

# CAT Cement Sub-Group GHG Reduction Strategies

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CAT Cement Sub-Group Leader



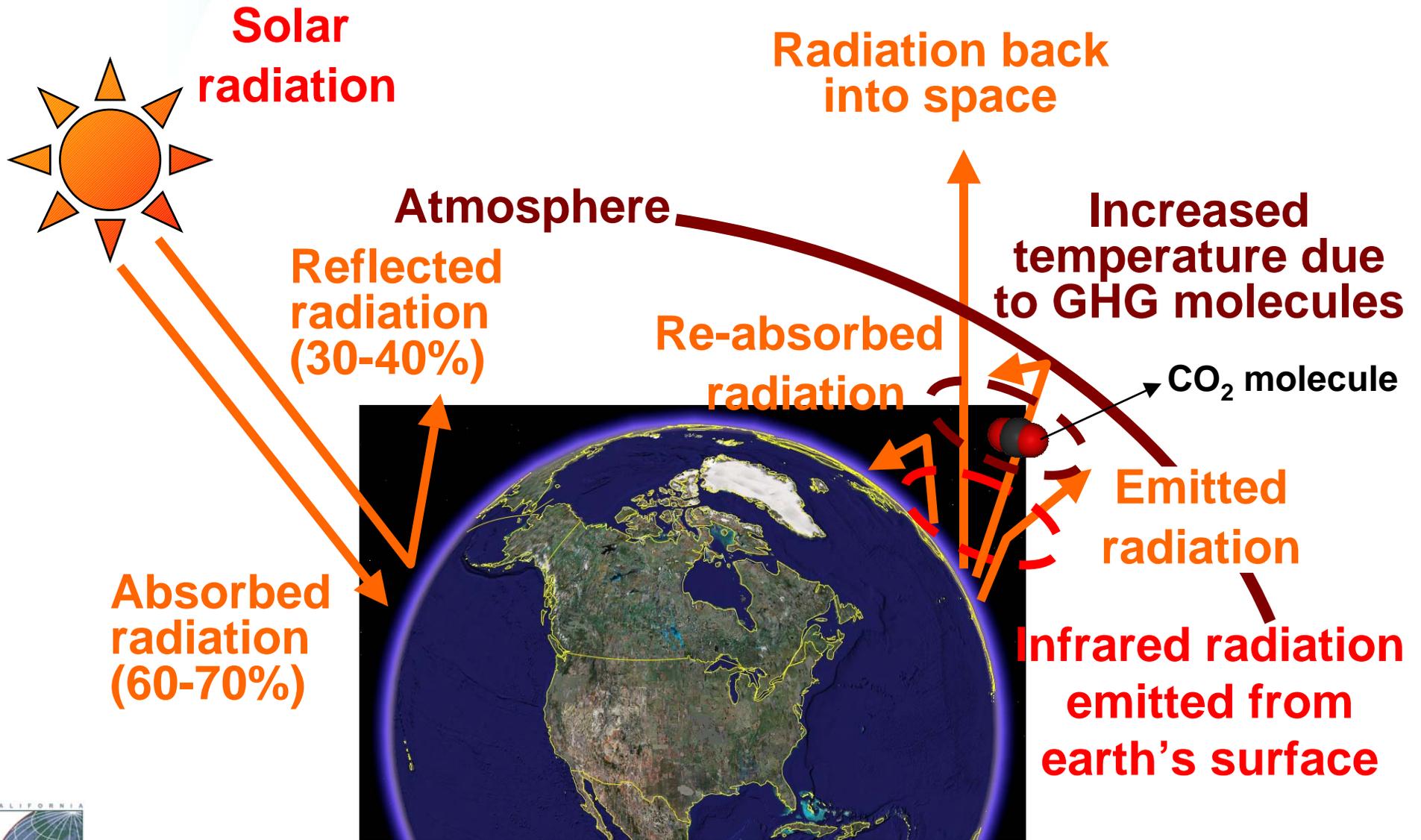
Cement Sub-Group

# What causes climate change?

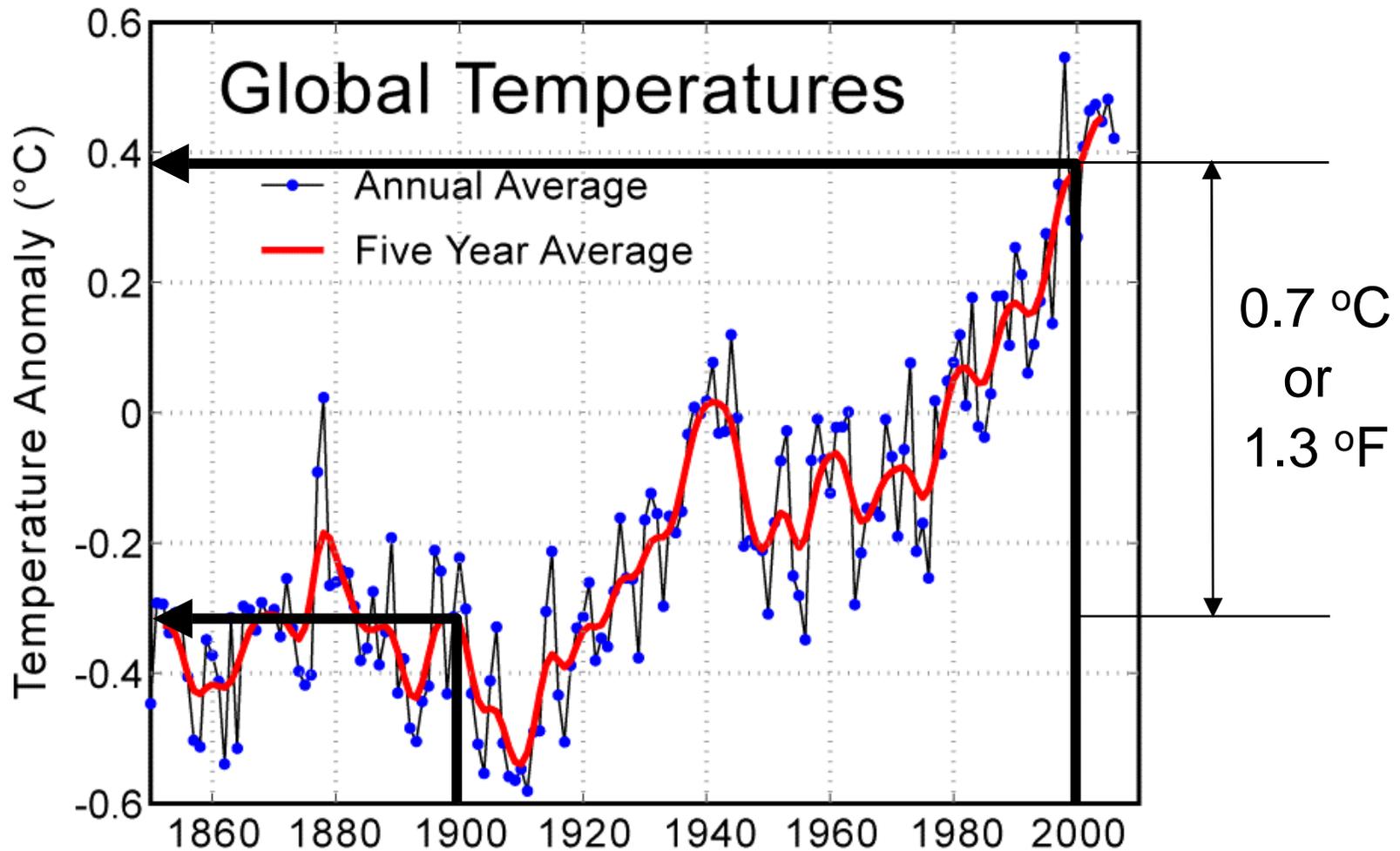
- Increase in Earth's **temperature** due to **greenhouse gas (GHG)** effect.



