



## Black Carbon Reduction Council

### **Targeting Black Carbon and Short-Lived GHGs to Reduce Climate Change and Improve Public Health**

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Climate Institute  
International Forum on Climate Change: Local Actions  
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To date, climate policy making has focused on a standard set of six greenhouse gases including CO<sub>2</sub>.

New research has identified a new category of pollutants called 'Short-Lived Climate Forcers' which are fundamentally different from long-lived species like CO<sub>2</sub>. Powerful heating agents, short-lived climate forcers make outsized contributions to the heating of our planet. Short-lived forcers include black carbon, methane, and tropospheric ozone. I'll talk about all this in detail.



Climate Institute

## Tickell Interactive Network



Let me start by saying that The Climate Institute is an NGO with a 25 year track record of convening constructive dialogue, disseminating objective research, and creating effective partnerships for practical climate solutions. In addition to our global Black Carbon Reduction Program, the Climate Institute works here in Mexico to establish climate education programs, installing the compelling Science-on-a-Sphere projection systems in science museums and other public facilities throughout Mexico.

To date, the Institute has established 11 climate theatres in Mexico. Puebla, first State to have a Tickell Climate Theatre, also first state on the planet to have BC an active part of Climate Mitigation Plan. Climate Education Network in Mexico already providing platform for policy change on BC



## Black Carbon Reduction Council

The Council works to avert near-term climate change by raising awareness, convening constructive dialogue, mapping a consensus agenda for action, and promoting best practices and win-win solutions for reducing emissions of the powerful heating agents called short-lived climate forcers including BC, methane and tropospheric ozone.”

I am the Director of the Black Carbon Reduction Council at the Climate Institute. The Council is a new global effort to raise awareness of the powerful heating agents called short-lived climate forcers, and the unique opportunity they provide to reduce warming in the critical near-term.

## Critical Need for Climate Action

“On the basis of the increasing pace of global warming, including the potential for an abrupt acceleration, ... the risk appears to be increasing that a **tipping point** leading to ‘dangerous,’ or perhaps even catastrophic change could surprise us in the years ahead.”

Dr. Michael C. MacCracken  
Chief Climate Scientist, Climate Institute  
2009

There is widespread scientific consensus that the climate is warming now, and immediate action is required. Scientists like Dr. MacCracken are now concerned that we are approaching tipping points beyond which dangerous irreversible change may occur.

# Climate Tipping Points

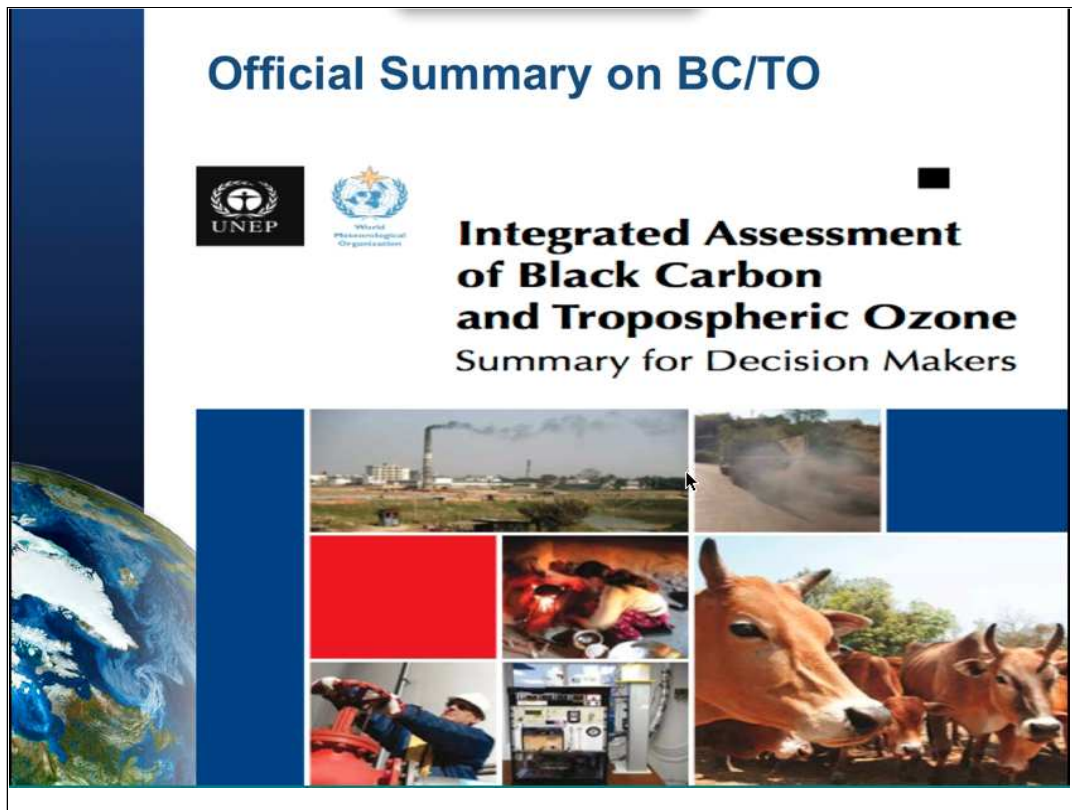
- Threshold events that lead to sudden acceleration of global climate change such as:
  - Loss of Arctic sea ice and/or much of Greenland ice sheet
  - Thawing of permafrost releases trapped methane
- Difficult to predict, very likely to occur before 2050
- Reducing total warming before 2050 is critical to avoiding these tipping points

The term tipping points refers to threshold events such as severe polar melting and permafrost thaw can trigger sudden acceleration of change.

