Regional Assessment of Short-Lived Climate Pollutants in Latin America and the Caribbean

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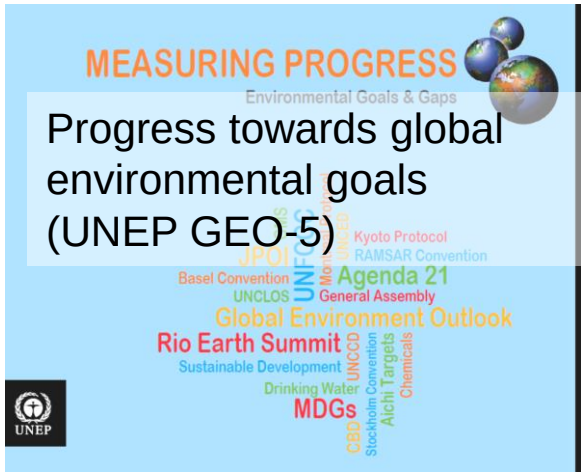
21 June, Santiago Chile

Air pollution and Public Health: unfinished business on the sustainable development agenda



Outdoor air pollution

Urgent issue in most large urban areas

About 90.000 premature deaths each year due to outside air pollution in LAC.

Indoor air pollution

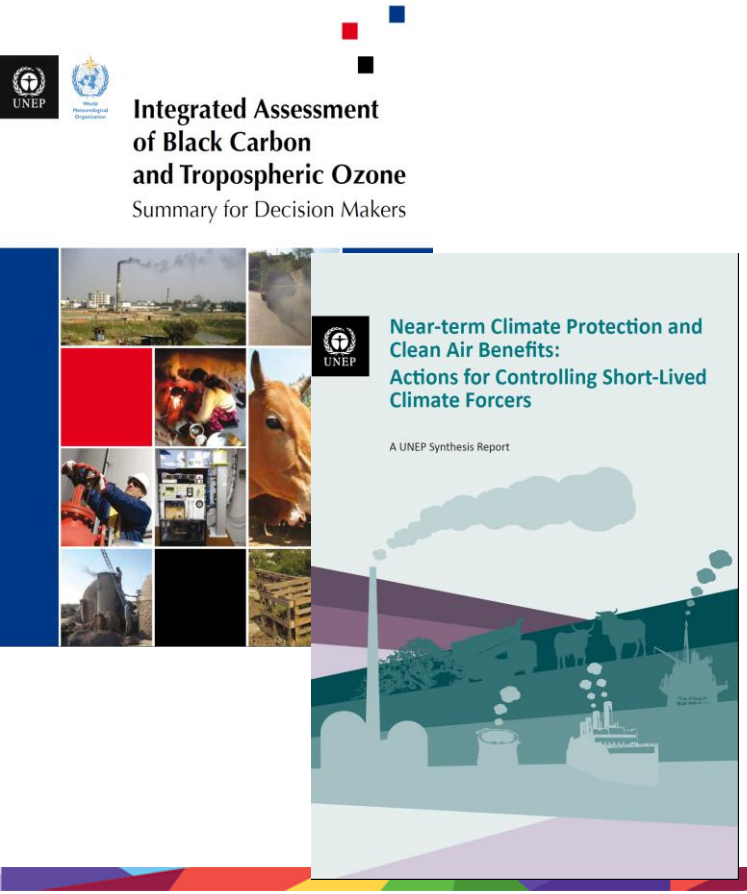
"Indoor air pollution from particulate matter continues to have major health impacts, particularly on women and children."

Around 39.000 people die each year prematurely from illness attributable to indoor air pollution in LAC

Source: WHO statistics

Short-lived Climate Pollutants (SLCPs):

BC, O_3, CH_4 and HFC



The global assessment highlighted certain opportunities for the reduction of SLCPs that would allow to gain some time for the full and widespread implementation of CO_2 abatement measures (2011).

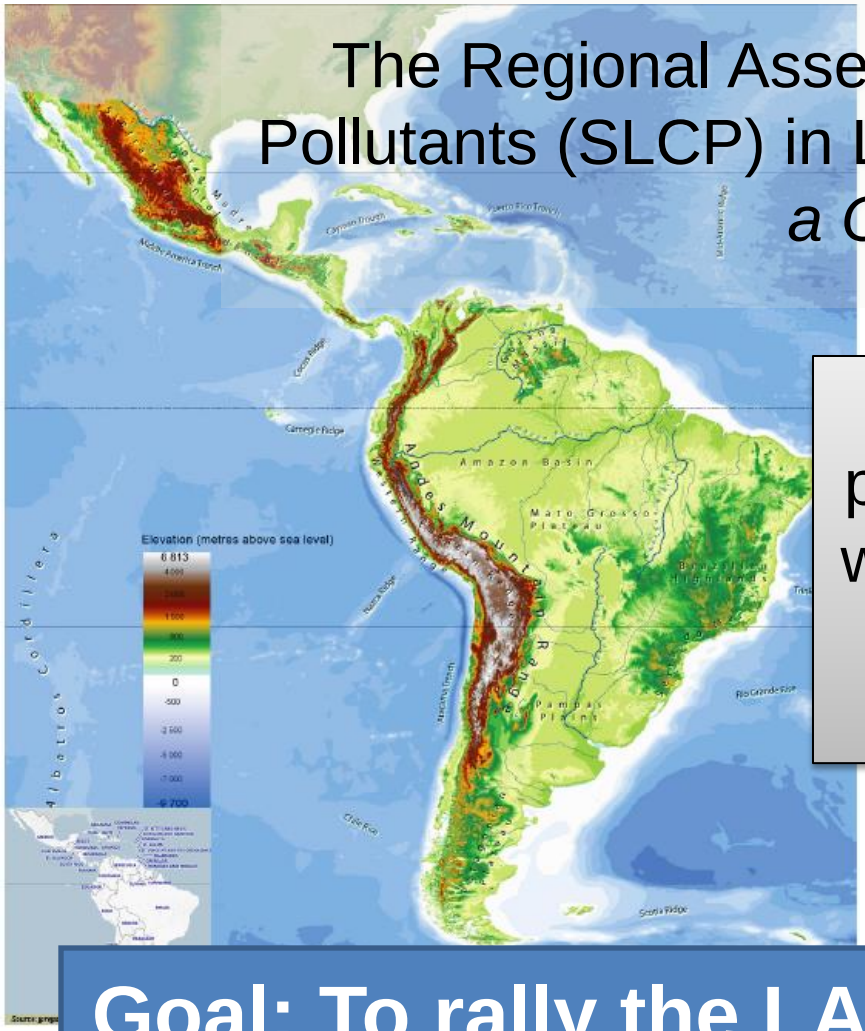
It gave rise to the formation of the Climate and Clean Air Coalition to reduce ***Short-lived Climate Pollutants*** (CCAC) in February 2012 with 7 partners

It has been very successful since then with now 50 country and 45 NGO partners (http://www.ccacoalition.org/)

In LAC:

Chile, Colombia, Costa Rica, Dominican Rep, Mexico, Paraguay, Peru, Uruguay

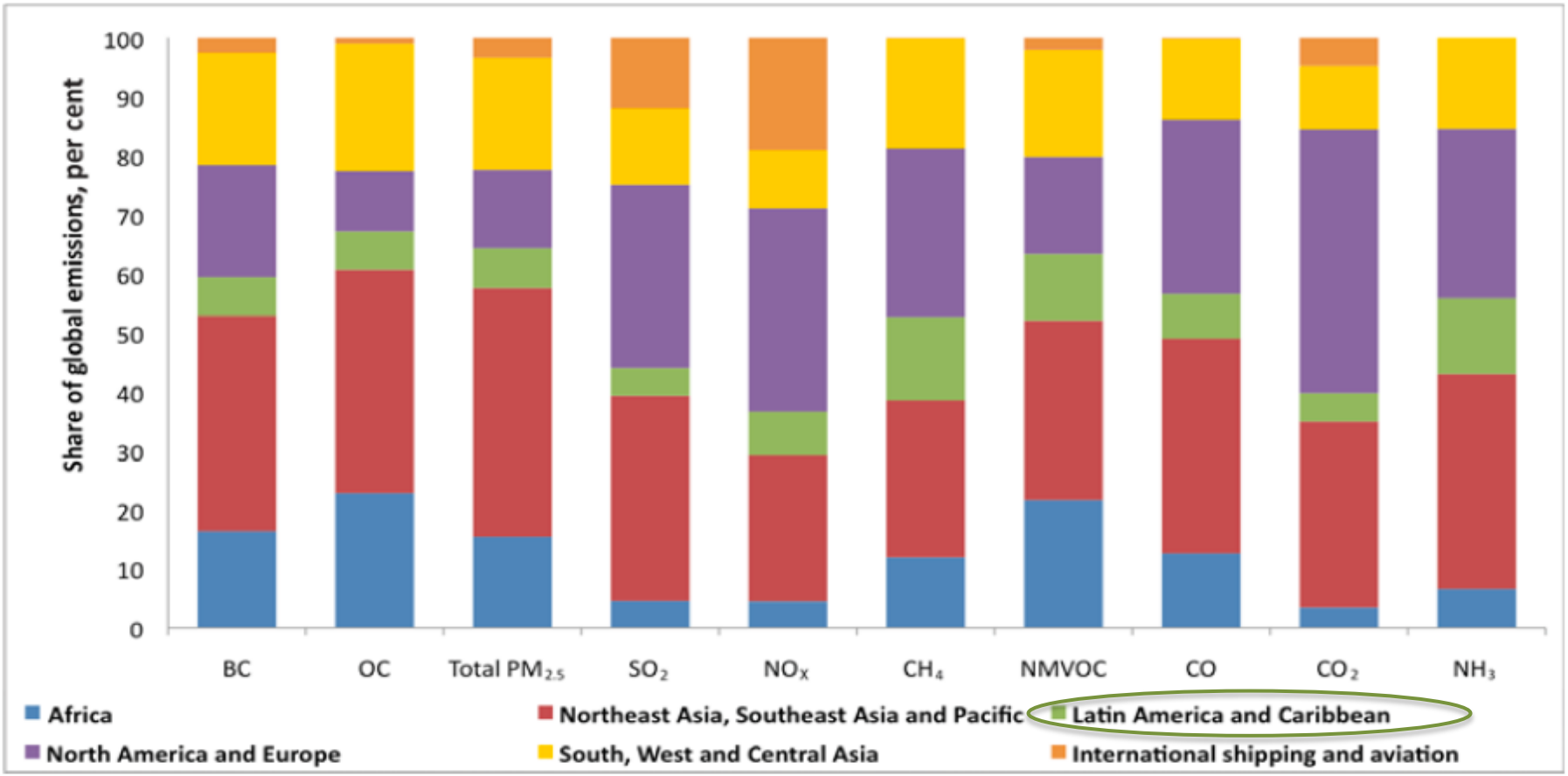
The Regional Assessment of Short-Lived Climate Pollutants (SLCP) in Latin America and the Caribbean, *a CCAC initiative*



Coordinated ***by*** the region, produced by scientists ***in*** the region with focus ***on*** the region, supporting rapid actions ***in*** the region, unleashing benefits ***for*** the region

<u>Goal</u>: To rally the LAC Region to develop a scientifically-robust, policy-relevant integrated assessment of SLCPs

LAC Emissions in the Global Context



Regional estimates of global anthropogenic emissions for 2005 generated from the IIASA GAINS model [UNEP/WMO, 2011].

LAC Regional Assessment: Methodology

The DPSIR framework is used:

- *Drivers (e.g. GDP; population)*
- *Pressure (emissions)*
- *State (ambient concentration)*
- *Impact (health, agriculture, ecosystems, etc.)*
- *Response (policy/measures/case studies)*

This methodology is extensively used, such as in the UNEP Global Environment Outlook (GEO) reports

What is different in the LAC Assessment?

- ✓ Increased spatial resolution of GAINS model to better reflect the emissions profiles throughout LAC: 13
- ✓ Updated emissions inventories, through collaborations with local scientists working in the field
- ✓ Involvement of natural and social scientists that have already worked with local stakeholders, to determine the barriers for implementation of measures throughout the region

Emission scenarios

GAINS: Greenhouse gas–Air pollution Interactions and Synergies model from IIASA (Amann et al., 2011)

- *Baseline for 2010*

- *Reference scenario to 2050*
- *Mitigation scenario to 2050 including measures already planned by different countries (e.g. introduction of EURO V, VI)*
- *Climate change scenario (mainly CO_2 mitigation)*

Modeling components

- Global coupled climate model (***GISS***) run by Drew Shindell at Duke Univ.: fully coupled and with off-line climate
- ***GEOS-Chem*** model run by Daven Henze at the Univ. of Colorado
- Air quality receptor model ***TM5-FASST***, run by Rita Van Dingenen at the EU Joint Research Centre
- ***Adjoint modelling*** carried out using the GEOS-Chem modeling results for countries of the LAC region, run by Daven Henze
- Coefficients resulting from adjoint modeling are used in the ***Integrated Benefits Calculato***r (run at SEI) to calculate country-scale population-weighted average concentrations for $PM_{2.5}$ for all countries and ozone concentrations for 7 countries

Key message 1

Poor air quality and global warming have already affected vulnerable populations and ecosystems in LAC, resulting in premature deaths, crop

Particulate matter

Three models used as part of this assessment suggest that 64 000 premature deaths in 2010 were associated with outdoor exposure to ambient $PM_{2.5}$. This is likely, however, to be an underestimate and premature deaths could be up to about 81 000 according to the latest figures from the Global Burden of Disease (GBD) project.

Ozone

Premature deaths in LAC associated with outdoor exposure to O_3 in 2010 were estimated to be about 5 000.

Deaths from exposure to ambient O_3 concentrations in LAC were calculated using the TM5-FASST model, and this estimate is the same as that from the GBD project, according to the data available through the Institute for Health Metrics and Evaluation.

Exposure to tropospheric O_3 in 2010 resulted in yield losses of approximately 7.4 million tonnes of four major crops – soybean, maize, wheat and rice.

Most of the total estimated crop yield losses in 2010 were concentrated in three countries – Argentina, Brazil and Mexico. Soybean is a large source of export revenue for several LAC countries.