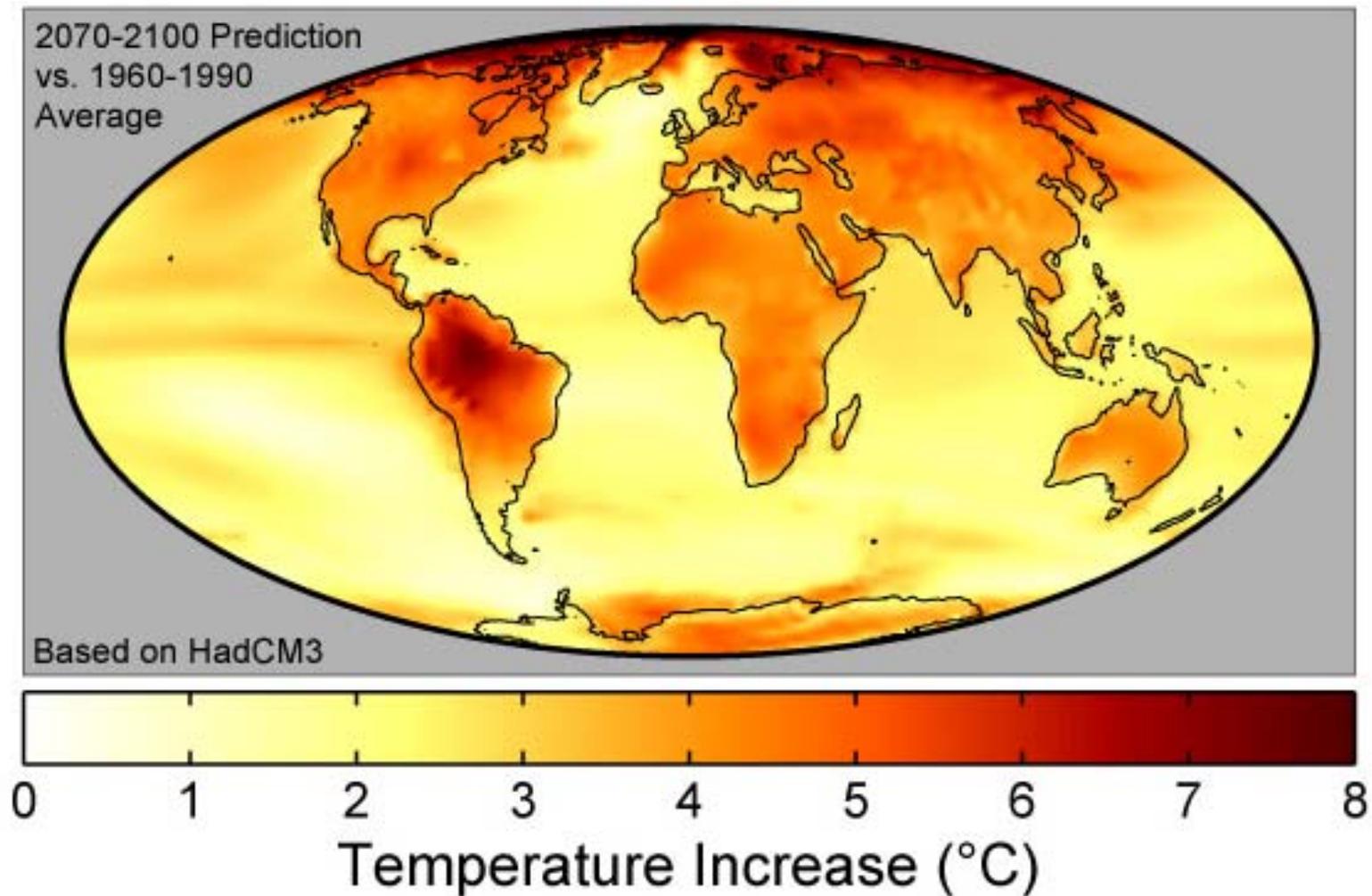
# What is the GHG effect?



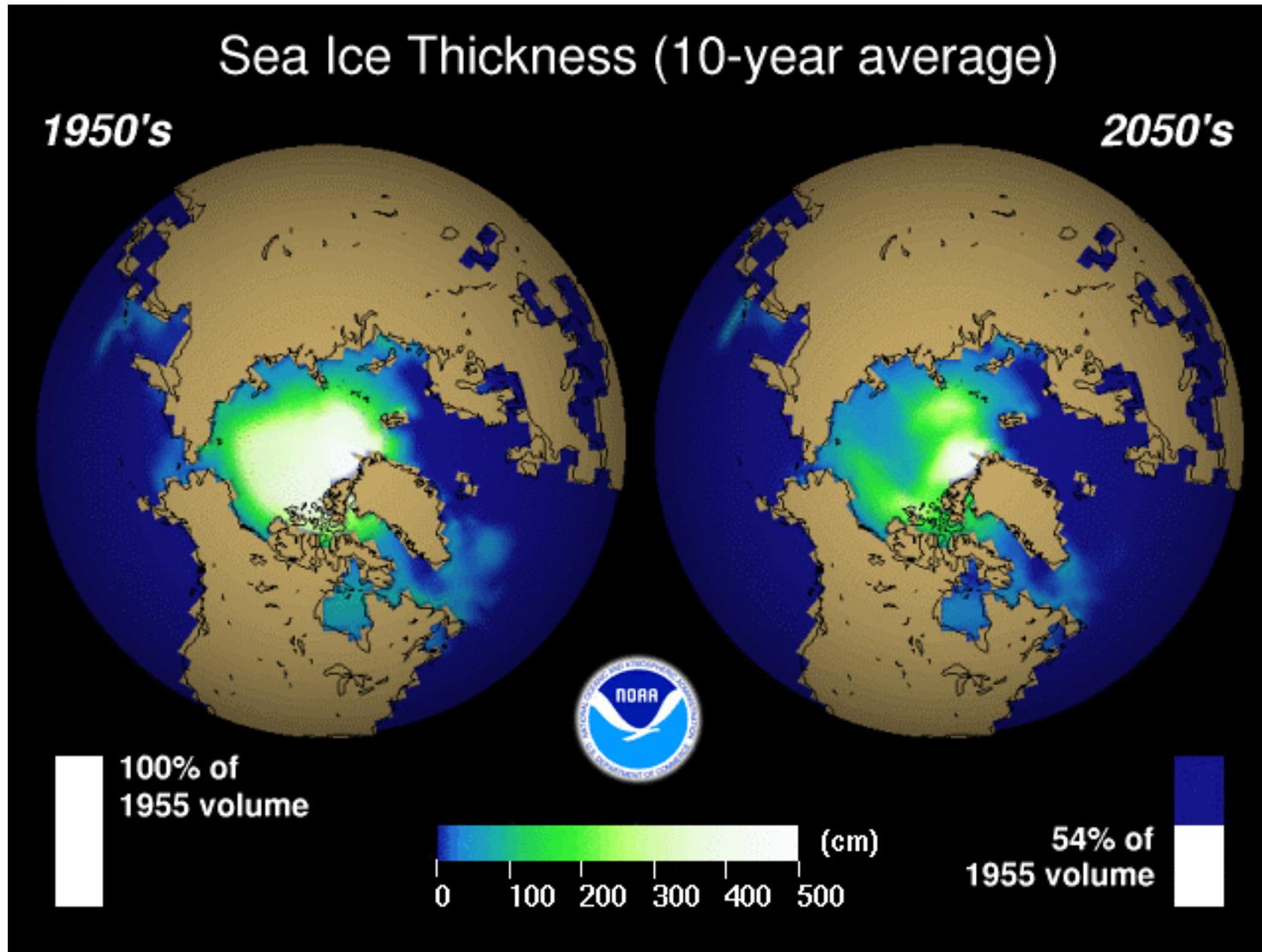
# How much has the global temperature increased in the last century?



