

RAMANATHAN, 2015

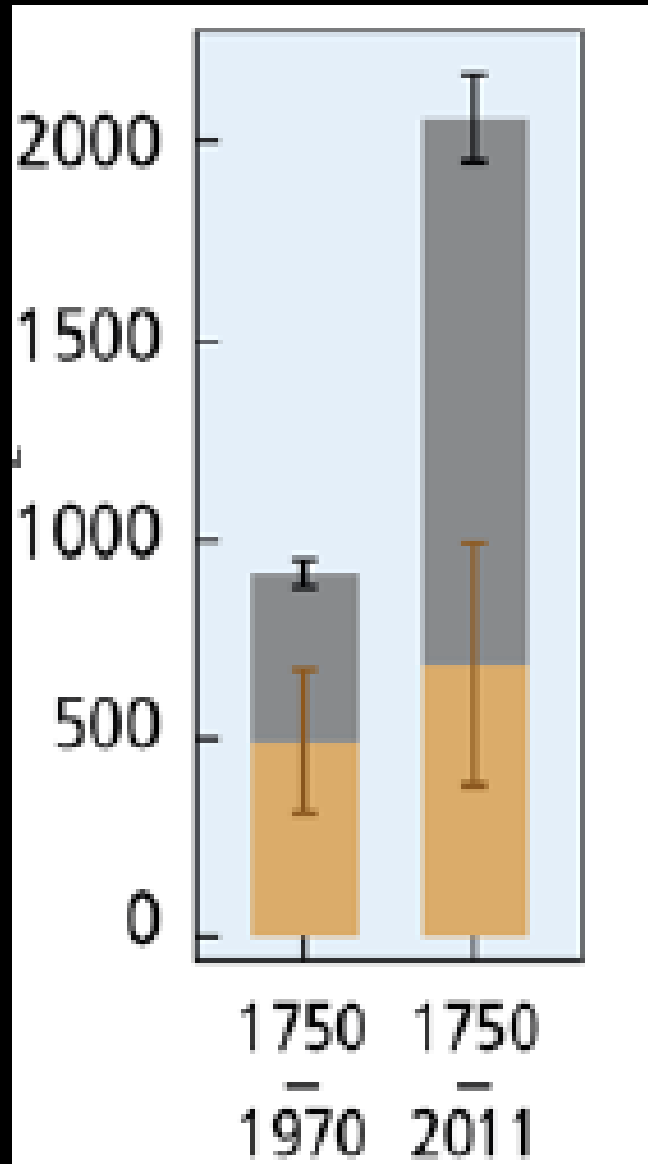
*Two Knobs for Bending the Curve:
Short Lived Climate Pollutants & Carbon Pollution*

*VEERABHADRAN (RAM) RAMANATHAN
UNIVERSITY OF CALIFORNIA AT SAN DIEGO*

Mitigating methane emissions: From science to innovative solutions
November 9, 2015, at the ESEC (9 place d'Iena, 75116 Paris, France)

Two Trillion Tonnes Have Been Emitted So Far

CO2 EMISSIONS, BILLION TONS



IPCC-2013

BENDING THE CURVE

3Tt

2030

2050

EXCEEDING 2 C
BY 2050

***NEED TO WORRY ABOUT
TWO TIME SCALES:***

- ***NOW TO 2030***
- ***2030 TO 2050***

Is There Another Knob Beyond CO₂ ?

The Short Lived Climate Pollutants

Methane; Black Carbon; Ozone (Lower Atmosphere); HFCs

Life times are about a week to 15 years

- **Off-the-shelf Technologies Exist For Drastic Reductions**
- **Given The Short Life Times, The Climate Effects Of Mitigation Will Show Up Within 10 Years!!**

The Science Of SlCPs Dates Back To 1975
[See Next Slide]