Tipping points are difficult to predict but one or more is seen as 'very likely' by 2050.

The science shows that climate change, even in the near-term has the potential to trigger abrupt transitions.

Lowering total warming effect As Soon As Possible is critical.



A major new report by the United Nations Environment Program confirms that short-lived forcers – including black carbon, methane and tropospheric ozone – are making significant contributions to global warming.

The good news is that these potent drivers of climate change can be controlled through proven emission reduction measures which would have immediate and numerous benefits for human health, for water and food security, and for ecosystems and biodiversity..

That's the punchline so now I am going to take you into some of the details.

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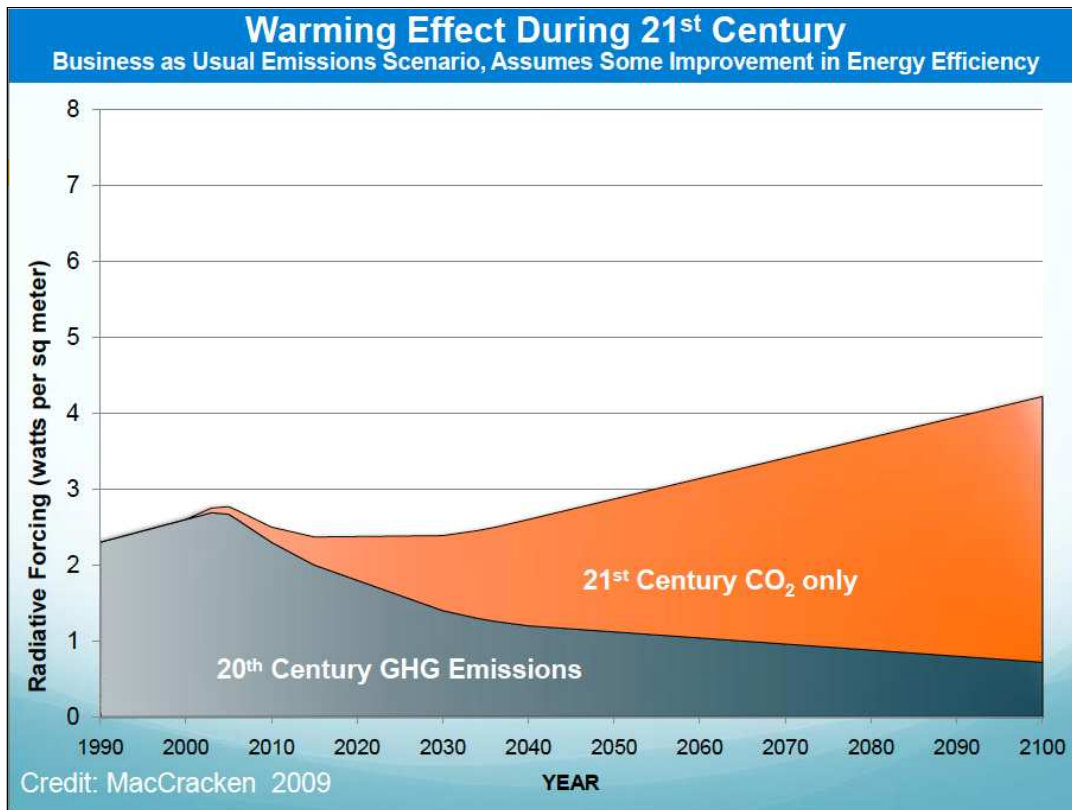
Short-lived climate forcers are fundamentally different from long-lived ghgs, remaining in the atmosphere for only a short period of time.

**Reducing short-lived forcers including black carbon and tropospheric ozone now will slow the rate of climate change within the first half of this century.**

Black Carbon has been called a 'virulent climate forcer'. When it lands on ice it begins to absorb heat like no other and the pace of melting increases dramatically.

BC is going to catch up to CO2's contribution to warming – its pushing the whole climate system faster and harder than any other factor.

'new scientific evidence and analyses demonstrate that control of black carbon particles and tropospheric ozone through rapid implementation of proven emission reduction measures would have immediate and multiple benefits for human well-being.'