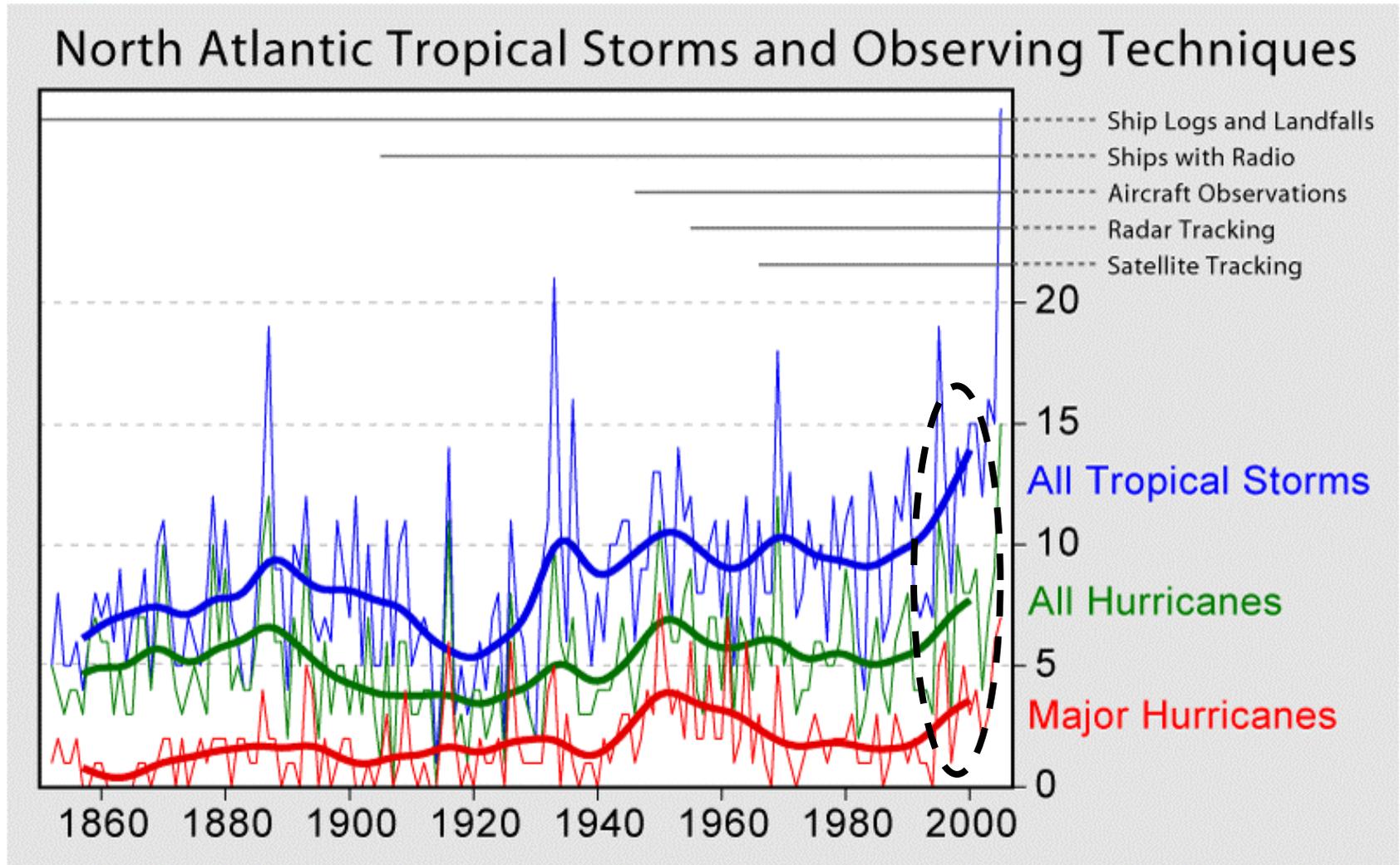
# What is the estimated global temperature increase in the next century?



