

# **Transport, Black Carbon & Climate Change**

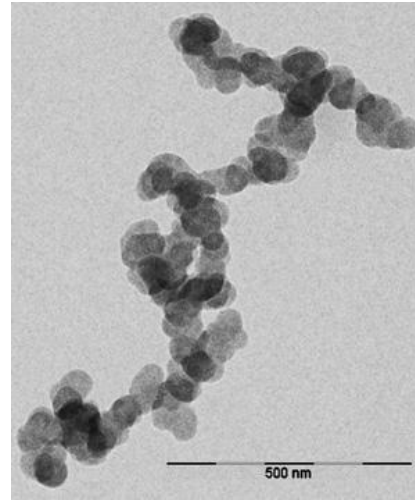
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**AIT-UNEP Regional Resource Center for Asia and the Pacific**



**5<sup>th</sup> Regional Environmentally Sustainable Transport Forum**  
Bangkok, 23-25 August 2010

# Black carbon (Soot)



Fossil fuel



Fossil fuel

**Source:** Incomplete combustion of fuel

**Size:** ~ few nanometers to 10 micrometer

**Atmospheric life-time:** few weeks

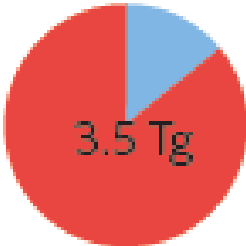
Biofuel



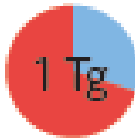
Biomass burning



# Relative importance of BC Sources: Global



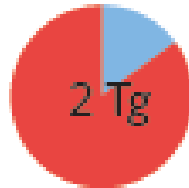
Open burning



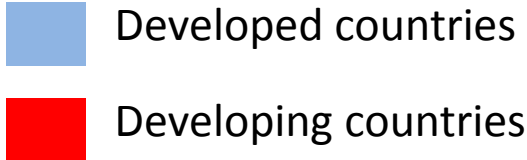
