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First Phase Report 2018–2021

CLIMATE AND
CLEAN AIR IN
LATIN AMERICAN
CITIES PLUS



/ BOGOTA
/ MEXICO CITY
/ LIMA
/ SANTIAGO DE CHILE

Glossary

ACRONYMS AND ABBREVIATIONS

ANPACT. Asociación Nacional de Productores de Autobuses, Camiones y Tractocamiones (National Association of Bus, Truck and Tractor-Truck Producers)

ATU. Autoridad de Transporte Urbano de Lima y Callao (Urban Transport Authority of Lima and Callao)

BEV. Battery Electric Vehicle

CAF. Development Bank of Latin America

CALAC. Climate and Clean Air in Latin American Cities

CCAC. Climate and Clean Air Coalition

CCVC. Contaminantes Climáticos de Vida Corta

CDMX. Mexico City

CIDATT. Centro de Investigación y Asesoría del Transporte Terrestre (Centre for Research and Consultancy in Land Transport)

CORFO. Corporación de Fomento de la Producción de Chile (Chilean Corporation for the Promotion of Production)

COSUDE. Agencia Suiza para el Desarrollo y la Cooperación

DPF. Diesel Particle Filter

DPF. Diesel Particle Filter

DTPM. Directorio de Transporte Público Metropolitano de Chile (Metropolitan Public Transport Directory of Chile)

ED. Emergency Decree

FISE. Fondo de Inclusión Social Energético de Perú (Peruvian Energy Social Inclusion Fund)

GDP. Gross Domestic Product

GEF. Global Environmental Fund

GEI. Greenhouse Gases

GIZ. Deutsche Gesellschaft für Internationales Zusammenarbeit (German Corporation for International Cooperation)

HC. Hydrocarbons

HEV. Hybrid Electric Vehicle

ICCT. International Council for Clean Transport

INECC. Instituto Nacional de Ecología y Cambio Climático de México (National Institute of Ecology and Climate Change of Mexico)

INEGI. Instituto Nacional de Estadística y Geografía de México (National Institute of Statistics and Geography of Mexico)

LPG. Liquefied Petroleum Gas

MADS. Ministerio de Ambiente y Desarrollo Sostenible de Colombia (Ministry of Environment and Sustainable Development of Colombia)

MINAM. Ministerio del Ambiente de Perú (Ministry of Environment of Peru)

MINEM. Ministerio de Energía y Minas de Perú (Ministry of Energy and Mines of Peru)

MINSA. Ministerio de Salud de Perú (Ministry of Health of Peru)

MMA. Ministerio de Medio Ambiente de Chile (Ministry of Environment of Chile)

MOP. Ministerio de Obras Públicas de Chile (Ministry of Public Works of Chile)

MR. Ministerial Resolution

MTC. Ministerio de Transportes y Comunicaciones de Perú (Ministry of Transport and Communications of Peru)

MTT. Ministerio de Transporte y Telecomunicaciones de Chile (Ministry of Transport and Telecommunications of Chile)

NDC. National Determined Contributions

NGV. Natural Gas Vehicles

MMNC. Non-Road Mobile Machinery

PAHO. Pan American Health Organization

OMS. Organización Mundial de la Salud

PHEV. Plug-in Hybrid Electric Vehicle

PIB. Producto Interno Bruto

PUCP. Pontificia Universidad Católica del Perú (Pontifical Catholic University of Peru)

SD. Supreme Decree

RTP. Red de Transporte de Pasajeros de México (Passenger Transport Network of Mexico)

SDA. Secretaría Distrital de Ambiente de Bogotá D.C. (District Secretariat of Environment of Bogotá)

SDC. Swiss Agency for Development and Cooperation

SEDEMA. Secretaría de Medio Ambiente de la Ciudad de México (Ministry of Environment of Mexico)

SEMARNAT. Secretaría de Medio Ambiente y Recursos Naturales de México (Ministry of Environment and Natural Resources of Mexico)

SEMOVI. Secretaría de Movilidad de la Ciudad de México (Ministry of Mobility of Mexico)