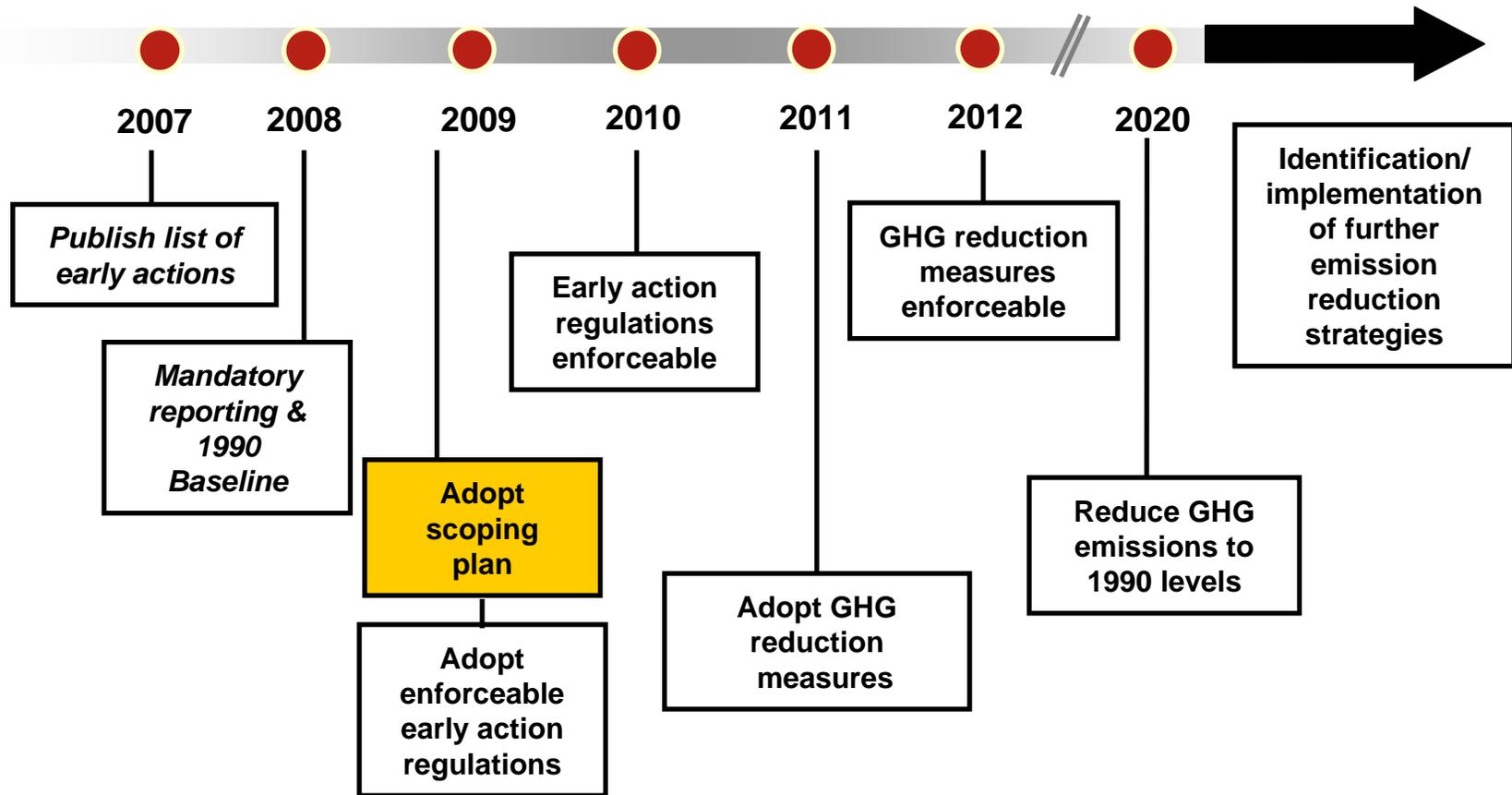
# Examples of climate change



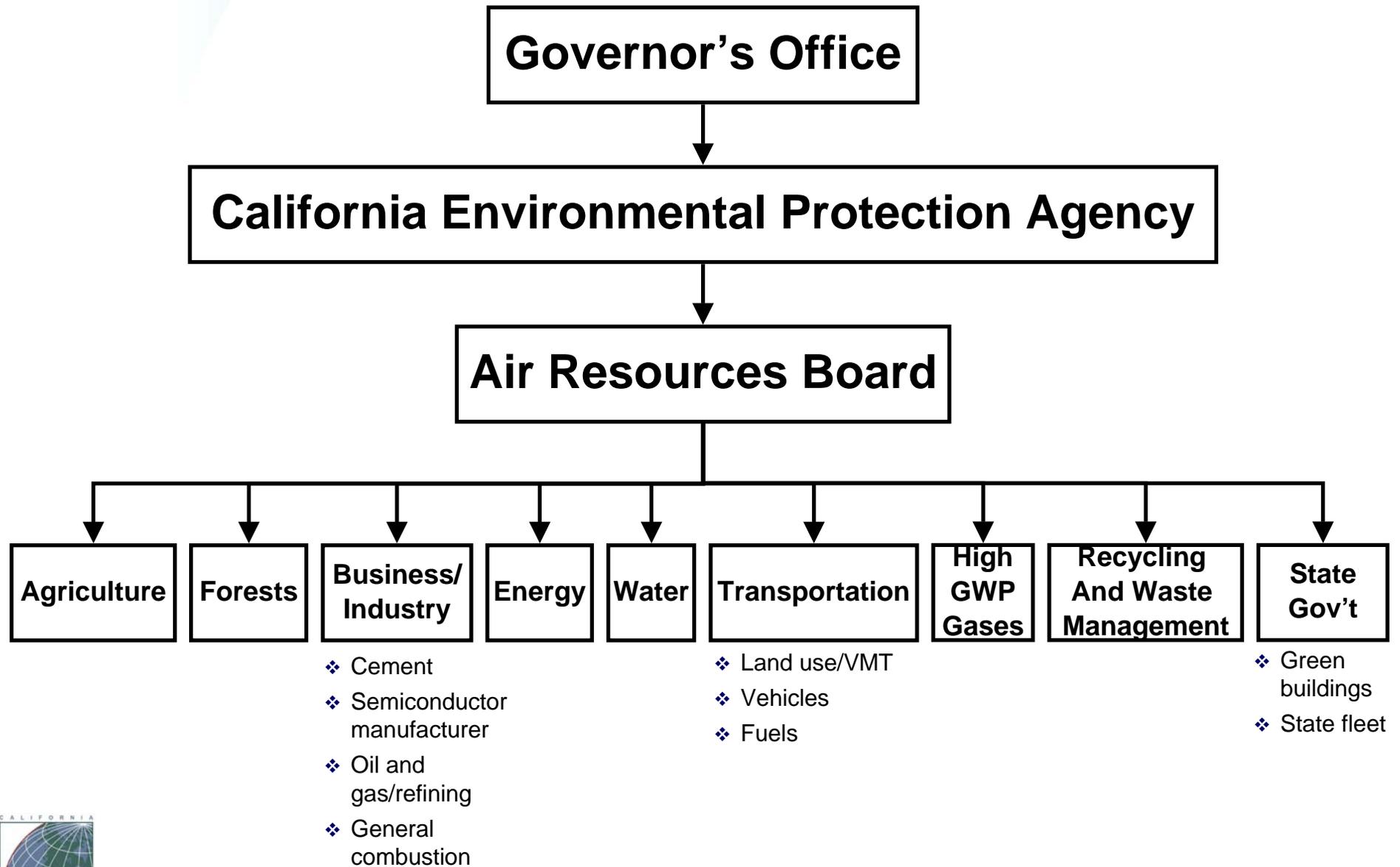
# Examples of climate change (cont.)



# AB 32 overview timeline



# CAT relation with the Governor, Cal/EPA and ARB



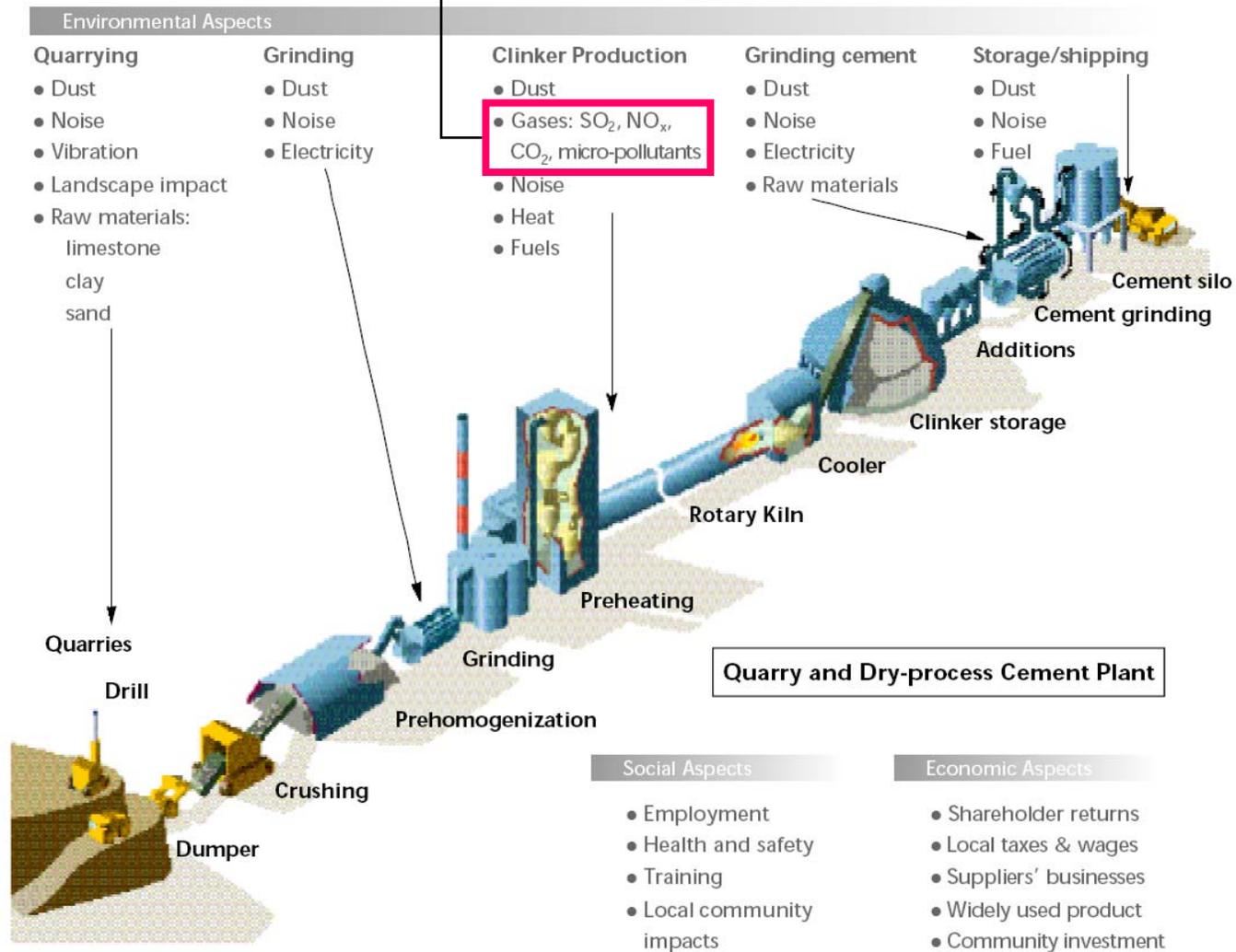
# What is our goal?

- Reduce cement and concrete GHG emissions to the 1990's levels by 2020.