Industry and power



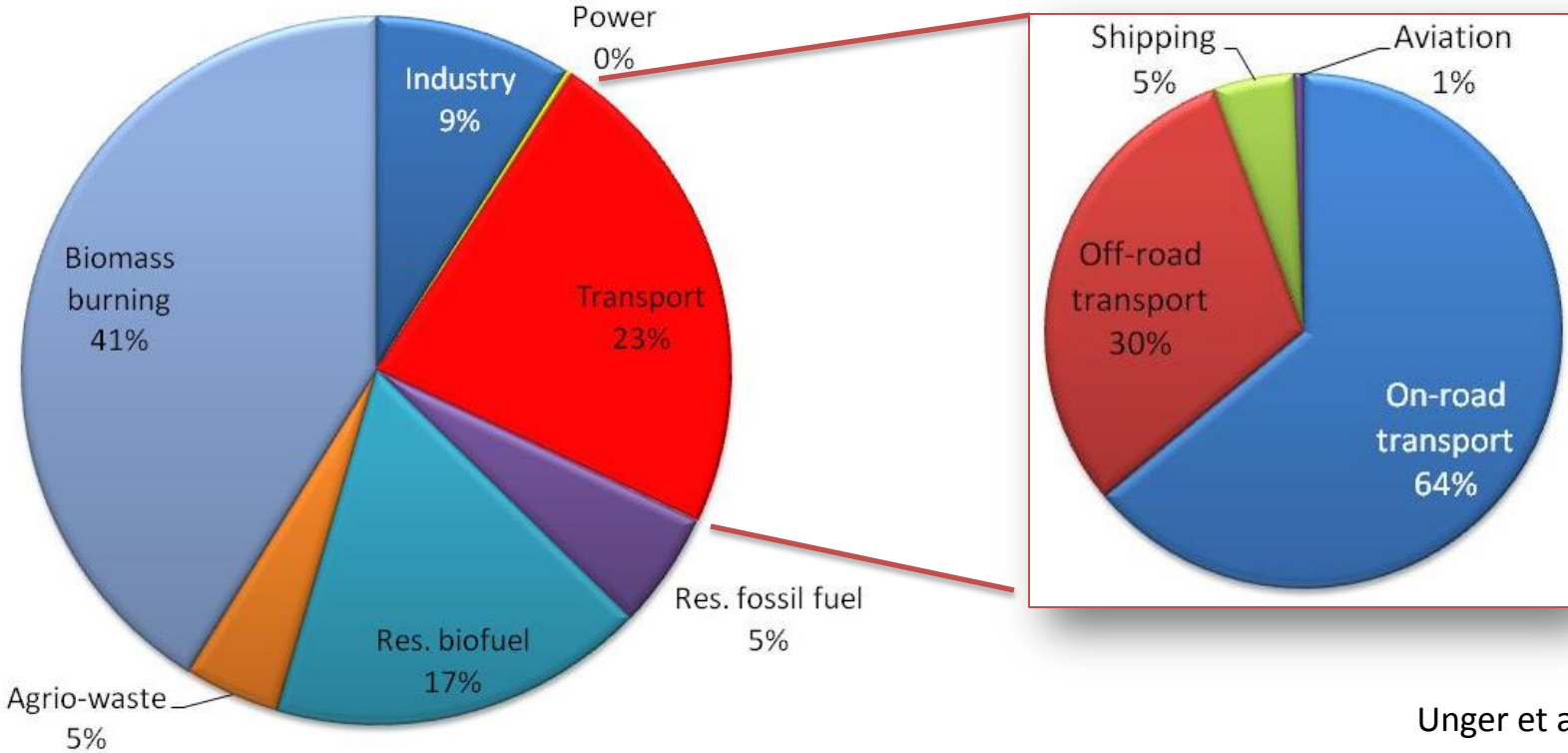
Transport



Residential fuel use

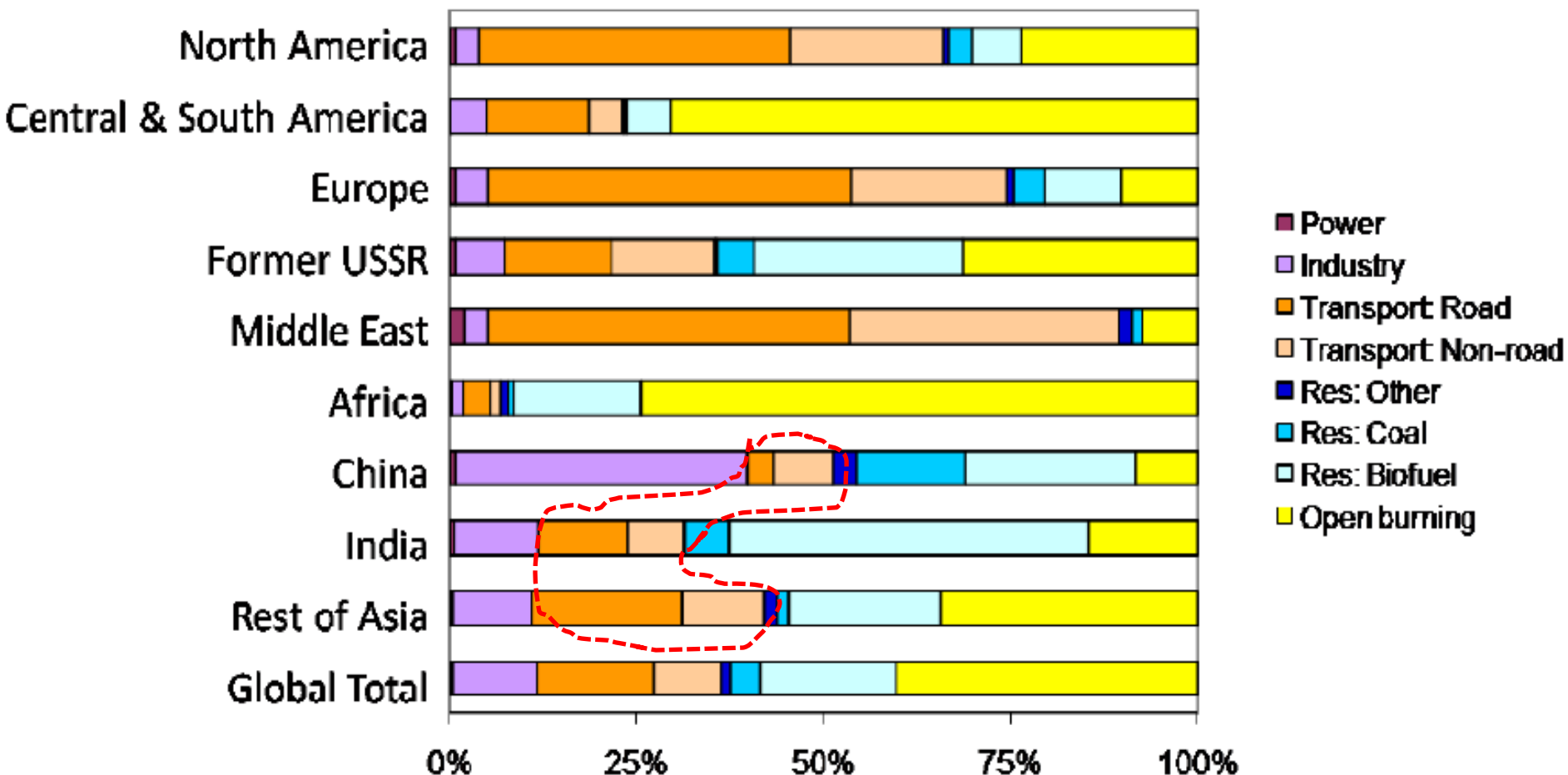


Grieshop et al, 2009



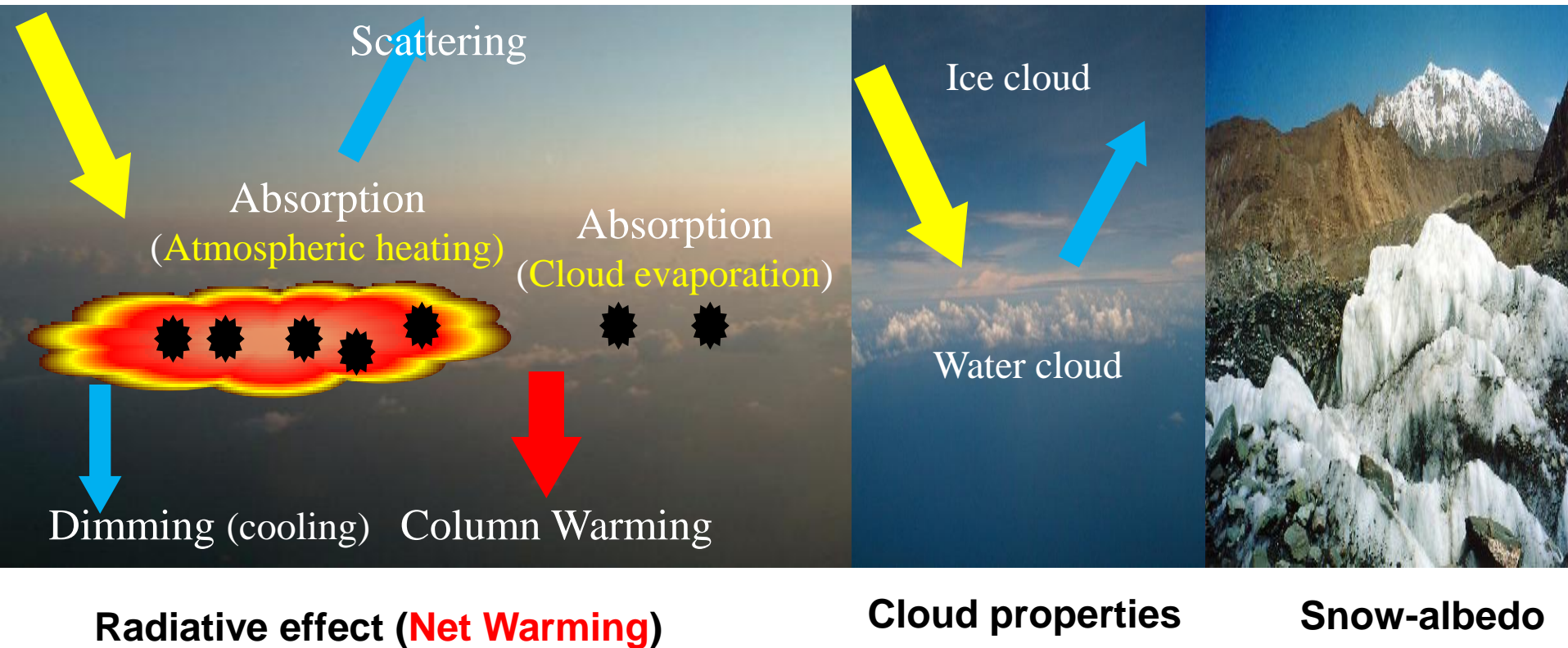
Unger et al. PNAS, 2010

# Relative Importance of BC Sources: Regions



Transport : 3<sup>rd</sup> largest energy-related source of BC in Asia