SITP. Sistema Integrado de Transporte Público en Bogotá (Integrated Public Transport System in Bogota)

SLCP. Short-Lived Climate Pollutants

ULS. Ultra-Low Sulphur

UMV. Unidad Administrativa Especial de Rehabilitación y Mantenimiento Vial de Bogotá (Special Administrative Unit for Road Rehabilitation and Maintenance of Bogota)

UBA. Ultra Bajo en Azufre

UN. United Nations

UNEP. United Nations Environmental Program

UMV. Unidad Administrativa Especial de Rehabilitación y Mantenimiento Vial de Bogotá

USEPA. United States Environmental Protection Agency

WHO. World Health Organization

ZMVM. Zona Metropolitana del Valle de México (Metropolitan Zone of the Valley of Mexico)

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Healthy and low-emission cities

CALAC+ seeks to improve air quality in four Latin American cities: **Bogota, Mexico City, Lima and Santiago de Chile**, by building up the capacity of public officials. The programme provides support and technical assistance to the Government, as well as inputs and technical evidence to improve policy-making decisions.

The growth of cities, in terms of inhabitants and urban area, has coincided with an increase in the number of in-service vehicles, whose pollutant emissions significantly affect the population. In addition, the operation of non-road mobile machinery (NRMM) in capital cities also contributes to the emission of air and climate pollutants.

Given this context, the current health crisis —which initially led to a reduction of these emissions— represents **an opportunity to consider the introduction of efficient transport systems and the adoption of measures to regulate NRMM emissions in Latin America**, where reducing harmful air pollutants is a priority to protect human health and the environment.

Lima is one of the Latin American cities that has improved its air quality in recent years.



Mexico City is introducing soot-free technologies in its public transport.

Sustainability Vision

The Andean Programmes in the Andes of the Swiss Agency for Development and Cooperation (SDC) finances the **Climate and Clean Air in Latin American Cities (CALAC+)** programme, based on an earlier experience implemented in Santiago de Chile, Bogota and Mexico City. CALAC+ seeks to build the capacity of public stakeholders, as well as provide technical assistance to

promote healthier and more sustainable cities under the programme. Thus, it provides authorities and counterparts (ministries, municipalities, transport sector institutions) **with inputs and technical evidence for enhancing public policy decision-making** in each country through various actions. To this end, its work focuses on three main areas:



Soot-free and low-carbon buses



Urban policy incubator for non-road mobile machinery



Global knowledge management network

CALAC+ actions have impacted these three areas since its inception in March 2018, where a three-year operating horizon was established (with an additional five-month extension to complete activities that were affected by the health emergency). This first phase —to be followed by a second— was conducted under the umbrella of the International Cooperation Office, as well as under **Component 02 (Low-Emission Development) and Outcome 02 (Air pollution reduction with a particular focus on urban areas, resulting in improved health)** of SDC's new Global Programme Climate Change and Environment (GPCCE) Strategic Framework 2017-2020.

At the global level, CALAC+ facilitates capacity building and knowledge transfer, and disseminates experiences in coordination with the Climate and Clean Air Coalition (CCAC), the Pan American Health Organization (PAHO)/ World Health Organization (WHO) and other platforms or organizations, to strengthen an emerging voluntary alliance in Latin American cities committed to taking rapid action **and achieving positive impacts on two areas: public health and climate.**



CALAC+'s work contributes to achieving four United Nations Sustainable Development Goals.



Challenges and opportunities

In the last 50 years cities have grown six times and with very little planning. The consequences can be seen every day in terms of infrastructure, sanitation and public transport problems. But not only this: pollution has a significant impact on the health of the population, which calls for a coordinated action by all

the sectors involved to face this challenge. CALAC+ operates as an agent that contributes to better decision making **through technical assistance, knowledge and experience.** In this way, the proposed emission reduction targets for both urban buses and non-road mobile machinery (NRMM) will be achieved.