# Environmental aspects of cement production

## Cement sub-group focus: GHG



# How does cement production emit GHG?



CO<sub>2</sub> intensity factor  
(MMT CO<sub>2</sub>/cement)

**1990**    **2005**    **Change**

**Calcination**     $\text{CaCO}_3 = \text{CaO} + \text{CO}_2$     0.52    0.52    0.00

**Fuel Combustion**



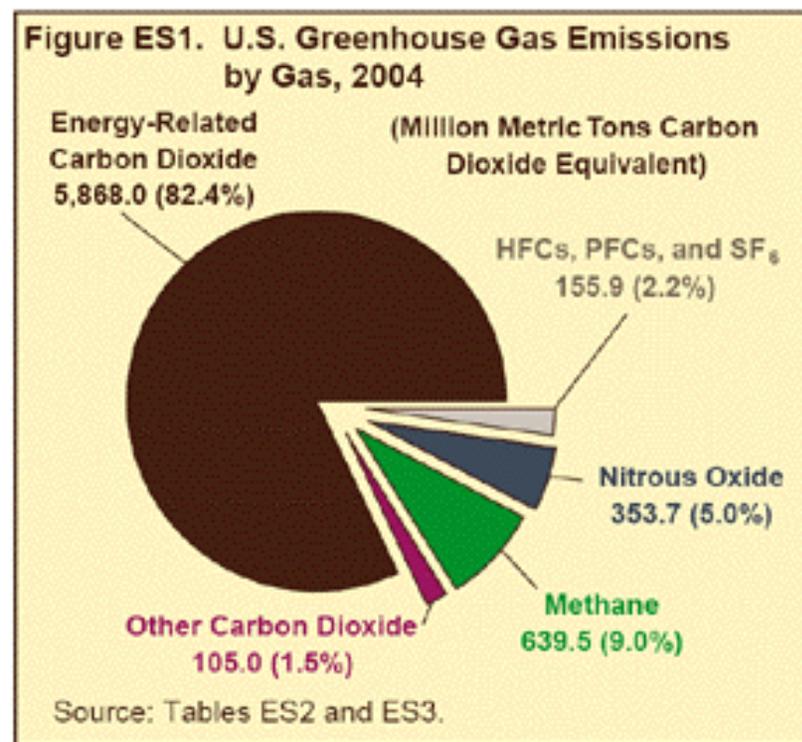
0.40    0.34    -0.06

**TOTAL**    **0.92**    **0.86**    **-0.06**

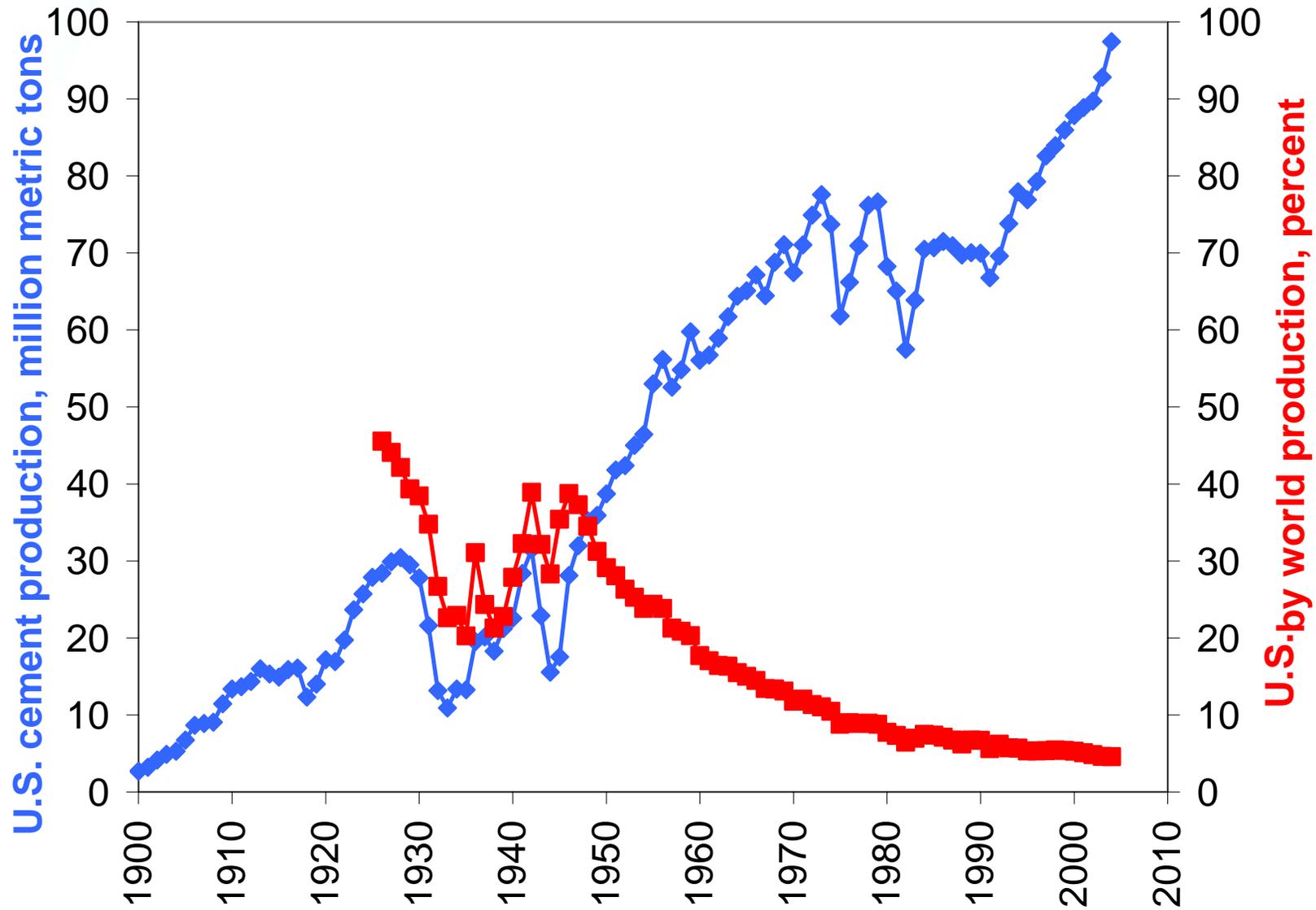


# What are the GHG sources?

- Main type of GHG: CO<sub>2</sub>.
- CO<sub>2</sub> emissions from cement production:
  - ❖ ~ 7% worldwide.
  - ❖ ~ 19% in China.
  - ❖ ~ **2.5%** in California.
  - ❖ ~ 2% in the U.S.



# How has cement production changed?



# What are our strategies?

## ■ Concrete-related:

- ❖ Replace cement
- ❖ Optimize concrete construction/design

## ■ Cement-related:

- ❖ Use environmentally friendly fuels
- ❖ Dilute cement with inert limestone
- ❖ Improve energy efficiency
- ❖ Capture carbon dioxide
- ❖ Universal GHG emission standards



