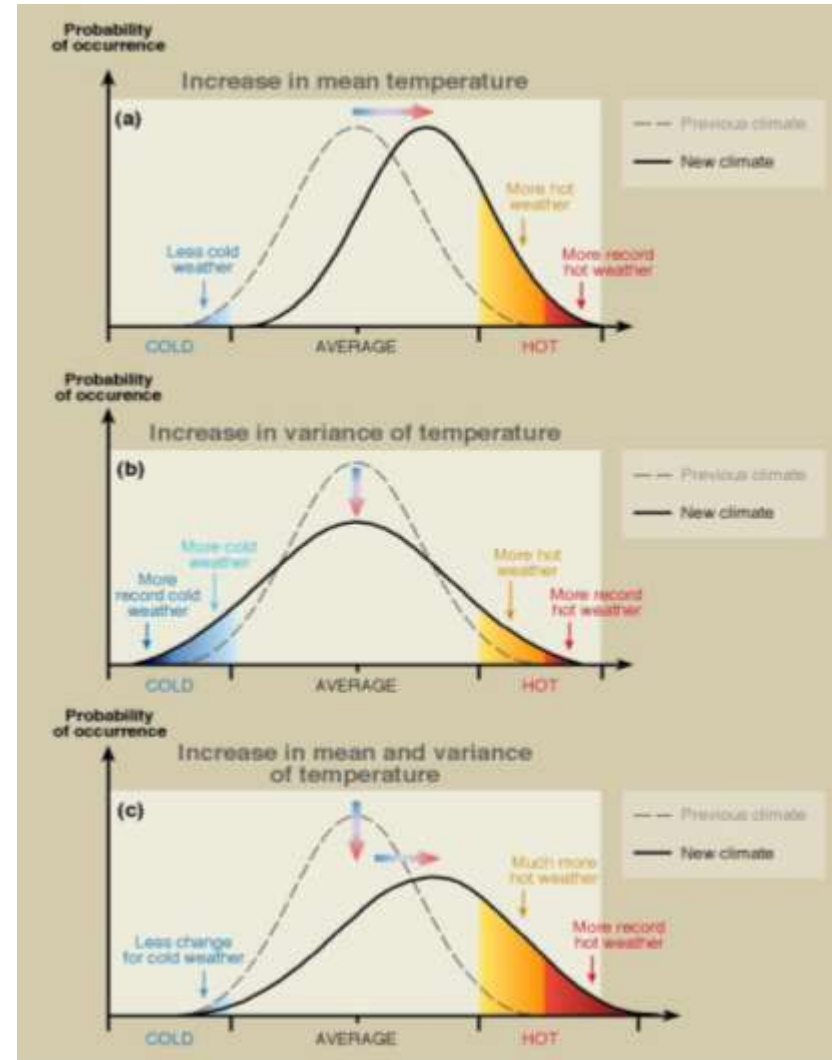
# ...And Whose Affects Can Only be Partially Mitigated!





# And, the Climate Will Continue to Become More Variable

- “Hotter” Hots but the Same “Colds”
- Greater Day-to-Day and Through the Day Temperature Variations
- More Droughts
- More Floods
- More Hurricanes





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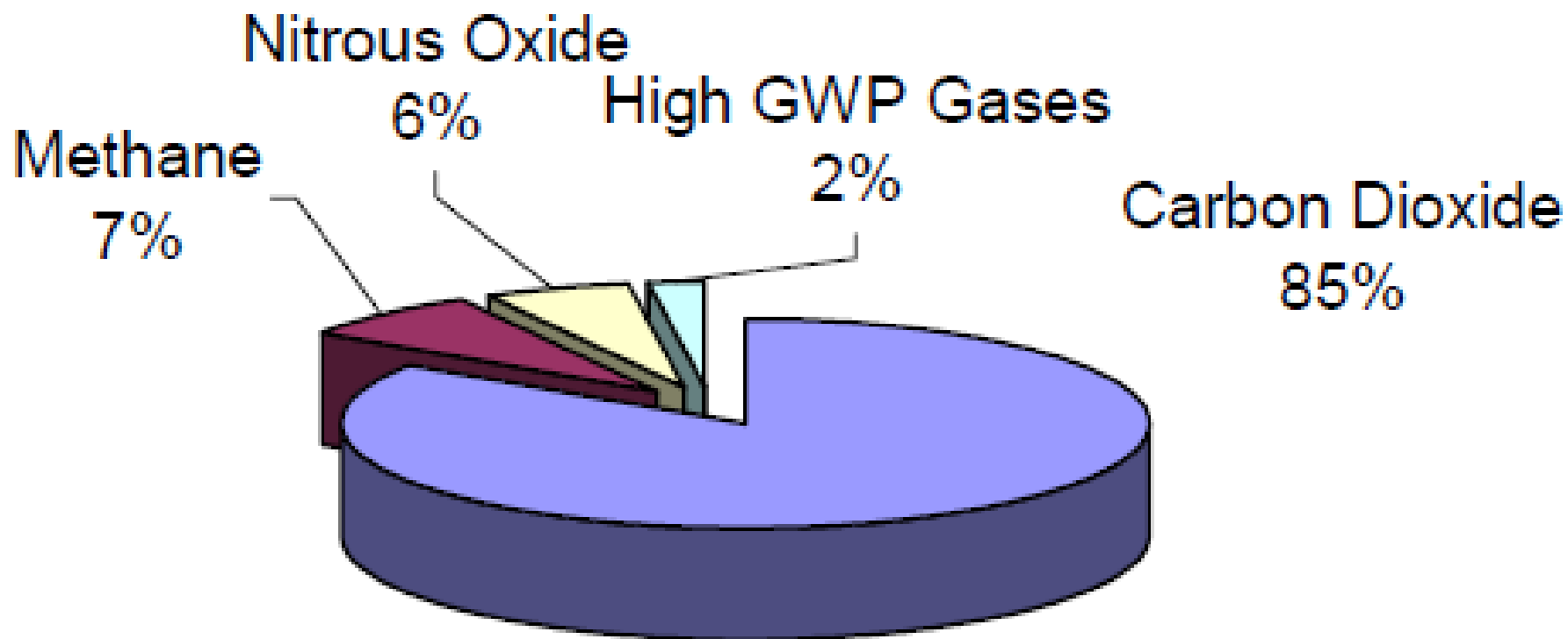
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# How are US GHG Emissions Distributed by Type?

