TIME TO ACT

TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

CCAC

The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) is a voluntary partnership uniting governments, intergovernmental organisations, civil society and the private sector in the first global effort to address short-lived climate pollutants (SLCPs) as an urgent and collective challenge, in ways that protect the environment and public health, promote food and energy security, and address near term climate change. The Coalition's work is complementary to the global action to reduce carbon dioxide, in particular efforts under the United Nations Framework Convention on Climate Change (UNFCCC).

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“If someone proposed that you could save close to 2.5 million lives annually, cut global crop losses by around 30 million tonnes a year and curb climate change by around half a degree Celsius,

what would you do?”

“Act of course …”

Achim Steiner
Executive Director
United Nations Environment Programme (UNEP)

Time to Act

Short-lived climate pollutants are everywhere in our lives. They are impacting the climate system and the quality of our air. It is time to act against these pollutants and deliver near term and multiple benefits for human well-being.

BC CH_4 HFCs

Major Preventable SLCP Sources

01 Time to Act

It is time to act.

Recent scientific assessments coordinated by the UN Environment Programme (UNEP) have identified a number of "win-win" measures for near term climate protection and clean air benefits (UNEP & WMO 2011; UNEP 2011a, UNEP 2011b). Fast uptake of these cost-effective and readily available measures, which target emissions of short-lived climate pollutants (SLCPs) in key sectors, could bring rapid and multiple benefits for human well-being.

SLCPs, such as black carbon (BC), methane (CH_4), tropospheric ozone (O_3), and many hydrofluorocarbons (HFCs), have a warming effect on climate, and most of them are also dangerous air pollutants with detrimental impacts on human health, agriculture and ecosystems.

These measures are spread across a variety of sectors, from waste management, where CH_4 emissions can be harnessed as a source of energy, to transport, where high-emitting vehicles can be eliminated to reduce BC emissions, to industry where new technologies can be phased in to avoid use of HFCs with a high global warming potential (GWP) (see full list of measures on page 20).

"If someone proposed that you could save close to 2.5 million lives annually, cut global crop losses by around 30 million tonnes a year and curb climate change by around half a degree Celsius, what would you do? Act, of course" UNEP's Executive Director, Achim Steiner, has written. "More than a decade of painstaking science has built a case that cannot be ignored, namely, that swift action on the multiple sources of black carbon, HFCs, and methane can deliver extraordinary benefits in terms of public health, food security and near term climate protection."

The SLCP Challenge

SLCPs are responsible for a substantial fraction of near-term climate change, with a particularly large impact on sensitive regions of the world, and have significant detrimental health, agricultural, and environmental impacts.

CLIMATE AND AIR POLLUTION IMPACTS

Climate	Contribute to **global warming**	Disrupt **weather patterns**	Accelerate **melting**
Human Health	**3.5 MILLION/Yr Premature Deaths From** Indoor **Air Pollution**	**3.2 MILLION/Yr Premature Deaths From** Outdoor **Air Pollution**	
Crop Yields	**110 MILLION TONNES/Yr Crop Losses From** 4 Major Staples		

Latin America and Caribbean	2%	9.5%
N. America and Europe	10%	52%
Africa	9%	3.5%
S. W. and Central Asia	35%	18.4%
NE, SE Asia and Pacific	45%	16.6%

Regional share of annual global premature deaths and crop losses due to **air pollution**

02 The SLCP Challenge

SLCPs and co-emitted pollutants have important impacts on our climate system and the quality of our air.

CH_4, BC, and O_3 are the most important contributors to current global warming after carbon dioxide (CO_2). While HFCs emissions are currently small, they are projected to rise and could be equivalent to 7 to 19% of CO_2 emissions by 2050 (UNEP 2011b).

At the regional level, BC and O_3 in the lower atmosphere disturb rainfall and regional circulation patterns, such as the Asian Monsoon, and may increase destructiveness of storms, such as tropical cyclones in the Arabian Sea. BC darkens the surface of snow and ice, increasing the absorption of sunlight and exacerbating melting, particularly in the Arctic and other glaciated and snow-covered regions.

BC and co-pollutants make up for the majority of particulate matter 2.5 (PM2.5) air pollution, one of the leading environmental causes of ill health and premature death. 3.5 and 3.2 million people die prematurely each year from exposure to indoor and outdoor PM2.5 pollution, respectively (Lim S. *et al*. 2012). O_3, of which CH_4 is one of the main precursors, is also a major air pollutant, which damages ecosystem structure and functions and the health and productivity of crops, thus threatening food security. O_3 also reduces the ability of plants to absorb CO_2, altering their growth and variety.

SLCPs are responsible for a substantial fraction of near term climate change, with a particularly large impact in sensitive regions of the world, and can have significant, detrimental health, agricultural and environmental impacts. However, the challenge is yet to be fully recognised by the international community.

The SLCP Opportunity

Benefits of Control Measures

A number of available mitigation options have been identified that if rapidly implemented have the potential to deliver **rapid multiple benefits** for human well-being by improving air quality and reducing near-term global warming.

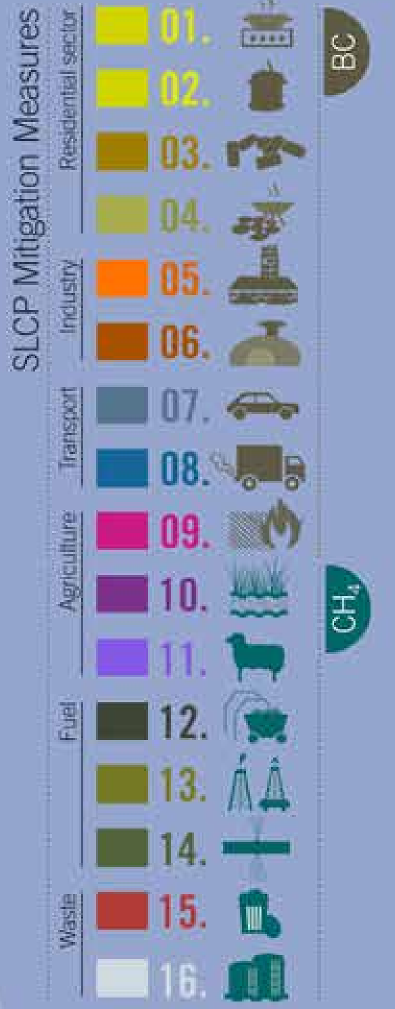
ANNUAL BENEFITS

From large-scale mitigation by 2030

Climate	Avoided **warming**	Reduced disruption of **weather patterns**	Reduced rate of **melting**
Health	**2.4 MILLION**	avoided premature deaths anually from outdoor air pollution	
Crops	**52 MILLION**	tonnes of avoided crop losses from 4 major staples/year	

	Health	Crops
N. America and Europe	5%	26%
Latin America and Caribbean	2%	8%
Africa	9%	3%
S. W. and Central Asia	47%	35%
NE, SE Asia and Pacific	37%	28%

AVOIDED WARMING



FROM 16 MEASURES
UP TO 0.5 °C
TOTAL AVOIDED WARMING

FROM HFCs MEASURES
UP TO 0.1 °C
ADDITIONAL AVOIDED WARMING

HFCs

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03 The SLCP Opportunity: Benefits of Control Measures

Compelling scientific evidence indicates that rapid and large-scale implementation of SLCP control measures could deliver near term multiple benefits for climate protection, public health and food and energy security.

Recent reports have identified 16 BC and CH_4 measures that can deliver significant benefits to human well-being by protecting the environment and public health, promoting food and energy security, and addressing near term climate change. These measures involve technologies and practices that already exist and in most cases are cost effective.

If fully implemented by 2030, these measures could reduce global CH_4 emissions by about 40% and BC emissions by about 80% relative to a "reference" scenario (UNEP & WMO 2011).

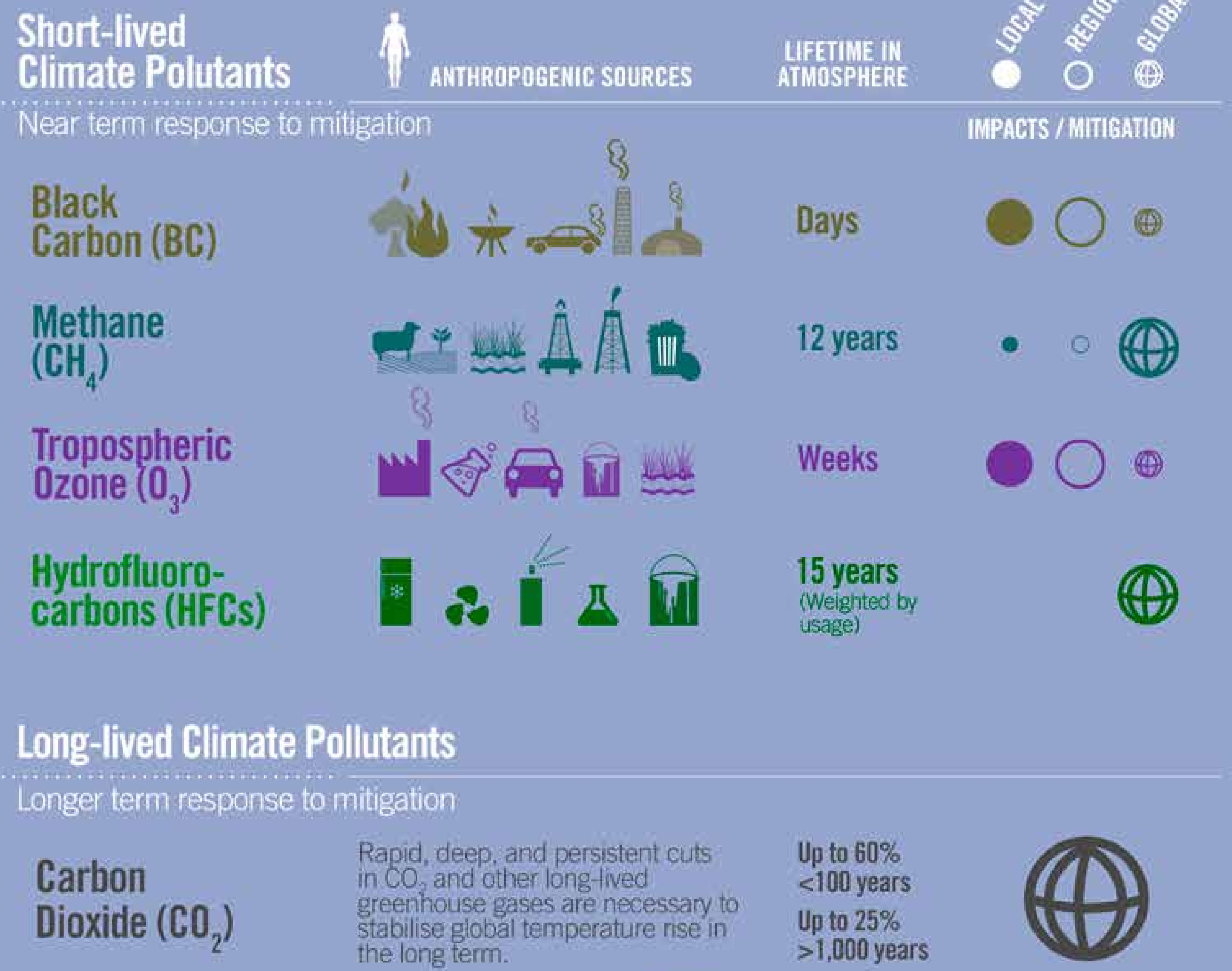
For CH_4, the main reductions would be achieved by addressing emissions from coal mining and oil and gas production, including through pre-mine degasification, recovery and oxidation of methane from ventilated air from coal mines, and improved control of unintended fugitive emissions from oil and natural gas production.

At the global level, measures targeting the residential and transport sectors offer the largest potential for reductions of BC emissions, including implementation of standards for the reduction of pollutants from vehicles, elimination of high-emitting vehicles, and dissemination of cleaner and more efficient cooking and heating stoves. About half of these emission reductions could be achieved through net cost savings over the lifetime of the measures (UNEP 2011a).

Large-scale implementation of these measures by 2030 would likely prevent 2.4 (0.7–4.6) million premature deaths from outdoor air pollution annually and avoid annual crop yield losses of over 50 (30–135) million tons, which represents an increase of a up to 4% of the total annual global crop production. Implementation could also slow down the warming expected by 2050 by about 0.5°C (UNEP & WMO 2011) – and by about 0.7°C in the Arctic by 2040 – and could have significant regional climate benefits in sensitive regions of the world, reducing disruption of rainfall patterns and slowing the melting of some glaciers (WB & ICCI 2013). Action to reduce the climate impacts of HFCs, such as using hydrocarbon refrigerants in domestic refrigerators, freezers and small air conditioning units, could deliver additional near term climate change mitigation benefits.

However, while fast action to mitigate SLCPs could help slow the rate of climate change and improve the chances of staying below the 2°C target in the near term, longer term climate protection will only be possible if deep and persistent cuts in CO_2 emissions are rapidly realised.

What are Short-Lived Climate Pollutants?