Regional climate

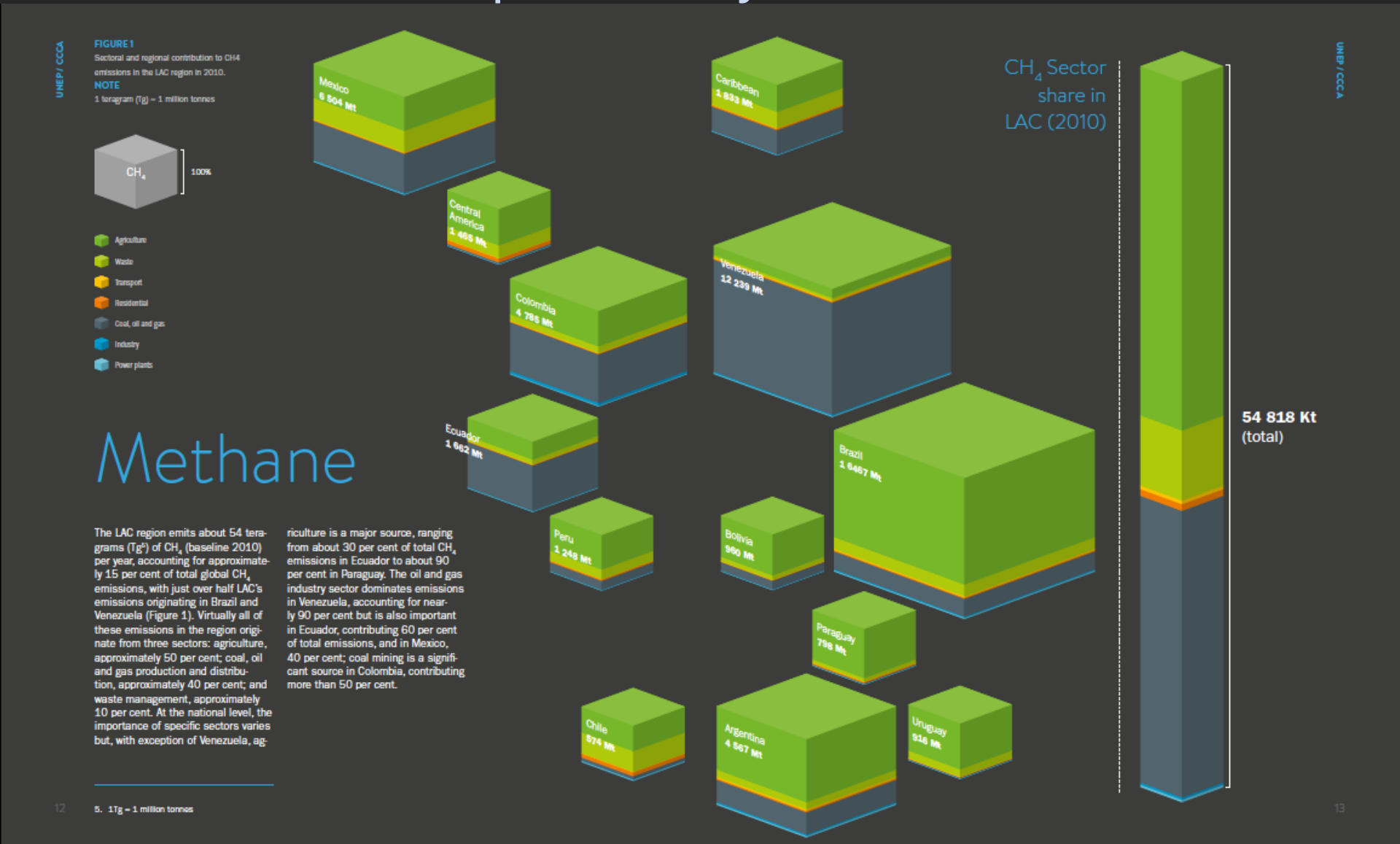
There are a large variety of climates in LAC, due to its latitudinal extent and to the presence of the Andes and other mountain ranges. Very sensitive ecosystems are associated with specific climates and are vulnerable to the rapid climate changes experienced in recent decades.

Temperatures have been increasing globally and in LAC in recent years, particularly at high altitude, contributing to the retreat of glaciers.

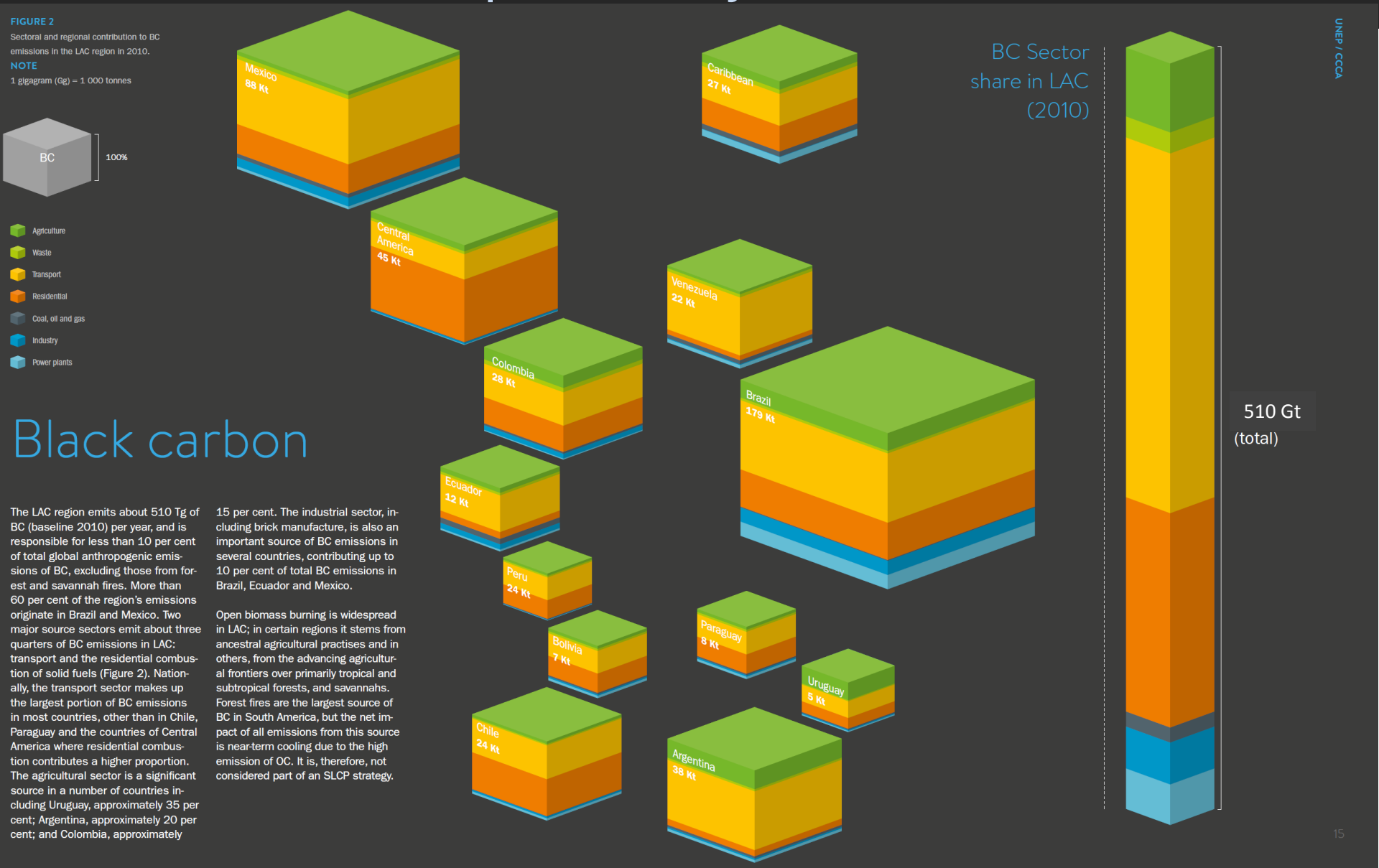
Key message 2

Agriculture, mobile and commercial refrigeration, and transport are the sectors that produce the largest emissions of CH_4, HFCs and BC.

Emissions per country and sector 2010



Emissions per country and sector 2010



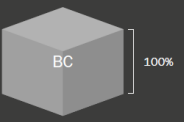
Black carbon

The LAC region emits about 510 Tg of BC (baseline 2010) per year, and is responsible for less than 10 per cent of total global anthropogenic emissions of BC, excluding those from forest and savannah fires. More than 60 per cent of the region's emissions originate in Brazil and Mexico. Two major source sectors emit about three quarters of BC emissions in LAC: transport and the residential combustion of solid fuels (Figure 2). Nationally, the transport sector makes up the largest portion of BC emissions in most countries, other than in Chile, Paraguay and the countries of Central America where residential combustion contributes a higher proportion. The agricultural sector is a significant source in a number of countries including Uruguay, approximately 35 per cent; Argentina, approximately 20 per cent; and Colombia, approximately 15 per cent. The industrial sector, including brick manufacture, is also an important source of BC emissions in several countries, contributing up to 10 per cent of total BC emissions in Brazil, Ecuador and Mexico.