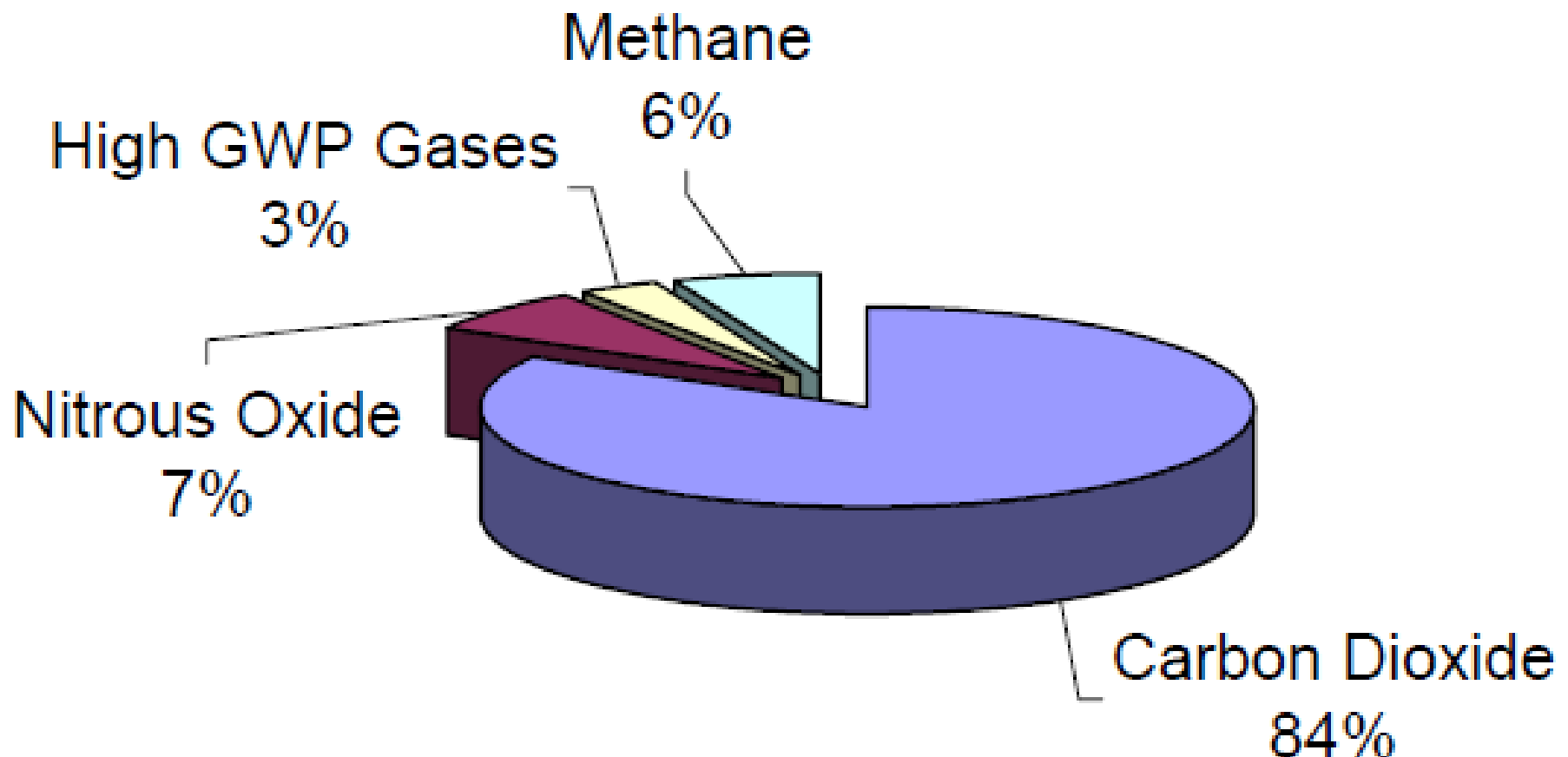
## EPA National GHG Distribution





# How are US GHG Emissions Distributed by Type?

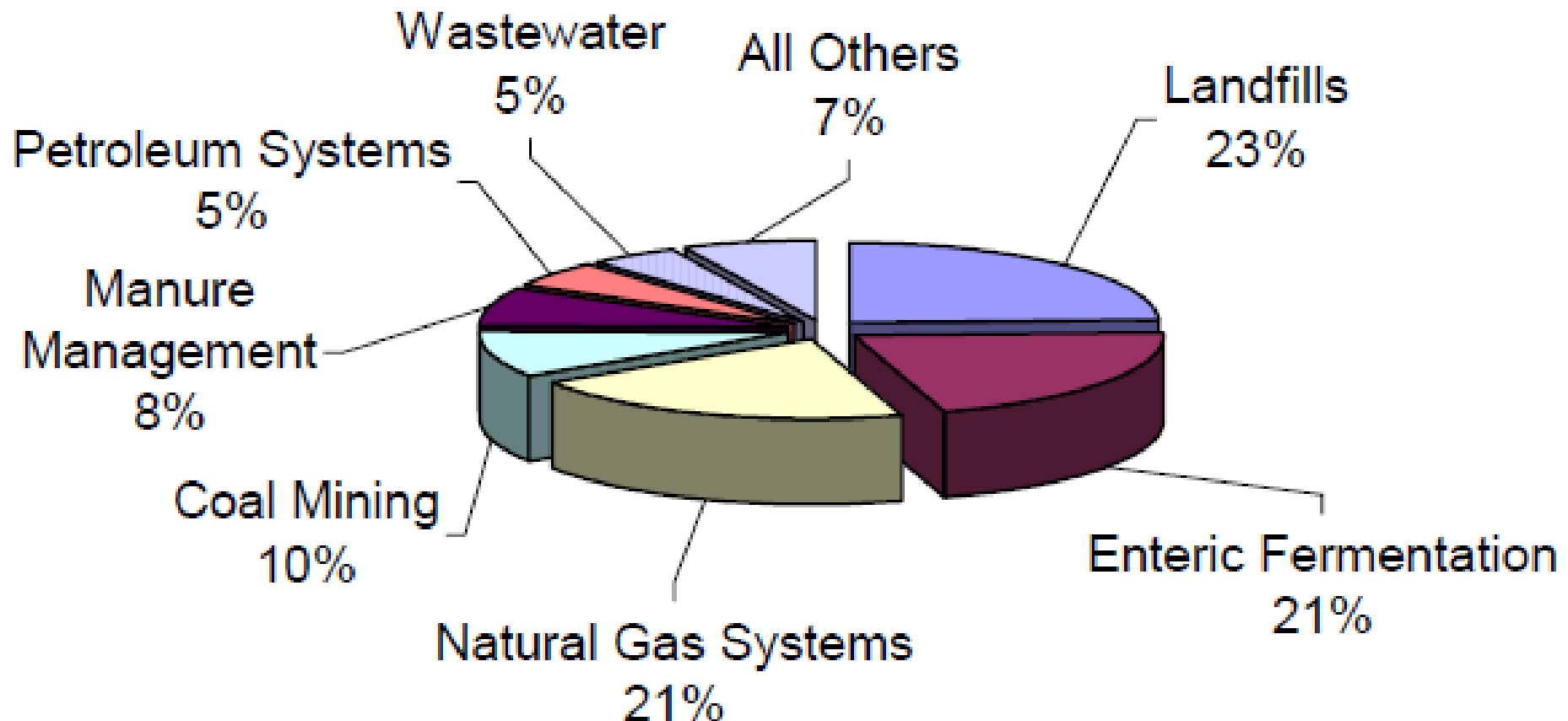
## California GHG Emissions by Compound





# Wastewater Contributes Minor Amount to Methane Emissions

## EPA Distribution of Methane Sources

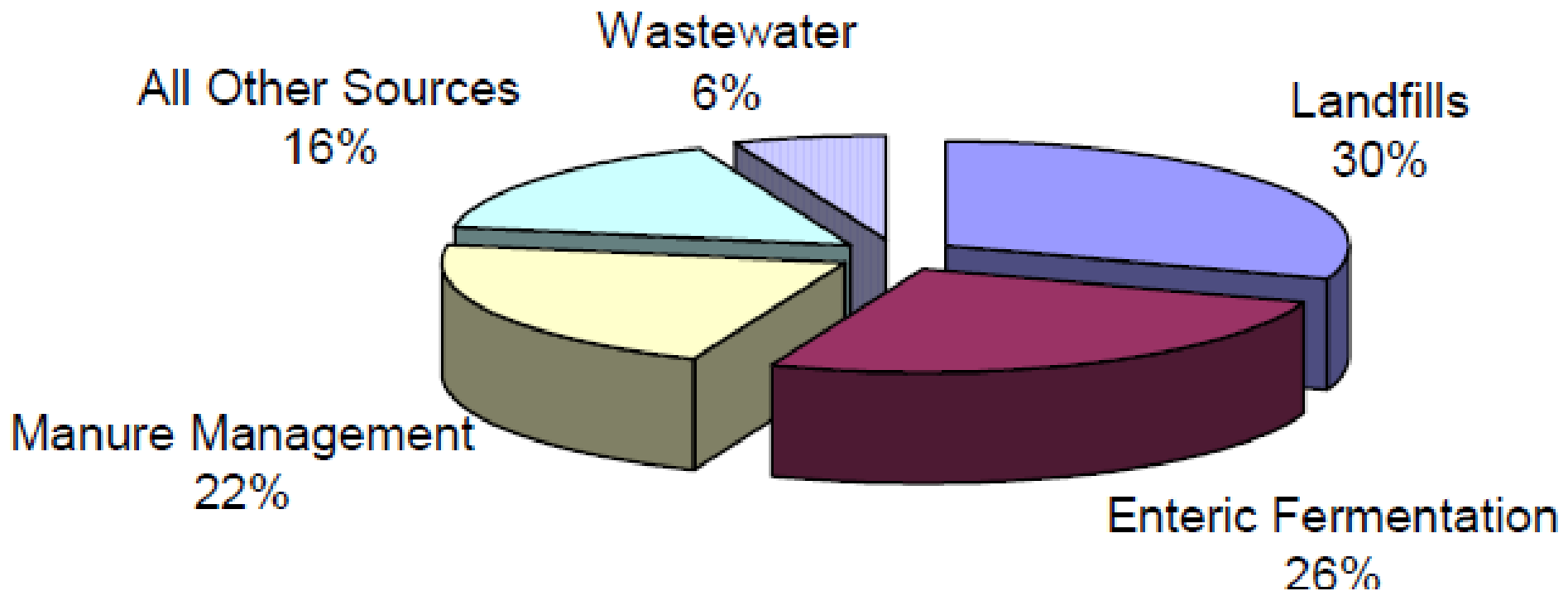






# Wastewater Contributes Minor Amount to Methane Emissions

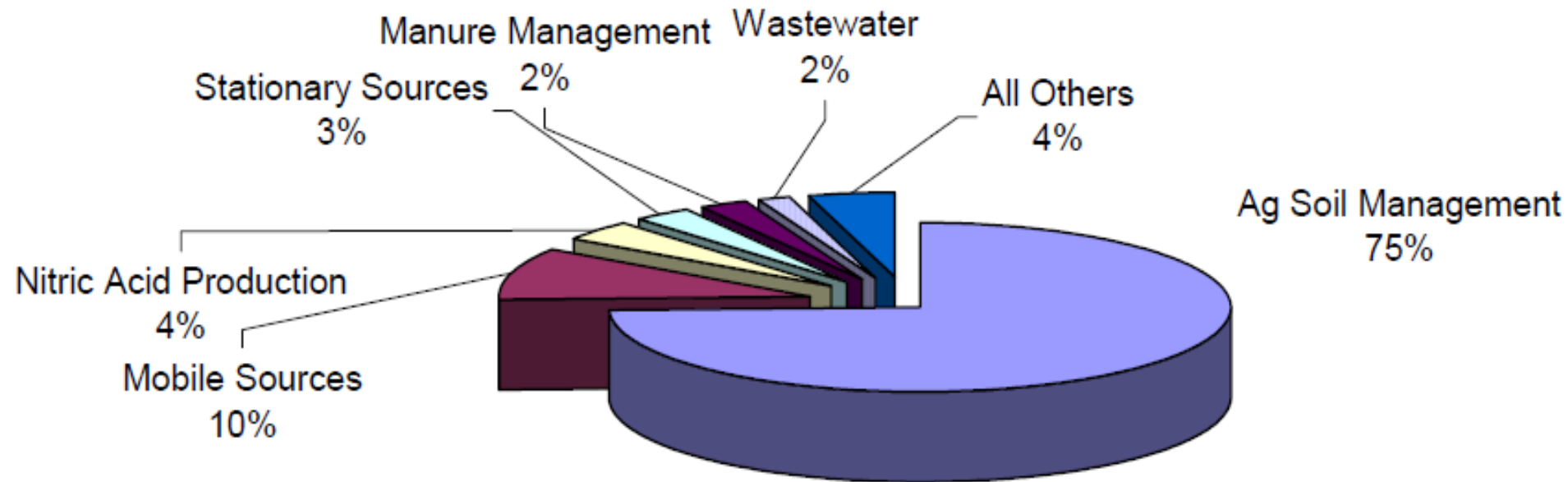