Short-lived Climate Polutants

Near term response to mitigation

Short-lived Climate Polutants	ANTHROPOGENIC SOURCES	LIFETIME IN ATMOSPHERE	LOCAL	REGIONAL	GLOBAL
			IMPACTS / MITIGATION		
Black Carbon (BC)		Days	●	○	⊕
Methane (CH_4)		12 years	●	○	⊕
Tropospheric Ozone (O_3)		Weeks	●	○	⊕
Hydrofluoro-carbons (HFCs)		15 years (Weighted by usage)			⊕

Long-lived Climate Pollutants

Longer term response to mitigation

Carbon Dioxide (CO_2)	Rapid, deep, and persistent cuts in CO_2 and other long-lived greenhouse gases are necessary to stabilise global temperature rise in the long term.	Up to 60% <100 years Up to 25% >1,000 years	⊕

SLCP IMPACTS

- Harm public health
- Reduce food security
- Warm the atmosphere
- Increase ice and snow melting
- Disrupt weather patterns

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04 What are Short-Lived Climate Pollutants?

SLCPs are substances with a relatively short lifetime in the atmosphere – a few days to a few decades – and a warming effect on near term climate. The main SLCPs are BC, CH_4, tropospheric O_3, and many HFCs.

The short atmospheric lifetime of SLCPs means that their concentrations can be reduced in a matter of weeks to years after emissions are cut, with a noticeable effect on global temperature within the following decades. In contrast, CO_2 has a long lifetime, so the majority of the climate benefits will take many decades to accrue after the reductions. Long-term warming, however, will be essentially determined by total cumulative CO_2 emissions – assuming SLCPs are eventually reduced – and will be effectively irreversible on human timescales without carbon removal. Thus SLCPs and CO_2 both have important effects on climate, but these occur on very different timescales.

In some cases, mitigation of SLCPs and CO_2 will be achieved via different strategies, aimed at different sectors, and many SLCP reductions may be motivated primarily by their air quality benefits. Hence, reducing emissions of SLCPs and CO_2 are complementary goals.

Slowing the rate of near term climate change leads to multiple benefits, including reducing impacts from climate change on those alive today, reducing biodiversity loss, providing greater time for climate adaptation, and reducing the risk of crossing thresholds for irreversible climate feedbacks. Additionally, reducing SLCPs is likely to have enhanced benefits in mitigating warming in the Arctic and other elevated snow- and ice-covered regions in the Himalayan/Tibetan regions and in reducing regional disruption of traditional rainfall patterns. There are some longer term benefits as well via carbon-cycle responses and reduced sea-level rise.

Black Carbon (BC)
and Co-pollutants from Incomplete Combustion

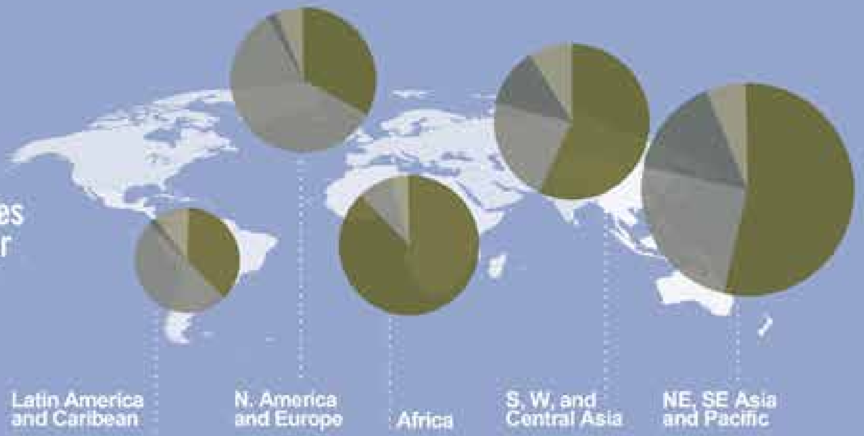
Black carbon particles are formed from the incomplete combustion of biomass and fossil fuels. It is a powerful climate forcer and dangerous air pollutant.

LIFETIME IN ATMOSPHERE

Days

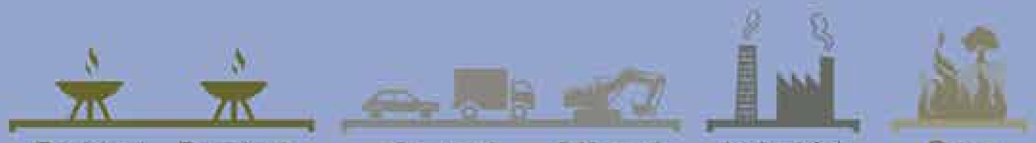
EMISSIONS

Main BC-rich sources by region and sector (2005)



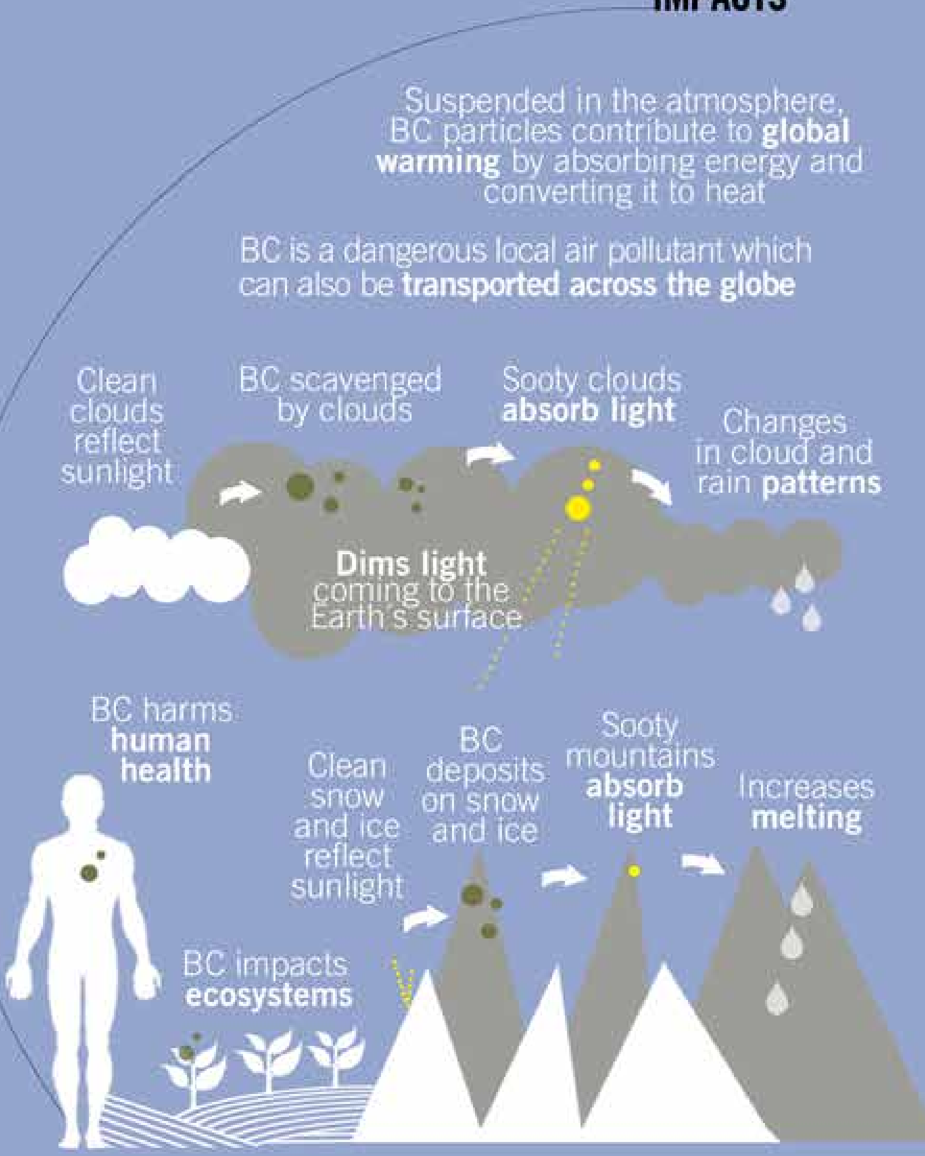
PRIMARY BLACK CARBON-RICH SOURCES

BC is always emitted with co-pollutant particles, some of which have a cooling effect on climate. The ratio of BC to co-pollutants varies by source and determines if a measure has a **net warming or net cooling effect.**



- Resident. **biofuel** cooking and heating
- Resident. **coal** cooking and heating
- **On-road** diesel engines
- **Off-road** diesel engines
- Industrial **coal** and **brick kilns**
- **Open burning** agricultural fields

IMPACTS



Suspended in the atmosphere, BC particles contribute to **global warming** by absorbing energy and converting it to heat

BC is a dangerous local air pollutant which can also be **transported across the globe**

Clean clouds reflect sunlight

BC scavenged by clouds

Sooty clouds **absorb light**

Changes in cloud and rain **patterns**

Dims light coming to the Earth's surface

BC harms **human health**

Clean snow and ice reflect sunlight

BC deposits on snow and ice

Sooty mountains **absorb light**

Increases **melting**

BC impacts **ecosystems**

05 Black Carbon and Co-pollutants from Incomplete Combustion

BC (or soot) is a tiny black particle and major component of particulate matter 2.5 (PM2.5) air pollution, which is emitted with other co-pollutants through the incomplete combustion of fossil fuels and biomass.

When suspended in the atmosphere, BC particles contribute to global warming by absorbing incoming solar radiation and converting it to heat. When deposited on ice and snow, black carbon darkens the surface, making it less reflective and more light absorbent, which causes local warming and increases the melting rate of snow and ice. The Arctic and glaciated regions like the Himalayas are particularly vulnerable to the effects of BC.

BC is always emitted with co-pollutant particles, such as organic carbon and sulphates, which can have a neutral or even cooling effect on the climate. The ratio of BC to its co-pollutants varies depending upon the emission source and fuel-type, and impacts whether the source has a net-positive or -negative warming effect. For example, emissions from diesel engines have a high proportion of BC to cooling co-pollutants, whereas emissions from wildfires and the open-burning of biomass contain a more balanced ratio. It is important to take the net climate effect into account when assessing BC emission reduction measures.

BC and co-pollutants make up the majority of PM2.5 air pollution, which consists of particles 2.5 micrometres or smaller in diametre (approximately 40 times smaller than a grain of table salt), and is the leading environmental cause of poor health and premature death. In 2010 household PM2.5 air pollution and ambient outdoor PM2.5 air pollution were estimated to have caused over 3.5 and 3.2 million premature deaths, respectively (Lim S. *et al*. 2012).

BC can also affect ecosystem health in several ways: by depositing on plant leaves and increasing their temperature, dimming sunlight that reaches the earth, and modifying rainfall patterns. The latter can have far-reaching consequences for ecosystems and human livelihoods, for example by disrupting monsoons, which are critical for agriculture in large parts of Asia and Africa.

The main sources of BC include residential and commercial combustion and transport, which accounted for 80% of anthropogenic emissions in 2005 (UNEP & WMO 2011). Other important sources include industrial processes and the burning of agricultural waste. There are also small sources such as fossil fuel extraction, large scale combustion (including power plants and industrial boilers) and open burning of garbage. New data also shows that kerosene lamps may be a significant source of black carbon (Jacobson A. *et al*. 2013). Important regional variations in emissions are expected in the coming decades, with decreases of up to half in North America and Europe due to mitigation measures in the transport sector and significant increases in Asia and Africa.

Methane (CH_4)

Methane emissions caused by human activities are one of the most significant drivers of climate change. Methane is also the main precursor of tropospheric ozone, a powerful greenhouse gas and air pollutant.

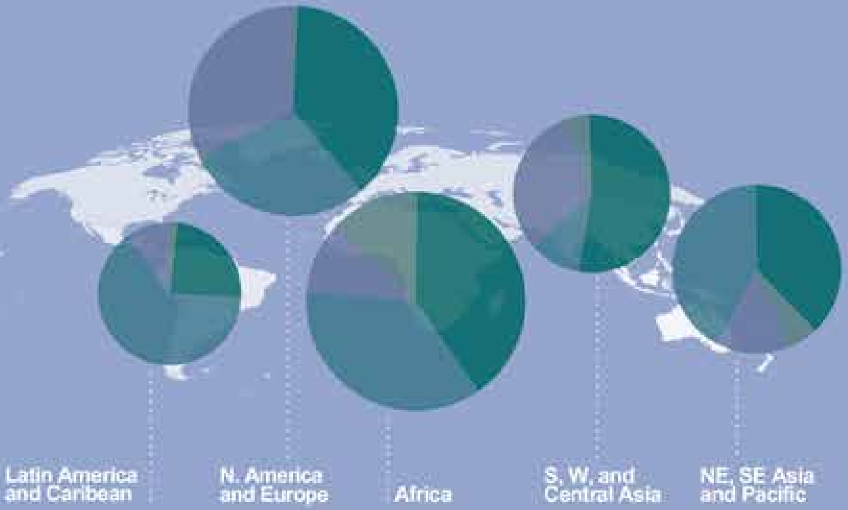
LIFETIME IN ATMOSPHERE

12 years

CH_4 is a powerful GHG contributing to **global warming**

EMISSIONS

and main sources by region and sector (2005)



29%	29%	4%	10%	7%	11%	9%	1%
Fossil Fuels	Livestock enteric fermentation	Livestock manure	Rice cultivat.	Other agricultural sources	Waste treatment	Waste water treatment	Others

Major anthropogenic **SOURCES** (60% of methane emissions come from human activities)

310 Mt Global CH_4 **anthropogenic emissions** in 2005

IMPACTS

Globally, increased methane emissions are **responsible for half of the observed rise in O_3 levels**

While methane does not cause direct harm to human health or crop production, its role **as precursor gas contributes greatly to the health and agricultural impacts of O_3**

06 Methane

CH_4 is a powerful greenhouse gas with an atmospheric lifetime of approximately 12 years. CH_4 emissions caused by human activities are one of the most significant drivers of climate change. CH_4 directly influences the climate system but also has indirect impacts on human health and ecosystems, including agricultural production, through its role as the primary precursor of tropospheric O_3, a powerful greenhouse gas and air pollutant (UNEP & WMO 2011). O_3 air pollution has been estimated to cause around 150,000 deaths annually worldwide and affects the health of many more (Lim S. *et al*. 2012).