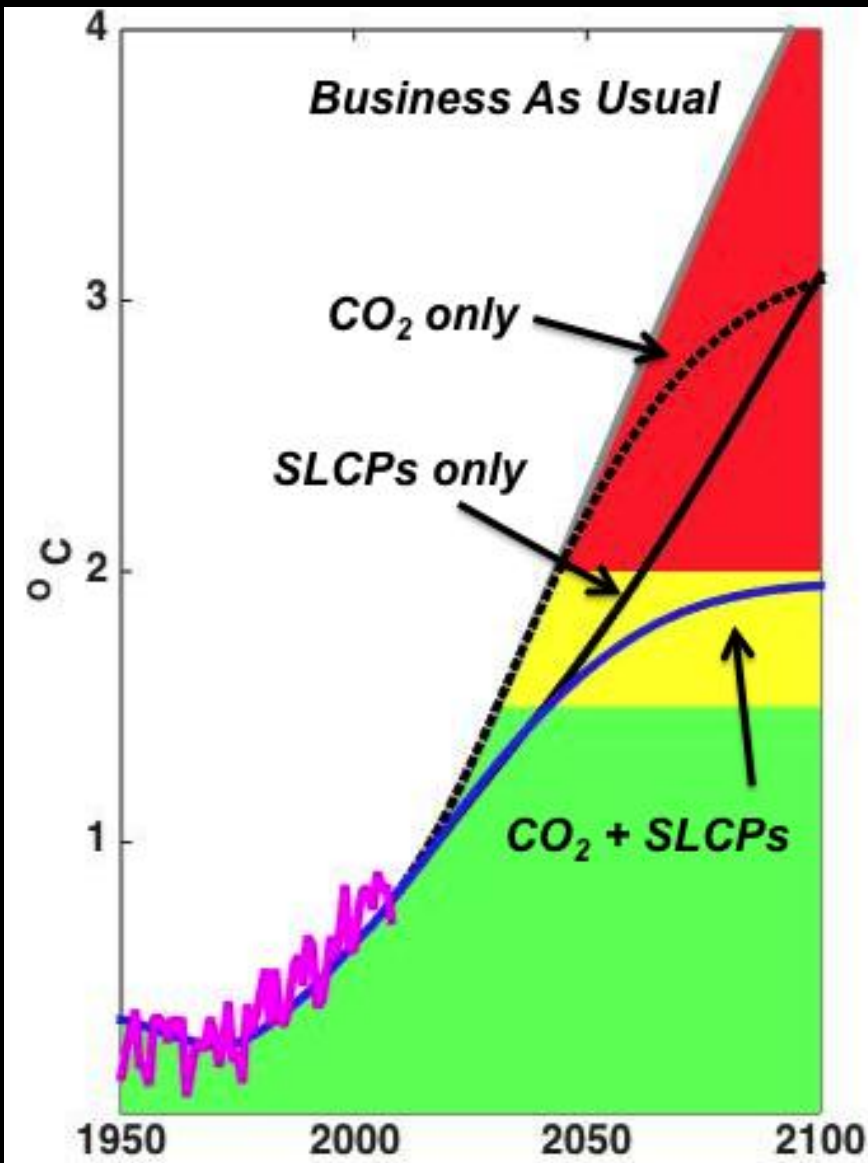
Greenhouse Effect Due to Chlorofluorocarbons: Climatic Implications