## California Methane Emissions





# Along with Contributions to Nitrous Oxide ( $\text{N}_2\text{O}$ )

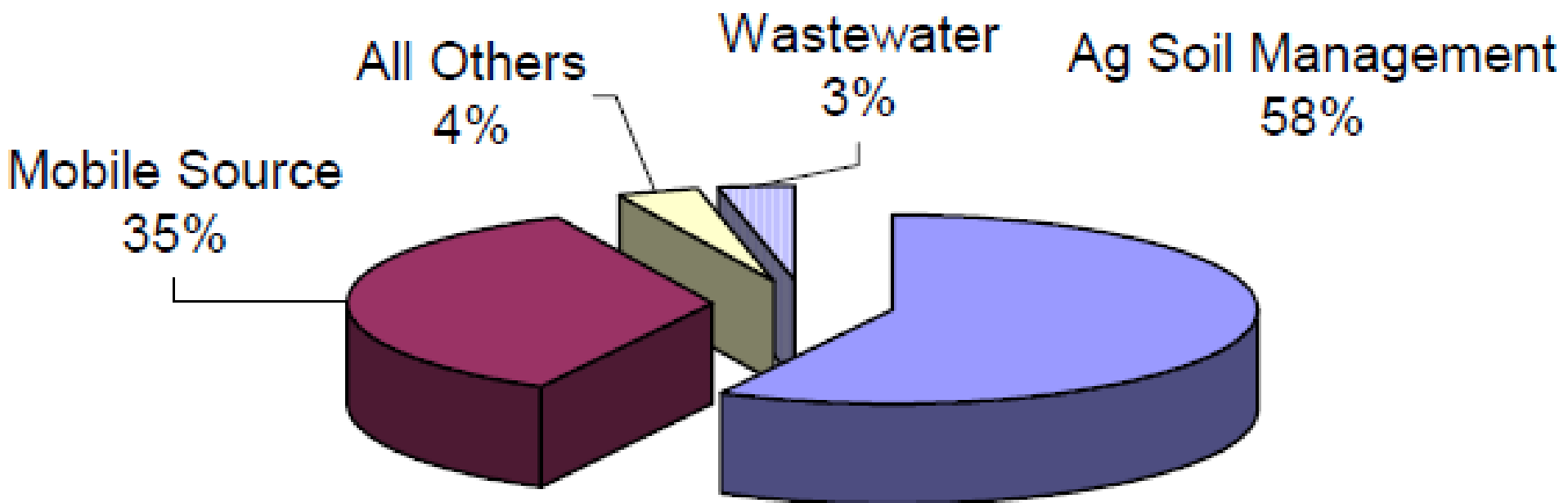
## EPA Distribution of Nitrous Oxide Sources





# Along with Contributions to Nitrous Oxide ( $\text{N}_2\text{O}$ )

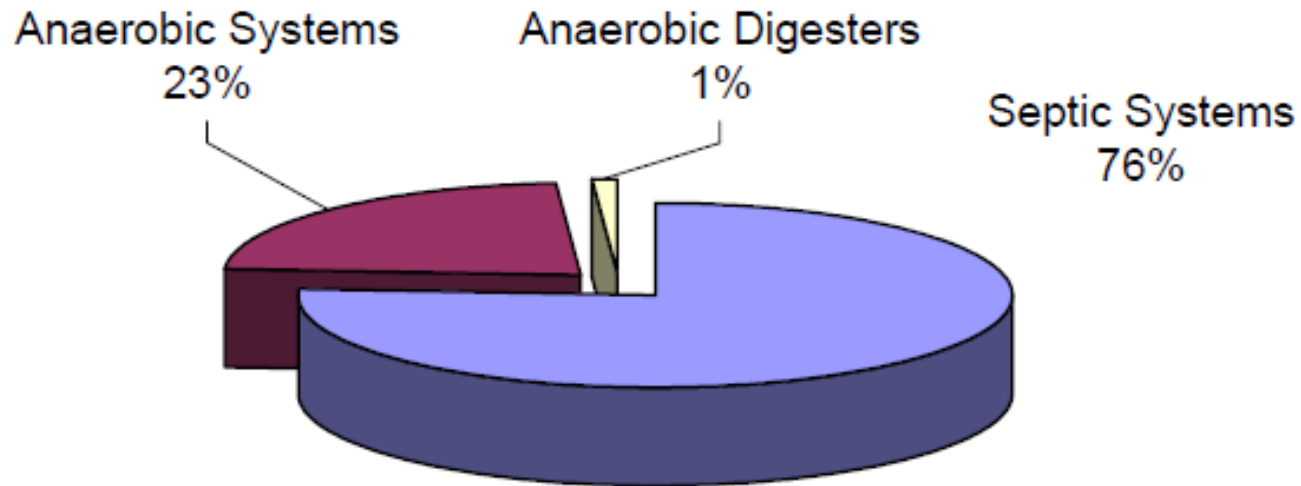
## California Nitrous Oxide Emissions





# Conventional WWTP's are Minor Methane Contribution From Wastewater Sector

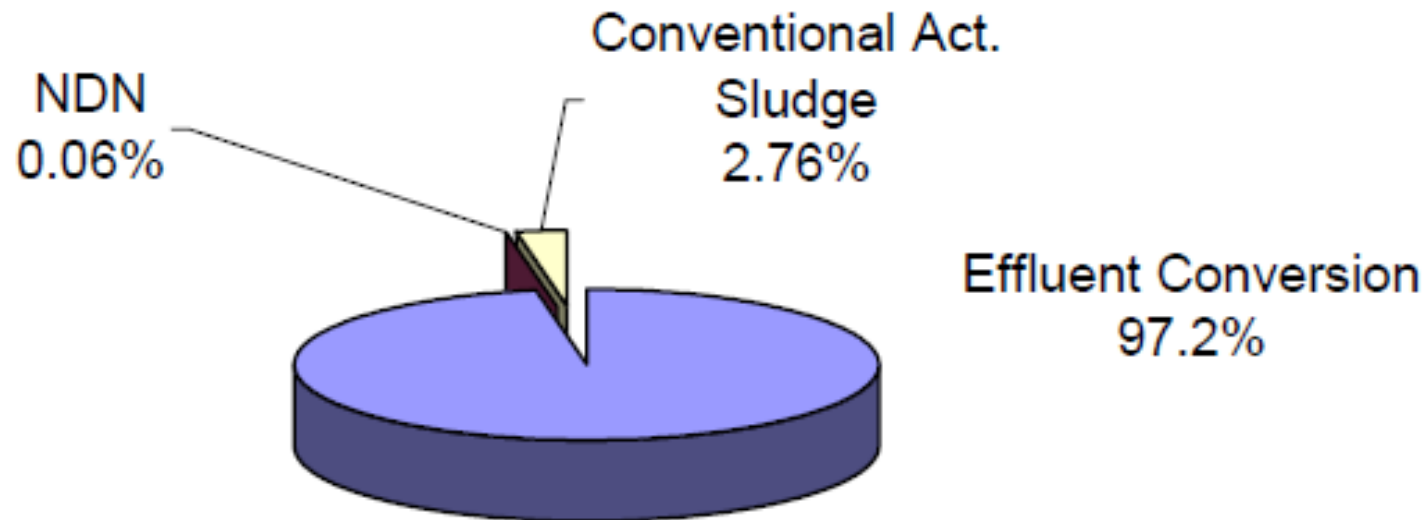
## EPA Inventory Methane Contribution by Wastewater Sector





