

# Climate Science Update: Highlights from the 2009 Haagen-Smit Symposium



*source: Jim Haagen-Smit*

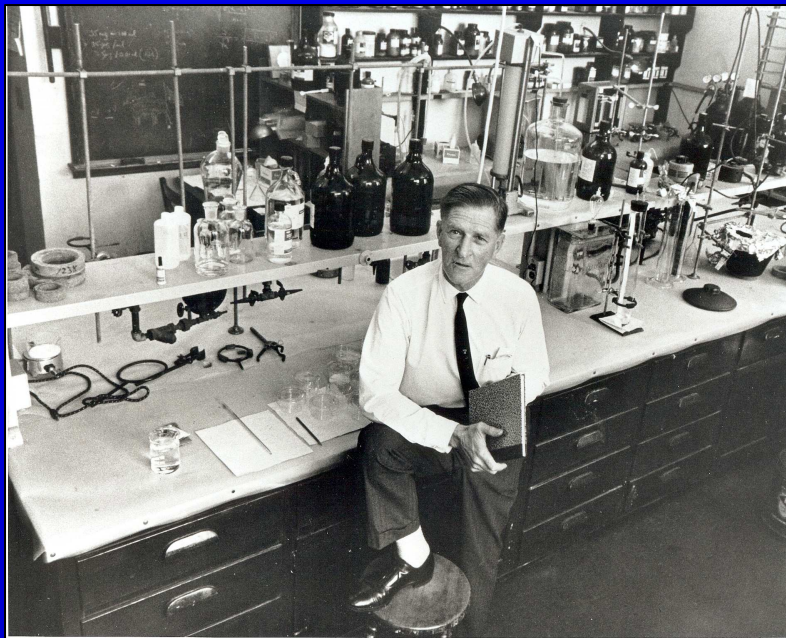
**Air Resources Board**



**California Environmental Protection Agency**

# What is the Haagen-Smit Symposium?

- Annual event to foster informal discussion and interaction among policy makers, researchers, and the regulated community
- Past topics include PM health effects, goods movement, transportation fuels
- Several landmark policy initiatives grew out of Haagen-Smit Symposium, *e.g., Goods Movement Emission Reduction Plan and Low Carbon Fuel Standard*



Professor Arie Haagen-Smit in the Pasadena laboratory where he conducted research that led to regulation of motor vehicle emissions.



source: Jim Haagen-Smit

# Symposium topic: Addressing the Missing Pieces of California's Carbon Footprint

- Scientific findings since the 2007 IPCC Assessment Report offer even more compelling reasons to act now
- Some climate-active pollutants not fully integrated into policy
- Some emissions sources not included in current policy
- Emerging tools and policy options can help California and its partners to address gaps in climate policy





# Emerging Science:

## What have we learned since the 2007 IPCC Report?

- Recent trends **concur** with climate projections
- Mechanisms becoming more clear, particularly regarding **strength of positive feedbacks**
- 2000-2007 emissions trends higher than IPCC scenarios, with U.S. emissions projected to decrease 3-4%/yr in 2008-2009
- Only about 25% of 2.4° C “committed warming” has been realized so far (Ramanathan & Feng 2008)
  - masking effect of sulfate, organic PM<sub>2.5</sub>
  - *past emissions sufficient to push climate system beyond critical thresholds*