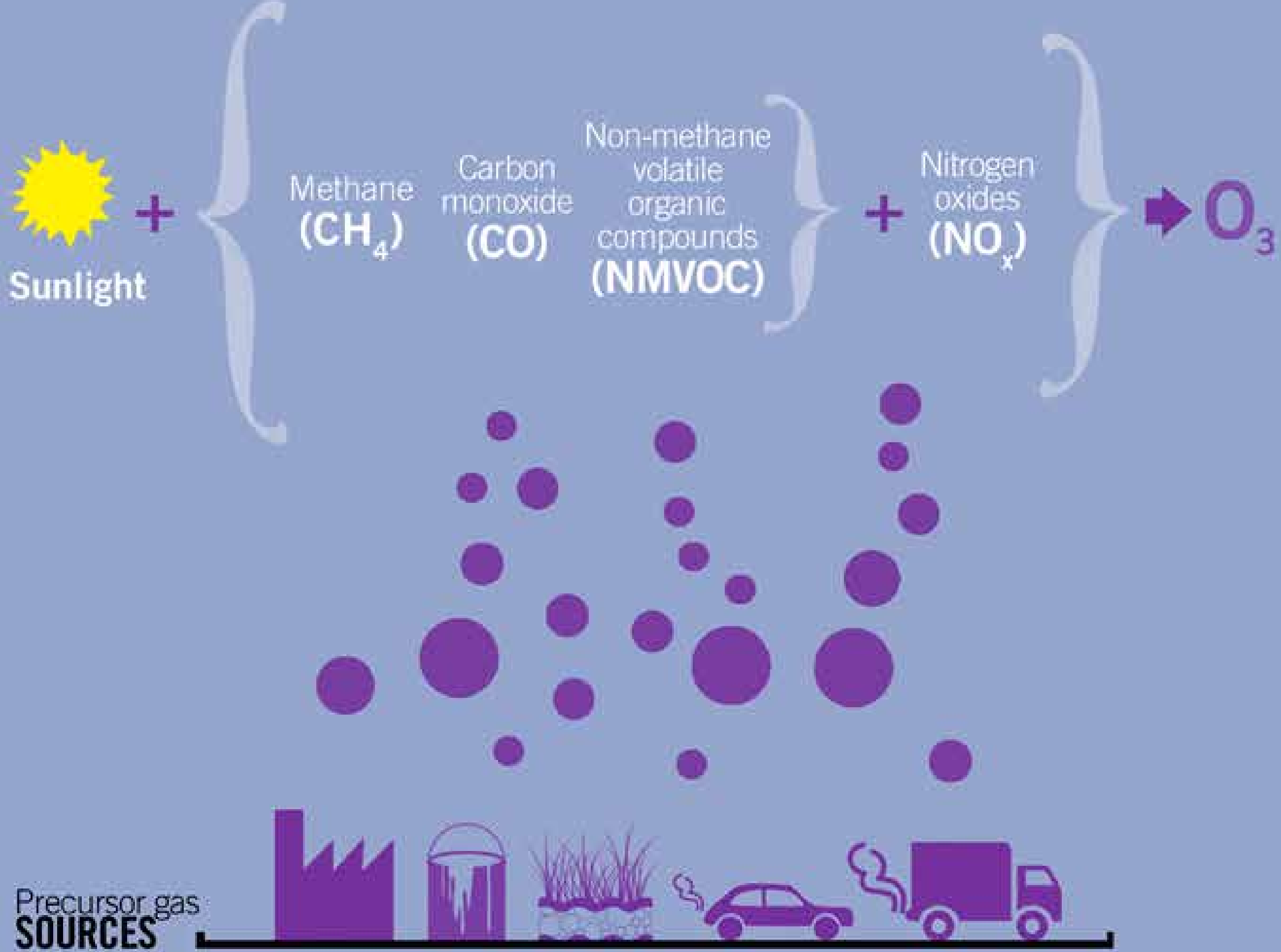
Approximately 60% of methane is emitted from human activities. In 2005, agriculture (livestock rearing and rice production), fossil fuel production and distribution, and municipal waste and wastewater management accounted for 93% of global anthropogenic methane emissions. According to the projected trends, without further mitigation efforts, anthropogenic methane emissions are expected to increase by about 25% by 2030 (UNEP & WMO 2011).

Tropospheric Ozone (O_3)

Tropospheric Ozone (O_3) is a major air and climate pollutant. It causes warming and is a highly reactive oxidant, harmful to crop production and human health. O_3 is known as a 'secondary' pollutant because it is not emitted **directly**, but instead forms when precursor gases react in the presence of sunlight.

LIFETIME IN ATMOSPHERE

Weeks



IMPACTS

O_3 precursors can be carried round the globe, making it a **transboundary pollution problem**

Tropospheric O_3 **warms the atmosphere**

O_3 damages plants and affects **agricultural production**:

- Reducing photosynthesis
- Reducing the plants ability to sequester carbon
- Reducing health and productivity of crops

O_3 air pollution causes over **150 thousand premature deaths** every year, and **millions more chronic diseases,** particularly in children and the elderly

07 Tropospheric Ozone

O_3 is known as a secondary gas because it is not directly emitted, but rather formed by sunlight-driven oxidation of "precursor gases" such as non-methane volatile organic compounds (NMVOCs) and nitrogen oxides (NO_x) (U.S. EPA 2013; UNEP & WMO 2011).

In the upper atmosphere (stratosphere) O_3 acts as a shield, protecting the earth from harmful ultraviolet radiation. But in the lower atmosphere (troposphere) O_3 is a potent greenhouse gas and a harmful air pollutant adversely affecting public and ecosystem health.

Tropospheric O_3 also reduces the ability of plants to absorb CO_2, altering their growth and variety. It damages ecosystem structures and functions, as well as the health and productivity of crops, thus threatening food security. As a result, O_3 is understood to reduce net carbon sequestration in terrestrial ecosystems due to reduced net primary productivity, which could, according to estimates, be responsible for as much warming as O_3´s greenhouse effect.

Tropospheric O_3 is a major component of urban photochemical smog, and a highly reactive oxidant which, when inhaled, can worsen bronchitis and emphysema, trigger asthma, and permanently damage lung tissue. Tropospheric O_3 exposure is responsible for an estimated 150,000 premature deaths every year (Lim S. *et al.* 2012). Children, older adults and people with lung or cardiovascular diseases are particularly at risk of adverse health effects.

Hydrofluorocarbons (HFCs)

HFCs are man-made fluorinated powerful greenhouse gases rapidly building up in the atmosphere. They are used as replacements for ozone-depleting substances (ODS) in air conditioning, refrigeration, foam-blowing, fire retardants, solvents, and aerosols.

LIFETIME IN ATMOSPHERE

15 years

(Weighted by usage)

HFCs are powerful GHGs which contribute to **global warming**

CONSUMPTION
by sector

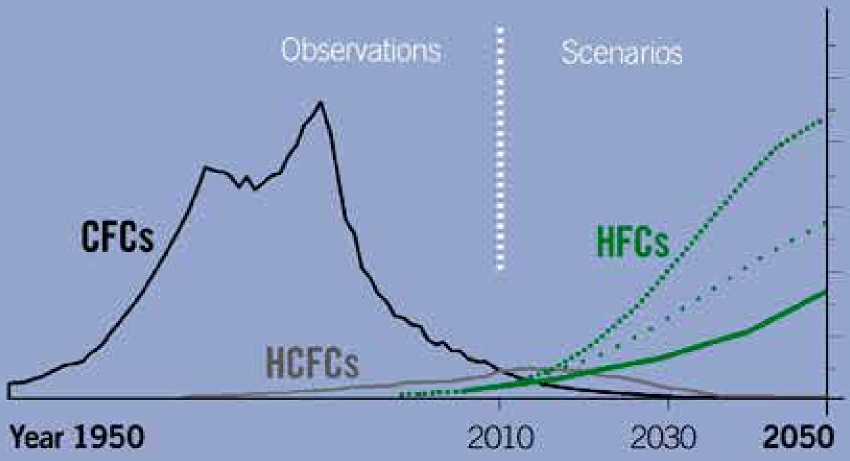
While HFCs have caused less than 1% of total global warming to date, production, consumption, and emissions of these factory-made gases are **growing at a rate of 8% per year**.

Consumption by sector **2010**

PROJECTED GROWTH

The demand for **air conditioning** and **refrigeration** is **increasing** as the world warms and as wealth increases.

The use of HFCs is rapidly growing because they are widely adopted as replacements for Ozone Depleting Substances (ODS), such as Chlorofulorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs), whose use is being phased out under the Montreal Protocol.



08 Hydrofluorocarbons

Hydrofluorocarbons (HFCs) are powerful factory-made greenhouse gases used primarily in air conditioning, refrigeration, foam-blowing, fire suppression, solvents, and aerosols. Their use is growing because they are being widely adopted as replacements for O_3-depleting substances (ODS), including chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), which are being phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer.

The mix of HFCs in current use, weighted by usage (tonnage), has an average atmospheric lifetime of 15 years (Velders G.J.M. *et al.* 2009). Although they currently represent only a small fraction of the total greenhouse gases (less than 1%), they are among the fastest-growing ones (in percentage) in many countries, including the United States, the European Union, China, and India. Emissions of high-global warming potential (GWP) HFCs are rising very quickly at 8% or more per year (UNEP 2011b).

A recent study concluded that replacing high-GWP HFCs with low-GWP alternatives could avoid 0.1°C of warming by 2050 (Xu Y. *et al.* 2013).

SLCP Control Measures

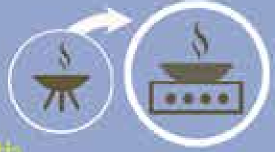
16 cost effective control measures involving technologies and practices that already exist and could significantly reduce SLCP emissions. If implemented globally, these measures could reduce global methane emissions by 40% and black carbon by 80% by 2030. Measures to mitigate high-GWP HFCs could deliver additional near term climate benefits.

BC

Residential Sector

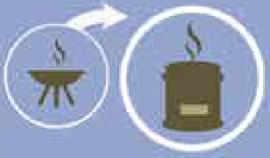
01.

Replace traditional biomass cookstoves with **modern fuel cookstoves**



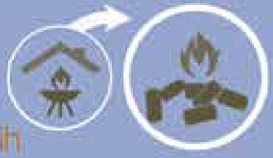
02.

Replace traditional cooking and heating with **clean-burning biomass stoves**



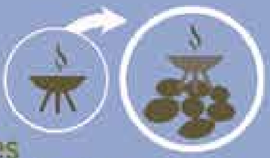
03.

Replace wood stoves and burners wih **pellet stoves**



04.

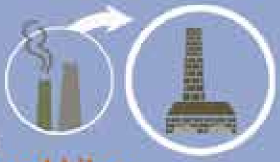
Replace lump coal with **coal briquettes** for cooking and heating



Industry

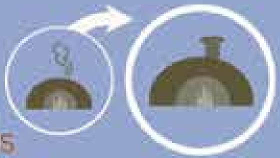
05.

Replace traditional brick kilns with **improved kilns**



06.

Replace traditional coke ovens with **modern recovery ovens**



Transport

07.

Diesel particulate **filters for road and off-road vehicles** (EURO VI)

08.

Eliminate **high-emitting diesel vehicles**

Agriculture

CH4

09.

Ban **open-field burning** of agricultural waste

10.

Intermittent aeration of continously **flooded rice paddies**

11.

Improve **manure management** and **animal feed**

Fossil Fuel

12.

Pre-mine degasification, recovery, and oxidation of CH_4 from ventilation air from **coal mines**

13.

Recovery and utilization of gas and **fugitive emissions from oil and natural gas** production

14.

Reduce **leakage from long-distance gas transmission** pipelines

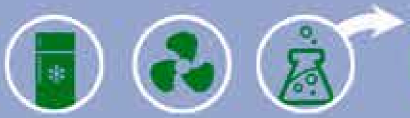
Waste Management

15.

Separation and treatment of biodegradable **municipal waste** and landfill gas collection

16.

Upgrade **wastewater** treatment with gas recovery and overflow control



HFCs

+HFC measures

Replacement of high climate impact HFCs with **low impact alternatives**

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09 SLCP Control Measures

In 2011 a scientific assessment coordinated by UNEP and the World Meteorological Organisation (WMO) identified 16 SLCP control measures. If implemented globally by 2030, these measures could deliver significant benefits for near term climate protection and air quality (UNEP & WMO 2011).