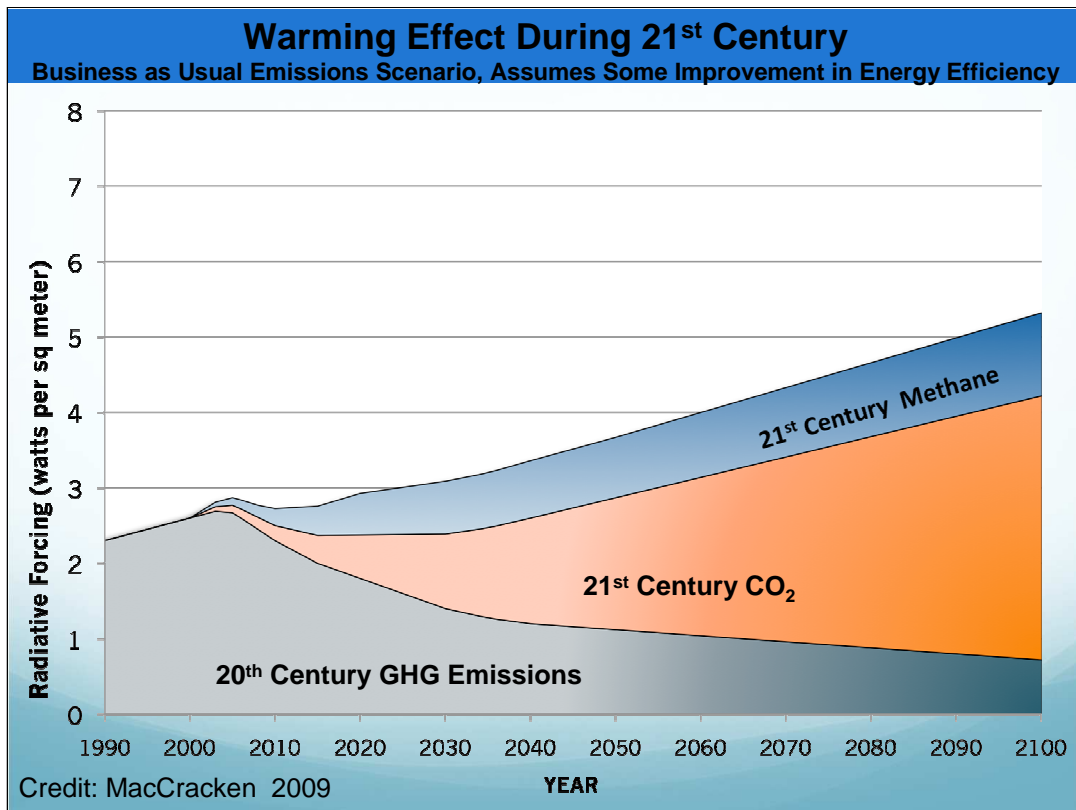


On the Y axis, warming effect, or radiative forcing, is the amount of heat energy trapped in the climate system by a particular pollutant.

This chart shows warming trends of long-lived green house gas emission trends, assuming improvements in energy efficiency.

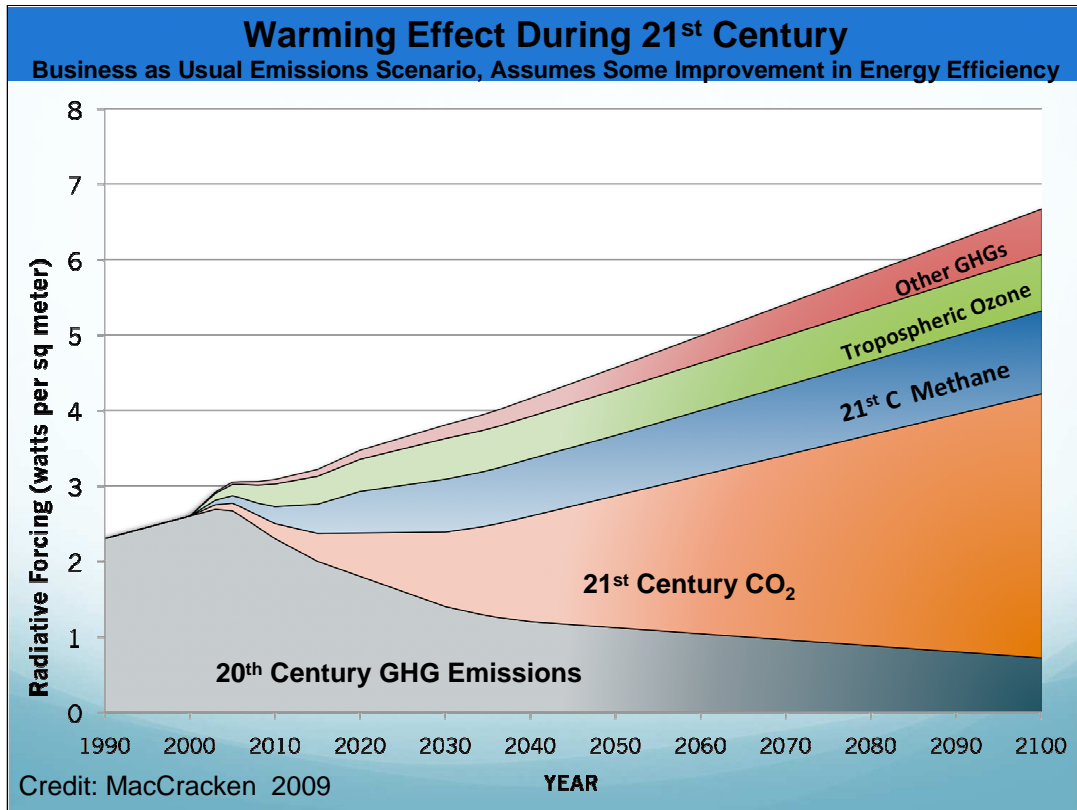
Notice that CO<sub>2</sub> emissions from this 21<sup>st</sup> century so far have only a minor effect but will grow over time as emissions amass.