# Effluent Conversion is Principal $\text{N}_2\text{O}$ Contribution From Wastewater Sector

## EPA Inventory Nitrous Oxide Contribution by Wastewater Sector

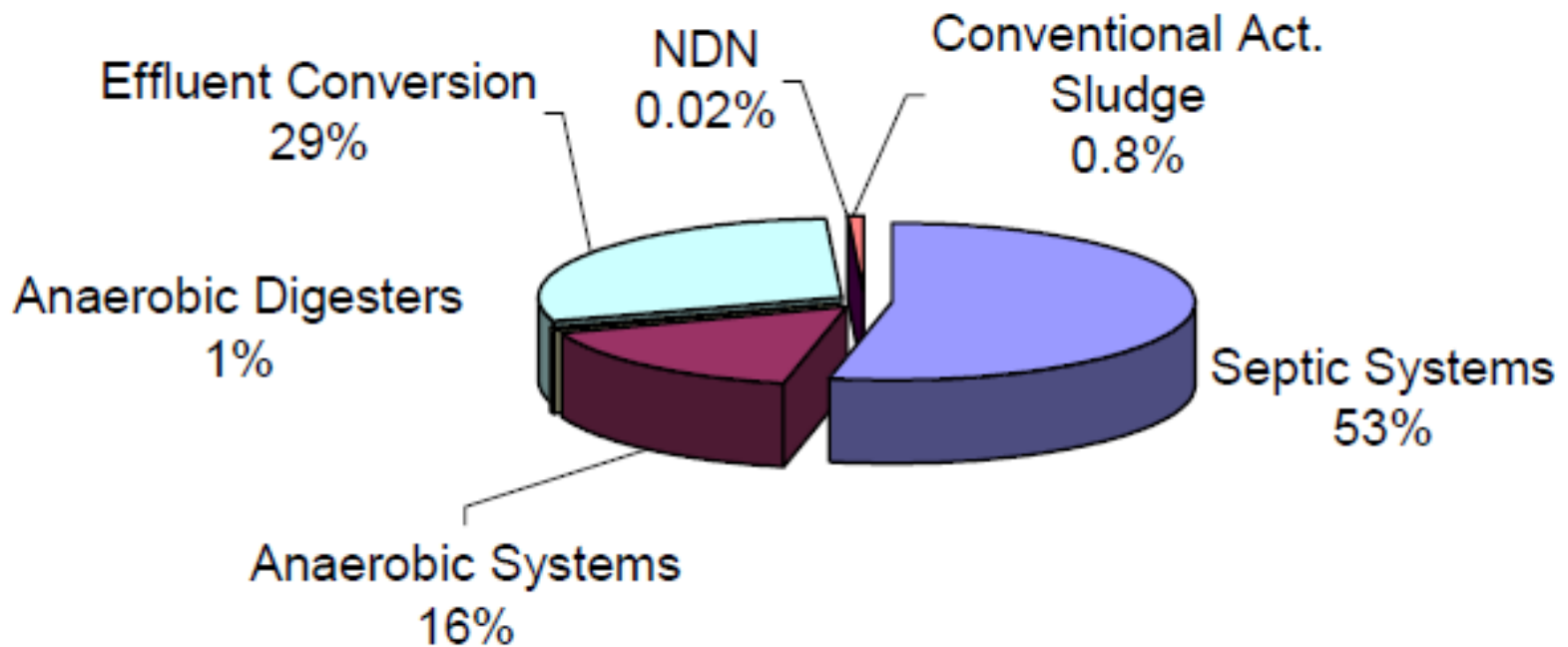






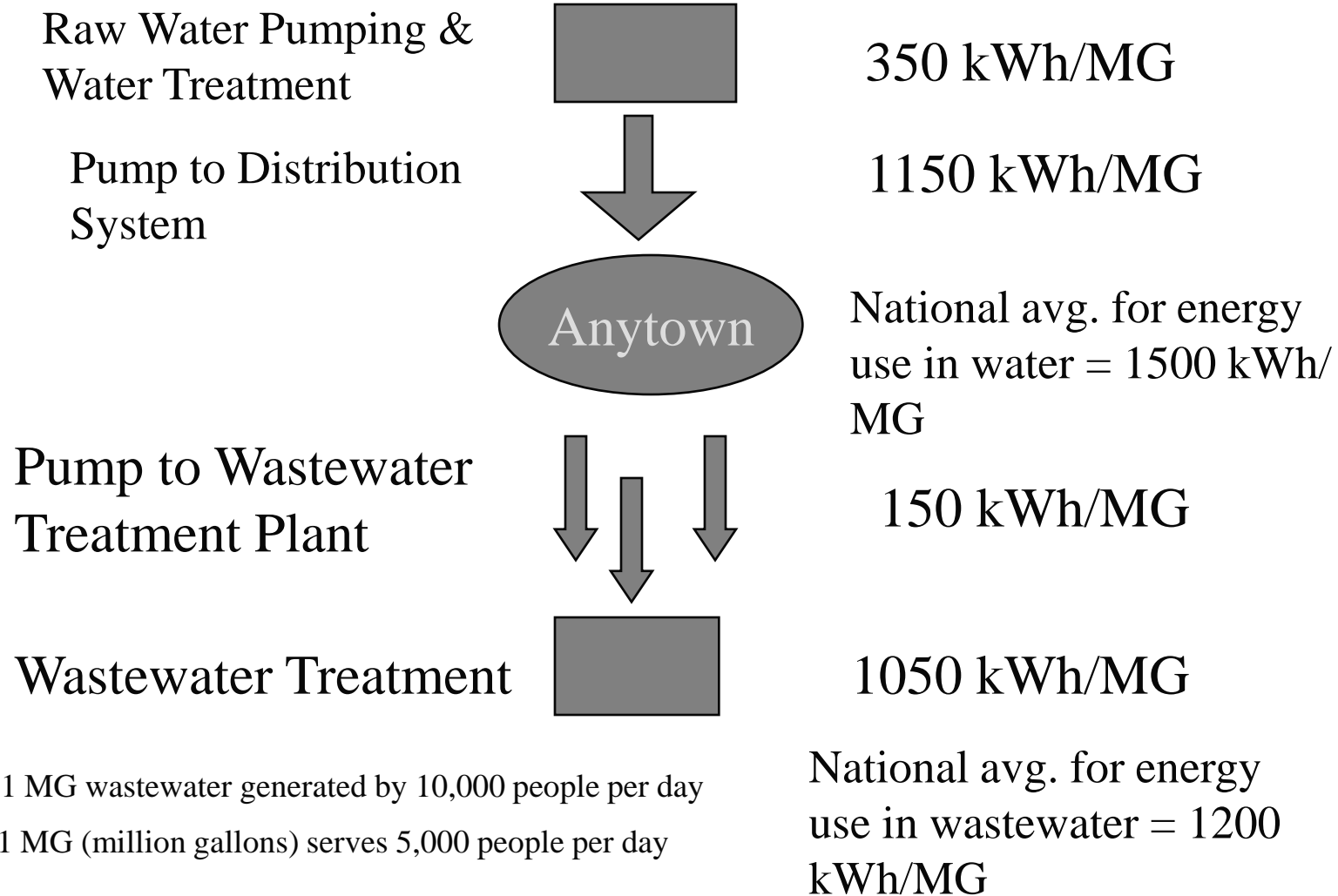
# In Total Conventional WWTP's Contribute <30 % of Total Wastewater Contribution