# Black Carbon & Climate Change



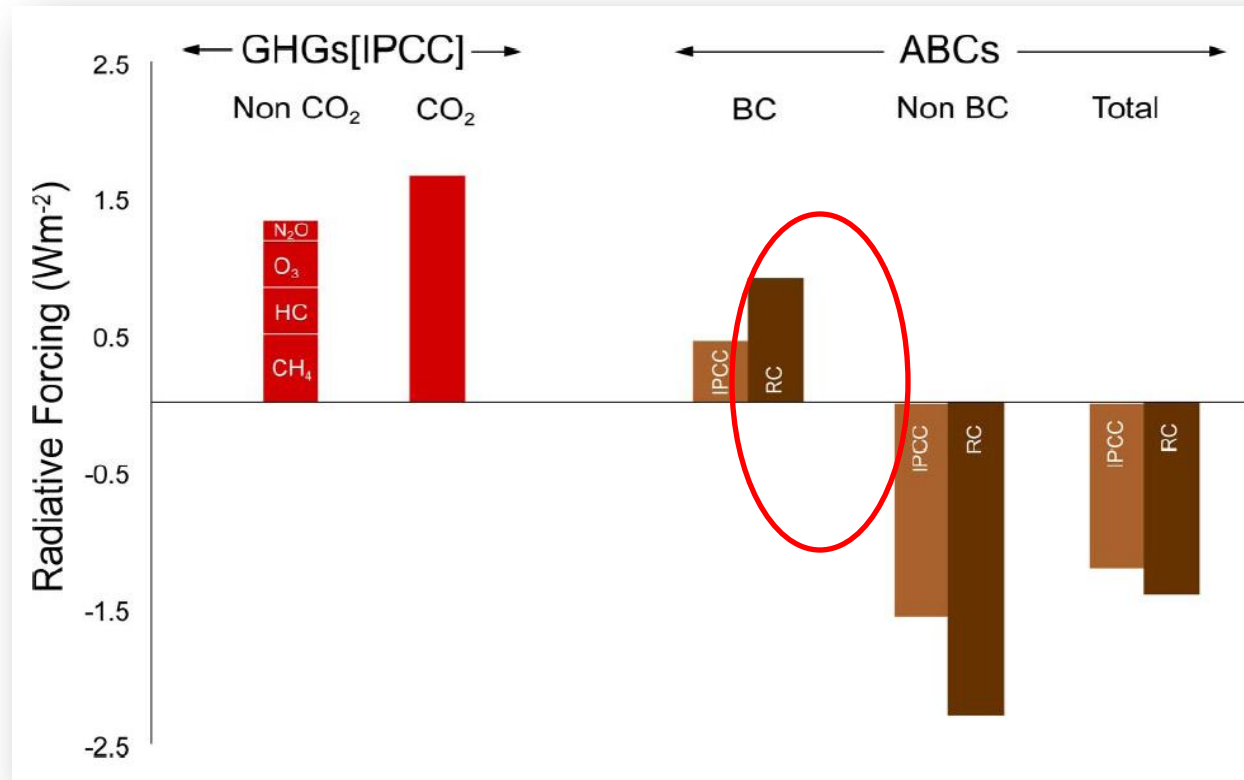
Radiative effect (**Net Warming**)

Cloud properties

Snow-albedo

- Global warming potential of BC (20 yrs) : ~ 2000-3000 times that of CO<sub>2</sub>.
- In addition, BC deposition on snow is attributed to accelerated melting of snow/ice in Arctic and glacier melting in the Himalayas.