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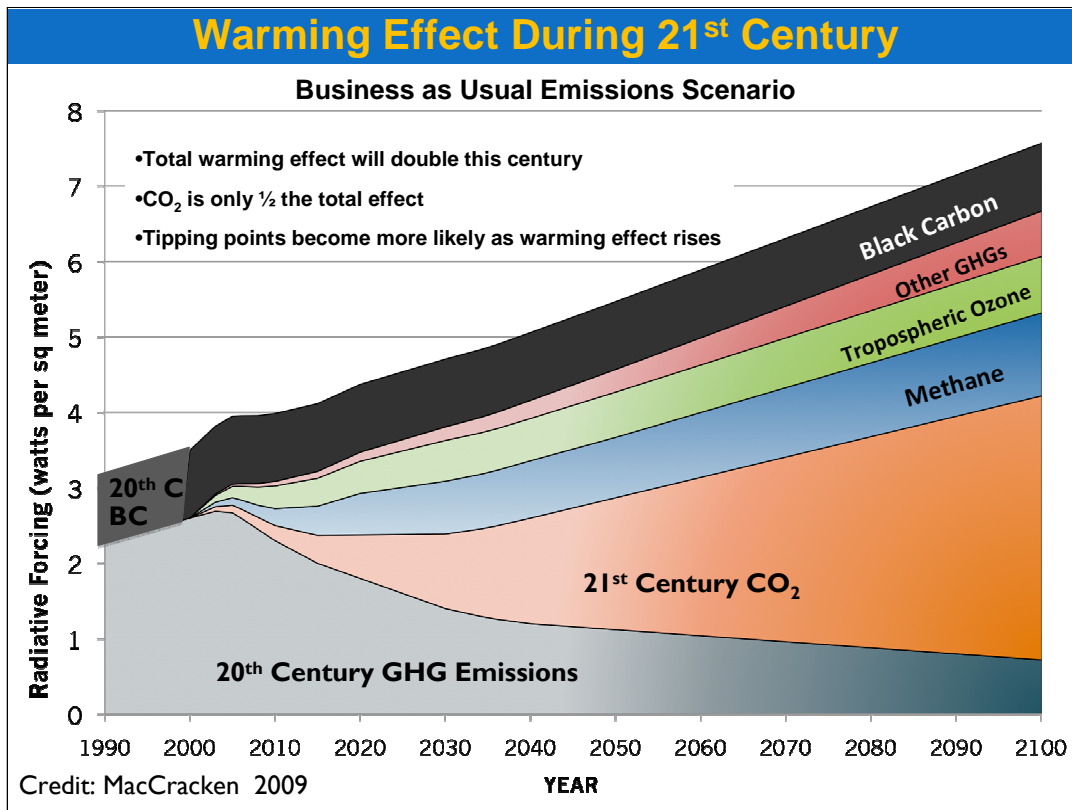


This slide adds methane emissions.





This slide adds ozone, and other GHGs.



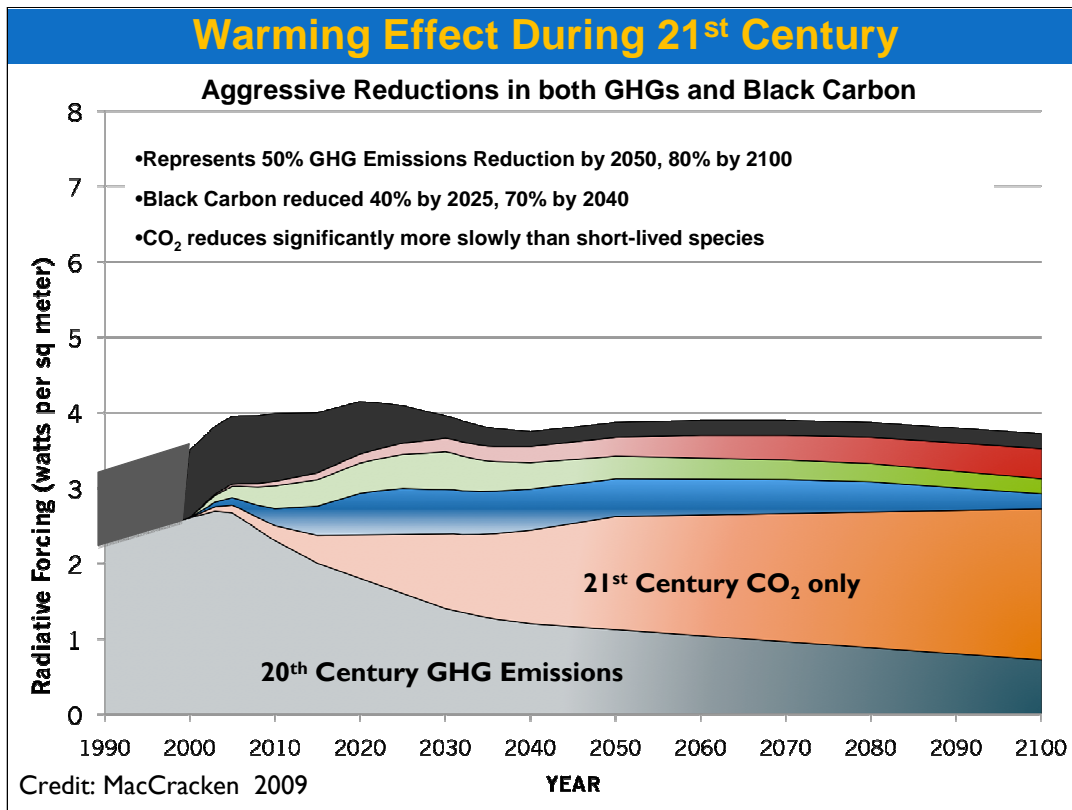
Here we see the full set of emissions added by ‘short lived climate forcers.’