## EPA Distribution of Wastewater Sources by Global Warming Potential



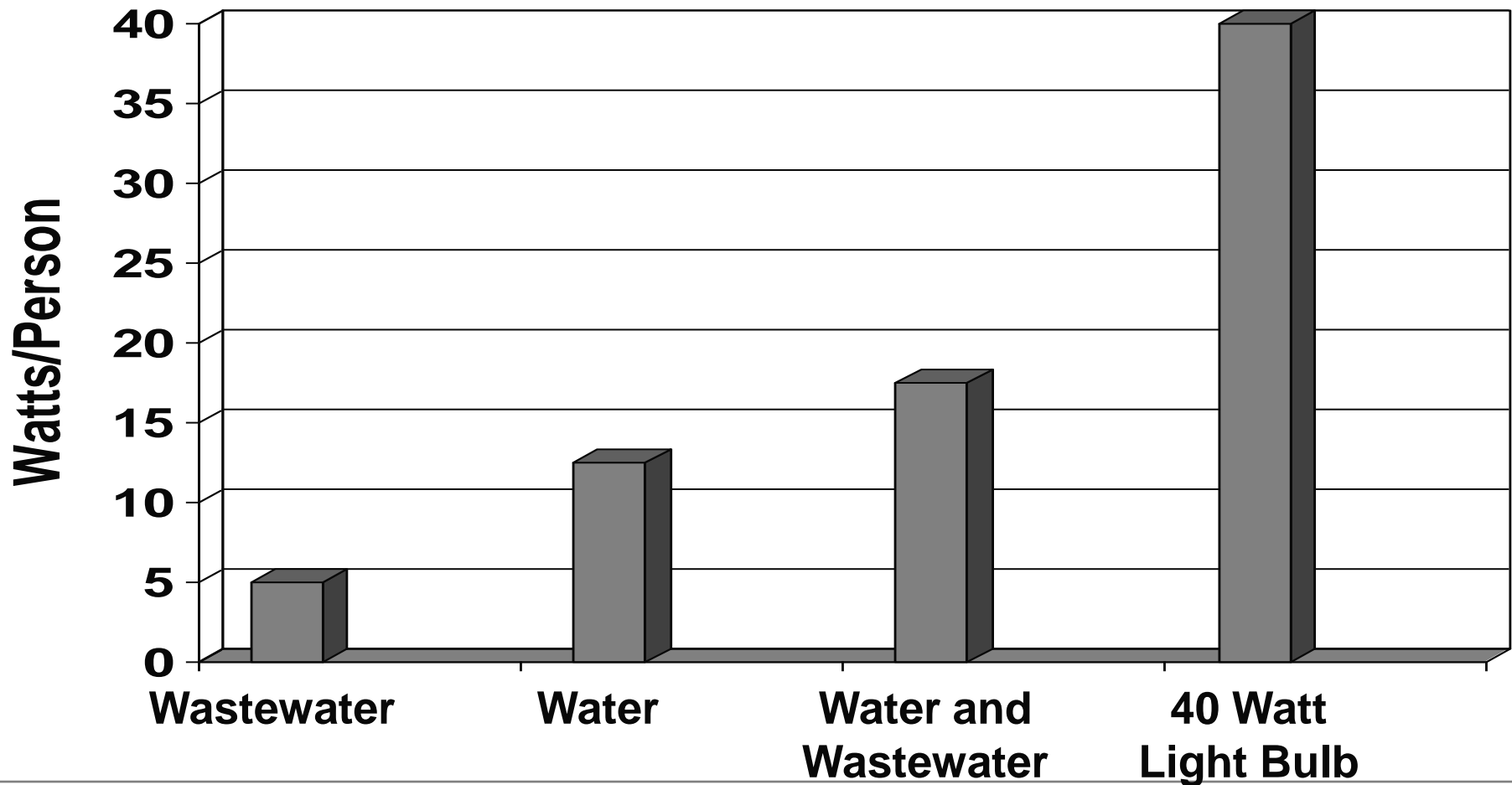


# Electric Use within Water/Wastewater Industry



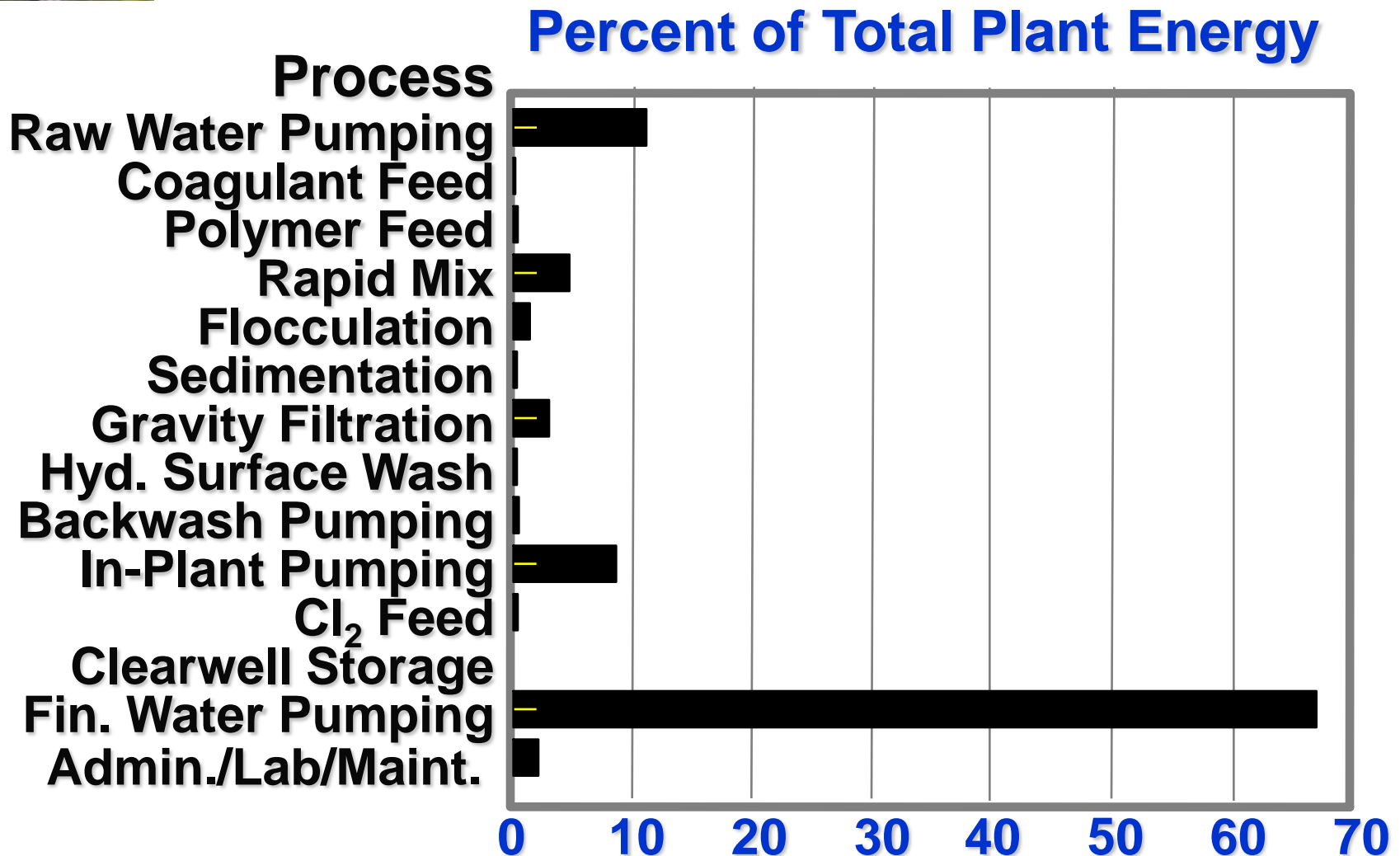


## Let's Put These Numbers Into Perspective!



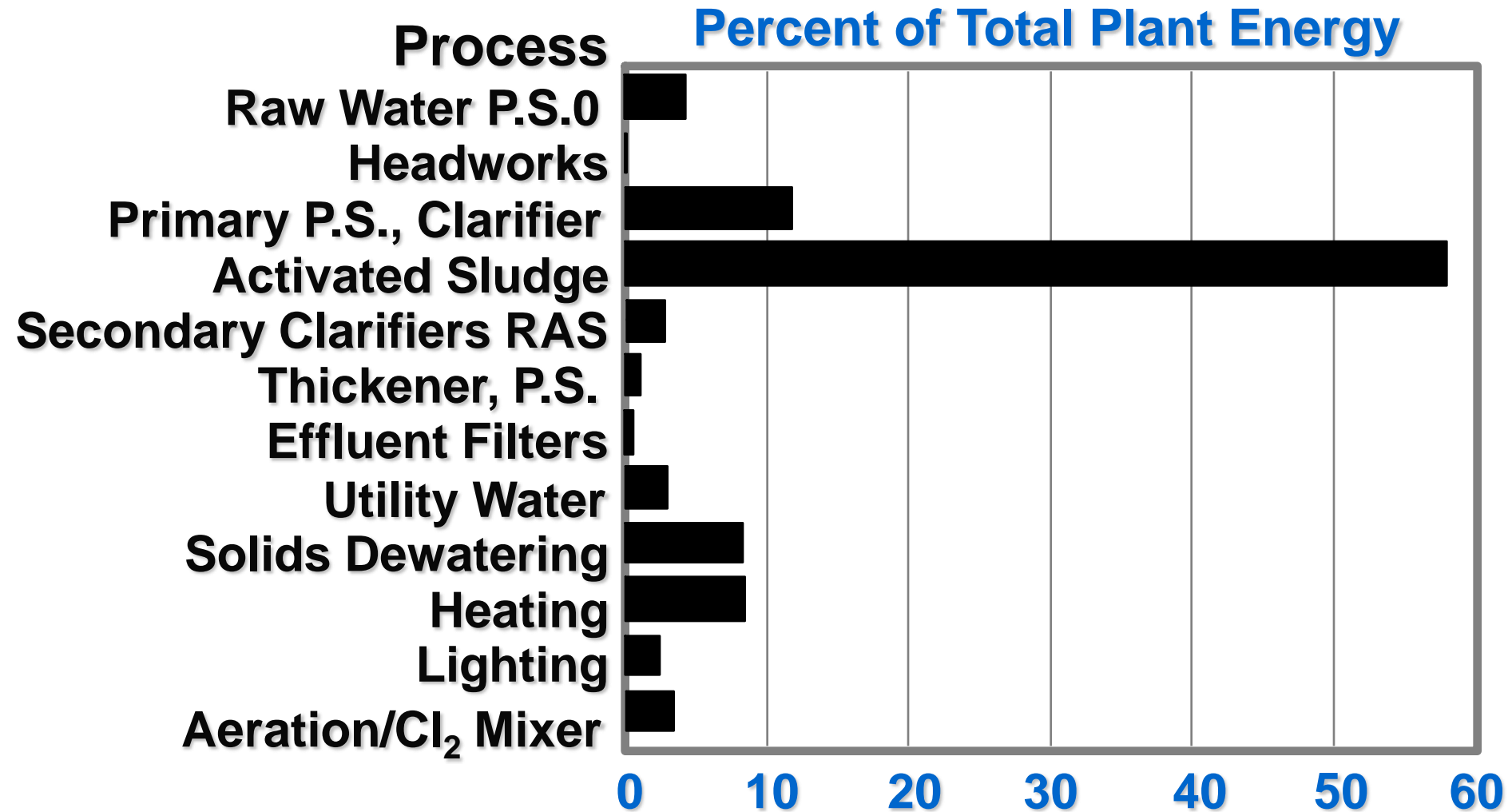


## Relative Distribution in Water Treatment (10 MGD example)





# Relative Distribution of Plant Power -- 7.5 MGD WWTP



Source: Keith Carns/Global Energy Partners





# GHG Regulations and Carbon Trading Offers Threats and Opportunities

## ■ Threats

- Rising energy prices
- Rising commodity prices
- Rising material prices
- More wet weather flow (increased storms)
- More severe storms (Hurricanes, Tornados)
- Lower stream flows (increased droughts), leading to more stringent discharge standards
- Rising sea level (coastal communities)

## ■ Opportunities

- Renewable energy pricing
- Carbon trading
  - Renewable energy
  - Phasing out septic tanks
  - Phasing out lagoons
- Increased demand for reclaimed water



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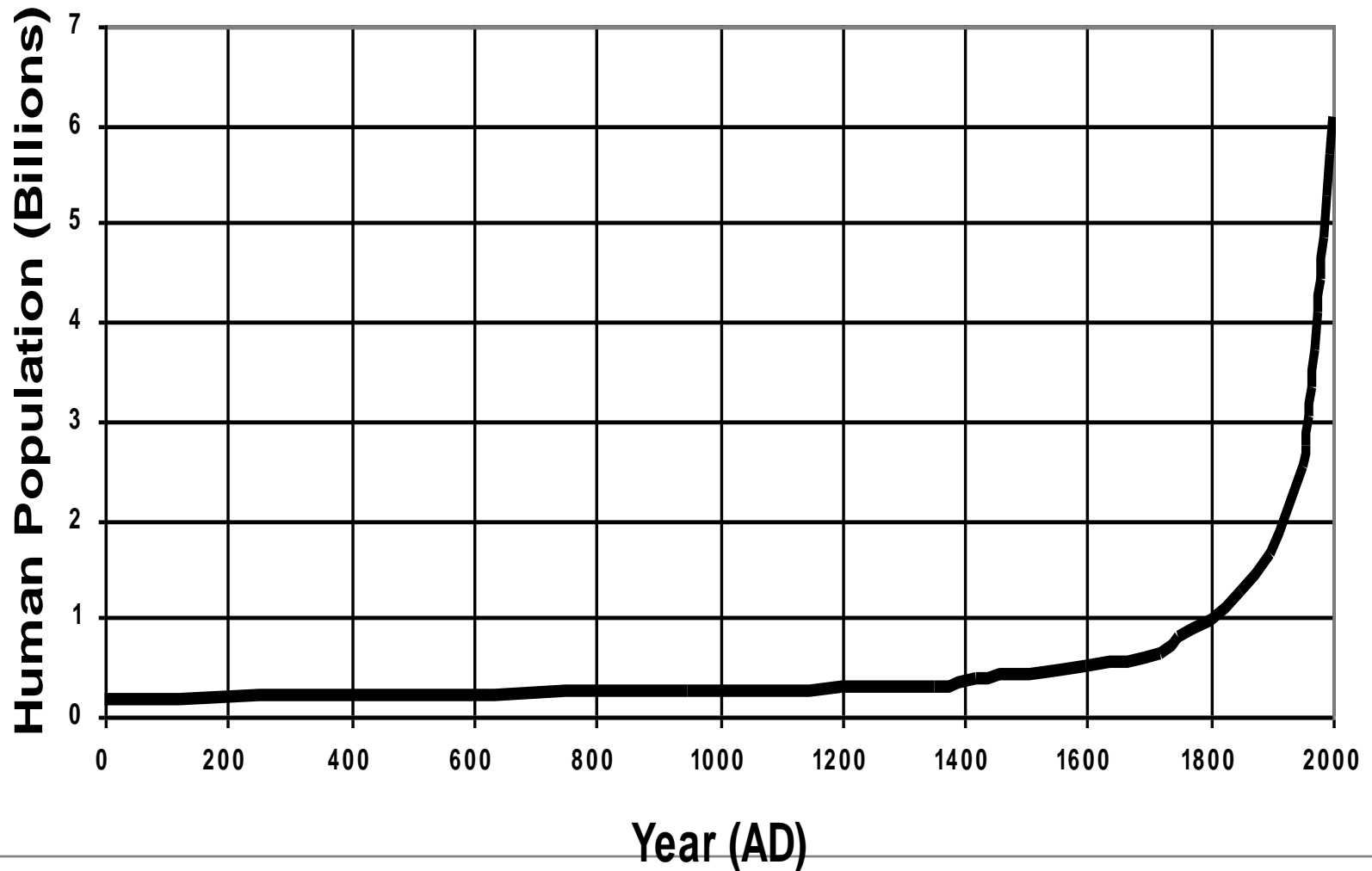