These control measures involve technologies and practices that already exist and have been implemented around the world, targeting primary SLCP emitting sectors, including fossil fuel production and distribution; energy use in the residential, industry, and transport sectors; waste management; and agriculture.

If globally implemented by 2030, these 16 measures could reduce global CH_4 emissions by about 40% and global BC emissions by about 80%, relative to a "reference" scenario (UNEP & WMO 2011). About half of these emission reductions could be achieved through net cost savings over the lifetime of the measures.

In addition to these measures, replacing high-GWP HFCs with available low-GWP and not-in-kind alternatives has the potential to effectively address climate forcing from this sector. Because they are factory-made, HFCs can be most effectively controlled through a phase-down of their production and consumption (UNEP 2011b). In addition to the direct climate benefits from HFC mitigation, a global HFC phase-down could also provide indirect benefits through improvements in the energy efficiency of the refrigerators, air conditioners, and other products and equipment that use these chemicals. These efficiency gains could reduce CO_2 emissions as well (UNEP & CCAC 2014).

While fast implementation of measures to mitigate SLCPs, including BC, methane, tropospheric O_3 and many HFCs, could help slow the rate of climate change and improve the chances of staying below the 2°C target in the near term, longer term climate protection will only be possible if deep and persistent cuts in CO_2 emissions are rapidly realised (UNEP & WMO 2011).

Cost of Control Measures

Half of the emission reductions of both BC and CH_4 could be achieved at net cost savings or low costs over the lifetime of the measures, taking into account climate benefits only. If all benefits are considered, all control measures are cost effective.

🌐 **GLOBAL CLIMATE BENEFITS** Share of total avoided warming from SLCP reductions in 2050

$ **NET SAVING OR LOW COST**

$ **MODERATE COST**

$ **HIGH COST**

* **DIFFICULT TO QUANTIFY***

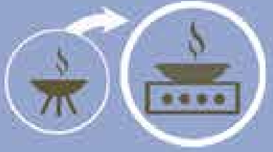
*Because they depend upon strong governance and regulatory frameworks for success and costs of overcoming implementation barriers, and monitoring and enforcement are difficult to quantify

👍 **NON-CLIMATE BENEFITS**

Residential Sector

01.

Replace traditional biomass cookstoves with **modern fuel cookstoves**

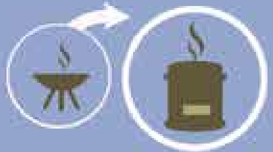


🌐 25% $ (NET SAVING OR LOW COST)

- 👍 Health protection
- 👍 Indoor air quality
- 👍 Crop protection

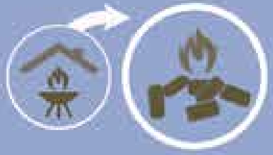
02.

Replace traditional cooking and heating with **clean-burning biomass stoves**



03.

Replace wood stoves and burners wih **pellet stoves**

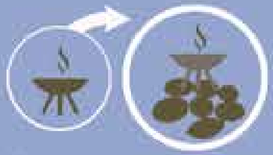


🌐 2% $ (HIGH COST)

- 👍 Energy efficiency
- 👍 Health protection

04.

Replace lump coal with **coal briquettes** for cooking and heating



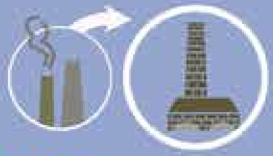
🌐 4% $ (NET SAVING OR LOW COST)

- 👍 Energy efficiency
- 👍 Health protection

Industry

05.

Replace traditional brick kilns with **improved kilns**

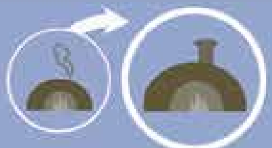


🌐 0.5% $ (NET SAVING OR LOW COST)

- 👍 Improved quality of bricks
- 👍 Health protection
- 👍 Energy efficiency

06.

Replace traditional coke ovens with **modern recovery ovens**



🌐 1.5% $ (MODERATE COST)

- 👍 More cost-effective production
- 👍 Energy efficiency

Transport

07.

Diesel particulate **filters** for road and off-road vehicles (EURO VI)

- 👍 Health protection
- 👍 Crop protection

Light	🌐 1%	$ (HIGH COST)
Heavy	🌐 3%	$ (HIGH COST)
Off-road	🌐 3%	$ (HIGH COST)

08.

Eliminate **high-emitting** diesel vehicles

🌐 6.5% * (DIFFICULT TO QUANTIFY)

- 👍 Health protection
- 👍 Energy efficiency

Cost of Control Measures

🌐 GLOBAL CLIMATE BENEFITS
$ NET SAVING OR LOW COST
$ MODERATE COST
$ HIGH COST
* DIFFICULT TO QUANTIFY*
👍 NON-CLIMATE BENEFITS

Agriculture

09.
Ban **open-field burning** of agricultural waste

🌐 5% *
- Energy efficiency
- Health protection

10.
Intermittent aeration of continously **flooded rice paddies**

🌐 3% $
- Crop protection

11.
Improve **manure management** and **animal feed**

Liquid manure management
- Energy efficiency
- Crop production

🌐 0.5% $

Animal feed
- Improved meat quality

🌐 1.5% $

Fossil Fuel

12.
Pre-mine degasification and recovery and oxidation of CH_4 from ventilation air from **coal mines**

Recovery
- Occupational safety

🌐 6% $

Oxidation
- Occupational safety
- Energy efficiency

🌐 8.5% $

13.
Recovery and utilisation of gas and **fugitive emissions**

Vented during **oil** production
- Energy efficiency
- Crop protection

🌐 11% $

Vented during **natural gas** production
- Long-term economics
- Energy efficiency
- Crop protection

🌐 1% $

13.
(Continued)

Leaked during **oil** production
- Energy efficiency
- Occupational safety

🌐 2% $

Leaked during **natural gas** production
- Energy efficiency
- Occupational safety

🌐 1.5% $

14.
Reduce **leakage from long-distance gas transmission** pipelines

🌐 2.5% $
- Long-term economics
- Energy efficiency
- Crop protection

Waste Management

15.
Separation and treatment of biodegradable **municipal waste** and landfill gas collection

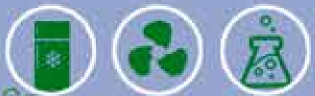
🌐 9.5% $
- Improved waste management
- Energy efficiency
- Crop protection

16.
Upgrade **wastewater** treatment with gas recovery and overflow control

🌐 1.5% $
- Improved water quality

HFCs

HFC
Replace high-GWP HFCs with low-GWP alternatives



🌐 -0.1°C by 2050 *
- Energy efficiency

CCAC

← 10 A/B Cost of Control Measures *(previous spread)*

The 16 BC and CH_4 control measures identified have already been implemented around the world. Hence direct implementation costs can be estimated for most of the measures. Indirect costs of the measures linked, for instance, to the valuation of health and crop production benefits are more difficult to assess.

Even without taking into account the value of health and crop production benefits, about half of the temperature reduction benefits associated with BC and CH_4 measures could be achieved at net cost savings (as a global average) over the full technical lifetime of the measures, i.e. the initial investment will be offset by subsequent cost savings (e.g. through the use of recovered gas).

The costs of some measures relying not only on the implementation of a new technology but on a governance change, such as the elimination of high-emitting vehicles or the ban of open burning of agricultural waste, are more difficult to quantify. These measures represent just over 10% of the total temperature benefits (UNEP 2011a).

Assessments of the costs of low-GWP HFCs alternatives are underway. Such measures can be associated with important energy efficiency benefits in a number of sectors, such as domestic and commercial refrigeration and some air conditioning systems (UNEP & CCAC 2014).

11 SLCP Climate Benefits: Avoided Global Warming

Full implementation of the 16 BC and CH_4 control measures by 2030 could prevent up to 0.5°C of additional warming by 2050 (UNEP & WMO 2011). Recent studies project that replacing high-GWP HFCs with low-GWP alternatives could avoid an additional 0.1°C of warming by 2050 (Xu Y. *et al.* 2013).

Rapid implementation of SLCP control measures, if accompanied by deep and persistent measures to reduce CO_2 emissions, would greatly improve the chances of keeping the Earth's temperature increase to less than 2°C relative to pre-industrial levels.

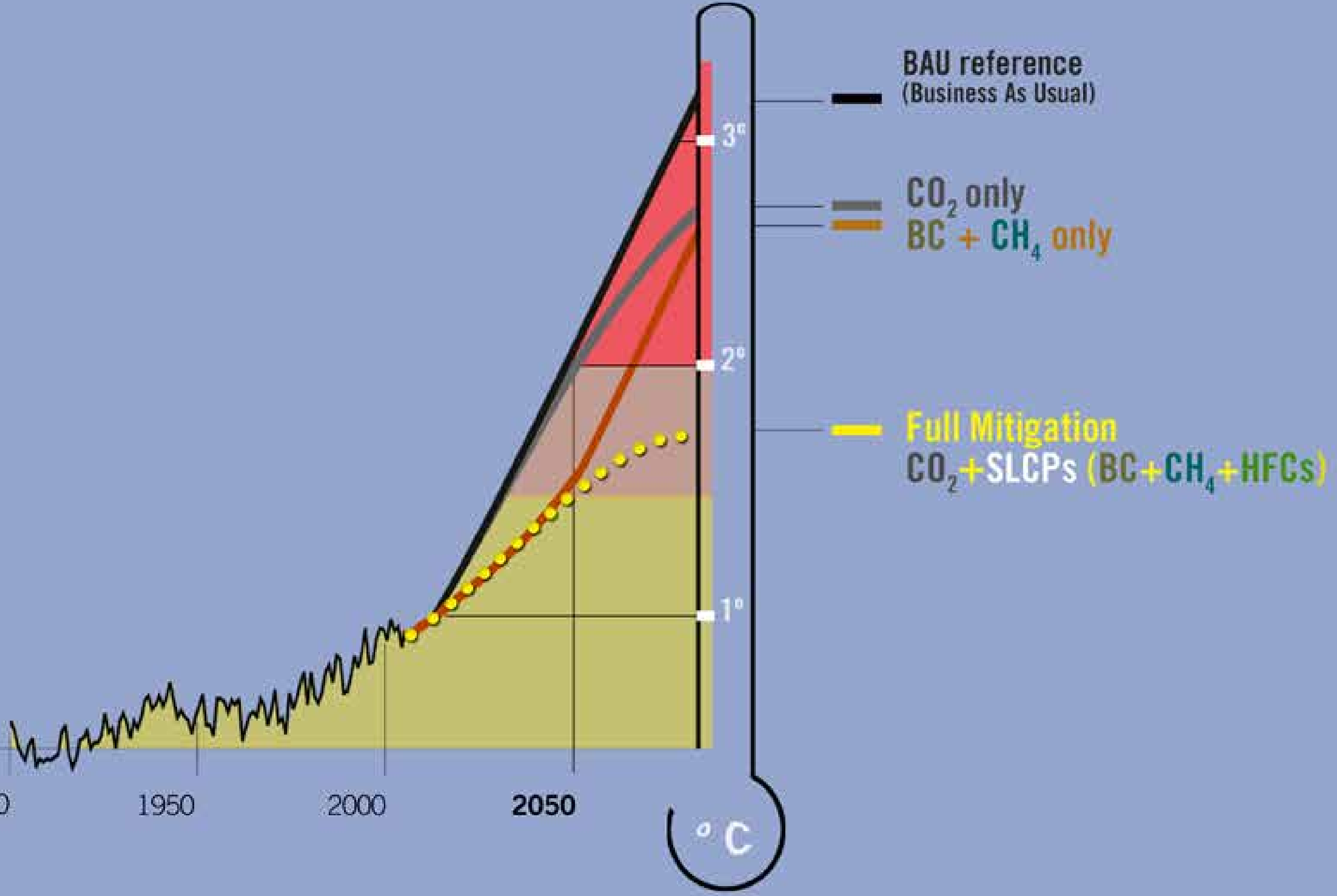
Finally, although the greatest benefits are near term, reducing SLCPs could have some longer term benefits as well, regarding carbon-cycle responses and reduced sea-level rise.

However, it is important to note that implementation of SLCP control measure does not buy us any time to act on CO_2. Regardless of the trend of SLCPs, scientists tell us it will be nearly impossible to stay within the 2˚C limit unless the growth in CO_2 emissions is quickly curtailed and reversed.

SLCP Climate Benefit Avoided global warming

Rapid implementation of SLCP mitigation measures, together with measures to reduce CO_2 emissions, would greatly improve the chances of keeping the Earth's temperature increase to **less than 2°C** relative to pre-industrial levels.