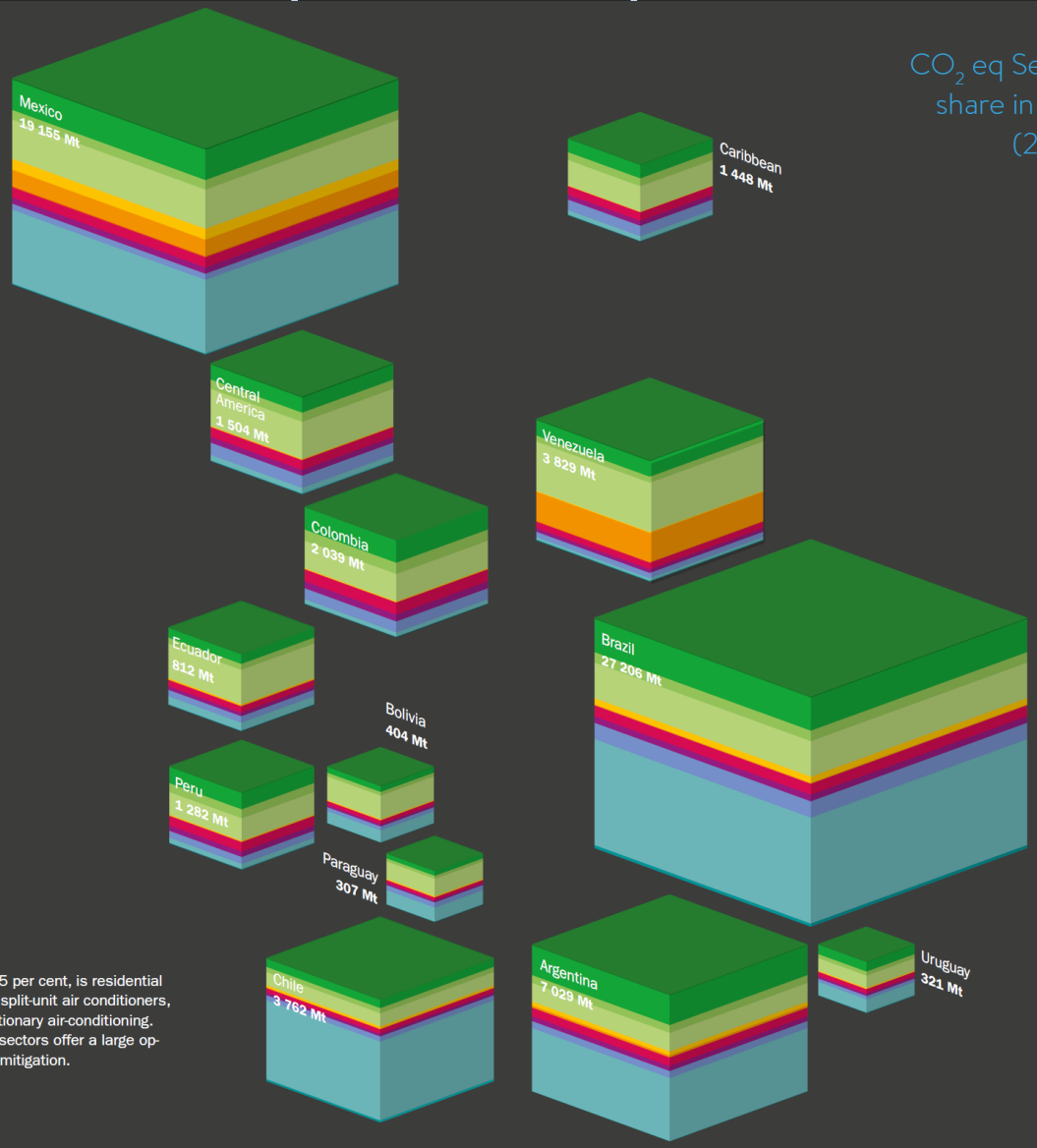
Open biomass burning is widespread in LAC; in certain regions it stems from ancestral agricultural practises and in others, from the advancing agricultural frontiers over primarily tropical and subtropical forests, and savannahs. Forest fires are the largest source of BC in South America, but the net impact of all emissions from this source is near-term cooling due to the high emission of OC. It is, therefore, not considered part of an SLCP strategy.

Emissions per country and sector 2010

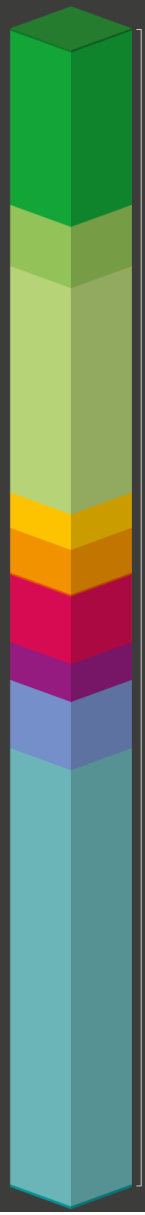
FIGURE 3
Sectoral and regional contribution to HFCs emissions in the LAC region in 2010.
NOTE
1 teragram (Tg) = 1 million tonnes;
CO2eq = carbon dioxide equivalent



- Solvents
- Stationary air-conditioning
- Refrigerated transport
- Mobile air-conditioning
- Industrial refrigeration
- HCFC-22 production
- Ground source heat pump
- Foam
- Fire extinguishers
- Domestic refrigerators
- Commercial refrigeration
- Aerosols



CO_2 eq Sector share in LAC (2010)



69 Mt CO_2 eq (total)

UNEP / CCCA

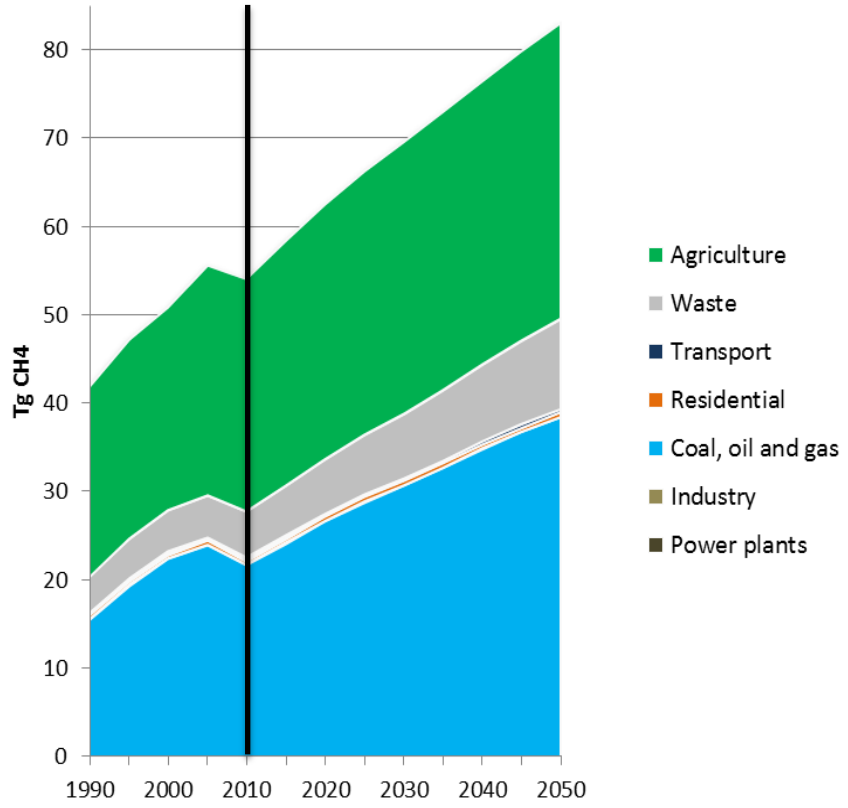
Hydrofluoro-carbons

In 2010, the LAC region was responsible for only 8 per cent of total global HFC emissions, with 77 per cent originating in Argentina, Brazil and Mexico (Figure 3). The majority of the HFC emissions come from two sectors, mobile air conditioning, about 20 per cent, and commercial refrigeration, around 38 per cent. The third largest source of emissions, contributing around 15 per cent, is residential window- and split-unit air conditioners, listed as stationary air-conditioning. These three sectors offer a large opportunity for mitigation.