V. Ramanathan



The Two Knob Approach For Bending The Curve

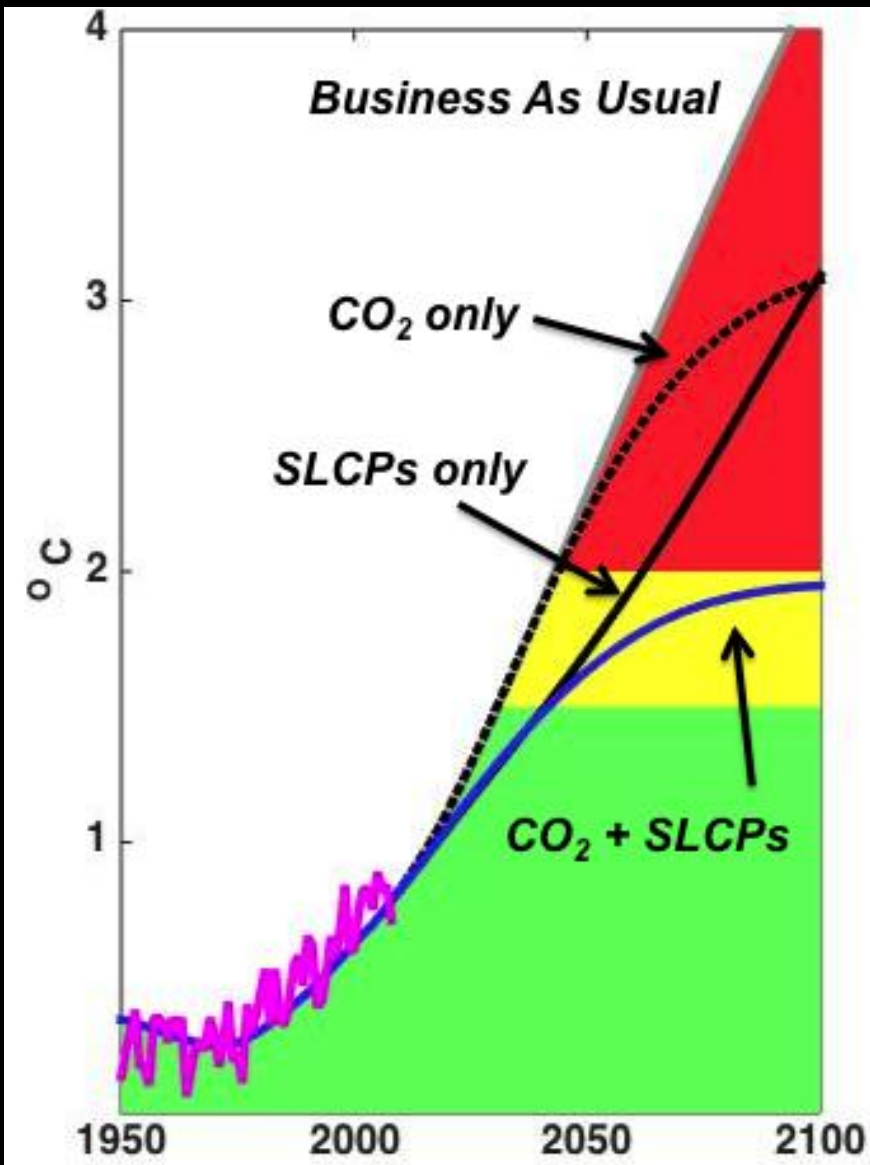
Ramanathan & Xu, 2010; Hu et al, 2013



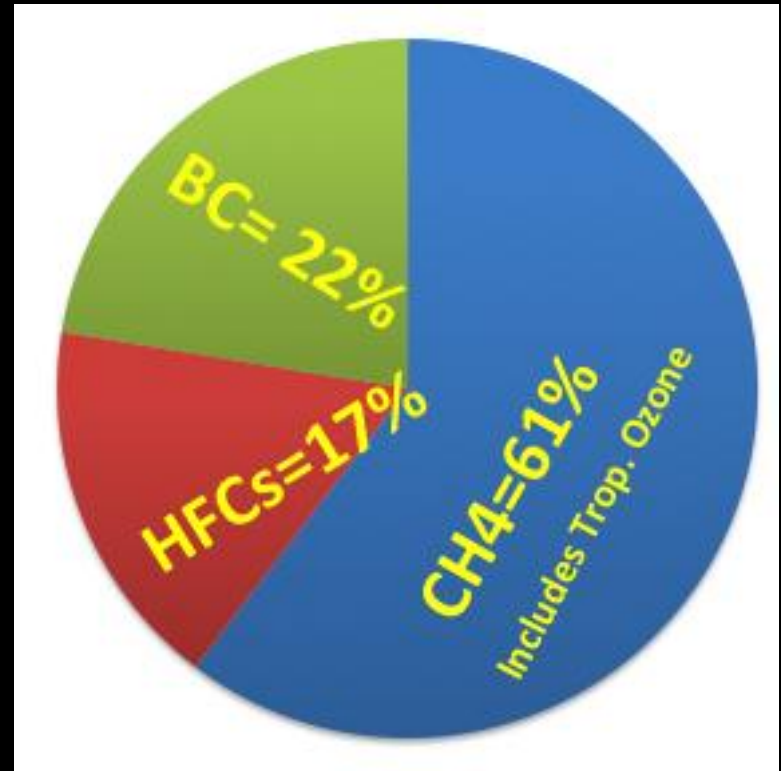
***MITIGATION OF
WARMING***

The Two Knob Approach For Bending The Curve

Ramanathan & Xu, 2010; Hu et al, 2013



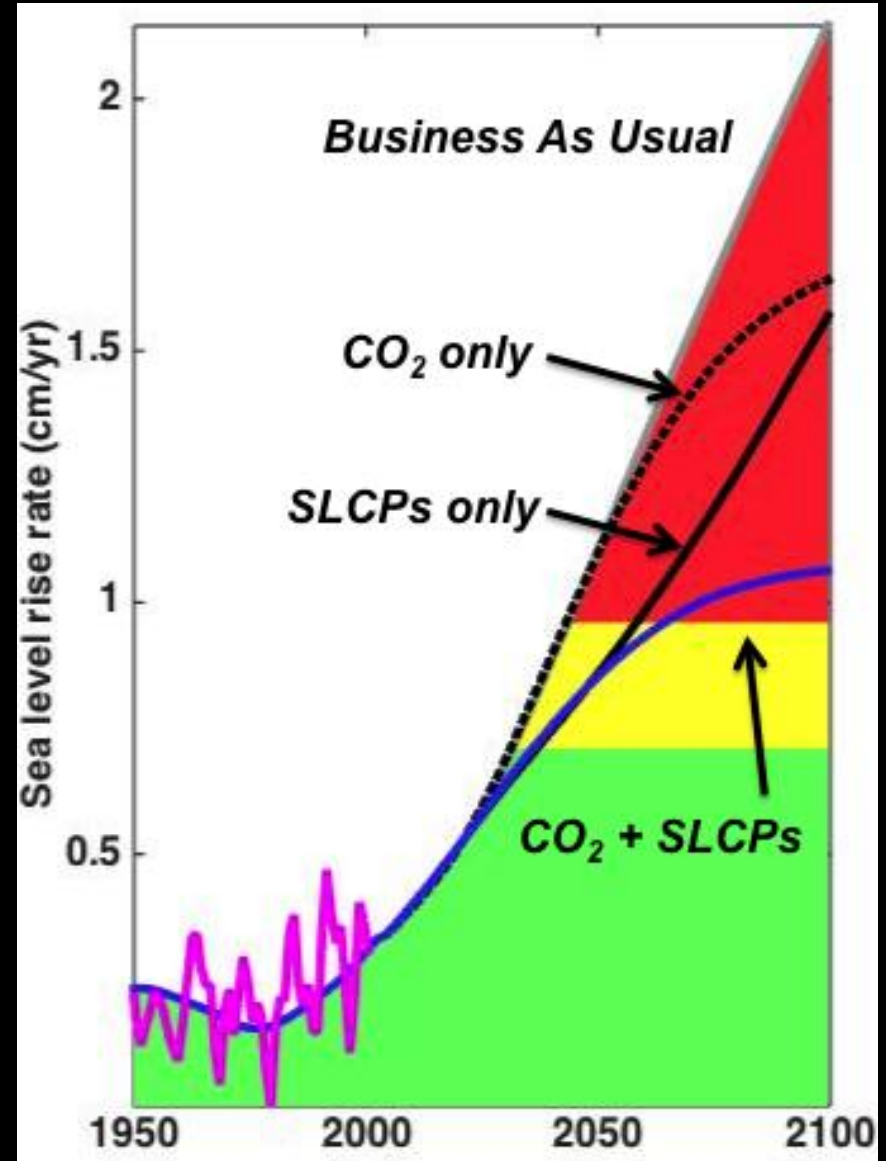
SLCPs MITIGATION [2050] - 0.6 C