# Fly ash: by-product of coal power plant



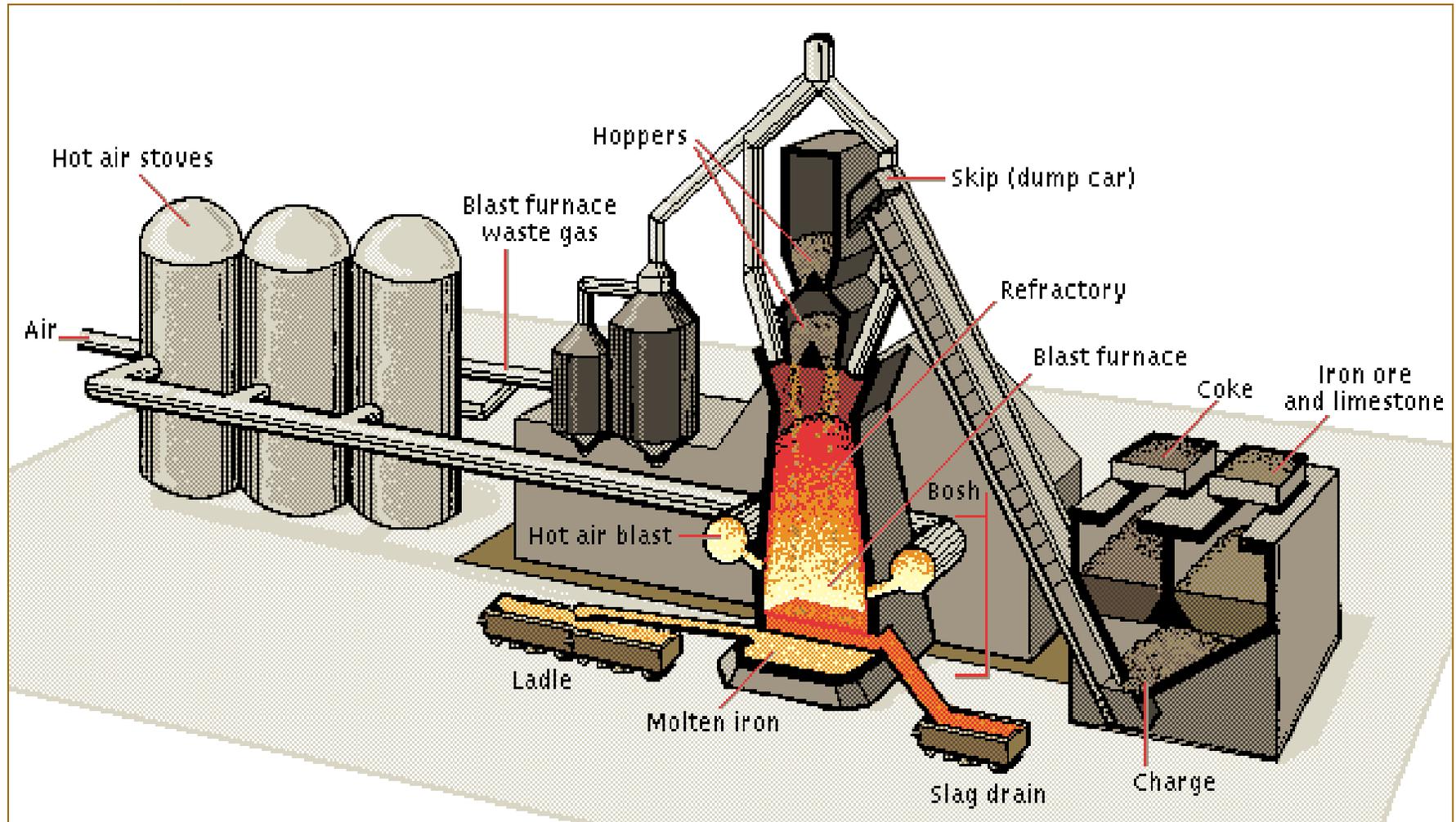
**Notes.** Navajo Generating Station located at Page, AZ.  
Fly ash class F production: 550,000 tons distributed to UT, AR, NE and CA.



**Climate Cement Sub-Group**

**Courtesy:** Headwaters Resources.

# Slag: by-product of iron production



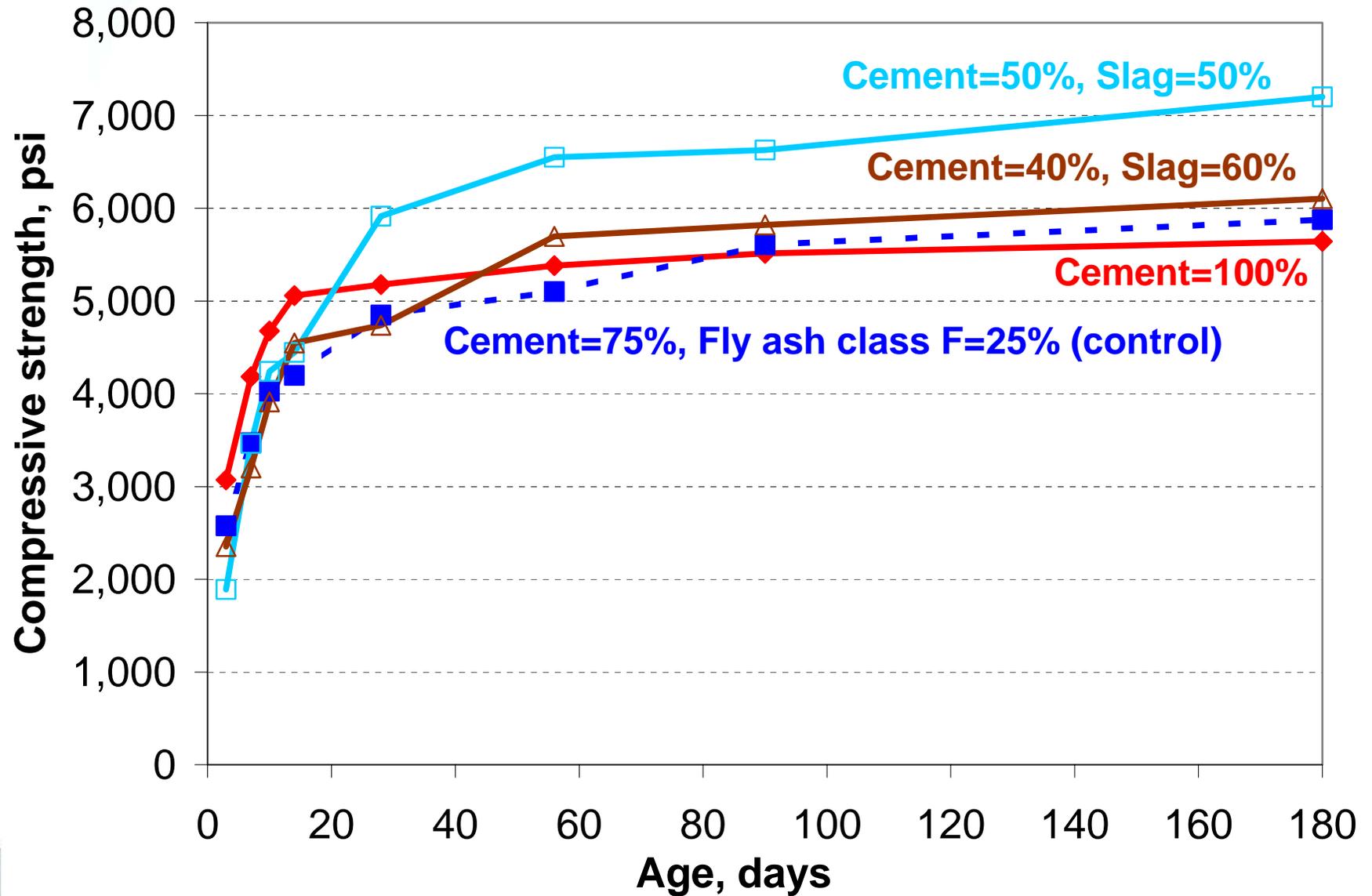
# Cement replacement with SCM

- Cement replacement with **supplementary cementitious materials (SCM)**



- Why SCM?
  - ❖ Makes better concrete
  - ❖ Doubly environmental benefits:
    - Reduce GHG emissions
    - Use recycled products