Key message 3

Based on the reference scenario, without any action to reduce SLCP emissions, the influence of LAC emissions on climate, human health and agriculture will increase significantly by 2050.

Projected Methane emissions per sector in LAC to horizon ***2050*** (Reference Scenario)

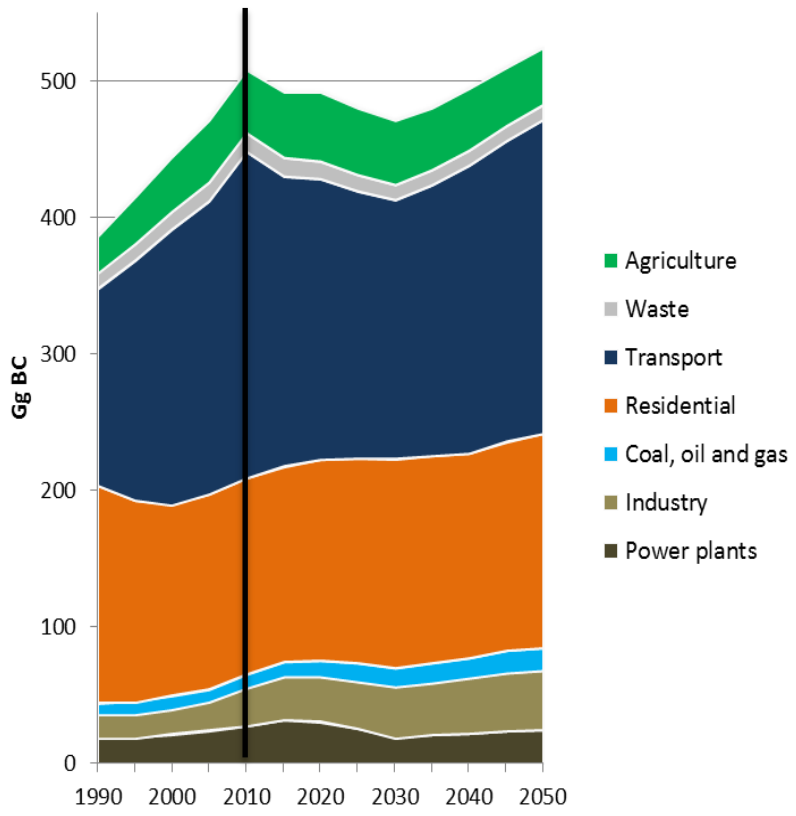


Methane

Under the reference scenario LAC methane emissions are ***expected to increase to 2050*** and beyond.

A large part of that growth is due to projected increase in oil and gas output followed by livestock production development. The projections highlight opportunities for mitigation potential in sectors like oil and gas production, waste and agriculture.

Projected BC emissions per sector in LAC to horizon ***2050*** (Reference Scenario)

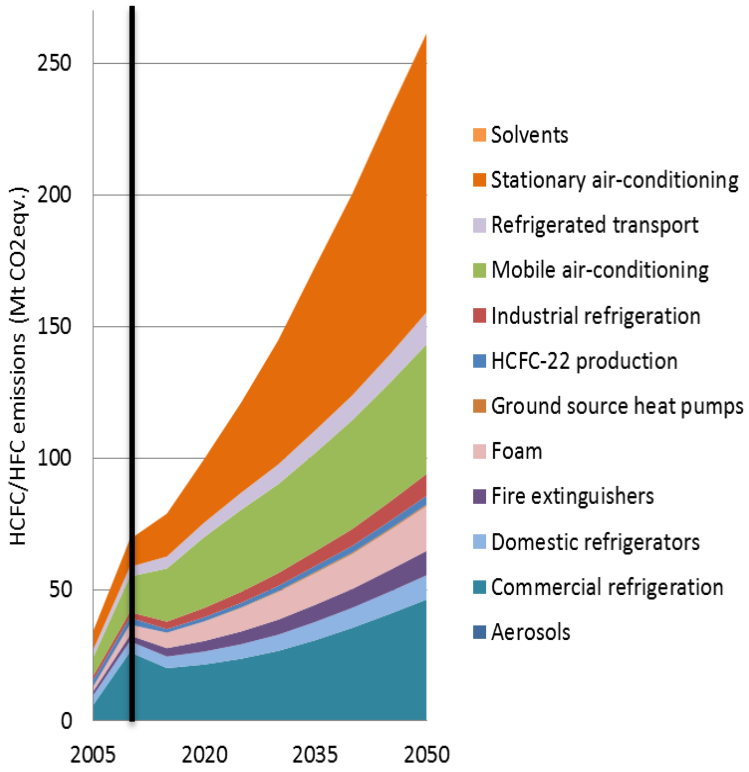


Black Carbon

Black carbon emissions in LAC are expected ***to decrease in the next decades*** owing to the introduction of ever more stringent transport legislation in several regions to reduce urban air pollution.

However, in the longer term, the ***current legislation is not sufficient*** to constrain growth of emission highlighting the existing mitigation opportunity. While the residential sector emissions are not expected to grow in the future, this source offers a major mitigation opportunity across the region.

Projected HFC emissions per sector in LAC to horizon ***2050*** (Reference Scenario)



HFCs

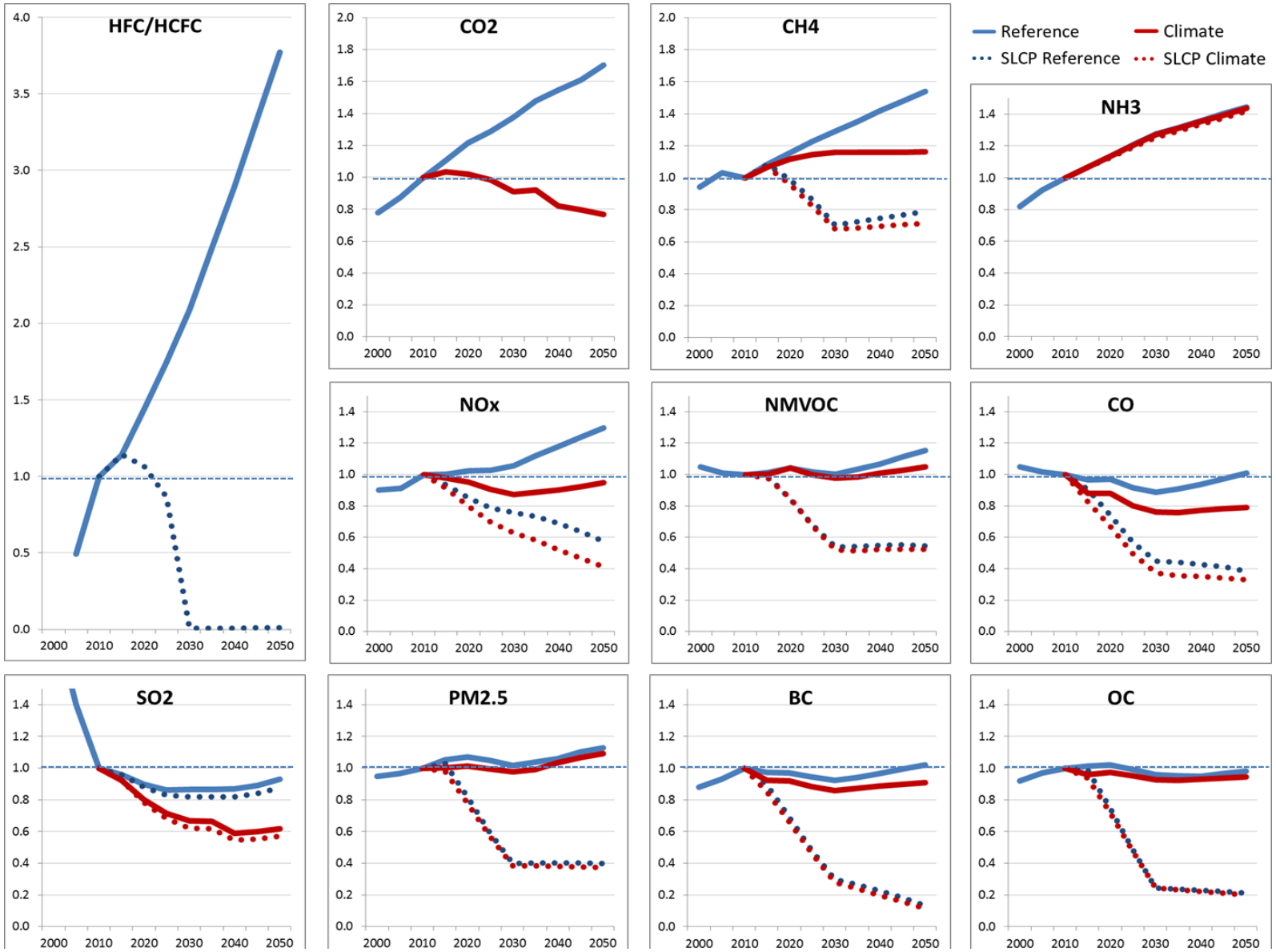
Assuming no targeted policies to control emissions of HFCs, they are expected to ***continue a strong growth*** with foams, commercial refrigeration, and stationary and mobile air-conditioning representing over 90% of total emissions.