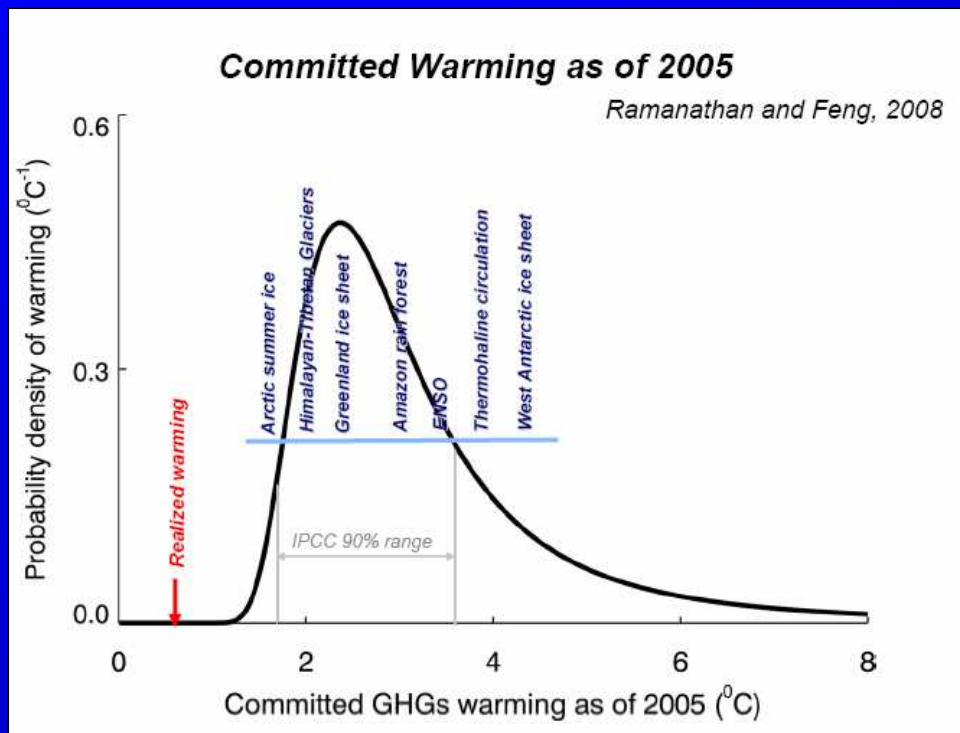
Reflection of sunlight by particulate matter.

source: Anderson et al 2003



# Emerging Science: Policy implications

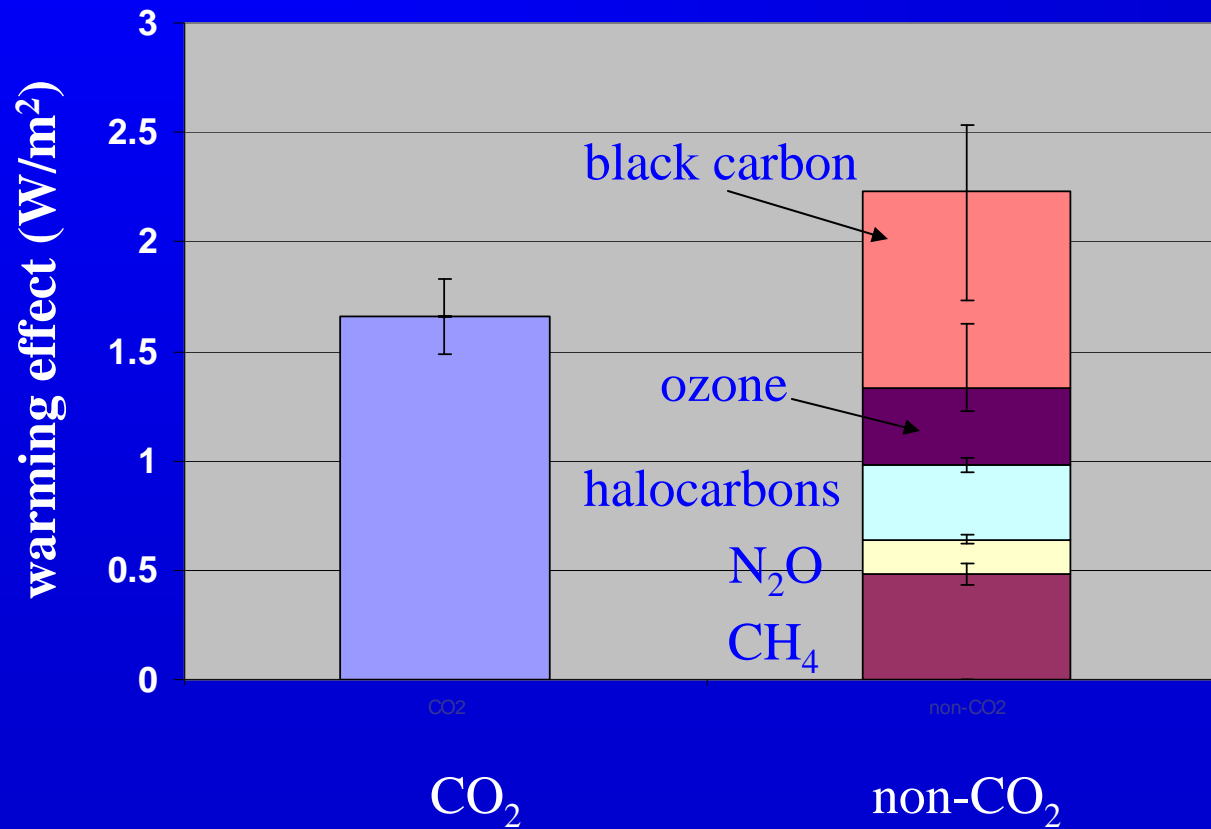
- Must make dramatic emissions reductions soon
- Must target not only total warming, but the **rate** of warming