CALAC+ OBJECTIVE

To reduce harmful air pollutants in order to protect human health, especially of the poorest and most vulnerable populations, and mitigate climate change by using soot-free engines in public transport systems and urban construction machinery in four Latin American cities: Bogota, Mexico City, Lima and Santiago de Chile.

EXPECTED OUTCOMES

CALAC+ seeks to achieve three main outcomes in the cities in which it works.



OUTCOME 1 Soot-free and low-carbon buses

To reduce ultrafine particulate matter, black carbon and GHGs from urban public transport systems through technical assistance and support to improve legal frameworks, as well as environmental and transport regulations.



OUTCOME 2 Urban policy incubator for non-road mobile machinery

To support the development of policies that significantly reduce ultrafine particulate matter, black carbon and GHGs from non-road mobile machinery, through the design and implementation of regulations and technical-institutional capacity-building.



OUTCOME 3 Global Knowledge Management Network

To share systematized experiences on successful policies, cost-effective actions and technologies to reduce fuel consumption, air pollution and carbon emissions in urban settings, both regionally and globally. The knowledge management component is cross-cutting since it contributes to achieving the first two outcomes.

Calculate to decide

CALAC+ CONTRIBUTION TO THE GENERATION OF DECISION-MAKING TOOLS

The programme has developed a set of tools to solve one of the biggest challenges in policy-making: transforming technical information into practical inputs for defining

cost-benefit emission reduction strategies and plans. These are **versatile and easy-to-use tools**, supported by widely available software such as Microsoft Excel.

CALMAQ+

Designed for easily calculating emissions from machinery fleets at construction sites or specific work sites using NRMM. It can be a work in progress, already completed or under design, where the specific type of machinery, hours of use, age and other characteristics are known.

HEBASH+

Designed for assessing the environmental and human health benefits from changes in air quality. It uses the same international and well-known methodologies, such as WHO's AirQ+, and has preloaded data from CALAC+ target cities. It assesses the effects on ambient concentrations of fine particulate matter and metrics such as avoided mortality, years of life lost and years lived with disability. The valuation in monetary terms of avoided mortality is included.

HEMAQ+

Designed for the cost-benefit analysis of the economic and environmental impact of migrating to emission standards for NRMM. It allows to calculate criteria pollutant and GHG emissions from a machinery fleet inventory, as well as to carry out simulations under different regulatory scenarios of fleet growth and emissions until 2050. It also measures the impact of pollutant and GHG emissions reduction over time, environmental and human health benefits associated with the implementation of different regulatory scenarios for machinery emissions.

HETRANS+

Designed for the cost-benefit analysis of the economic and environmental impact of migrating to Euro VI emission standards, electric vehicles and vehicle labelling. It allows to calculate criteria pollutant and GHG emissions from a fleet inventory of light, medium and heavy-duty vehicles, as well as to carry out simulations under different regulatory scenarios of vehicle fleet growth and emissions until 2050.

METHODOLOGICAL OUTLINE



HEMAQ+ Y HETRANS+



Cities in figures

WHAT IS THE AIR QUALITY LIKE IN THE CAPITAL CITIES WHERE CALAC+ WORKS?

Mexico City



MÉXICO

POPULATION
9'004.000

PUBLIC BUSES
45.149 units
(Metrobus, RTP and concessionaires)

NON-ROAD MOBILE MACHINERY
71.447 units

AIR QUALITY
23,2 micrograms per m³
annual concentration (2020) of PM2.5 µg/m³ (fine particulate matter)

CONTRIBUTION OF PUBLIC TRANSPORT TO PM2.5 generation
18%

CONTRIBUTION OF TOTAL TRANSPORT TO PM2.5 generation
37%

CONTRIBUTION OF NRMM (NON-ROAD MOBILE MACHINERY) TO PM2.5 generation.
4%

850,000

deaths in the Americas are attributable to environmental factors, according to the World Health Organization. Air pollution is the main environmental health risk in the region.