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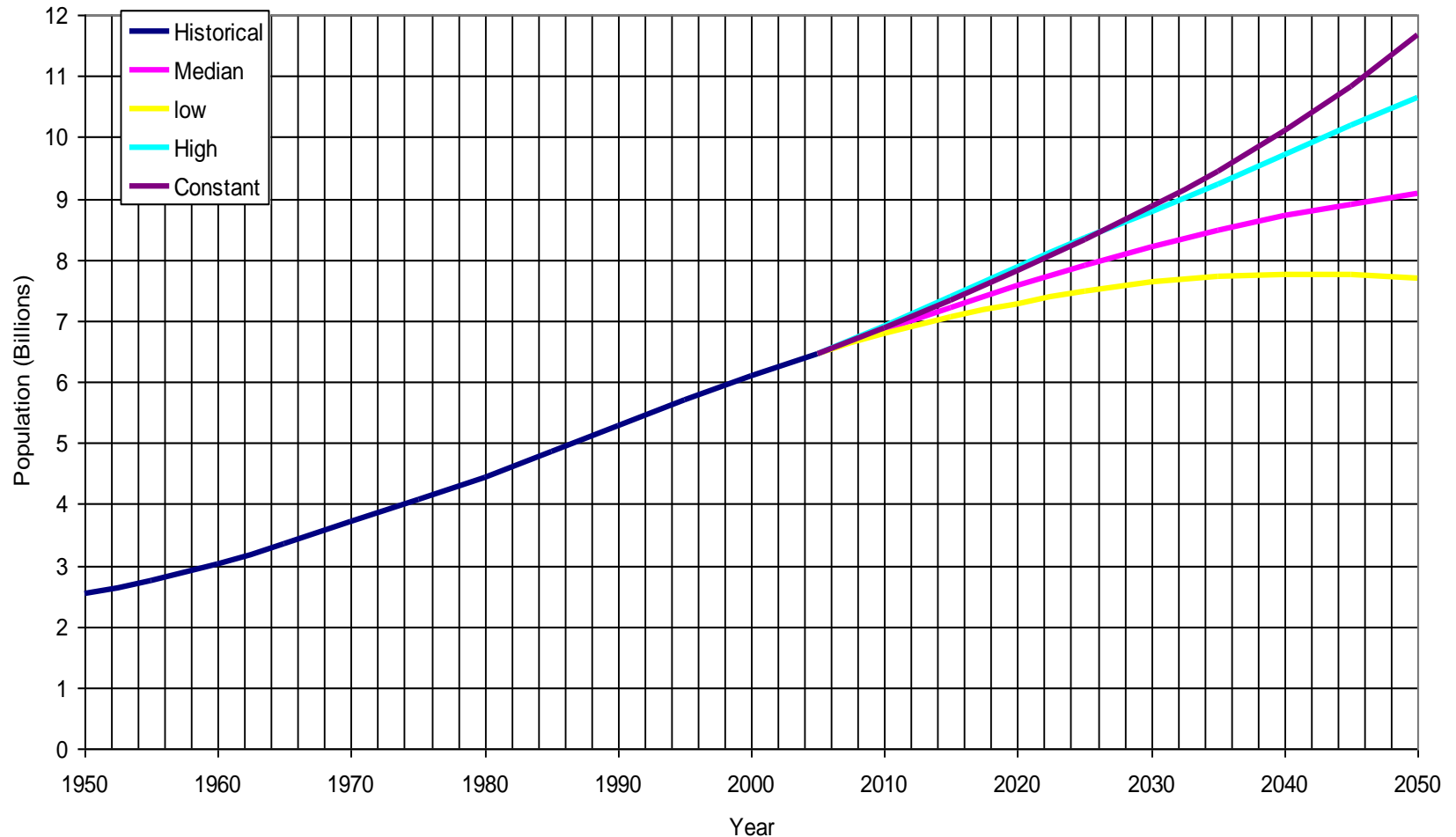


# World Population Has Increased Exponentially in Recent Years





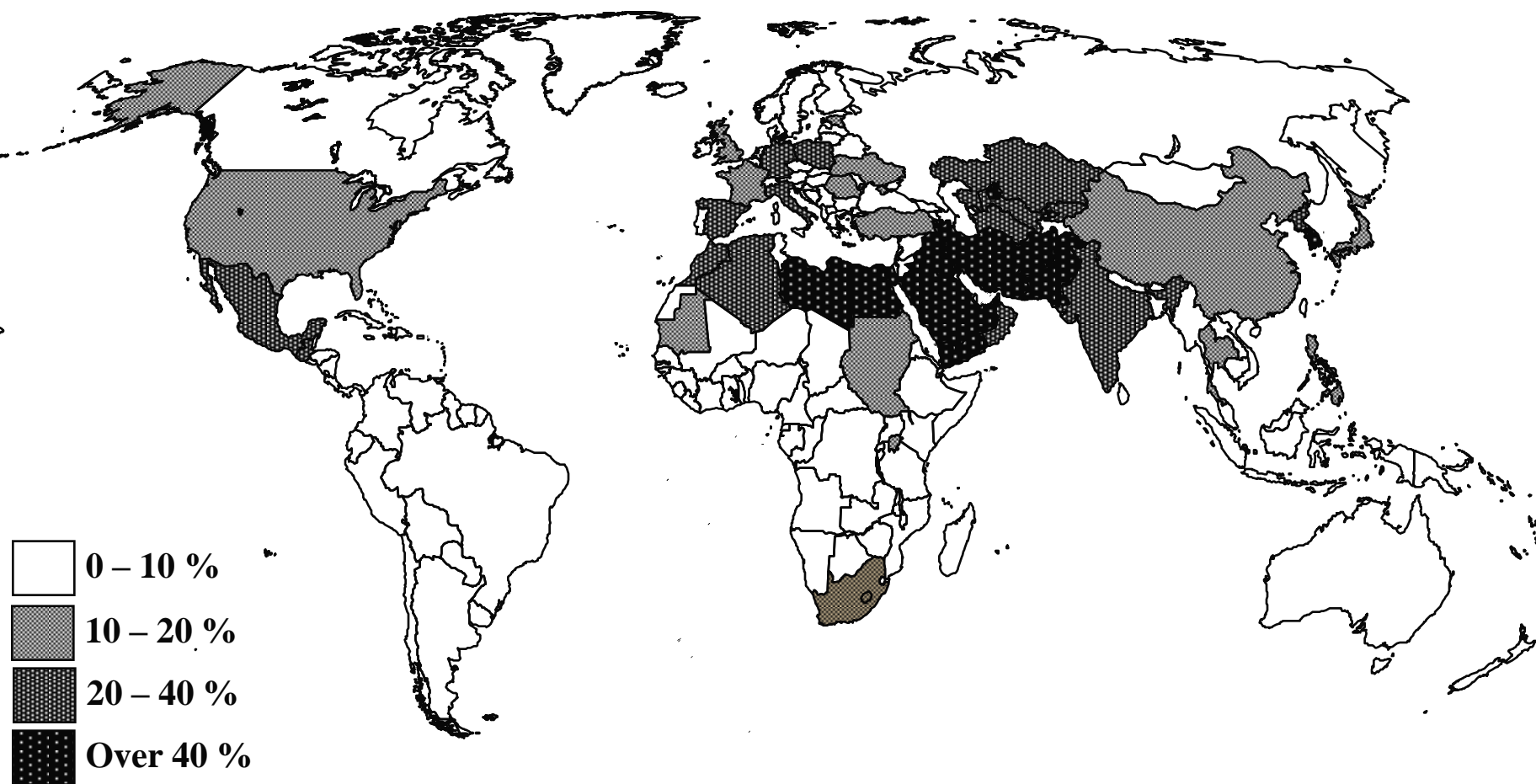
# Population Growth is Expected Through 2050, and Perhaps Beyond