# Preliminary Caltrans results of SCM study



# SCM amount in SFOBB major elements

**Precast lightweight panels:** 25% fly

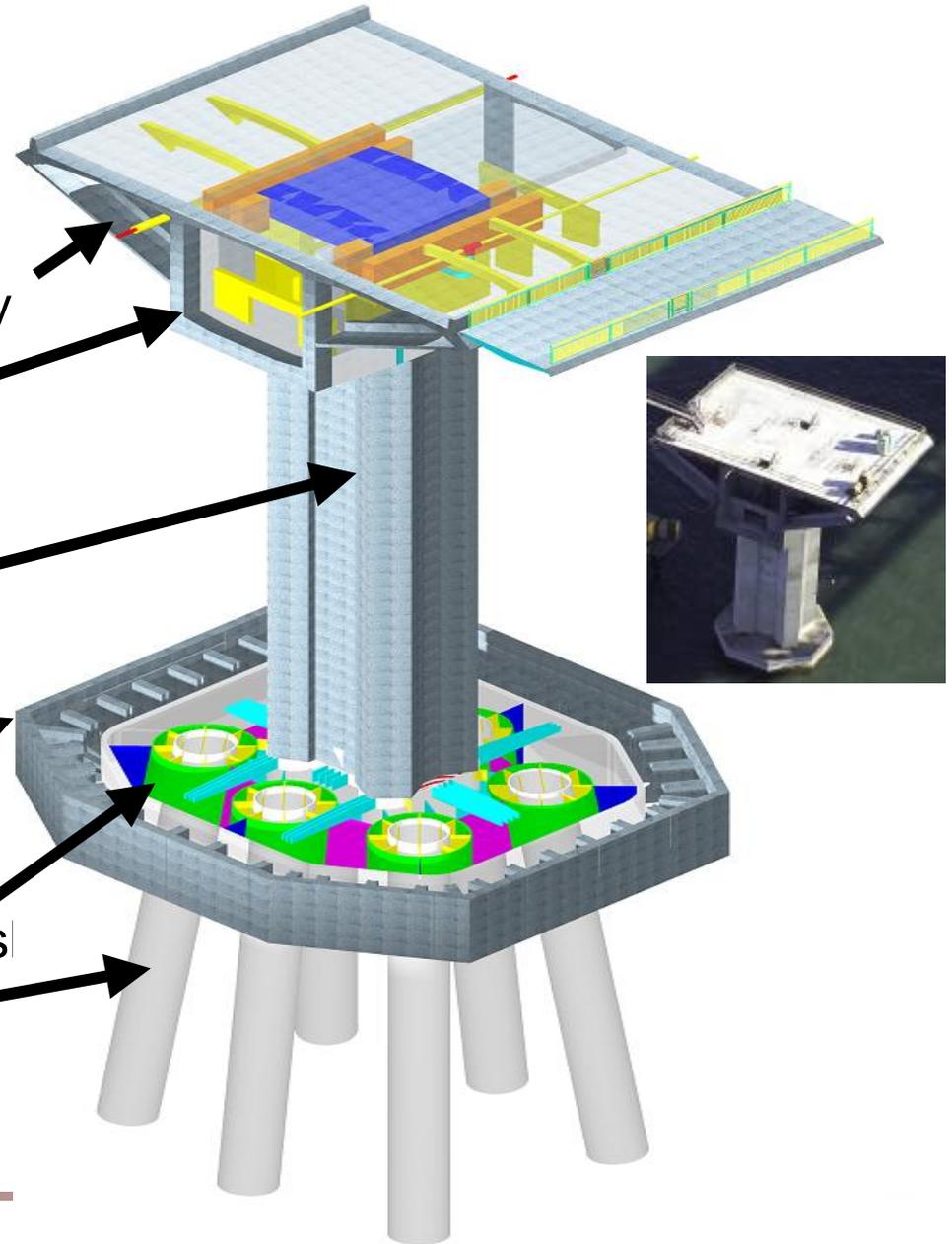
**Pier table:** 25% fly ash

**Pier column:** 50% slag

**Precast fender:** 20% fly ash

**Lightweight footing cell:** 60% fly ash

**Pile:** 35% fly ash



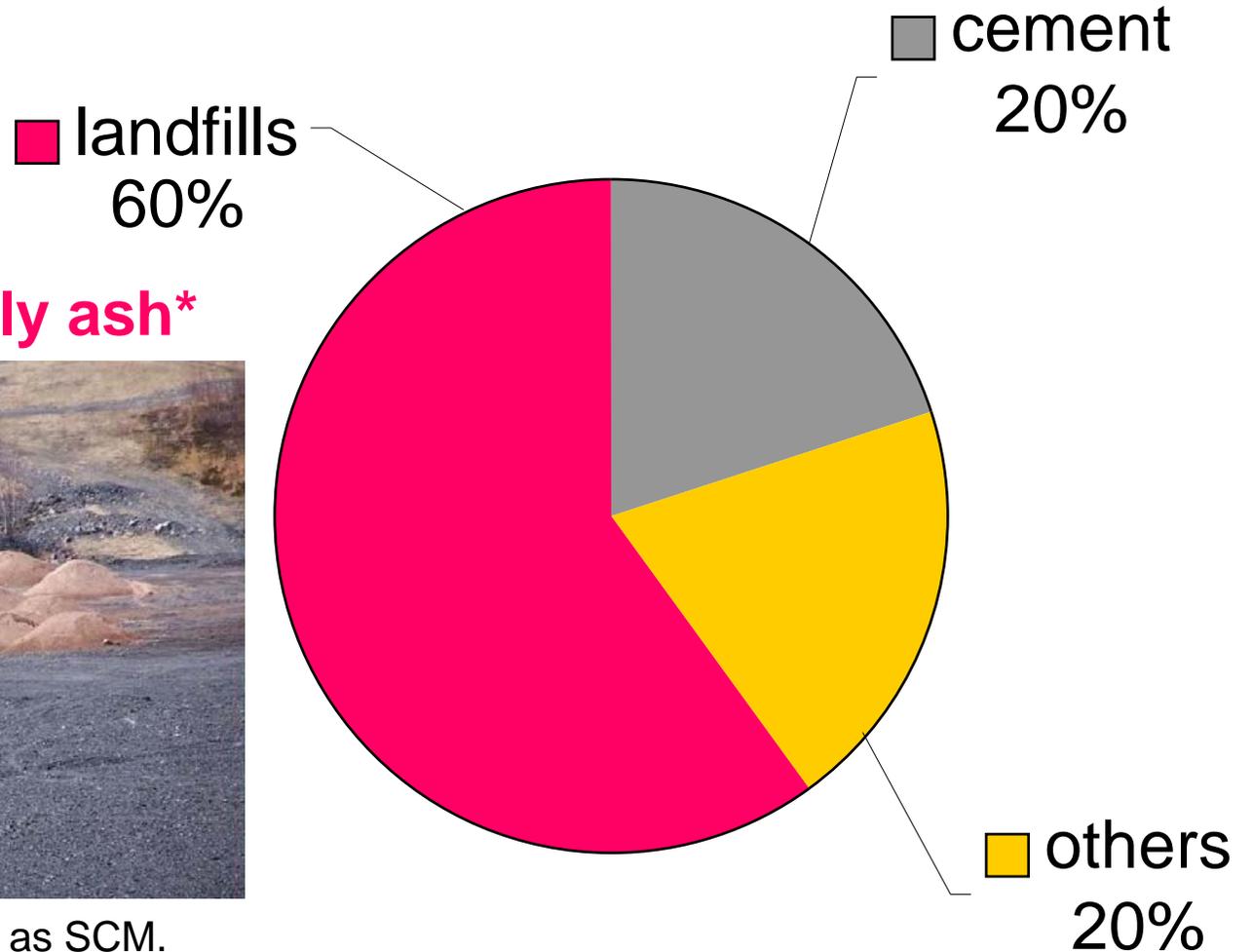
# Fly ash usage in 2004

**Total production: 70.8 million tons**

**42 million tons of fly ash\***



\*Not all can be used as SCM.