# Black Carbon & Climate Change



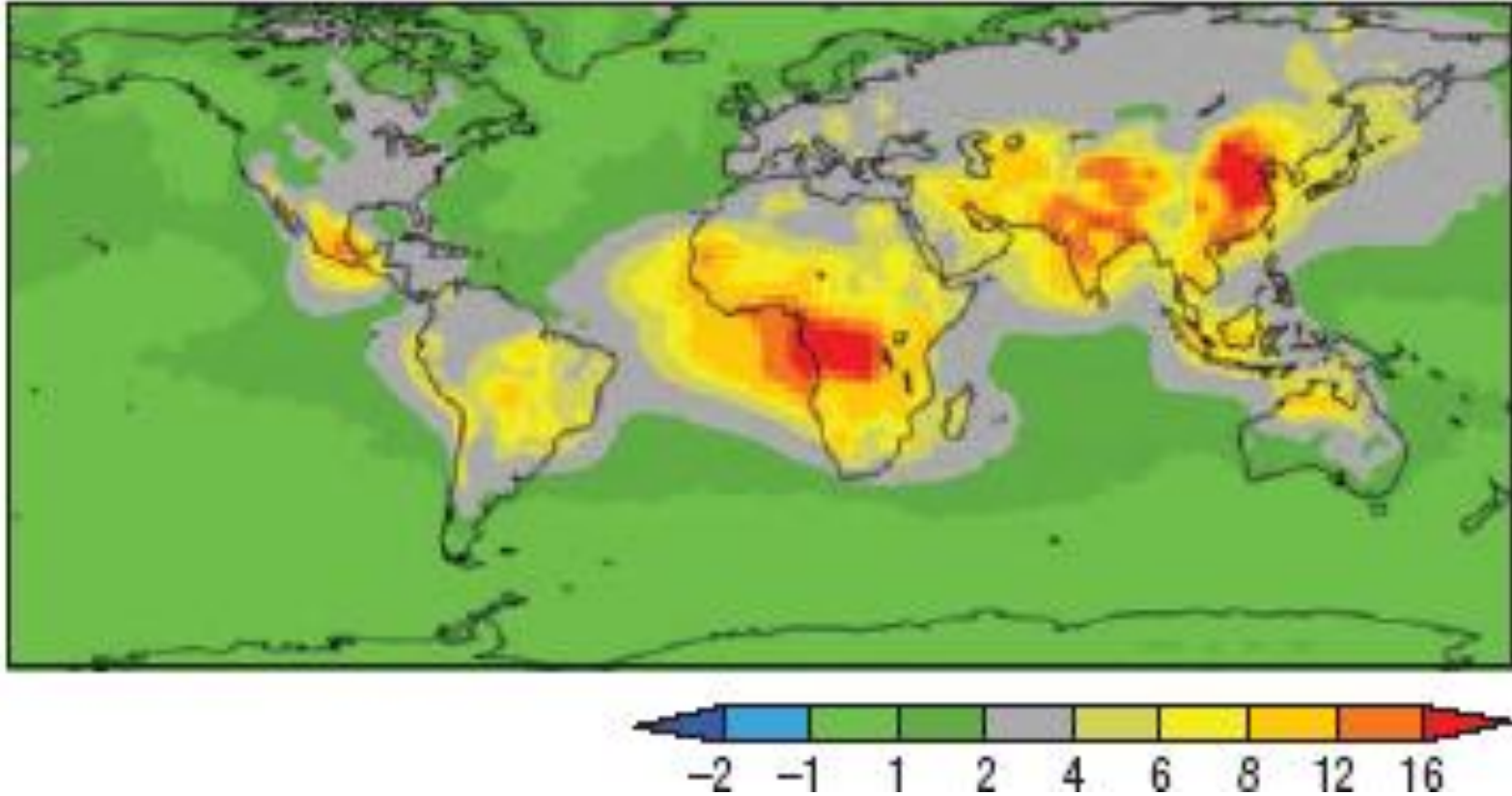
Ramanathan and Feng, PNAS, 2009  
Ramanathan and Carmichael, Nat. Geosci., 2008