While every sector is expected to experience growth, the largest increase is estimated for stationary and mobile air-conditioning and represents a significant mitigation opportunity.

Key message 4

A number of SLCP measures have been identified that, by 2050, have the potential to reduce warming in LAC by up to 0.9° C, premature mortality from $PM_{2.5}$ by at least 26 per cent annually, and avoid the loss of 3-4 million tonnes of four staple crops each year

Methane measures	
Oil and gas production and distribution	1. Recovery and use of vented gas in oil and gas production
	2. Reduction of gas leakage during distribution
Waste management	3. Separation and treatment of biodegradable municipal solid waste (MSW)
	4. Food industry solid and liquid waste treated in anaerobic digesters, with biogas recovery
Coal mining	5. Pre-mine degasification and recovery of CH_4 during mining
Agriculture	6. Anaerobic digestion – biogas from livestock manures
Measures addressing incomplete combustion (affecting BC and co-emitted species)	
Households	1. Clean cooking and heating stoves
Transport	2. Euro VI on new vehicles, including diesel particle filters (DPF)
	3. Eliminating high emitting vehicles
Industry	4. Modernized coke ovens
	5. Modernized brick kilns
	6. High efficiency particulate matter controls in industrial biomass and waste combustion
Agriculture	7. Enforced ban of open-field agricultural burning
Oil and gas production	8. Reduced gas flaring
HFCs measures	
All sectors	1. Switch to low global warming potential (GWP) HFC alternatives



Emission reductions for BC, OC, primary $PM_{2.5}$ (which includes BC and OC), methane, SO_2, NO_x, CO, NMVOC, NH_3, HFCs, and CO_2 relative to the Reference and Climate scenarios from the full implementation of measures (SLCP Mitigation scenario). This shows the changes in emissions relative to the 2010 emissions

Emission reductions of CH4 and BC in 2030 and 2050 from the full implementation of measures (SLCP mitigation scenario) in LAC compared to the reference and climate scenarios.

FIGURE 8

Emission reductions of CH4 in 2030 and 2050 from the full implementation of measures (SLCP mitigation scenario) in LAC compared to the reference and climate scenarios.

Most of the climate, human health, agricultural and ecosystem benefits could be achieved in LAC though the implementation of measures focusing on CH_4, HFCs and emissions from incomplete combustion, including BC and its co-emitted substances.

If no measures are implemented, the reference scenario suggests that CH_4 emissions would continue to increase, reaching more than 80 million tonnes by 2050, compared to about 54 million tonnes in 2010 (Figure 8). The implementation the suggested SLCP measures, however, could reduce current emissions by 48 per cent by 2050. This reduction would be mainly achieved by the implementation of measures to recover and use gas vented in the oil and gas production, as well as by reducing emissions from municipal and food industry waste, which together would account for more than 90 per cent of all emission reductions. A climate strategy focussed on reducing of CO_2 emissions would deliver lower reductions of CH_4.

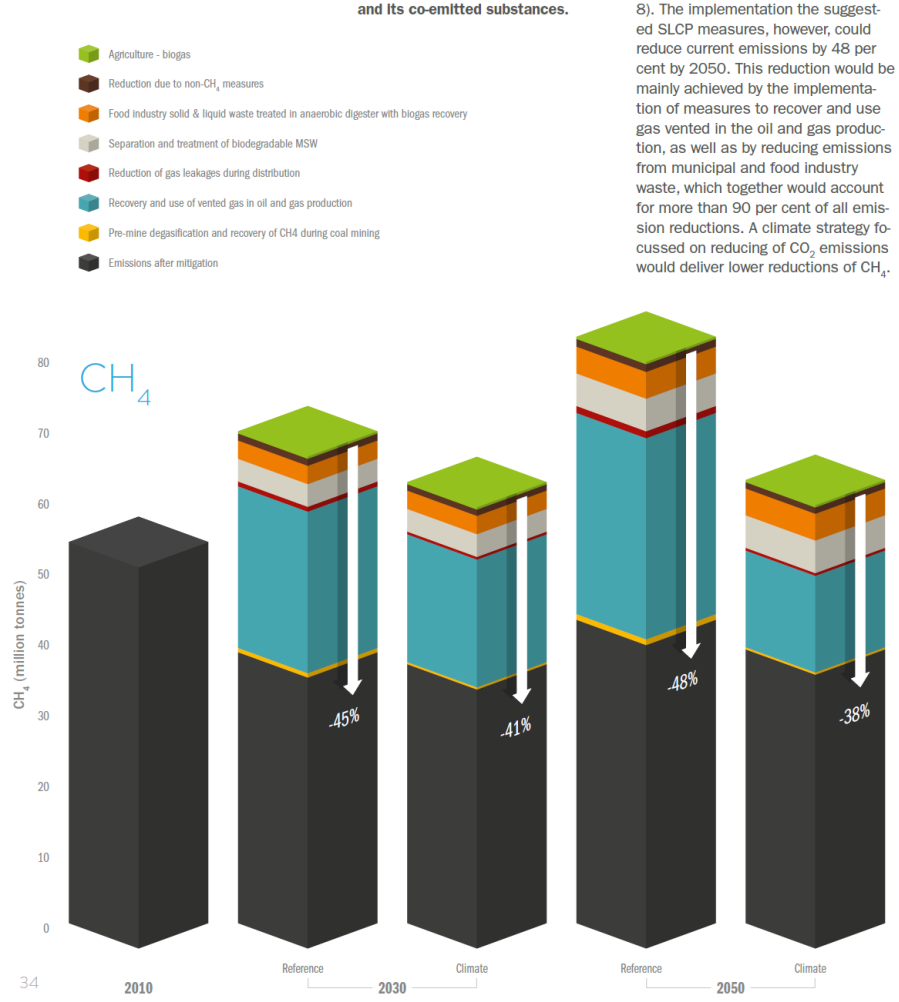
Full implementation of measures to mitigate $PM_{2.5}$ emissions could lead to significant reductions in primary particle emissions (BC and OC) and in NO_x emissions that lead to secondary nitrate particles. Up to an 88 per cent reduction in BC emissions by 2050, compared to 2010 levels, could be achieved (Figure 9). Key measures include a shift to using clean fuels for residential cooking and heating stoves, which would involve vulnerable populations adopting cultural changes. Measures associated with improved technology for diesel trucks and buses (EURO VI including DPF) and removal of high emitters from the roads would require government participation for full implementation. Banning the outdoor burning of agricultural residues also has significant mitigation potential.