Note that total warming effect will double this century AND that --- CO<sub>2</sub> is only ½ of the total effect.

BC, Methane, Ozone, and other GHGs are major sources of warming. **These short-lived species are a DISTINCT and newly understood opportunity to reduce global warming in the short term – before 2050 - because they last for shorter amounts of time.**

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 This assumes a constant value of 0.9 watts per square meter for black carbon (Ramanathan and Carmichael 2008). This does not include the warming caused by black carbon settling on snow and ice and increasing their rate of melt.

This graph does not show the cooling effect of sulfate aerosols. Reducing these emissions would cause an increase in the overall warming effect.

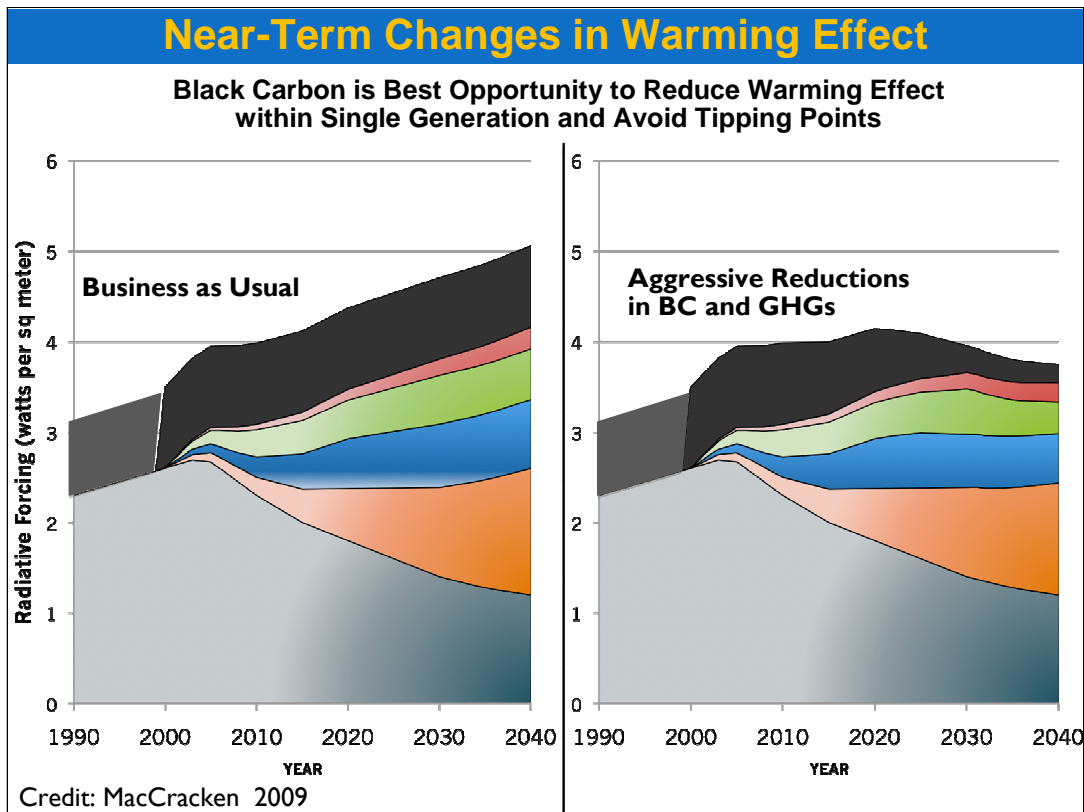


50% GHG Emissions Reduction by 2050, 80% by 2100

This show aggressive reductions in the full range of pollutants. Note that aggressive CO<sub>2</sub> reductions are needed now in order to keep CO<sub>2</sub> levels even barely manageable in 2100. It is critical to understand that reducing CO<sub>2</sub> remains central to long term climate stabilization.