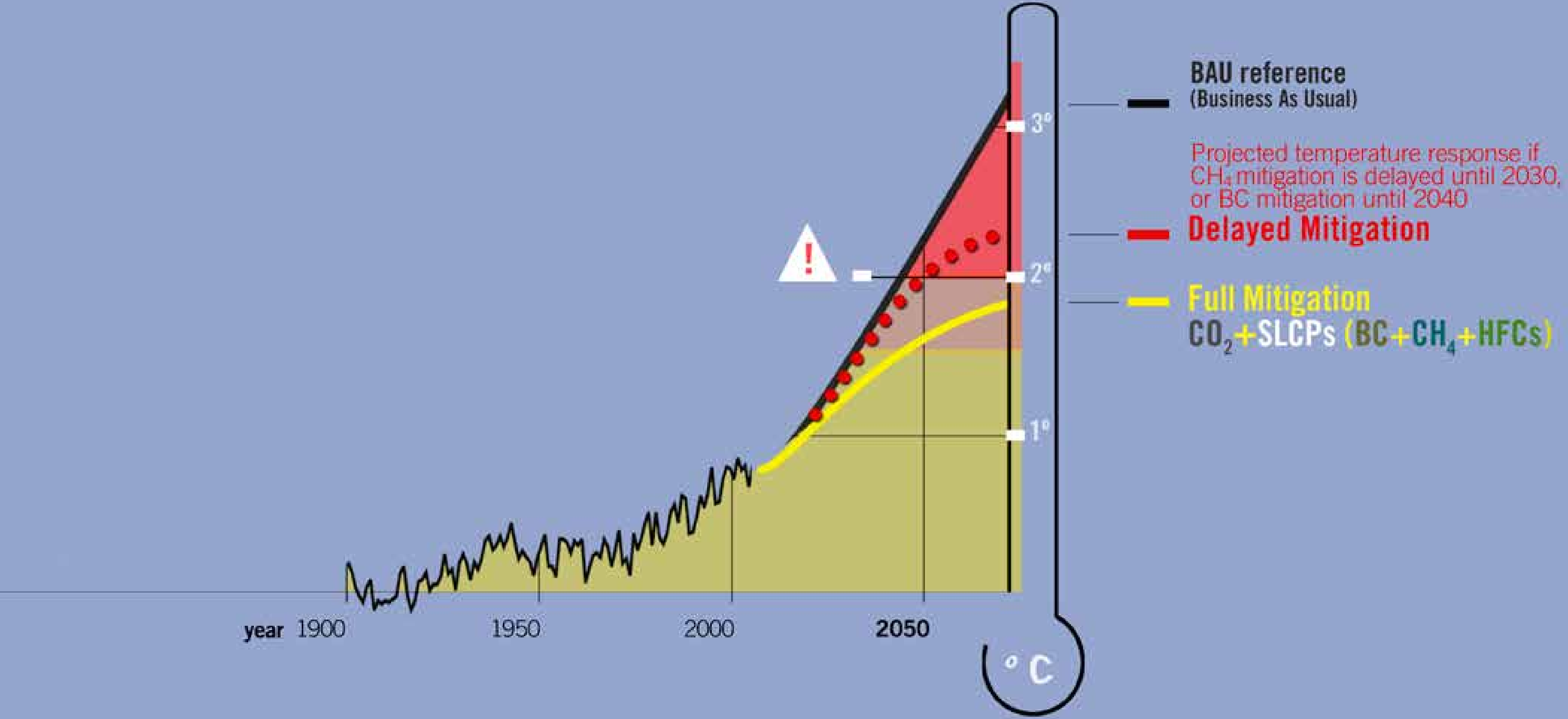
AVOIDED GLOBAL WARMING	by 2050
BC + CH_4	0.5°C
HFCs	0.1°C
SLCPs	0.6°C



Simulated temperature change
under various mitigation scenarios
CO_2, BC, CH_4, HFCs

Consequences of **Delayed Mitigation**

The delayed implementation of SLCP control measures could have important negative consequences on temperature rise.



Projected temperature response if CH_4 mitigation is delayed until 2030, or BC mitigation until 2040

12 Consequences of Delayed Mitigation

It is not enough to act. We have to act now. Delayed implementation of either CO_2 or SLCP control measures would have significant negative consequences on temperature, cumulative sea-level rise and human well-being.

The relatively short lifetimes of SLCPs means that climate benefits could be achieved quickly after mitigation, whether it occurs today or at the end of the century. In addition, the timing of reductions does not greatly affect the induced peak warming. However a delay in cuts could lead to a failure to reap multiple near term benefits. One recent modelling study has projected that delaying implementation of SLCP control measures by 25 years could lead to significant and irreversible impacts on the climate system (Hu. A. *et al.* 2013).

For CO_2, the slower climate response to mitigation means that the longer mitigation is delayed, the more severe the long-term and permanent warming and resulting impacts will be.

If action is not taken now, the inertia in the climate system would cause temperatures to surpass the 2°C threshold within this century, leaving people no time to adapt. Furthermore, this might push the climate over a tipping point – a point at which a chain of events escalates so fast that it is impossible to return to a previous condition.

SLCPs and Sea-Level Rise

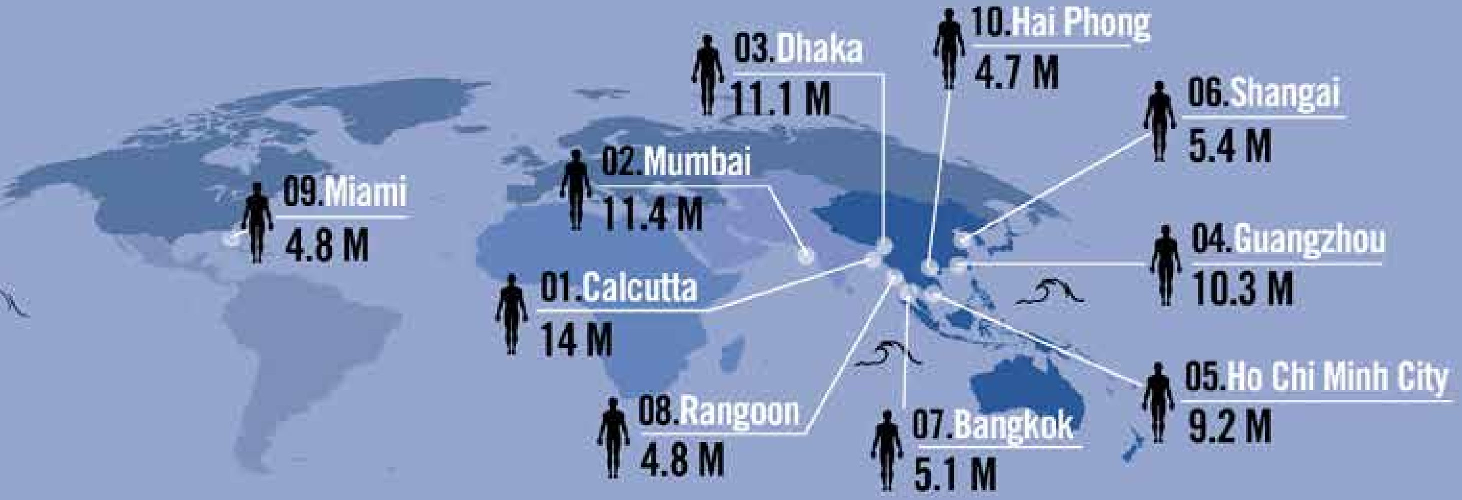
SLCP control measures could help reduce the rate of sea-level rise, one of the most concerning effects of climate change.

TOP 10 CITIES AT RISK

OF COASTAL FLOODING DAMAGE BY POPULATION

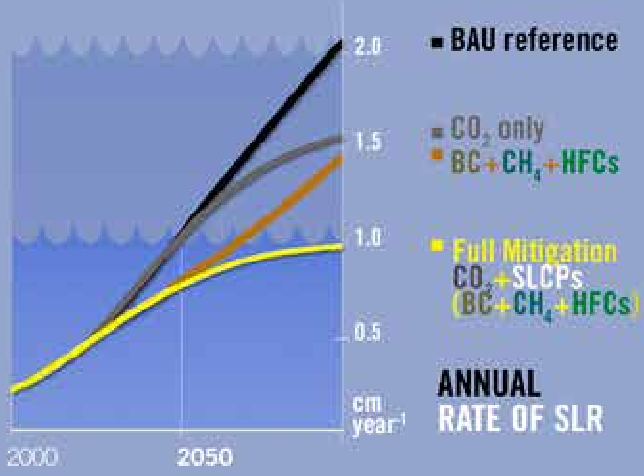
Vulnerability based upon projected 1 meter sea-level rise in 2070

Sea-level rise in **the Indian and Western Pacific Oceans** is expected to be **10-20% higher** than the global average

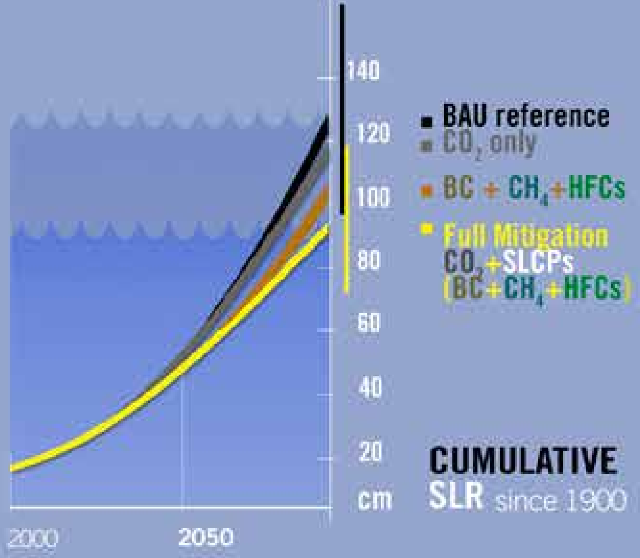


SEA-LEVEL RISE (SLR) PROJECTON

by 2100



ANNUAL RATE OF SLR



CUMULATIVE SLR since 1900

CCAC

13 SLCPs and Sea-Level Rise

As land glaciers and ice sheets melt and warming oceans expand, sea-level rise has accelerated to about 3 millimetres annually in recent years (IPCC 2013). The latest IPCC assessment pointed out that the rate of sea-level rise since the mid-19th century has been larger than the mean rate during the previous two millennia.

The potential impact of rising oceans is one of the most concerning effects of climate change. Many of the world's major cities, such as Amsterdam, Bangkok, Calcutta, Dhaka, Miami, New York, Shanghai, and Tokyo, are located in low-lying coastal areas. If temperatures continue to warm, sea-levels may rise by as much as a metre this century, and even more in subsequent centuries (IPCC 2013). Such an increase could submerge densely populated coastal communities, especially when storm surges hit.

Sea-level rise comes with various threats to populations: large inhabited coastal areas will be permanently flooded, and storm surges are expected to be stronger and reach further inland. Dramatic costs and damages lie ahead, entire island nations might be lost, and vast populations may need to be relocated. A report ranked the top twenty at-risk cities from sea-level rise of only one metre, and estimated that $35 trillion in assets and 150 million people could be at risk in these cities in 2070 (OECD 2010). Eight of the top ten cities with assets exposed, and nine of the top ten with populations at risk, are in Asia.

One recent study has estimated that immediate implementation of SLCP control measures could reduce the rate of sea-level rise by about 20% in the first half of the century, as compared to a "reference" scenario. By 2100, the combined mitigation of CO_2 and SLCPs could reduce the rate of sea-level rise by up to 50%, and cumulative sea-level rise by about 30% as compared to the same scenario (Hu A. *et al.* 2013).

Because some processes of the climate system, especially melting of the large land ice sheets of Greenland and Antarctica, have a nearly unstoppable momentum once begun, even with aggressive CO_2 and SLCP mitigation two-thirds of predicted sea-level rise is likely to be inevitable. But early mitigation could reduce its rate by up to one half, which would reduce vulnerability by giving coastal communities and low-lying states time to adapt (Hu A. *et al.* 2013).

Effects on Public Health

Air pollution, a preventable risk

SLCPs, particularly O_3 and BC and co-pollutants, which are important parts of PM2.5 air pollution, are harmful to human health. Globally, PM2.5 is the leading environmental cause of poor health and premature death.