- BC Forcing: +0.9 Wm<sup>-2</sup> (+0.4 --+1.2 Wm<sup>-2</sup>), ~ 55 % of CO<sub>2</sub> forcing (1.66 Wm<sup>-2</sup>).  
BC is 2<sup>nd</sup> or 3<sup>rd</sup> strongest contributor to global warming after CO<sub>2</sub>.
- Powerful regional climate forcing (atmospheric heating + BC deposition on snow/ice) due to inhomogeneous distribution of sources.



# Black carbon & Climate Change

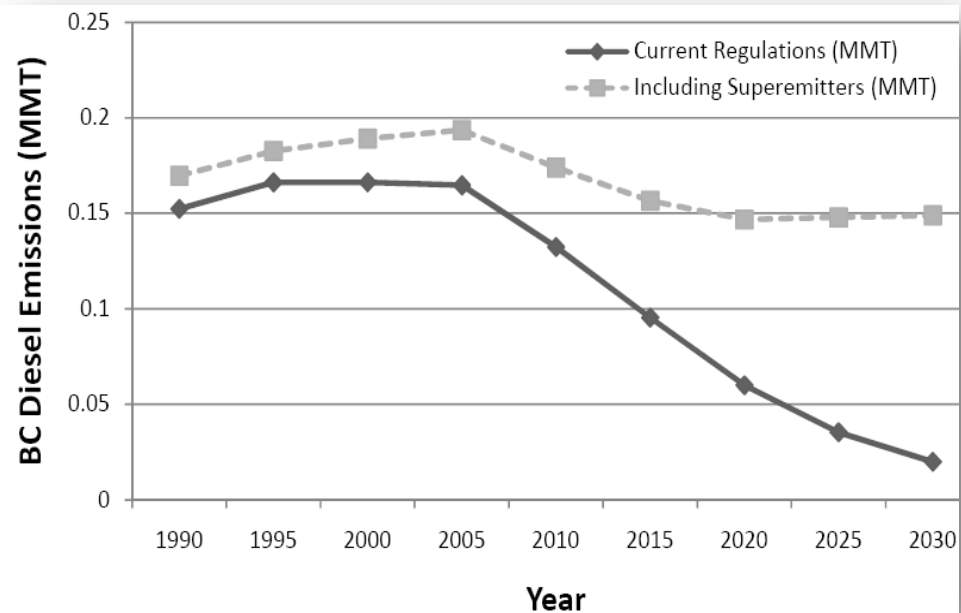
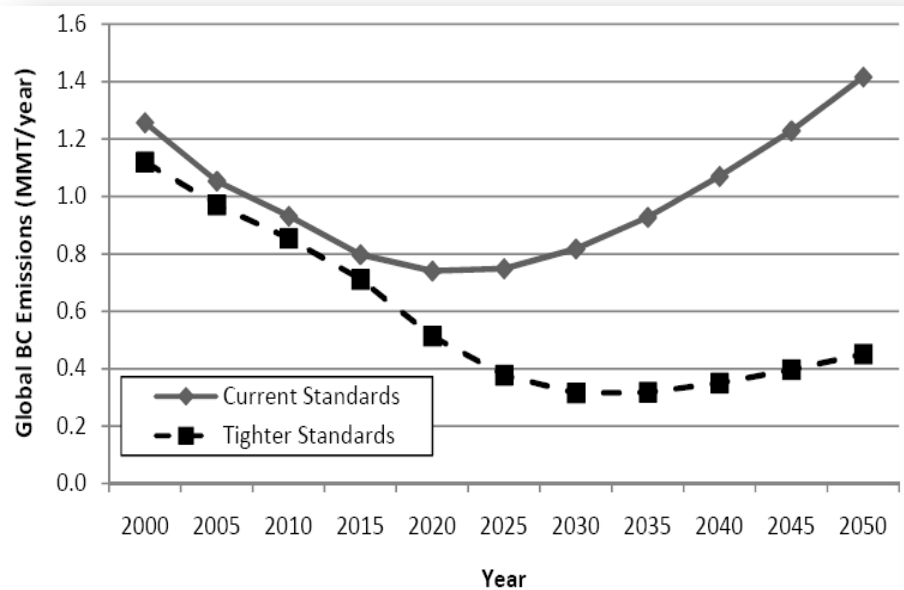
Atmospheric heating ( W/m<sup>2</sup>)