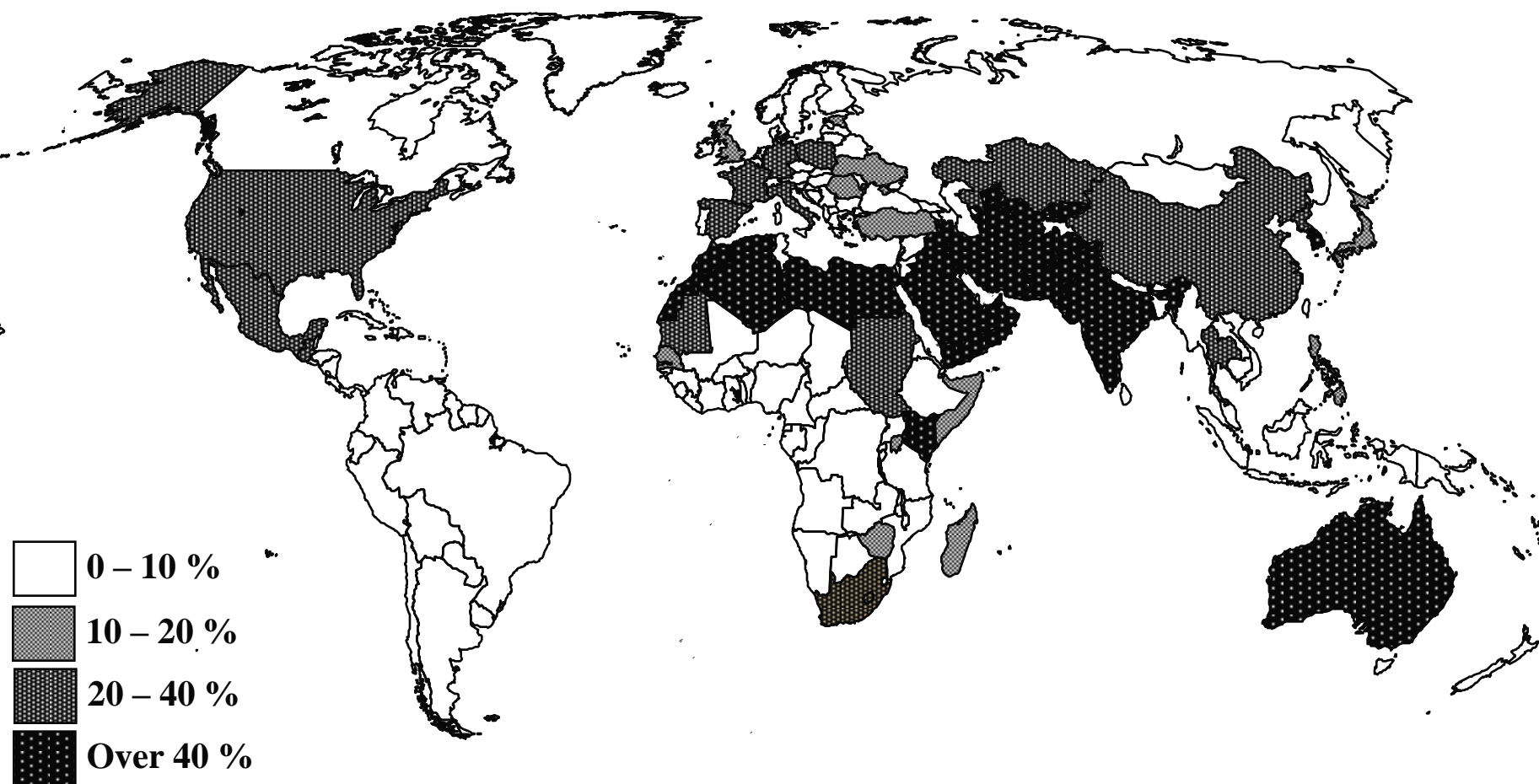


# Water Stress is Increasing Around the Planet - 1995

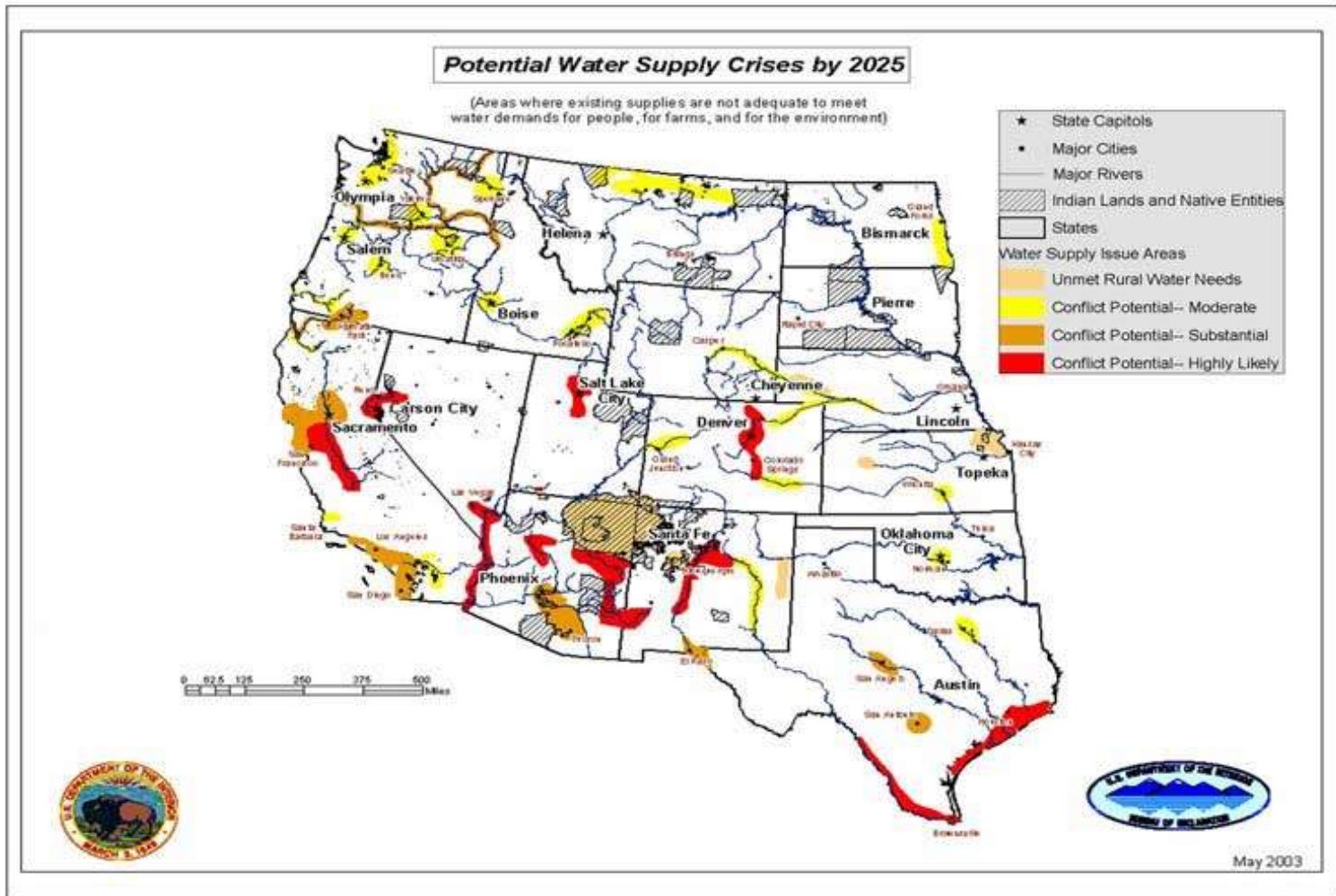




# Water Stress is Increasing Around the Planet - 2025

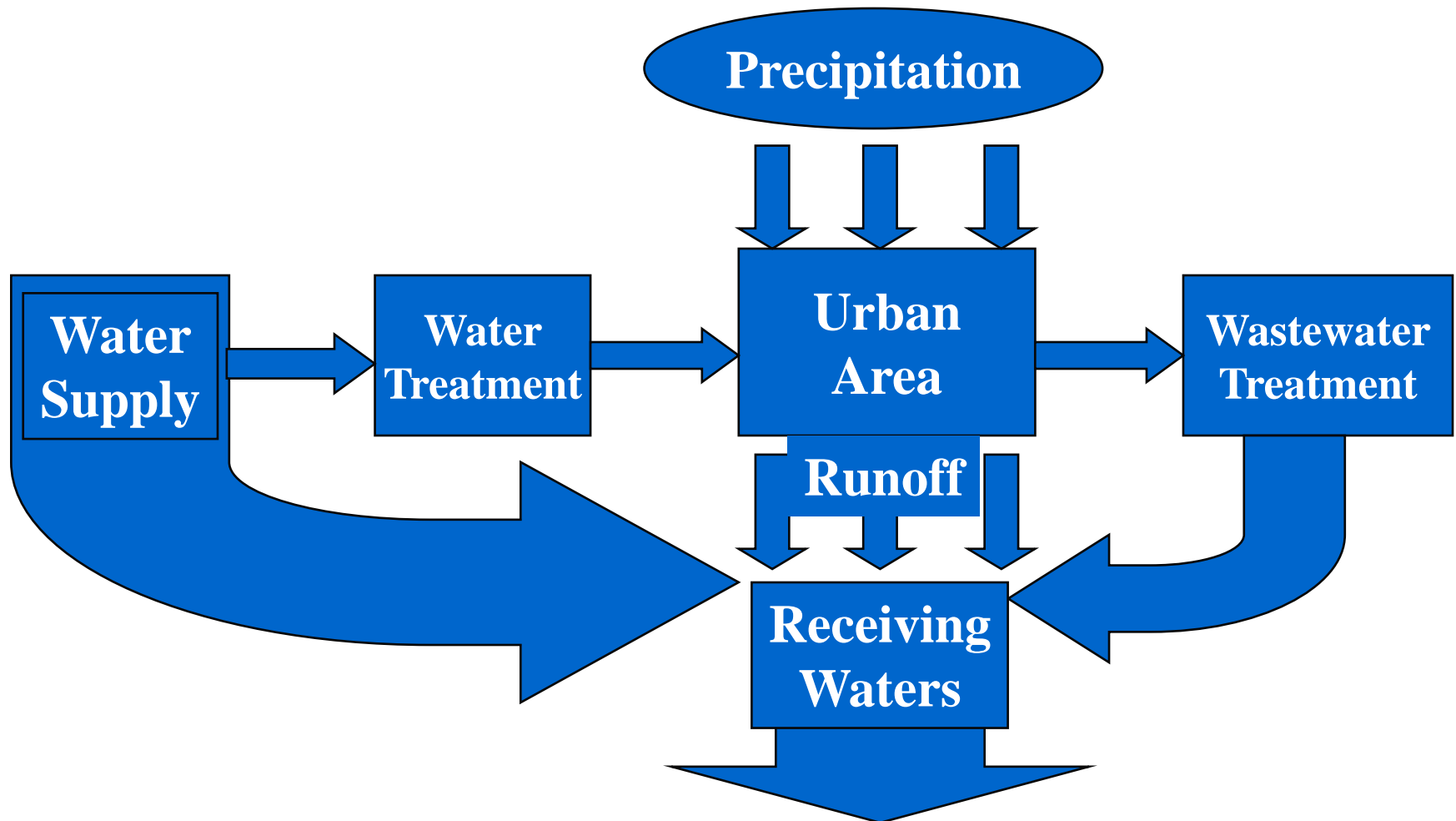


# Significant Water Stress Exists in the US as Well



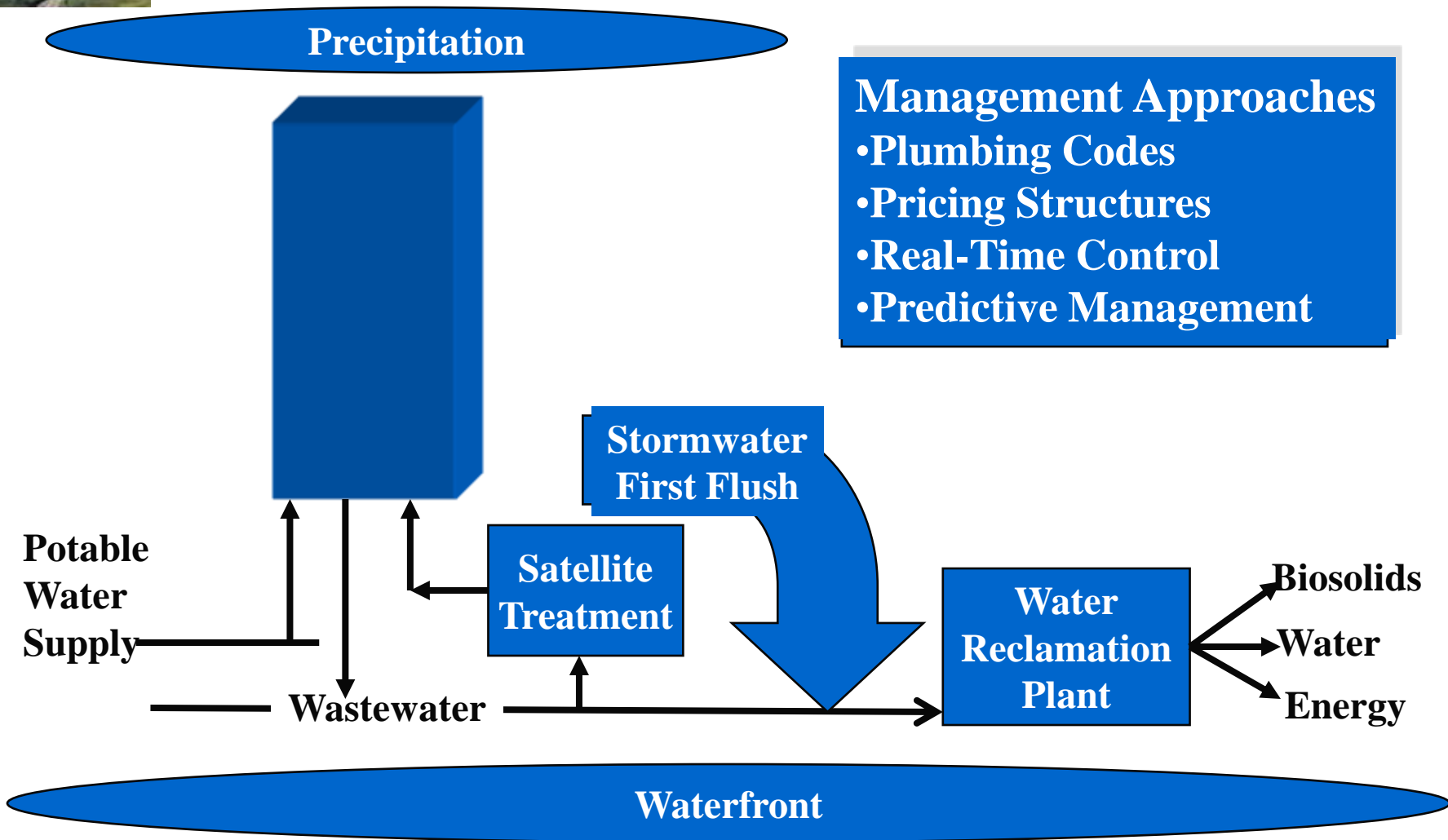


# Urban Water Management is Historically a “One Use” Approach





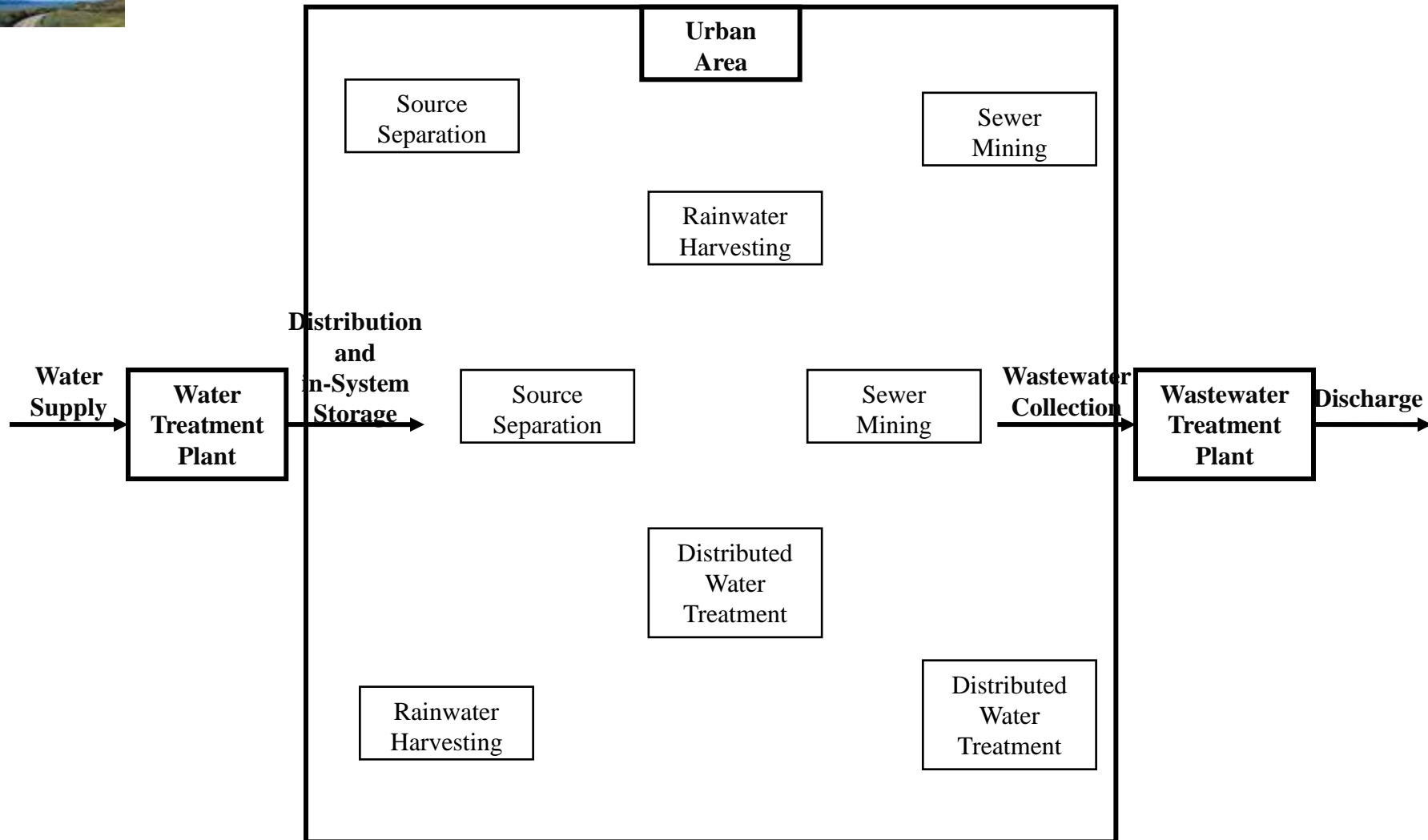
# In the Future We Must Focus on Multiple Use Systems







# Hybrid Concepts Can Be Applied with Surface Water





# Here are Some Proactive Steps Utilities Can Take to Prepare:

- Participate in National and State-Wide Activities to Achieve Reasonable and Realistic GHG and Carbon Trading Regulations and Systems
- Assess Energy Conservation and Renewable Energy Production Opportunities:
  - Funding Opportunity
  - Reduce Reliance on Increasingly Unreliable Fossil Fuel Energy Sources
- Assess Use of All Commodities and Investigate Alternatives
- Assess Impacts of Climate Change on Operations and Develop Mitigation Plans
- Engage with Local and Regional Partners to Develop and Implement More Sustainable Water Management Practices



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