The Two Knob Approach For Bending The Curve

Ramanathan & Xu, 2010; Hu et al, 2013

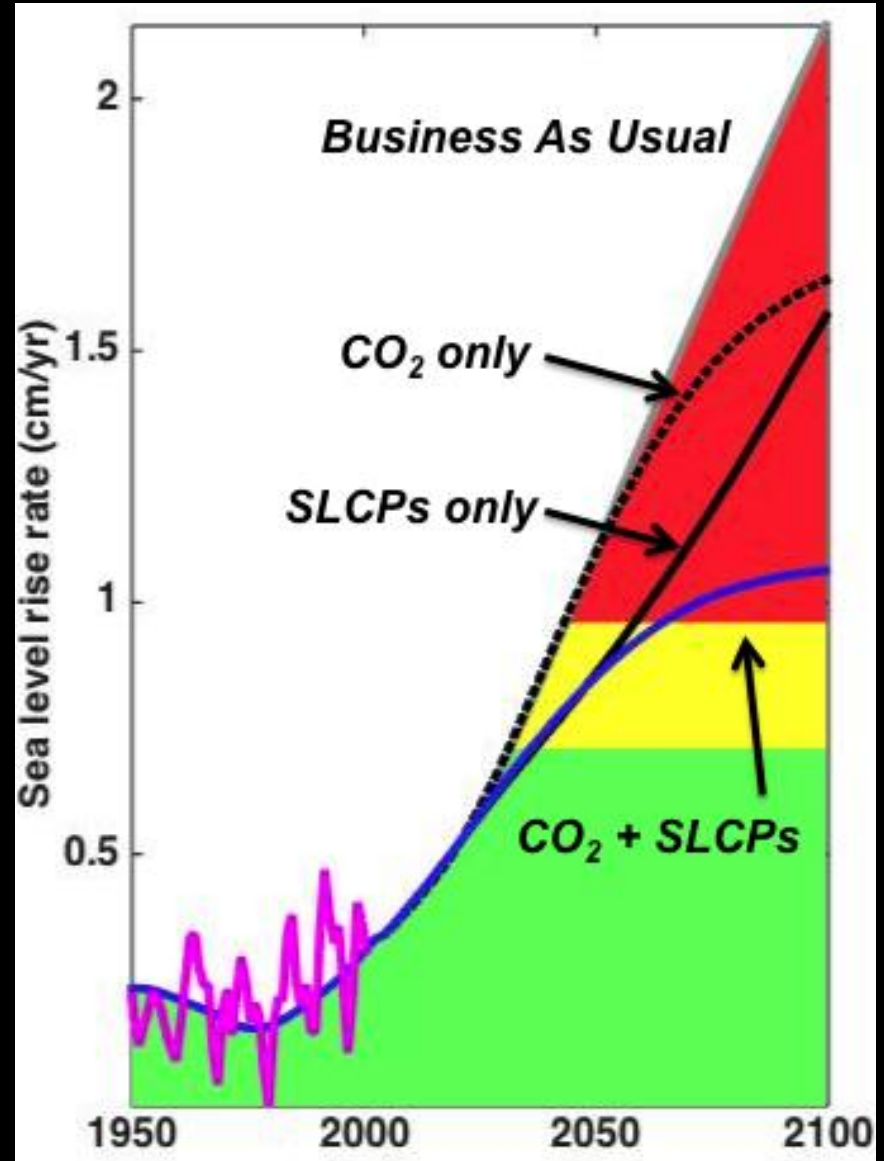
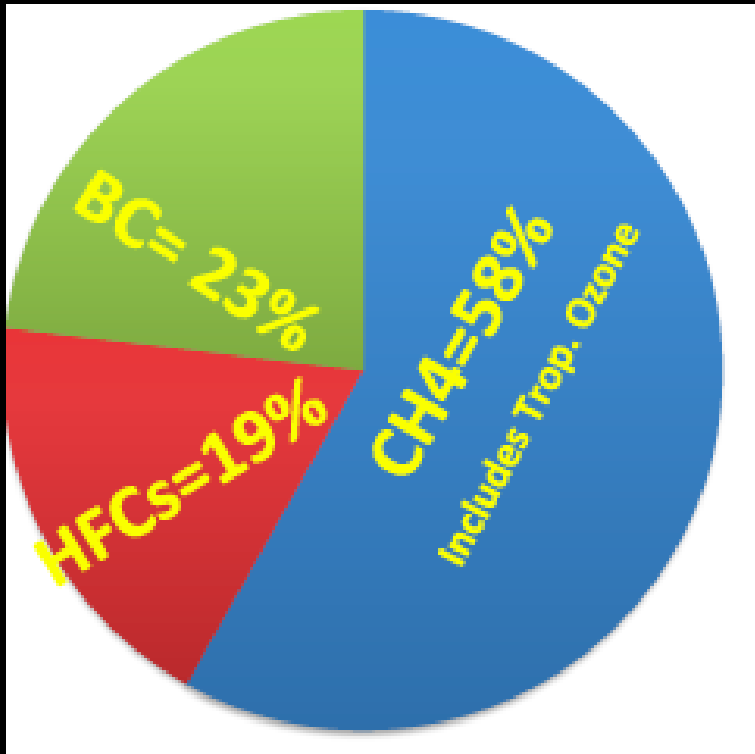
***RATE OF SEA LEVEL
RISE [CM/YEAR]***



The Two Knob Approach For Bending The Curve

Ramanathan & Xu, 2010; Hu et al, 2013

SLCPs MITIGATION [2100]



Effects on Public Health

Air pollution, a preventable risk

Some SLCPs are harmful to human health. Fast implementation of measures to reduce these pollutants could deliver significant public health benefits.

DEATHS

GLOBALLY AIR POLLUTION is responsible for over

6.000.000

PREMATURE DEATHS PER YEAR (2010)

Indoor pollution 3.5 mill.

Outdoor pollution 3.1 mill.

Ozone pollution 0.2 mill.