PREMATURE DEATHS YEAR 2010

GLOBALLY, **AIR POLLUTION** IS RESPONSIBLE FOR:

3,500,000	From **indoor** PM2.5 pollution
3,200,000	From **outdoor** PM2.5 polution
150,000	From **ozone** pollution

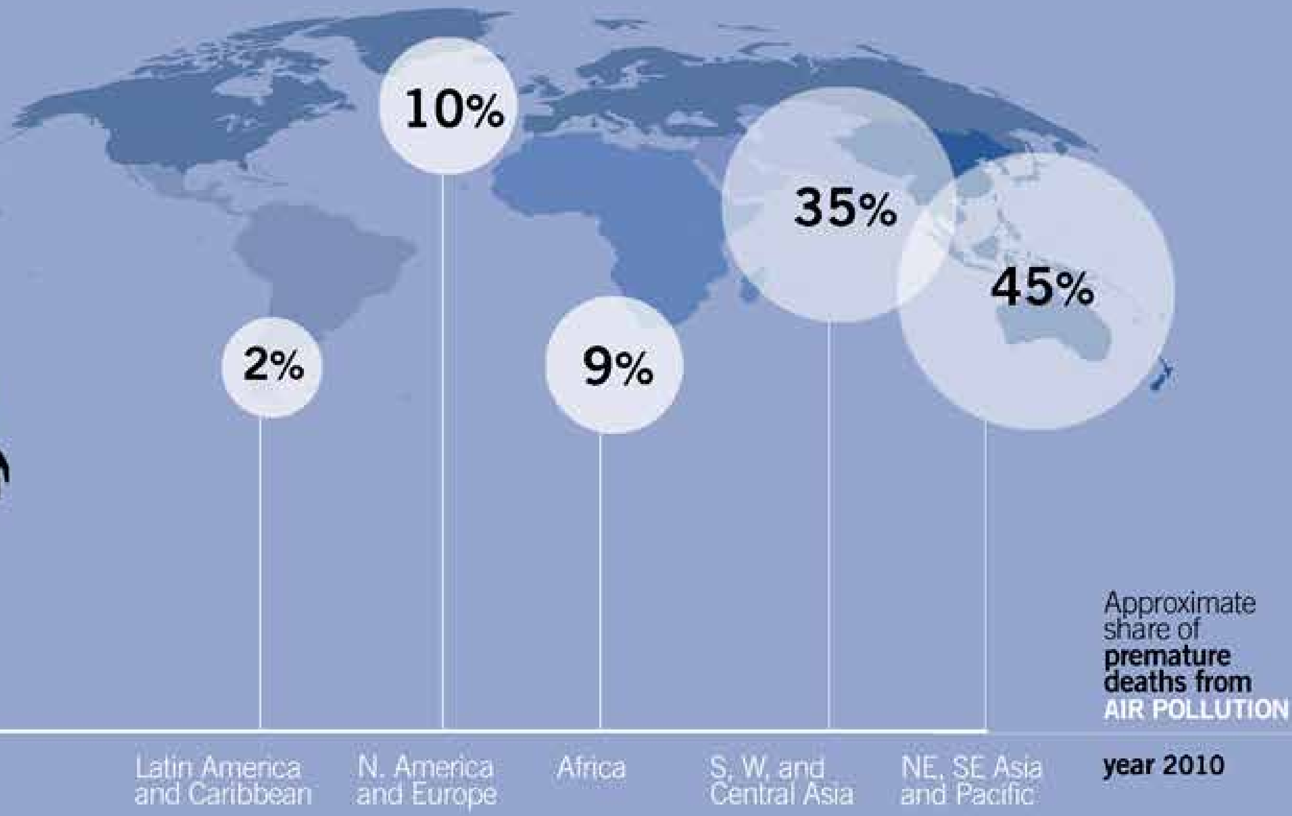
DISEASES DUE TO:

● PM2.5 AIR POLLUTION

● O_3

●	●	Heart attacks
	●	Strokes, heart disease
	●	Congestive 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 smoke.



Approximate share of **premature deaths from AIR POLLUTION**

year 2010

CCAC

14 Effects on Public Health

In addition to their climate impacts, BC and tropospheric O_3 are also powerful air pollutants with detrimental impacts on public health.

BC is a primary component of PM2.5 air pollution, and tropospheric O_3 is a major air pollutant. PM2.5 air pollution is a major global cause of premature mortality. According to the 2010 Burden of Disease study, indoor and outdoor PM2.5 air pollution are the fourth and seventh leading risk factors for early mortality globally (Lim S. *et al.* 2012).

In some regions its impacts can be much more significant. For example, in South Asia indoor PM2.5 air pollution alone is the leading preventable risk factor for the burden of disease, while in Eastern, Central, and Western Sub-Saharan Africa it is ranked second, and third in South East Asia (Lim S. *et al.* 2012).

Some populations are also particularly vulnerable. Globally, indoor and ambient PM2.5 air pollution are the two leading risks factors for the death of children in the first six days of life (Lim S. *et al.* 2012).

In 2010 indoor air pollution and ambient outdoor particulate matter pollution were estimated to have caused over 3.5 and 3.2 million premature deaths, respectively, while 0.15 million deaths were attributed to ambient O_3 pollution (Lim S. *et al.* 2012).

Recent assessments have shown that fast implementation of measures to reduce BC and CH_4 (tropospheric O_3 precursor) emissions, such as the widespread adoption of clean fuels, have the potential to prevent over two million premature deaths each year by 2030 from outdoor air pollution with significant additional benefits from reduced indoor air pollution (UNEP & WMO 2011).

Benefits for Public Health

Rapid SLCP mitigation can provide important benefits for public health, saving millions of lives every year.

HEALTH BENEFITS
FROM **GLOBAL IMPLEMENTATION OF SLCP MEASURES**

2,400,000
(0.7-4.6 MILLION)
DEATHS AVOIDED ANNUALLY
FROM REDUCED PM2.5 OUTDOOR
AIR POLLUTION BY 2030

+ ADDITIONAL HEALTH BENEFITS
FROM REDUCED PM2.5 INDOOR
AND O_3 AIR POLLUTION

SLCP Mitigation Measures

Residential sector	01. 02. 03. 04.	BC
Industry	05. 06.	
Transport	07. 08.	
Agriculture	09. 10. 11.	CH_4
Fuel	12. 13. 14.	
Waste	15. 16.	

% of total **prevented annual premature deaths** from outdoor air pollution thanks to large scale implementation of **BC measures**

by 2030

Latin America and Caribbean	N. America and Europe	Africa	S, W, and Central Asia	NE, SE Asia and Pacific
2%	5%	9%	47%	30%

15 Benefits for Public Health

Global implementation of the 16 BC control measures would substantially improve air quality and could avoid approximately 2.4 (0.7–4.6) million outdoor air pollution-related premature deaths annually, and have an even larger impact on reduced chronic morbidity beginning in 2030 (UNEP & WMO 2011; Shindell D. *et al.* 2012). These measures would also deliver significant additional health benefits from reduced indoor pollution, and smaller benefits could also be achieved from reduced O_3 pollution, including from CH_4 measures.

The most substantial benefits will be felt immediately in or close to the region of implementation, with the greatest health benefits expected in Asia, both in number of lives saved, and in terms of quality of life and avoided chronic diseases.

Improved cookstoves would deliver the greatest benefits in Africa, Asia and Latin America and the Caribbean, followed by measures targeting the transport sector. Replacing domestic wood-burning technologies with pellet stoves would bring the largest benefits in North America and Europe, while the ban of open burning of agricultural waste would also bring important health gains in all regions (UNEP & WMO 2011).

Effects on Agriculture

SLCPs, a threat to agricultural productivity

SLCPs, especially tropospheric O_3, detrimentally impact ecosystems including crop yields, and are affecting food security.

CROP LOSSES DUE TO OZONE POLLUTION

WHEAT+RICE+MAIZE+SOYBEAN

110,000,000 t

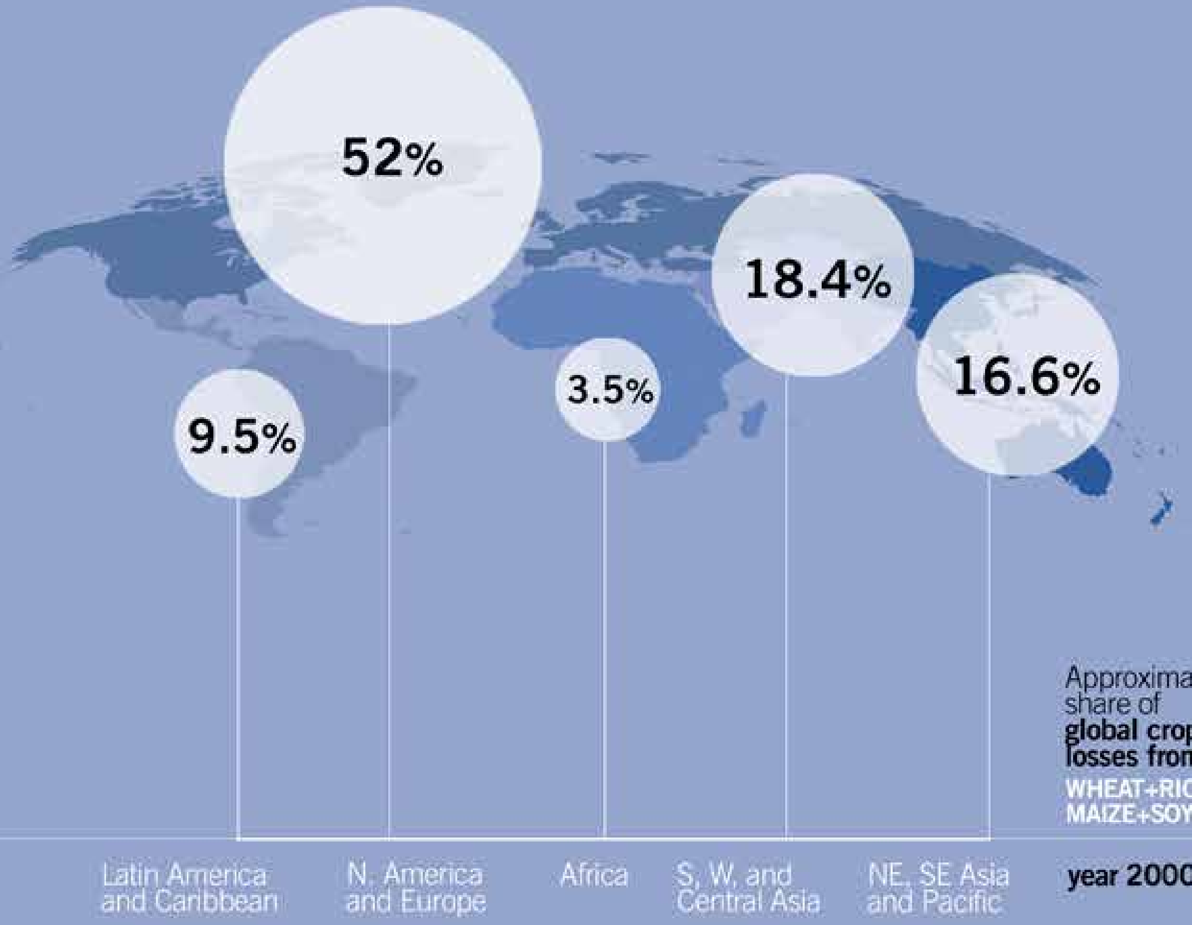
SLCP EFFECTS ON PLANTS DUE TO:

● O_3

● BC AND CO-POLLUTANTS

- ● Impeded photosynthesis
- ● Reduced ability to sequester carbon
- ● Plant cell damage
- ● Reduced crop production
- ● Reduced quality and nutritive value of food and feed

- ● Increased leaf temperature (uncertain effect)
- ● Reduced sunlight reaching plants affecting photosynthesis (uncertain effect)



Approximate share of **global crop losses from** **WHEAT+RICE+MAIZE+SOYBEAN**

year 2000

CCAC

16 Effects on Agriculture

While feeding a growing world population has become one of the major issues of our century, SLCPs are damaging ecosystems, including crop yields.

Tropospheric O_3 is the main air pollutant responsible for crop yield losses. It affects plants by suppressing their ability for photosynthesis, and, at high concentration, causes necrosis. Present day global relative yield losses due to tropospheric O_3 exposure has been estimated for four major crops and range between 7–12% for wheat, 6–16% for soybean, 3–4% for rice, and 3–5% for maize (Harmens H. *et al*. 2011).

Reductions in the quality of crops affect food security as well. Prolonged exposure to tropospheric O_3 has been shown to decrease carbohydrates and increase protein concentrations in wheat and potatoes, and reduce the protein and oil content of rapeseed (the world's third largest source of vegetable oil) (Harmens H. *et al*. 2011; U.S. EPA 2013). It can also decrease the nutritional value of forage plants, which can lead to lower milk and meat production, harming some of the world's most vulnerable populations.

BC may also affect crops in several ways. When deposited on leaves it increases temperature and impedes growth. By limiting the amount of solar radiation reaching the earth, it reduces photosynthesis. BC and its co-pollutants can also influence cloud formation and affect regional atmospheric circulation and rainfall patterns, disrupting, for example, the monsoons on which large parts of Asia and Africa rely.

Benefits for Agriculture

Fast implementation of BC and CH_4 (as a precursor of tropospheric O_3) measures could bring rapid and considerable benefits for food security.