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Again, the UNEP reports confirms that **Reducing short-lived forcers including black carbon and tropospheric ozone now will slow the rate of climate change within the first half of this century.**



-This is a comparison of the two previous slides out to the year 2040 (which is one generation)

-Reducing CO<sub>2</sub> alone will not alter warming trends.

Black carbon reductions offer the largest potential to quickly alleviate some level of global radiative forcing.

## Warming: Short/Long-Lived Forcers

Pollutant	Warming	LifeSpan
• Carbon Dioxide	1.56	Centuries-Millennia
• CFC / HCFC	0.28	100 to 1000 years
• N <sub>2</sub> O	0.14	114 years
• Methane	0.86	12 years
• VOC/CO (pre-O <sub>3</sub> )	0.27	hours/months
• <del>Black Carbon</del>	<del>0.44-0.9</del>	<del>1-2 weeks</del>
<b>Total</b>	<b>3.55 – 4.01 watts/ sq. meter</b>	

Sources: IPCC AR4 (2007), MacCracken and Moore (2008) Ramanathan and Carmichael (2008)

Now let's take a look at what we mean by short and long lived species. Each pollutant listed has a heating value and a lifespan,

First, notice that CO<sub>2</sub> is less than half of the total warming load. Out of a total 3 to 4 radiative forcing watts/ sq. meter of warming, CO<sub>2</sub> is only 1.56.

Also notice that while long-lived species like CO<sub>2</sub> live for hundreds to thousands of years, short lived species live from a few hours to about 12 years.

We will see that this difference in lifespan is very significant for modeling and policy making. It means that Short-lived climate forcers are fundamentally different from long-lived ghgs, and require special, immediate targeted reduction efforts.

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## Virulent Short-Lived Forcers Require New ANSI Measurement Standard

### Using 2050 Time Horizon

Global Climate Pollutants	GWP 2050
Carbon Dioxide	1
Methane	56
Nitrous Oxide	286
HFCs, CFC, HCFCs	200-3,000
Black Carbon	1,113
Tropospheric Ozone	49
	Source: Scientific Certification Systems

\*Under proposed standard, Arctic Regional Warming Potential of BC is equivalent to 44,000 times the warming power of CO<sub>2</sub>.

This chart shows WHY short lived species warrant immediate and special focus. Under a new proposed warming standard which I'll talk more about in a minute, methane has 56 times the warming effect of CO<sub>2</sub>, and black carbon has more than 1100 times the impact.

Black carbon is now referred to as a 'virulent climate forcer', given the intensity of its Global Warming Potential. However, the current standard for measuring Global Warming Potential is based on a 100 year timeframe so it obscures the impact of short lived forcers. The Climate Institute is involved in a committee of the American National Standards Institute which is working to take short lived forcers into account.

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Because virulent forcers like black carbon have exponential impact in regions like the Arctic, the new proposed standards include indicators such as the Arctic Regional Warming Potential which measures BC as equivalent to **44,000 times** the warming power of CO<sub>2</sub>.

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# Severe Arctic Warming

- BC is the driving force behind arctic warming:  
NASA estimates that combined sulfate decrease and BC increase caused 75% of direct Arctic warming over past 30 years.

“Tropospheric ozone and BC snow albedo effect contribute substantially to rapid warming and sea ice loss in the Arctic.” - James Hansen et al. 2005



When BC lands on polar ice, it begins to absorb heat like no other pollutant and the pace of polar melting increases dramatically.

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## Health and Other Impacts

### Black Carbon and Ozone:

- Indoor air pollution causes 1.8 million deaths annually; women and children make up 85% of all air pollution related deaths.
- Ozone reduces crop yields and disturbs rainfall and circulation patterns.

Black Carbon and ozone have major impacts on human health.

According to the World Health Organization, indoor air pollution causes 1.8 million deaths a year; women and children make up 85% of all air pollution related deaths.

Ozone reduces crop yields and alters rainfall patterns threatening both food and water security.



## Major Opportunity: Short-Lived Forcers

- Slashing emissions of black carbon (BC), methane and other short-lived climate forcers must be part of any credible strategy for climate stabilization before reaching major tipping points
- Reductions can be achieved through existing methods that provide public health and economic benefits
- BC and short-lived GHG reduction are the best opportunity for fast-acting climate change mitigation

**To review, short-lived forcers are a major opportunity.**

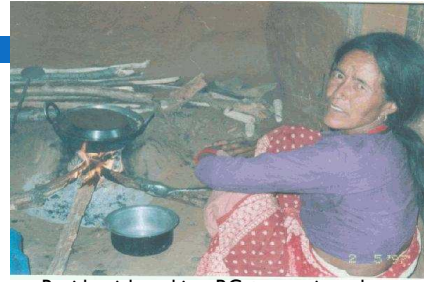
-If we are to have any realistic hope of climate stabilization before humanity and ecosystems have passed tipping points to irreversible damage we must focus much more heavily on slashing emissions of black carbon and short-lived GHGs such as methane.

-Limiting carbon dioxide is crucial in the long haul but due to its century or more persistence in the atmosphere, even if we could wave a magic wand and end all emissions tomorrow, CO<sub>2</sub> concentrations would stay relatively steady for a generation or more.