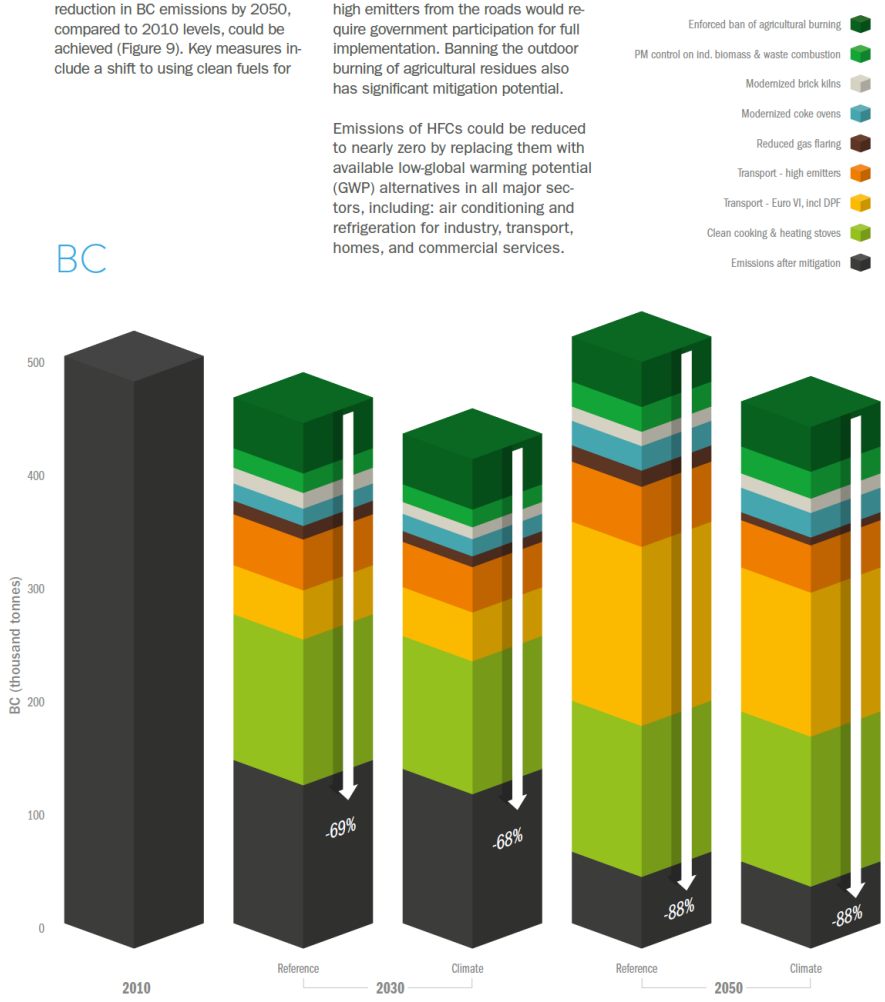
Emissions of HFCs could be reduced to nearly zero by replacing them with available low-global warming potential (GWP) alternatives in all major sectors, including: air conditioning and refrigeration for industry, transport, homes, and commercial services.

FIGURE 9

Emission reductions of BC in 2030 and 2050, from the full implementation of measures (SLCP mitigation scenario) in LAC compared to the reference and climate scenarios.

UNEP / CCAC



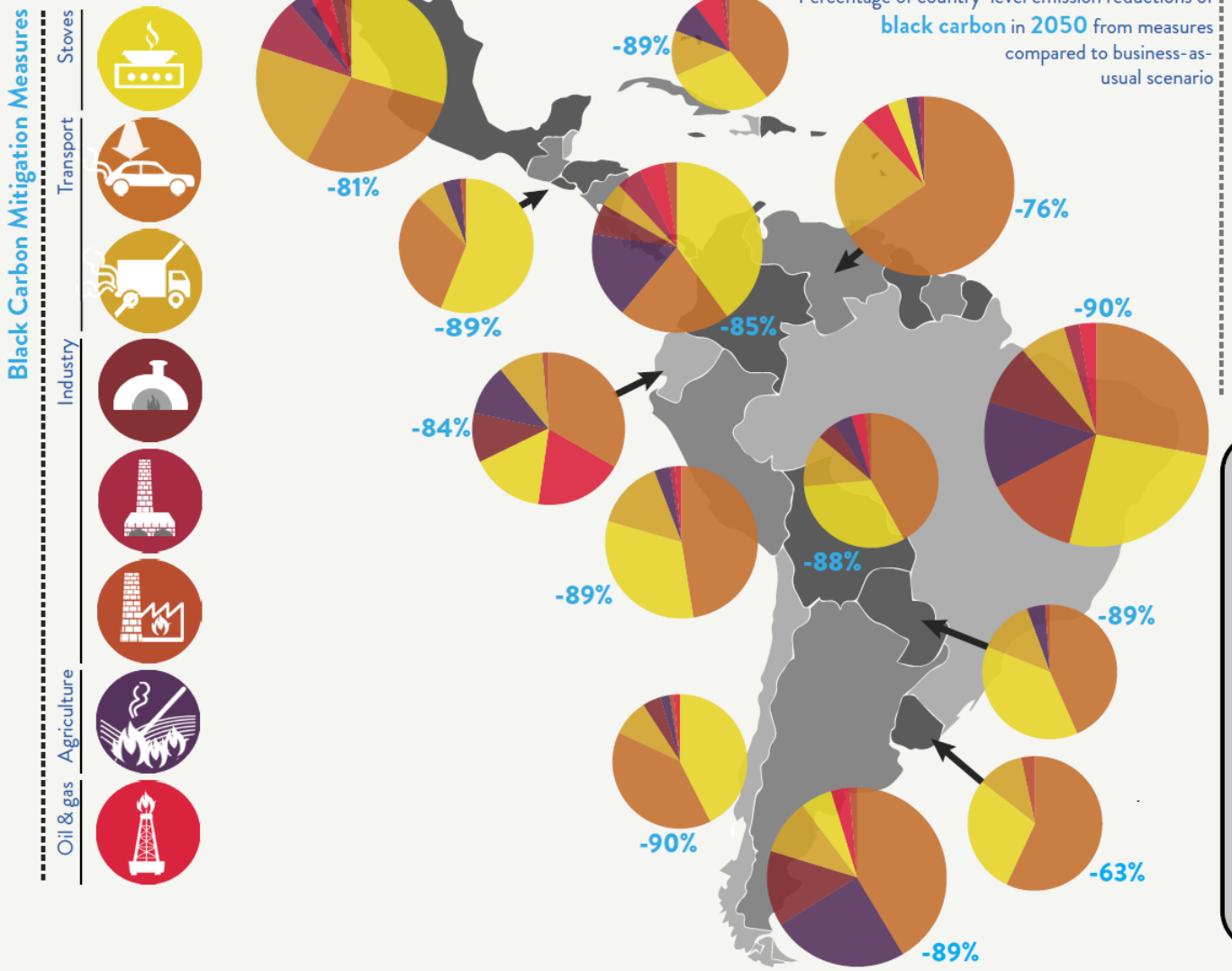


Key message 5

Efforts and experience reducing some SLCPs are already in place across LAC and could be scaled up if identified barriers were overcome.