- Powerful regional climate forcing (atmospheric heating + BC deposition on snow/ice) due to inhomogeneous distribution of sources.

# Mitigation of BC from Transport Sector

## Projected on-road BC emissions



Potential importance of “superemitters”

Superemitters: ~ 15% vehicles in Asia



# Mitigation of BC from Transport

- **Technical:**

Technologies exist to reduce most emissions of BC without limiting the underlying activities.

- Fuels Switch (LPG, CNG, electricity) etc.
- Low sulfur fuel ( required for PDF).
- Diesel Particle filter (DPF) for both New and Old vehicles
- Engine Modification,
- Stringent emission standards (new engine standards, replacement of old vehicles) and inspection/maintenance programs

- **Economical:**

Typically amenable to lower cost end-of-pipe control or equipment fixes which are readily deployable.

# Project Atmospheric Brown Cloud (ABC)

ABC-Asia, ABC-Africa and ABC-Latin America

## ABC -Asia

1. Observation

Aerosol and climate, precipitation chemistry, High altitude observatories

2. Impact Assessment

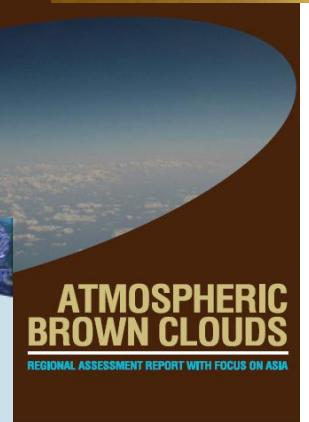
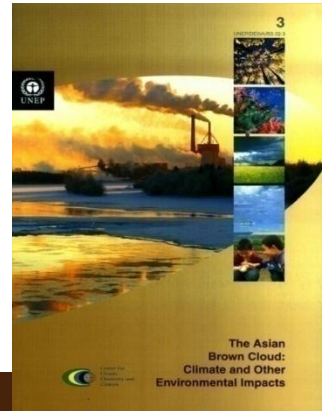
Climate Change, Water Budget, Agriculture and Human Health