Risks of dangerous changes to climate increase with increased total warming as well as total peak warming. 5



# Non-CO<sub>2</sub> Pollutants: Options for significant near-term reductions



*sources: IPCC (2007), Ramanathan & Carmichael (2008)*

# Methane (CH<sub>4</sub>): Opportunities and obstacles

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- Covered under the Kyoto Protocol
- Use of 100-year global warming potential (GWP) de-emphasizes CH<sub>4</sub>; considering a 20-year GWP would facilitate reductions
- Health and eco-system co-benefits due to reduced ozone
- Technologically feasible, low-cost mitigation feasible for a substantial fraction of California's methane inventory
- Unidentified sources being investigated
- ARB verifying large area source emissions with its mobile monitoring platform



*photo:* Chino Basin Dairy Farm digester  
*source:* CarbonFund.org



# Black Carbon (BC): Challenges and co-benefits

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- Not covered under the Kyoto Protocol
- Variable, location-dependent effects elude characterization in terms of GWP
- Co-emissions of BC with cooling pollutants complicates accounting and development of effective interventions
- Enormous potential health co-benefits due to reduced PM<sub>2.5</sub> exposures
- Deposition on snow & ice accelerates melting
- Low-cost, low-emission cook stoves for less developed countries offer health and climate benefits
- Diesel & coal controls also limit BC
- Accounting and verification frameworks need to be developed



source: Tollefson (2009) *Nature*





# Ozone-depleting substances (ODS): Call for continued leadership

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- New production phased out by Montreal Protocol, but little control of existing stock
- ~700 MMT CO<sub>2</sub>e stored in buildings, old refrigeration and A/C systems, and will eventually be released unless controlled
- Not covered under the Kyoto Protocol
- Covered under AB 32
- Extremely high GWPs (1000's – 10,000's)
- Scoping Plan identifies readily available mitigation



Emissions associated with foam insulation products are among the high GWP gases targeted by the Scoping Plan.