# How can we optimize construction/design?

- **Increase design life**

- ❖ **Example:** design 100-year pavements

**NO CONE ZONE FOR  
100 YEARS**



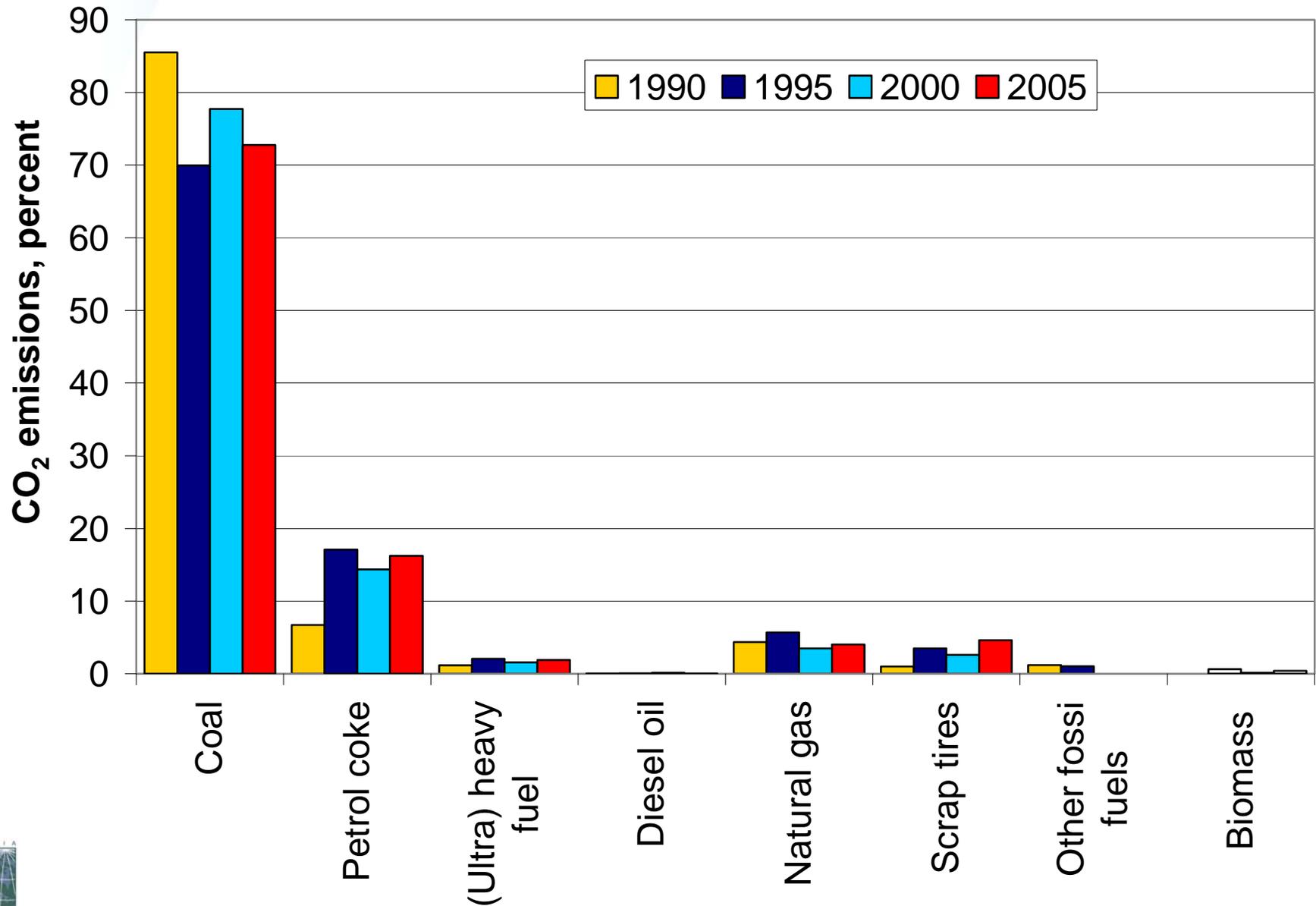
- **Adopt better construction/design practices**

- ❖ **Example:** optimize concrete mix design (use less cement and water)

- **Use environmentally friendly construction techniques**

- ❖ **Example:** use recycled concrete

# Cement-related fuel combustion in CA



# Which fuels should be considered?

- **Natural gas**
- **Biomass**
- **Scrap tires**

- ❖ With such high temperatures inside the kiln, there is no residue from tire burning.
- ❖ Produce lower amount of NO<sub>x</sub> than coal.
- ❖ Usually limited to about 25% of total fuel supply because contains zinc (slows setting time).

View  
inside  
kiln



# How much inert limestone should be used to reduce GHG?

- Caltrans recently finished a study to evaluate the effect of limestone on concrete performance.
  - ❖ **Conclusion:**
    - Cements tested with limestone had better short-term strength and less permeability, but slightly higher shrinkage (at 90 days).
    - Accept the full 5 percent specified by ASTM C 150 but add shrinkage control.
  - ❖ **Action:**
    - Caltrans will work with cement ad-hoc committee to develop a performance-related specification.



# How energy efficiency can be improved?

## ■ Use precalcinators:

- ❖ Only one cement plant in CA does not have it.



## ■ Use of dry kilns:

- ❖ All cement plants in CA have dry kilns.

## ■ Reduced number of kilns:

- ❖ Only one cement plant in CA has multiple kilns.

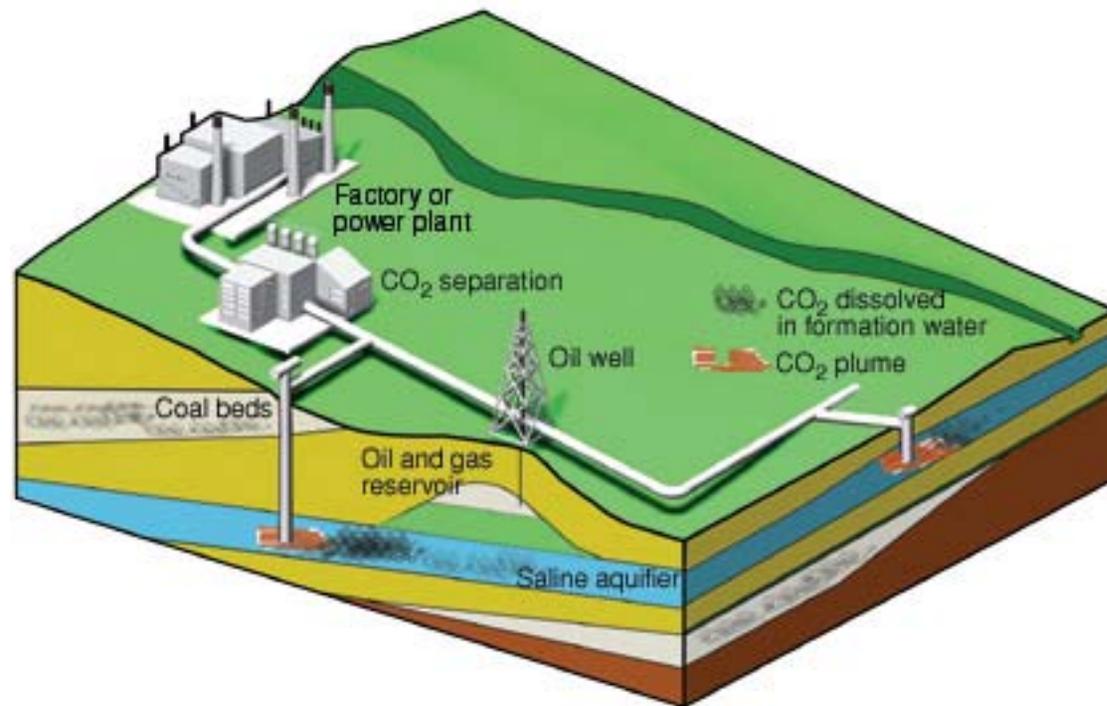


## ■ Replace cement with fly ash at the cement plants:

- ❖ Potential to reduce GHG by at least 25%.

# What is carbon dioxide sequestration?

- Technology to capture and inject CO<sub>2</sub> underground developed by U.S. oil companies.
- There are large scale demonstration projects of CO<sub>2</sub> sequestration.
- Potential to reduce high amounts of GHGs.





# Questions?