## Sources of Black Carbon



Open burning: BC+ organic carbon



Residential cooking: BC + organic carbon

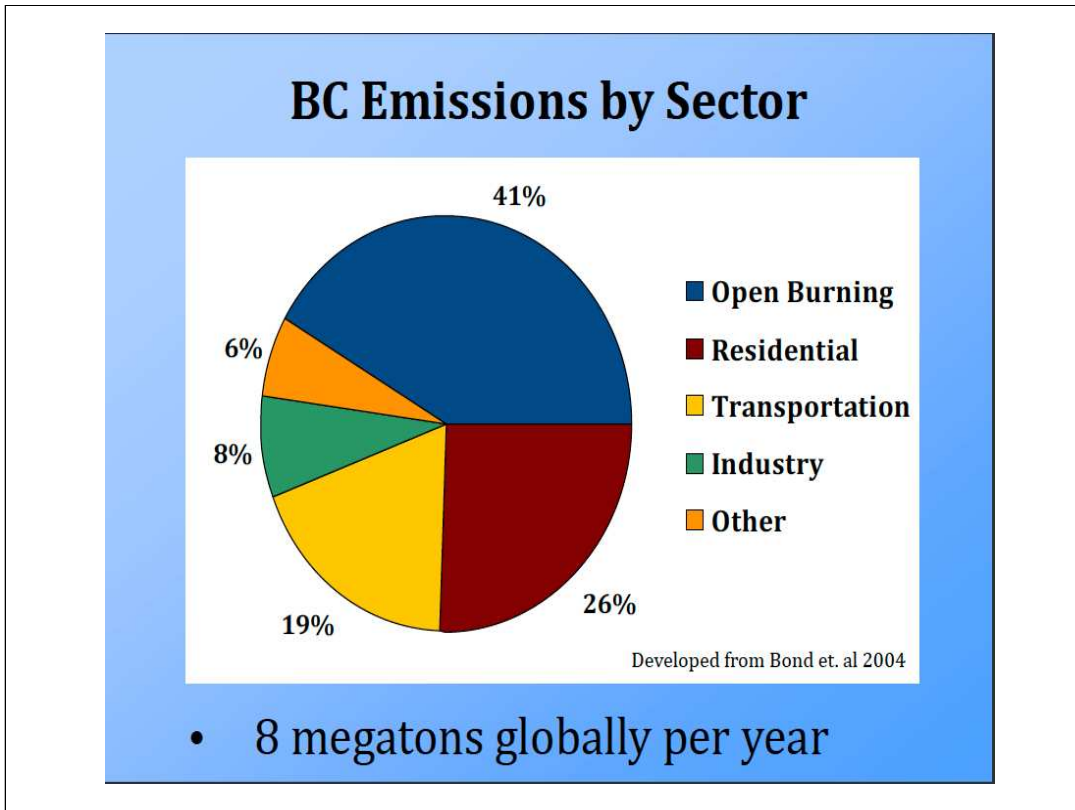


Transportation: Diesel is BC rich



Industry (coke) BC and sulfate

Sources of Black Carbon include open burning, residential cooking, diesel engines and industrial processes.



This gives a picture of global BC emissions.

## Benefits from BC Reduction

- Atmospheric loading and warming influence will drop as emissions drop
- Acute decrease in Arctic warming
- Reducing certain BC emissions will result in:
  - Reduced indoor air pollution, which kills 1.8M annually
  - Reduced outdoor air pollution, which kills 0.8M annually

Now some relief! benefits of reducing BC include acute decrease in Arctic and global warming, and millions of lives saved each year due to improved air quality.

## Ways to Reduce BC

- Cleaner Cookstoves
- Improved Diesel Engines using Low-Sulfur Fuel
- Diesel Particulate Traps
- Industrial Energy Recycling
- High-Efficiency Brick Kilns
- Suppression of Forest Fires (especially in the Arctic)
- Two-Stroke Engine Retrofits and Phase-out (Asia)

Now let's talk about some of the technologies that reduce BC emissions.

# Global Alliance for Clean Cookstoves

A new public-private partnership led by the United Nations Foundation seeking to create a thriving global market for clean cookstoves in the developing world in order to:

- **Save lives** by reducing exposure to cookstove smoke;
- **Empower women** through productive enterprises associated with stove use, distribution, and production;
- **Improve livelihoods** by reducing disease, freeing time and saving money (which can be used for the purchase of food, medicine, or school fees) and many other social benefits (e.g. clean kitchen, extra time, etc.
- **Combat climate change** by mitigating emissions of black carbon and greenhouse gases, reducing rate of deforestation
- **Advance Millennium Development Goals** related to poverty, health, gender equality, and the environment.



There is a newly launched Global Alliance for Clean Cookstoves led by the UN Foundation which aims to distribute 20 million clean stoves by 2020. States and municipalities can create programs to distribute cookstoves.

## Reducing Residential BC Cookstoves



- Improved-Combustion Stoves

- ~40% reduction in black carbon
- Faster cooking times; halves fuel consumption
- Envirofit sells for ~\$25, includes 5-yr warranty
- 60,000 sold in India since Oct 07
- 780 M stoves = \$20 B

This is an example of a clean cookstove which reduces black carbon by 40% which also translates into lives saved.