DISEASES

● DUE TO BC AND CO-POLLUTANTS

● DUE TO O₃



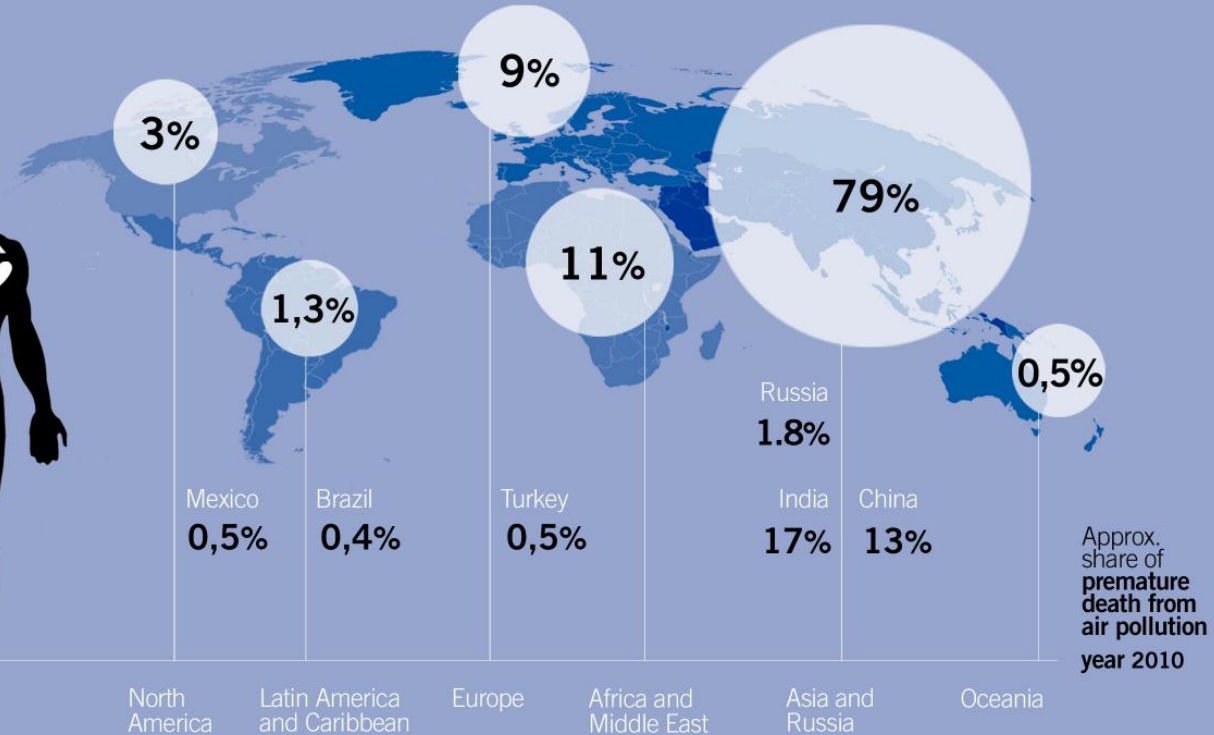
- Heart attacks
- Strokes, heart disease
- Congesive heart failure



- Lung cancer
- Chronic bronchitis ...
- Asthma
- Emphysema
- Scarred lung tissue



- Low birth weight



Globally, **air pollution** is the **2nd leading risk factor** for the global burden of disease in 2010, behind high blood pressure, and together with **tobacco smoking**, including second hand smoking.



Effects on Agriculture

SLCPs a threat to agricultural productivity

Some SLCPs have detrimental impact on ecosystems including crop yields. Fast implementation of measures to reduce these pollutants could deliver important food security benefits.