3. Mitigation

Emission Inventory and Project SURYA

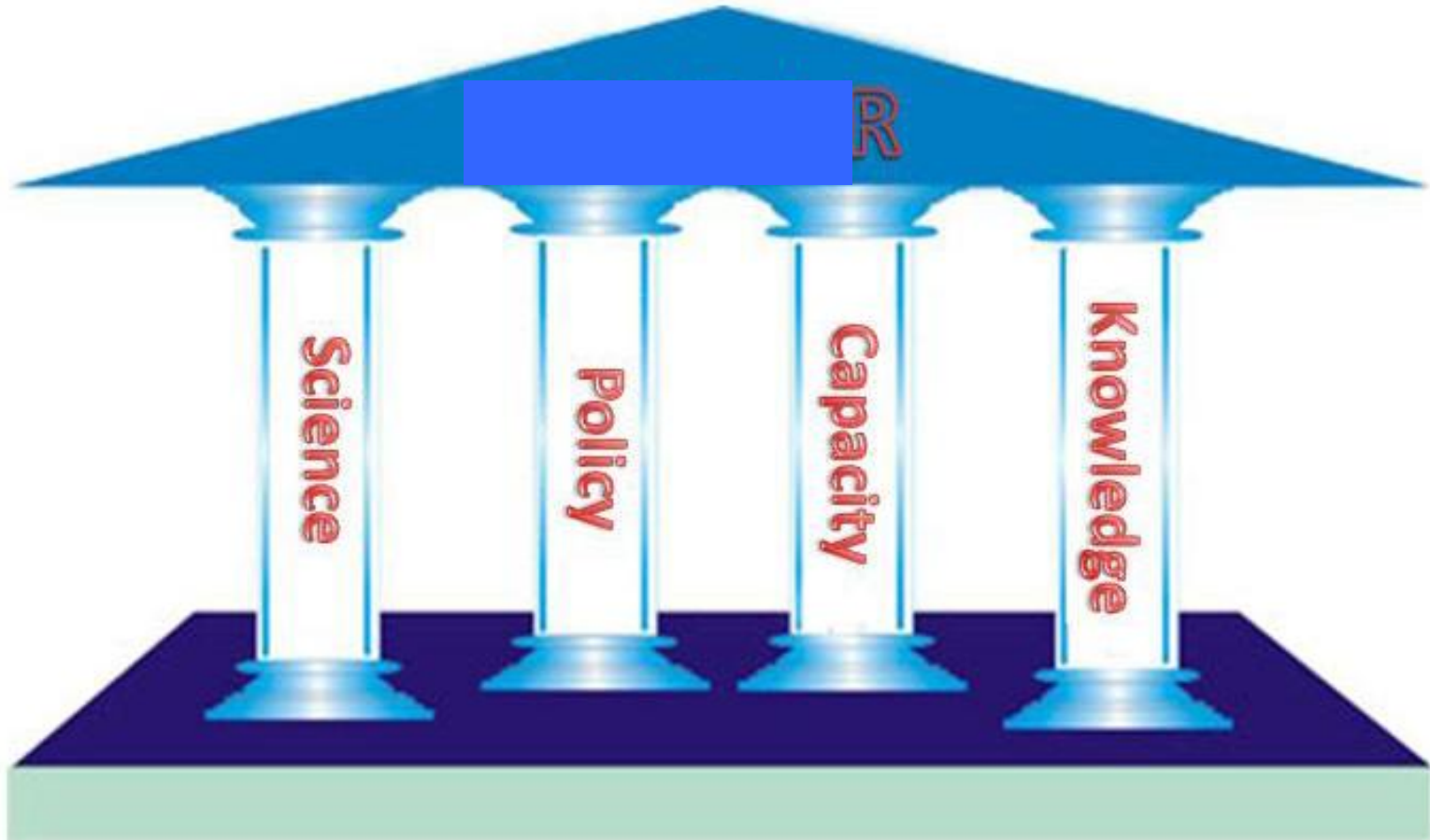
4. Knowledge Management

6. Awareness and Consensus for policy



[www.rrcap.unep.org/abc](http://www.rrcap.unep.org/abc)

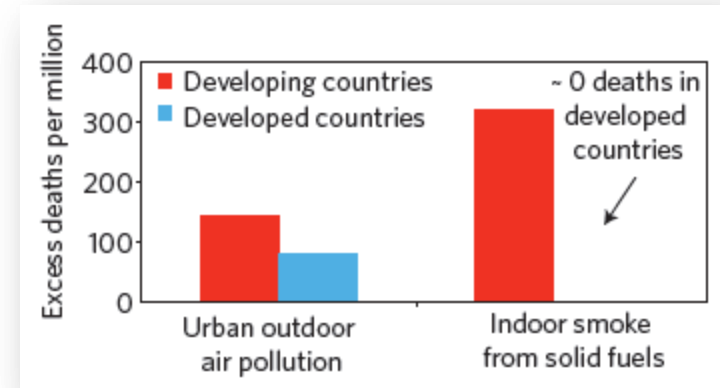
**AIT-UNEP Regional Resource For Asia and the Pacific:**  
**Regional Center of Excellence in Atmospheric Resources**



# SUMMARY

- **BC reduction from transport sector will result in immediate climate benefit in a short-period. But it will require matching Sulfur emission reduction, alongside a long term CO2 reduction.**

- Controlling particulate matter pollution (including BC) from diesel vehicles in developing Asia also results in very large **health benefits**



*Grieshop et al, 2009*

- Control of transport-based BC emissions should be an essential part in any comprehensive BC control strategy as well as Environmentally Sustainable Transport Strategies in Asia.