## Reducing Transportation BC Diesel Engines



### Ultra-Low Sulfur Diesel (ULSD)

15 ppm or less  
\$.08 per gallon extra

### New Engines

'07 buses and trucks 99% BC reduction  
over '04 models

### 2008 Production

3.6 M large trucks (+ 10%)  
0.7 M buses (+ 20%)

### Engine Retrofits

#### Diesel Particulate Filter (DPF)

PM reduction 85-97%  
Effective on models newer than '94  
\$5,000 - \$7,500

For diesel engines, there are two main reduction methods: new clean diesel engines and diesel particulate filters for trucks, buses, farm and construction vehicles. Trains and ships also use diesel.

New York City adopted regulations in 2000 and 2003 requiring the use of Diesel Particulate Filters in city buses and off-road construction equipment working on city projects. Santiago and London have adopted similar regs. Mexico City is also doing this.

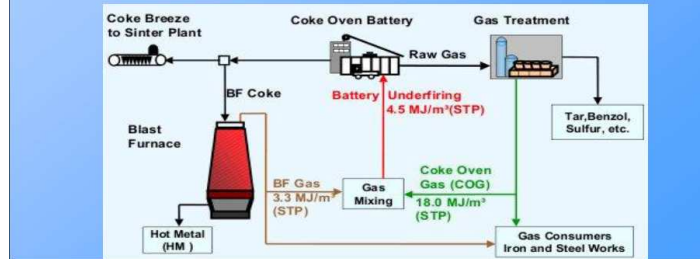
Also the Southern Alliance for Clean Energy secured federal funds (under the DERA program) to finance clean diesel trucks in the southeast region of the US. The program, *Clean Trucks Make Cents*, will finance up to 100 percent of the purchase or lease of pre-2007 tractor-trailer trucks. It is designed to help drivers and small businesses who might not normally qualify for such a loan but who want to make the move to a cleaner burning truck.

[The U.S. Environmental Protection Agency (EPA) awarded \$5 million to Southern Alliance for Clean Energy (SACE) to finance clean diesel trucks through [EPA's SmartWay® Clean Diesel Finance Program](#).]



## Reducing Industrial BC Coke Industry

- Production 2000 - 2007
  - World: + 56%
  - China: + 258%
  - China's market share grown from 36% to 59%
- Modern techniques
  - By-product coke making
  - Heat recovery coke making



Replacing traditional coke ovens with modern recovery ovens, including the improvement of tailpipe abatement measures is an emission reduction option..

## Reducing Industrial BC Brick Industry



- Manual production
  - 1.27 T bricks per year
  - 300,000 coal-fired kilns
  - China: 55%
  - India: 11%
    - 1/3 of all kilns
    - 1.4 M per kiln per year
- Vertical Shaft Brick Kilns
  - Use 60% less coal
  - 10x capacity of average Indian kiln

Small scale brick kilns are a significant source of air pollution. The UNEP report cites 20,000 in Mexico alone, emitting large amounts of black carbon. Ciudad de Juarez has a pilot project kiln which improved efficiency by 50 percent and decreased emissions by 80 percent.

# Ways to Reduce Methane

- **State of Illinois Biogas and Biomass to Energy Grant Program**

to support capture of landfill gas, biomass, CHP/Cogeneration, Biogas (methane produced by livestock manure and waste, municipal waste water sludge, segregated organic wastes), Anaerobic Digestion of manure, Other Distributed Generation Technologies

- **Fossil Fuel Production**

Recovery of methane leakage from extraction, transmission, and storage of coal, oil and natural gas.

**Methane capture can be done profitably.**

Many state and localities have renewable energy programs which include methane sources. The State of Illinois has a Biogas and BioMass to Energy Program which provides 50% of project financing to encourage methane capture and includes the full range of sources such as landfills, municipal solid waste sludge, and livestock methane.

According to the UNEP report, landfill methane emissions are 10 percent of total ghg emissions in Mexico.

# State and Local Policies

Database of State Incentives for Renewables &  
Energy Efficiency

[www.dsireusa.org](http://www.dsireusa.org)

There are renewable energy purchasing programs,

## **Black Carbon Reduction Council 5-Year Goals**

- Dramatically raise awareness of short-lived climate forcers across the globe
- BC and other win-win strategies included in 40 national/state Climate Action Plans or related policies
- Related reduction targets included in UN climate framework
- BC and fast-action metrics included in ISO-certified life cycle assessment standard

# Black Carbon Reduction Program

The program will support the Council's mission in the following ways:

- Publicize work of Council and its members through press releases, briefings and other communications
- Prepare papers on specific technologies critical to fast-action mitigation
- Publish quarterly summaries of relevant policy/legislative matters in U.S. and other important countries
- Assist efforts to give economic valuation to BC and to include BC in ISO Life Cycle Assessment Standards
- Assist in preparation of national climate mitigation strategies regarding black carbon reduction



Gracias

[www.climate.org](http://www.climate.org)