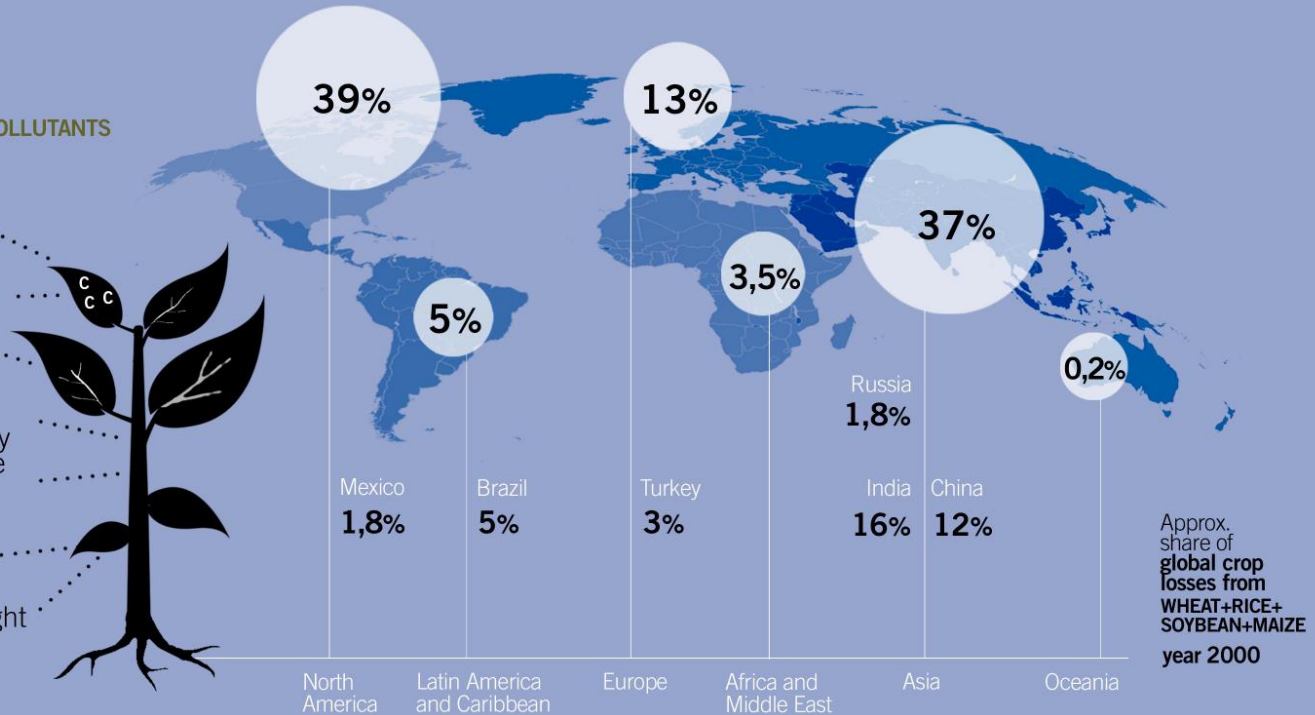
**CROP LOSSES
DUE TO AIR POLLUTION**
WHEAT+RICE+SOYBEAN+MAIZE

110.000.000 t

SLCPs EFFECTS ON PLANTS

- DUE TO O₃
- DUE TO BC AND CO-POLLUTANTS

- Impedes photosynthesis
- Reduces ability to sequester carbon
- Damages plants
- Can reduce crop production
- Can reduce quality and nutritive value of food and feed
- Increases leaf temperature
- Can reduce sunlight reaching plants affecting photosynthesis



Why Are These Co-benefits Vitally Important?

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TOP ONE BILLION: UNSUSTAINABLE CONSUMPTION



Responsible For 60% Of GHGs Emissions

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THE BOTTOM THREE BILLION WORLD