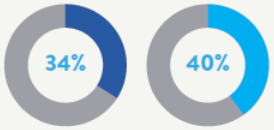
Black Carbon Measures & Benefits for Health

Fast implementation of black carbon measures could reduce black carbon emissions in the Latin American and Caribbean region by nearly 69% by 2030, growing to more than 88% by 2050. The reduction of particulate matter air pollution will provide significant immediate benefits for public health, especially amongst women and children.



HEALTH BENEFITS FROM SLCP MEASURES IN LAC

fewer deaths from particulate matter and ozone air pollution in **2030**



fewer deaths from particulate matter and ozone pollution in **2050**

* compared to business-as-usual scenario

CLEAN COOKING & HEATING STOVES

Transferring from a traditional solid fuel stove to a clean fuel such as LPG would considerably reduce premature mortality due to indoor PM air pollution particularly among **children**:

- **60%** less deaths from acute lower respiratory infections in children less than 5 years of age

and **women**:

- **51%** less deaths from ischaemic heart disease;
- **65%** less deaths from lung cancer; and
- **28%** less deaths from strokes.

The benefits for men are also significant (**36**, **58** and **27%** reduction in deaths respectively).

Measures proposed for mitigation of BC and co-emitted substances: Transport

1. Elimination of high emitting vehicles.

Mexico has eliminated over 25,000 older units, through a fiscal incentive to replace freight units over ten years old with less than six years old.

The ***main challenge*** remains remains in enforcing emissions standards and providing incentives for fleet turnover.

The goal: To build today the transportation sector of the future by achieving a more widespread penetration of this measure in the region.

Measures proposed for mitigation of BC and co-emitted substances: Residential

1. Introduction of improved biomass cookstoves and/or the use of liquefied petroleum gas (LPG) for cookstoves.

Several improved biomass cookstoves have been introduced in the LAC region (e.g., Patsari from Mexico, Onil from Guatemala, Turbococina from El Salvador, Justa stoves from Honduras, Malena from Bolivia).

The ***main challenge*** remains in overcoming cultural practices for more widespread penetration.

Methane Measures & Benefits for Agriculture

Fast implementation of methane measures could reduce methane emissions in the Latin American and Caribbean region by nearly 45% by 2030, growing to more than 48% by 2050. The reduction of ozone concentrations from SLCP measures can also bring rapid and considerable benefits for food security.

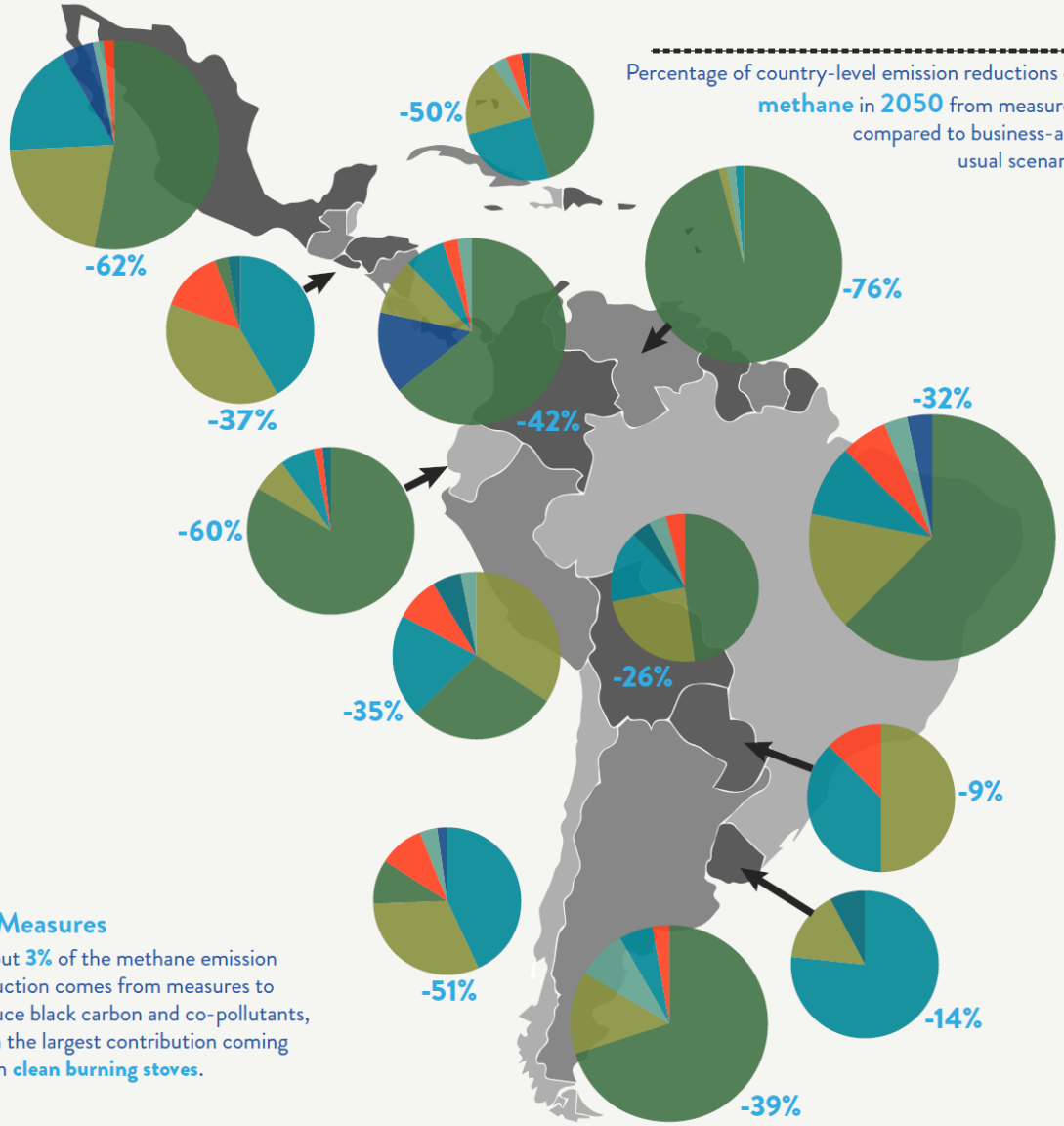
ANNUAL CROP YIELD BENEFITS BY 2030 FROM SLCP MEASURES

3-4 MILLION t

+ ADDITIONAL AVOIDED LOSSES FROM OTHER CROPS

Avoided crop losses from wheat, maize, soybean, and rice is equivalent to **1.1-1.3%** of the total yield for these four crops across the LAC region in **2030**.

Methane Mitigation Measures



Black Carbon Measures

About **3%** of the methane emission reduction comes from measures to reduce black carbon and co-pollutants, with the largest contribution coming from **clean burning stoves**.

Measures proposed for mitigation of methane: Fossil fuel production and distribution sector

1. Recovery and use of vented gas in oil and gas production.
2. Reduction of gas leakage during distribution

A Nationally Appropriate Mitigation Actions (NAMA) scheme for the whole oil and gas sector has been designed in Mexico to be financed with international funds.

3. Pre-mine degasification and recovery of CH4 during mining.

In Barranquilla, Colombia, a cooperation project for methane recovery in a power plant was approved in 2015.

Concluding remarks

- This is the first coordinated report on the status and projections of SLCPs in LAC
- This report has identified the impacts of SLCPs in LAC
- This report has gathered information of the SLCPs measures already implemented or under consideration in isolated regions within LAC
- This report has identified measures and their barriers that need to be overcome for more widespread implementation
- There is an opportunity to accelerate SLCPs leadership in LAC, with measures that can be strong drivers for sustainable strategic economic and inclusive growth
- Full implementation of measures can build a sustainable future in strategic sectors

We wish to express our thanks to all the authors, contributors and reviewers that made this project possible!

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FULL REPORT

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LAC Regional Assessment on SLCP

Evaluación Regional de CCVC en LAC

Avalição regional de PAVC