ANNUAL CROP YIELD LOSSES
BY 2030 **FROM 16 SLCP MEASURES**

52,000,000 t
(30-135 MILLION)

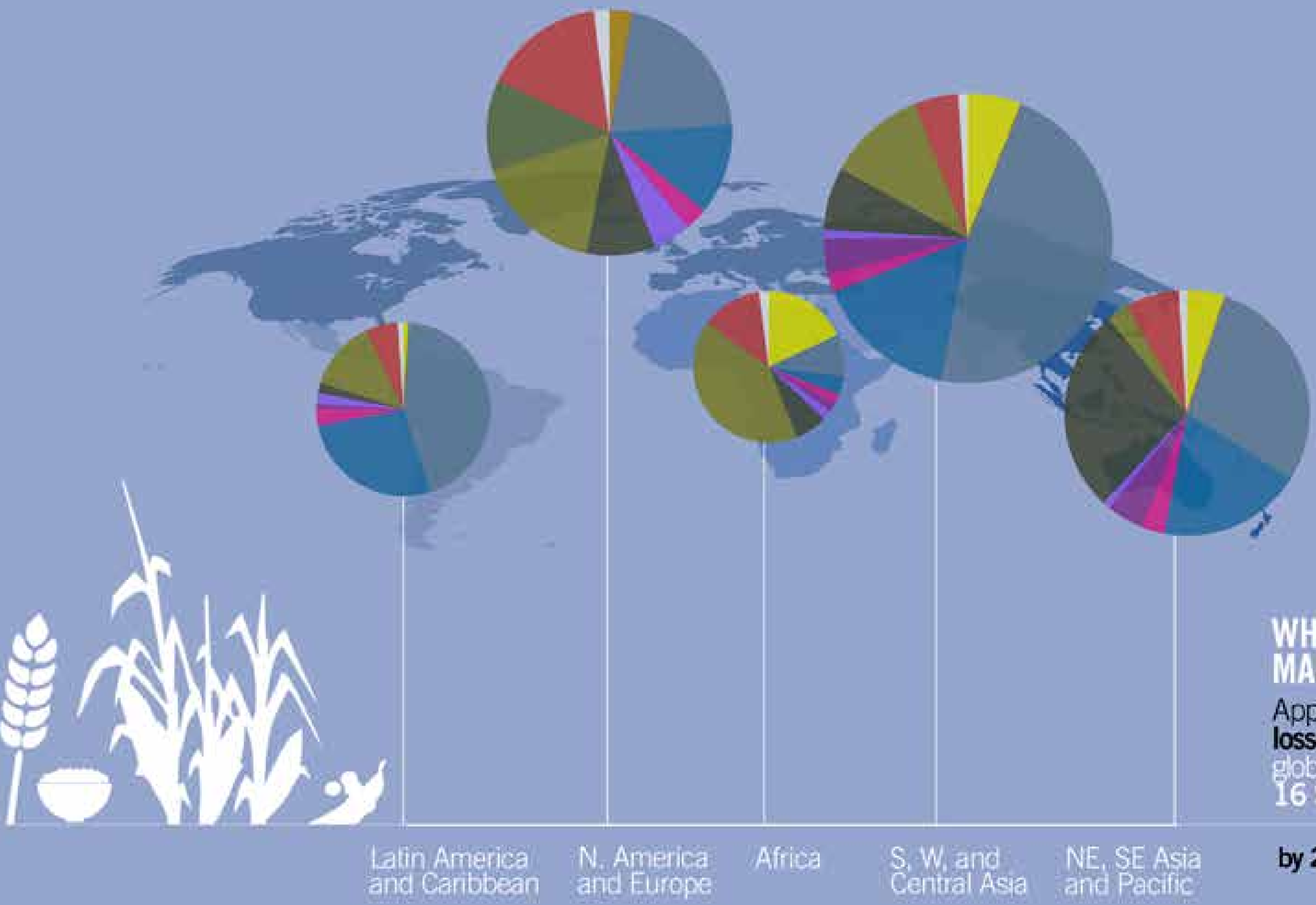
+ ADDITIONAL AVOIDED LOSSES
FROM OTHER CROPS

SLCP Mitigation Measures

Residential sector	🟨	01.
	🟨	02.
	🟫	03.
	🟨	04.
Industry	🟧	05.
	🟫	06.
Transport	⬜	07.
	🟦	08.
Agriculture	🟪	09.
	🟪	10.
	🟪	11.
Fuel	⬛	12.
	🟩	13.
	🟩	14.
Waste	🟥	15.
	⬜	16.

BC

CH_4



WHEAT+RICE+ MAIZE+SOYBEAN

Approximate **% avoided losses per year** from global implementation of **16 SLCP measures**

by 2030

17 Benefits for Agriculture

Rapid implementation of 16 SLCP control measures to reduce CH_4 and BC has the potential to avoid the annual loss of over 50 million metric tonnes of crop yields per year by 2030 (UNEP & WMO 2011). Benefits are evenly split between CH_4 and BC control measures, which similarly impact O_3 formation. For CH_4 measures, addressing emissions from coal mining, especially in Asia, and from oil and gas production, would bring the greatest benefits followed by improved waste treatment. For BC measures, the greatest benefits would come from measures addressing the transport sector. CH_4 tends to impact O_3 formation further away from the source than BC co-pollutants, some of which are also O_3 precursors. Hence benefits from BC measures are felt closer to the emission source than those of CH_4 measures.

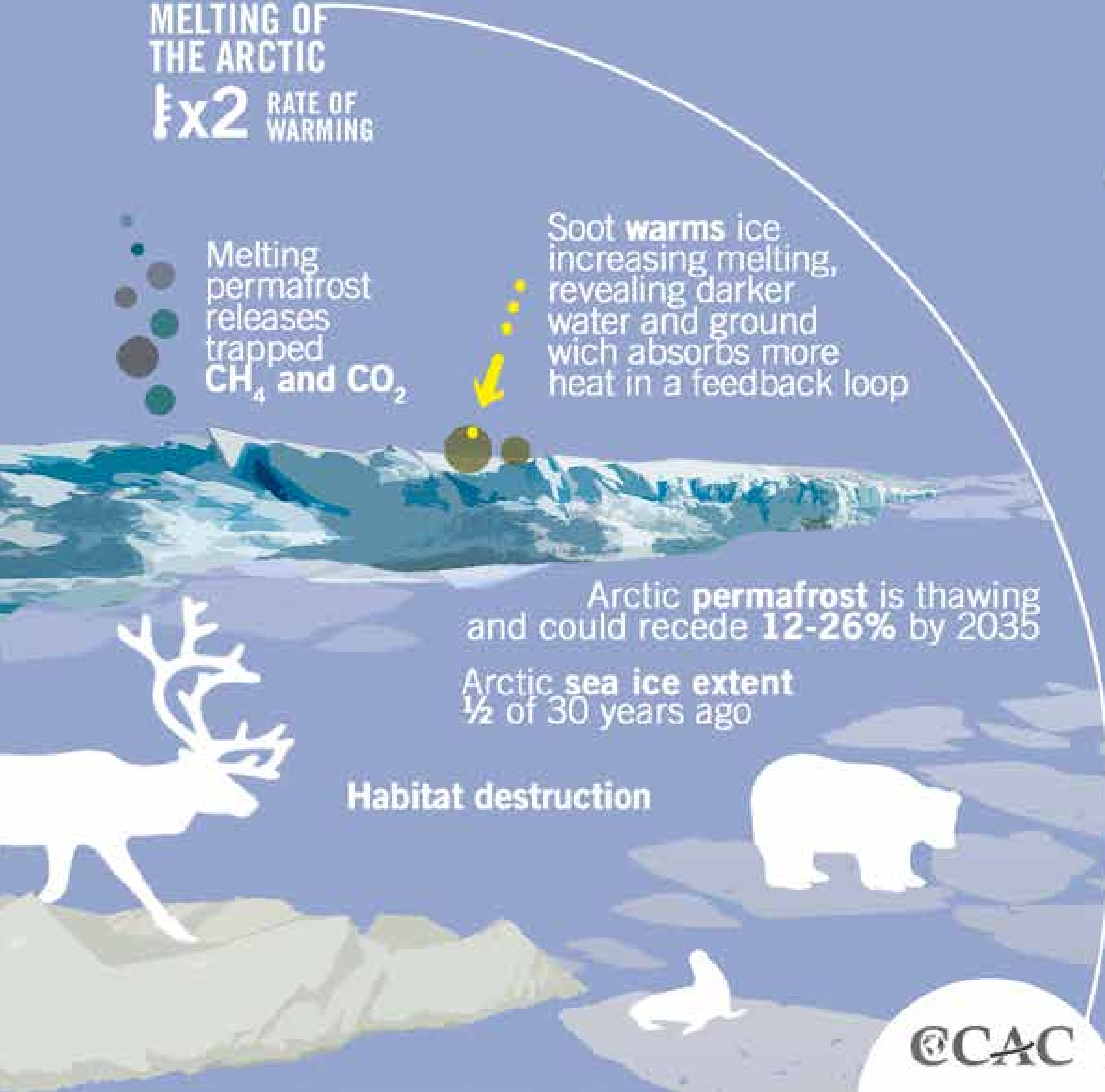
In terms of tonnage, the largest avoided crop yield losses will be achieved in China, India, and the United States, followed by Pakistan and Brazil. In terms of percentage, the main improvements will be gained in the Middle East, followed by Central and South Asia. A large impact on percentage crop yields in Mexico, quite distinct from neighbouring countries, reflects the influence of local emission changes (Shindell D. *et al.* 2012).

Cryosphere: Zoom In on the Arctic

The Arctic is currently warming two to three times faster than the global average and is expected to warm more than any other region on Earth. SLCPs contribute to increased melting in the Arctic, and BC deposited on snow and ice amplifies warming and exacerbates melting.

MELTING OF THE ARCTIC

x2 RATE OF WARMING



Melting permafrost releases trapped **CH_4 and CO_2**

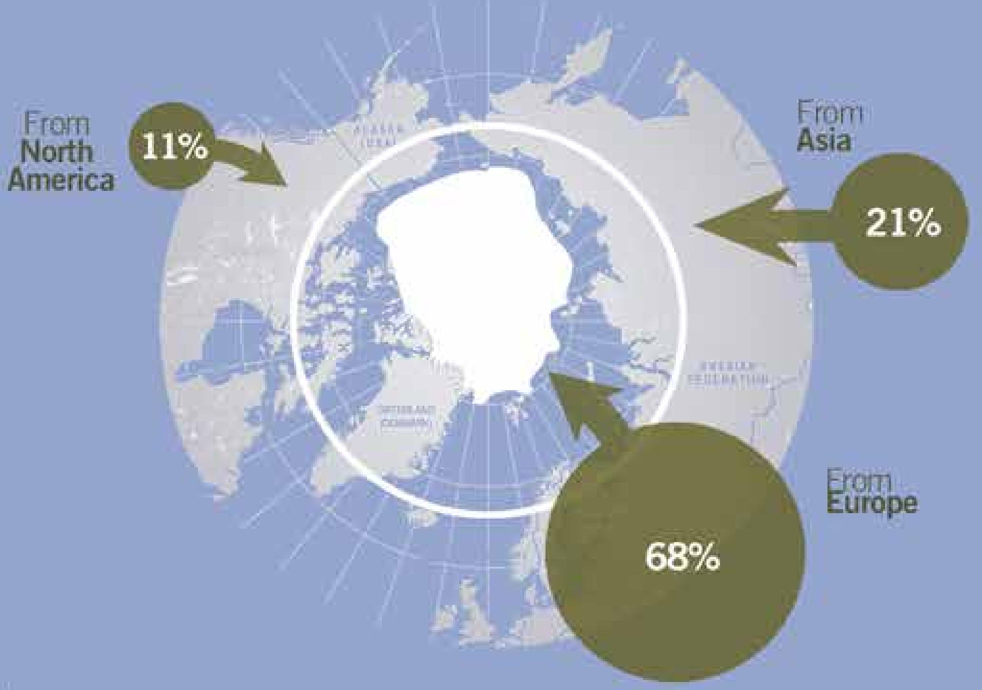
Soot **warms** ice increasing melting, revealing darker water and ground wich absorbs more heat in a feedback loop

Arctic **permafrost** is thawing and could recede **12-26%** by 2035

Arctic **sea ice extent** **½** of 30 years ago

Habitat destruction

BC TRANSBOUNDARY TRANSPORT TO THE ARCTIC



From **North America** **11%**

From **Asia** **21%**

From **Europe** **68%**

SLCP MITIGATION BENEFITS

Rapid implementation of SLCP mitigation could avoid 0.7°C of projected warming in the Arctic **by 2040**, slowing the pace of BAU warming by **two-thirds**

18 Cryosphere: Zoom In on the Arctic

Over the past century, the Arctic and many other portions of the earth's "cryosphere" – regions of ice and snow – have been warming two to three times faster than the global average rate, and are undergoing dramatic changes (WB & ICCI 2013). BC speeds warming, because when it deposits on the surface of ice and snow, it lowers albedo and accelerates melting. CH_4 reductions also have greater temperature reduction benefits in the Arctic.

Increased melting of the cryosphere makes these regions absorb more heat by uncovering the darker, more heat absorbent land and water below, driving additional warming and melting in a positive feedback loop. Arctic sea ice coverage at the summer minimum has retreated by nearly half since the 1970´s (WB & ICCI 2013).

In addition, vast areas of land and coastal waters in the Arctic and sub-Arctic consist of permafrost, which contain large quantities of carbon at least equal to the amount released by all human activities to date. Global warming is also gradually causing this permafrost to thaw. While the rate of thaw and release of permafrost carbon remains highly uncertain, some CH_4 and CO_2 are released, representing a potentially large risk to accelerating warming further.

Beyond the Arctic, almost all land glaciers are melting rapidly, and may disappear entirely by mid-century, posing threats to water resources. Increased iceberg carving poses a threat to ships and to operations of rescue preparedness and response (IPCC 2013).

These changes pose various threats to coastal communities, infrastructures and traditional indigenous livelihoods through greater storm surge risks, faster coastal erosion, infrastructure damage from permafrost melt and more hazardous and unpredictable sea ice routes.