## Sectors not accounted for:

### International travel & shipping, imports

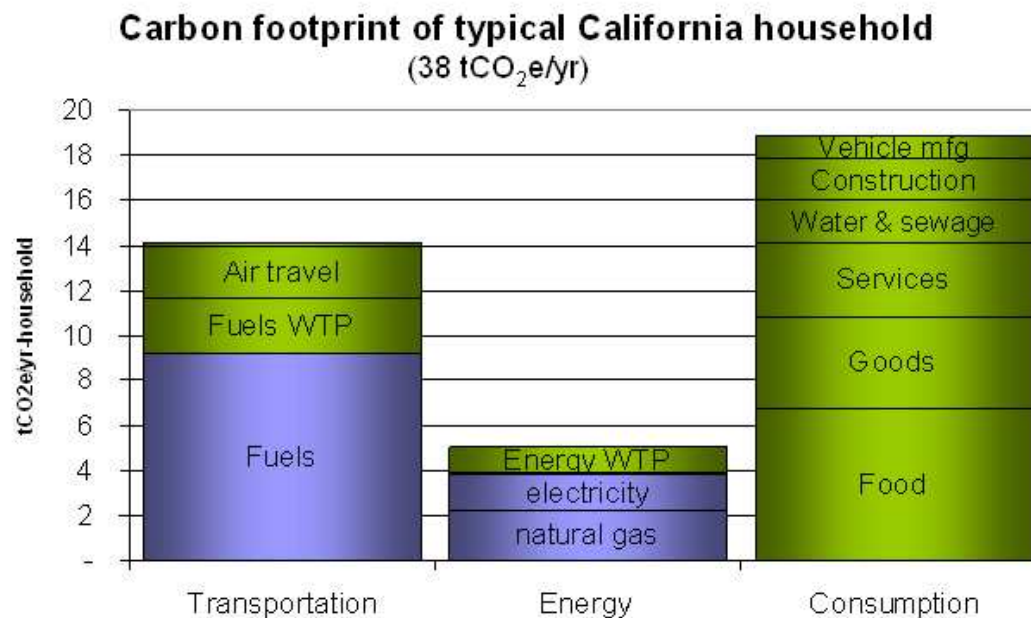
- Aviation: ~ 2.2% of global CO<sub>2</sub> emissions (6% in California)
  - sector projected to grow 2-5× by 2050
  - International Civil Aviation Authority (ICAO) yet to devise regulatory scheme
- Shipping: ~ 2.5% of global CO<sub>2</sub> emissions (3% in California)
  - sector projected to grow 1.5× by 2050
  - International Maritime Organization (IMO) actively considering several regulatory schemes
- Imported goods: whose responsibility?
  - nearly 1/3 of China's emissions associated with exports
  - imports to US equivalent to ~13-30% of total national CO<sub>2</sub> emissions in 2004 (Weber & Matthews 2007)



# Life-Cycle Carbon Footprinting:

## Emerging tools support voluntary initiatives

- Tools significant for *businesses* and *individuals*
- Supply chain footprints internalize overseas emissions
- Average California household: 38 tCO<sub>2</sub>e/yr (43 tCO<sub>2</sub>e/yr US)



Source: [coolclimate.berkeley.edu](http://coolclimate.berkeley.edu)



# Lessons Learned

## from the 2009 Haagen-Smit Symposium

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- Science indicates urgent need for dramatic, near-term reductions.
- Critical opportunities to buy time through reductions of non-CO<sub>2</sub> pollutants in tandem with sustained CO<sub>2</sub> reductions:
  - methane controls should be emphasized
  - black carbon control offers enormous health co-benefits, but challenging due to accounting and co-emissions of cooling species
  - ARB will continue to lead climate policy for ozone-depleting substances
- Several critical sectors require international cooperation, e.g., aviation, shipping, and imported goods.
- Emerging tools are available to support voluntary emissions reductions, e.g., carbon calculators and labeling.



# Concluding Points

## from the 2009 Haagen-Smit Symposium

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- California needs to remain engaged in national and international frameworks.
  - Ozone-depleting substances, black carbon, and other relatively short-lived pollutants should play a role in climate policy.
  - U.S. EPA's endangerment finding does not extend to ODS or BC.
- Considering a 20-year GWP for CH<sub>4</sub> (and possibly other pollutants) would incentivize near-term reductions.
- Policy should affect the manufacturing chain (suppliers, imports).
  - Indirect emissions must be accounted for.
- California will continue to set a precedent for handling high-GWP ozone-depleting substances.





# THANK YOU