Forced By Poverty To Rely On 18th Century Technologies

Mukteshwar, Central Himalayas, India



Photo:Ramanathan, 2009

BENDING THE CURVE

EXECUTIVE SUMMARY

Ten scalable solutions for carbon
neutrality and climate stability

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10

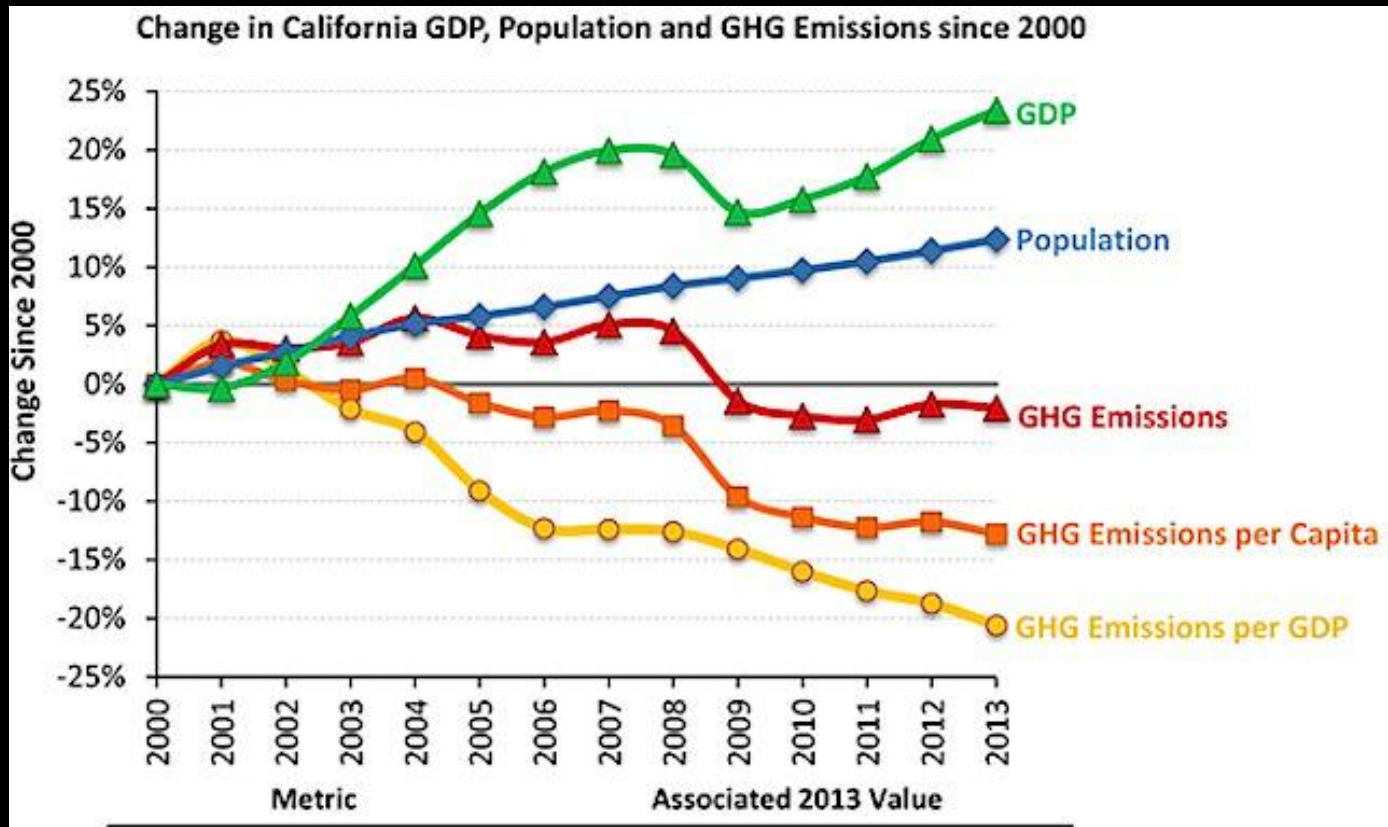
*Scalable Solutions for
Carbon Neutrality &
Climate Stability*

*From The University Of
California*

Ramanathan et al, 2015

*[http://uc-
carbonneutralitysummit
2015.ucsd.edu/_files/Be
nding-the-Curve.pdf](http://uc-carbonneutralitysummit2015.ucsd.edu/_files/Bending-the-Curve.pdf)*

CALIFORNIA AS LIVING LABORATORY FOR THE TWO KNOB APPROACH



GDP	2.05 trillion (2009 \$)
Population	38.2 million
GHG Emissions	459.3 MMTCO₂e
GHG Emissions per Capita	12 metric tons CO₂e per person
GHG Emissions per GDP	224 metric tons CO₂e per million dollars



California Delivers @CAdelivers · 8h

This is what effective climate action looks like. ^@MaryNicholsCA #AB32

10 SOLUTIONS

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- 1. Bend the curve immediately by mitigating short lived climate pollutants & sustainably by eliminating carbon pollution***
- 2. Foster A Global Culture Of Climate Action Through Communication & Education***
- 3. Foster An Alliance Between Science, Religion And Policy To Change Attitude & Behavior***
- 4. Scale Up Subnational Collaboration To Energize Iner-national Actions.***
- 5. Adopt Market-Based Instruments to Create Incentives for firms and individuals to reduce carbon emissions.***
- 6. Target direct regulatory measures at sectors not covered by market-based policies.***

- 7. *Make maximum Use of available mature technologies to mitigate carbon pollution by 40% by 2030***
- 8. *Innovate For Complete Electrification Of Energy including Transportation to mitigate carbon pollution by 80% by 2050.***
- 9. *Use available technologies & regulations to reduce by 2030 emissions of methane by 50%, black carbon by 90 % & HFCs by 100%.***
- 10. *Regenerate damaged natural ecosystems and restore soil organic carbon. Implement food waste reduction programs & energy recovery systems***

BEND THAT CURVE