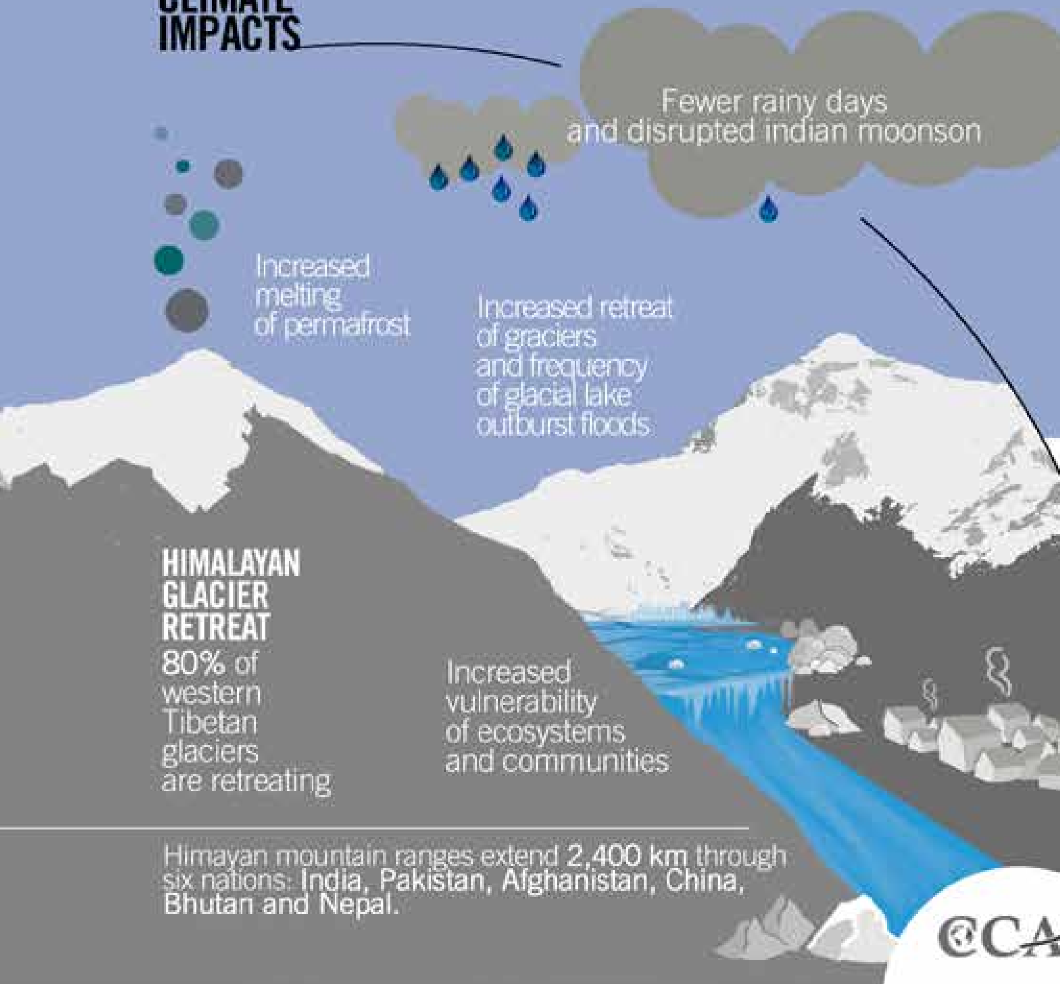
Implementing a defined set of SLCP control measures could cut the rate of warming in the Arctic by up to two-thirds by mid-century, and likely produce similar climate benefits in other cryosphere regions as well (Shindell D. *et al*. 2012).

The Himalayas

SLCPs in High Elevation Regions

SLCPs, especially BC and co-pollutants, are major contributors to the South Asian atmospheric brown cloud, with important consequences for monsoon rainfall and glacier retreat. Fast action on SLCPs could help slow the rate of warming over the Himalayan-Tibetan plateau, with multiple benefits for public health, food security and disaster risk reduction.

SLCP REGIONAL CLIMATE IMPACTS



Fewer rainy days and disrupted indian moonson

Increased melting of permafrost

Increased retreat of graciers and frequency of glacial lake outburst floods

HIMALAYAN GLACIER RETREAT
80% of western Tibetan glaciers are retreating

Increased vulnerability of ecosystems and communities

Himayan mountain ranges extend 2,400 km through six nations: India, Pakistan, Afghanistan, China, Bhutan and Nepal.

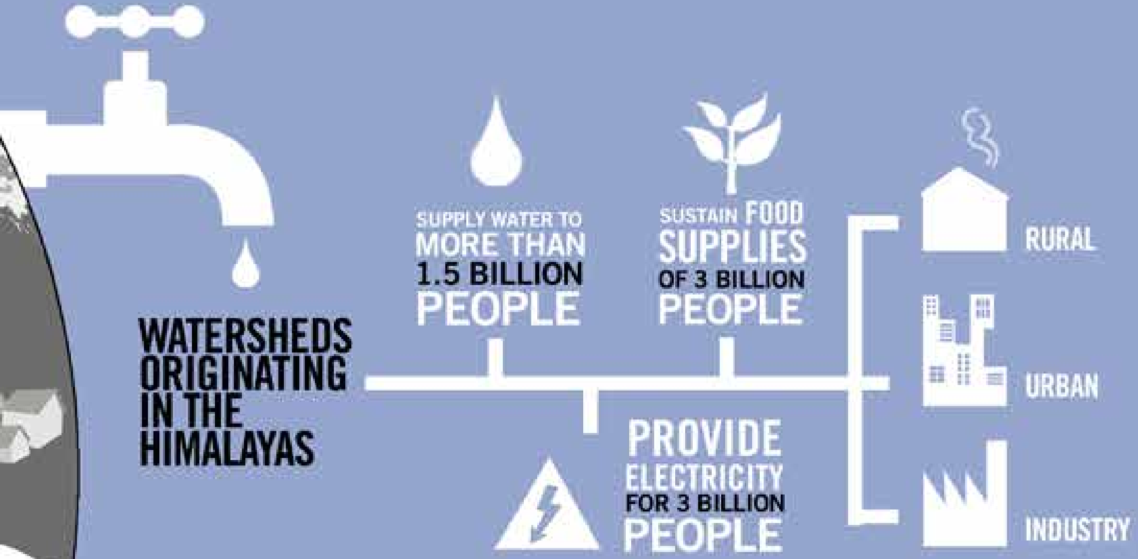
BC TRANSBOUNDARY TRANSPORT and main source sectors

BENEFITS FROM SLCP CONTROL MEASURES

In India, Pakistan, Afghanistan, China, Bhutan and Nepal

Avoided deaths from outdoor air pollution	1.2 MILLION
Increased staple crop production	15.4 MILLION

WATERSHEDS ORIGINATING IN THE HIMALAYAS



SUPPLY WATER TO MORE THAN 1.5 BILLION PEOPLE

SUSTAIN FOOD SUPPLIES OF 3 BILLION PEOPLE

PROVIDE ELECTRICITY FOR 3 BILLION PEOPLE

CCAC

19 The Himalayas: SLCPs in High Elevation Regions

Rapid implementation of SLCP control measures could help cut the rate of warming over the elevated regions of the Himalayan-Tibetan plateau, and would be beneficial to human health, food security and disaster risk reduction in the region (WB & ICCI 2013).

The Himalayas, together with the Tibetan Plateau, the Hindu Kush and the Karakoram region, are home to the largest area of glaciers and permafrost outside the Polar regions. Like the Arctic, this region is sensitive to warming and BC pollution. Fresh water in the Hindu Kush-Himalayas plays a substantial role in both regional and global food security. Ten of the largest rivers in Asia flow through the region. More than 1.3 billion of people find their livelihoods in these river basins, which supply water for over half of Asia´s cereal production, nearly 25% of the global total. Rapid climate-induced changes in the region directly affect water resources, as well as services, such as electricity, and the food supplies of 3 billion people (WB & ICCI 2013).

Increased glacier melt also leads to increased river floods and increased risk of glacial lake outburst floods. The Himalayan-Tibetan Plateau is near large emission sources of BC, which may increase warming, especially in those regions covered by snow and ice. Over half of global BC and methane emissions occur in Asia (Bond T.C. *et al*. 2013).

Cookstoves, coal stoves and likely kerosene lamps are key sources of BC that contribute to household air pollution, which is the leading preventable risk factor for the burden of disease in South Asia (including India) (Lim S. *et al*. 2012). BC also affects the monsoon cycles in the region, which in turn has implications for water access and agricultural yield (UNEP 2008).

The Climate and Clean Air Coalition

to Reduce Short-Lived Climate Pollutants

The CCAC is a partnership of governments, intergovernmental organisations, representatives of the private sector, the environmental community, and other members of civil society. It is a unique initiative to support fast action and make a difference on several fronts at once: public health, food and energy security, and the climate.

THE INITIATIVES OF THE CCAC

- Reducing Black Carbon Emissions from **Heavy Duty Diesel Vehicles and Engines**
- Mitigating SLCPs from **Municipal Solid Waste Sector**
- Mitigating Black Carbon and Other Pollutants from **Brick Production**
- Promoting **HFC Alternative Technology** and Standards
- Accelerating Methane and Black Carbon Reductions from **Oil and Natural Gas Production**
- Reducing SLCPs from **Household Cooking and Domestic Heating**
- Addressing SLCPs from **Agriculture**
- Supporting **National Planning for Action** on SLCPs (SNAP)
- **Regional Assessments** of SLCPs
- **Financing of** SLCP Mitigation

THE COALITION'S OBJECTIVES ARE TO ADDRESS SLCPs BY:

01. **Raising awareness** of SLCP impacts and mitigation strategies.

02. Enhancing and developing new **national and regional actions**, including by identifying and overcoming barriers, enhancing capacity, and mobilising support.

03. **Promoting best practices** and showcasing successful efforts.

04. **Improving scientific understanding** of SLCP impacts and mitigation strategies.

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20 The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants

Building on over a decade of scientific efforts, in February 2012, the Climate and Clean Air Coalition to Reduce SLCPs (the CCAC) was launched by six governments and UNEP as the first global effort to address SLCPs as an urgent and collective challenge. After two years it now has more than 80 Partners, including 40 countries which have endorsed its Framework and agreed to engage in meaningful action to reduce SLCPs.

The Coalition is a non-binding, voluntary international partnership, bringing together diverse, experienced, and influential players around the world to leverage high-level engagement and political will and catalyse concrete and substantial action to reduce SLCPs in ways that protect the environment and public health, promote food and energy security and address near term climate change. All Partners in the Coalition recognise that its work is complementary to global efforts to reduce CO2 in particular under the UNFCCC.

The Coalition's activities are structured around 10 high-impact initiatives led by the Partners:

1. Reducing Black Carbon Emissions from Heavy-Duty Diesel Vehicles and Engines
2. Reducing SLCPs from Household Cooking and Domestic Heating
3. Mitigating SLCPs from Municipal Solid Waste
4. Promoting HFC Alternative Technology and Standards
5. Mitigating SLCPs and Other Pollutants from Brick Production
6. Addressing SLCPs From Agriculture
7. Accelerating Methane and Black Carbon Reductions from Oil and Natural Gas Production
8. Financing Mitigation of SLCPs
9. Regional Assessments of SLCPs
10. Supporting National Planning for Action on SLCPs

To learn more about the Coalition, visit us at:
www.unep.org/ccac

Glossary

Aerosol
A suspension of airborne solid or liquid particles that reside in the atmosphere for at least several hours. For convenience the term aerosol, which includes both the particles and the suspending gas, is often used in this report in its plural form to mean aerosol particles.

Albedo
The albedo of a surface is its ability to reflect incoming solar radiation. It is expressed as a number between 0 (dark, all radiation absorbed) and 1 (total radiation reflected). The more radiation reflected, the higher the albedo. Ice and snow typically have a very high albedo.

Biomass
The total mass of living organisms in a given area or volume; dead plant material can be included as dead biomass. Biomass burning is the burning of living and dead vegetation.

Black carbon
Operationally defined aerosol species based on measurement of light absorption and chemical reactivity and/or thermal stability. It is sometimes referred to as soot.

EURO VI
European emissions standards which define acceptable limits for exhaust emissions of new vehicles sold in EU member states.

Global Warming Potential
The total energy a gas absorbs over a period of time (usually 100 years), compared to carbon dioxide.

Ozone
Ozone, the triatomic form of oxygen, is a gaseous atmospheric constituent. In the troposphere, it is created both naturally and by photochemical reactions involving gases resulting from human activities (smog). Tropospheric ozone acts as a greenhouse gas. In the stratosphere, it plays a dominant role in radiative balance and shields the Earth from excessive ultraviolet radiation.

Particulate Matter Air Pollution
PM is a widespread air pollutant, consisting of a mixture of solid and liquid particles suspended in the air. Commonly used indicators describing PM that are relevant to health refer to the mass concentration of particles with a diametre of less than 10 µm (PM10) and of particles with a diametre of less than 2.5 µm (PM2.5).

Positive feedback
A feedback is the way a system responds to a forcing. In the case of the climate system, a temperature forcing – like warming – can set the conditions for either the opposite effect (cooling), or further warming. The second case is known as a positive feedback, and the Arctic region is particularly rich in positive feedbacks.

Radiative Forcing
A measure of the influence of a particular factor (e.g. greenhouse gas (GHG), aerosol or land-use change) on the net change in the Earth's energy balance.

Acronyms

BC	Black Carbon
CFCs	Chlorofluorocarbons
CH4	Methane
CO	Carbon monoxide
CO2	Carbon dioxide
GHG	Green-House Gas
GWP	Global Warming Potential
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
NMVOCs	Non-Methane Organic Volatile Compounds
NOx	Nitrous Oxides
O3	Ozone
ODS	Ozone-Depleting Substances
PM	Particulate Matter
RF	Radiative Forcing
SLCPs	Short-Lived Climate Pollutants
SLR	Sea-level Rise
UNEP	United Nations Environment Programme
WMO	World Meteorological Organisation
UNFCCC	United Nations Framework Convention on Climate Change

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