Pacific ocean

Santiago de Chile



CHILE

POPULATION
7'112.808 (2017 census)

PUBLIC BUSES
6.909 units
(September 2021)

NON-ROAD MOBILE MACHINERY
22.244 units
(CALAC+ emissions inventory base year 2018)

AIR QUALITY
23,6 (µg/m³) PM2.5 annual concentration
(World Air Quality Report 2020)

CONTRIBUTION OF PUBLIC TRANSPORT TO PM2.5 generation
3,5% (AGIES PPDA RM 2016)

CONTRIBUTION OF TOTAL TRANSPORT TO PM2.5 generation
19.5% (AGIES PPDA RM 2016)

CONTRIBUTION OF NRMM (NON-ROAD MOBILE MACHINERY) TO PM2.5 generation.
20% (AGIES PPDA RM 2016)

Bogota



COLOMBIA

POPULATION
7'181.469

PUBLIC BUSES
23.124 units
(RUNT database - July 2020)

NON-ROAD MOBILE MACHINERY
12.542 units
(HEMAQ+ 2018 inventory)

AIR QUALITY
18 microgramos per m³
(annual average to 2019, Strategic plan for integrated air quality management in Bogota 2030).

CONTRIBUTION OF PUBLIC TRANSPORT TO PM2.5 generation
5%
(inventory of emissions from mobile sources and industrial stationary sources year 2018 - Document under validation)

CONTRIBUTION OF TOTAL TRANSPORT TO PM2.5 generation
40%
(Strategic plan for integrated air quality management in Bogota 2030)

CONTRIBUTION OF NRMM (NON-ROAD MOBILE MACHINERY) TO PM2.5 generation.
10%
(HEMAQ+ 2018 inventory)

Lima



PERÚ

POPULATION
10'804.609
(projection to 2020 in Metropolitan Lima and Callao)

PUBLIC BUSES
22.542 units
(buses, minibuses and rural vans, by 2020 in Metropolitan Lima and Callao)

NON-ROAD MOBILE MACHINERY
80.300 units
(as of 2016 at the national level, inventory under validation)

AIR QUALITY
27,4 microgramos por m³
2018 annual concentration of PM2.5 µg/m³ (fine particulate matter)

CONTRIBUTION OF MOBILE SOURCES (TRANSPORT) TO PM2.5 emission:
58%
(in 2016 in Lima and Callao)

CALAC+ DEVELOPS ACTIONS IN RESPONSE TO THE DEMANDS OF ITS GOVERNMENT PARTNERS, in accordance with each country's roadmaps, to generate the enabling conditions that promote policies to effectively reduce pollutant and GHG emissions.

ACHIEVING A LOW-EMISSION SYSTEM OF BUSES AND NON-ROAD MOBILE MACHINERY contributes to improving public health and strengthening climate action in the region.



OUTCOMES

MAIN ACTIONS OF CALAC+ DURING ITS PHASE I

OUTCOME 1



Soot-free
and low-carbon
buses

OUTCOME 2



Urban policy
incubator for
non-road mobile
machinery

OUTCOME 3



Global Knowledge
Management
Network

OUTCOME 1

Soot-free and low-carbon buses

Ultra-fine particulate matter, black carbon and GHG emissions from urban public transport systems are significantly and sustainably reduced.

In Latin America there is potential to implement zero emission bus systems. However, the reality in each country or city may shift the priorities. In this regard, there are two scenarios: introducing buses fitted with DPF technology and retrofitting in-service buses with this filter.

The I Latin American Conference on nanoparticle emissions in internal combustion engines, held in Mexico,

This event organized in 2019 is part of Outcome 3, which refers to knowledge transfer.

was the starting point for bringing together and engaging all the relevant stakeholders. The first step was to bring the issue to the table so that a guide could be developed to help achieve this first component.

It was a face-to-face event that was attended by more than 100 people from all over the region. The conference deepened the knowledge on pollution and health impacts. Experiences from Europe, North America and Latin America were shared about the technologies used to control and reduce the emission of nanoparticles. As a result of the event, a Technical

Working Group was formed, made up of experts from the four countries, which led to the development of three technical guides. These guides contribute to the development of regulations in each country.

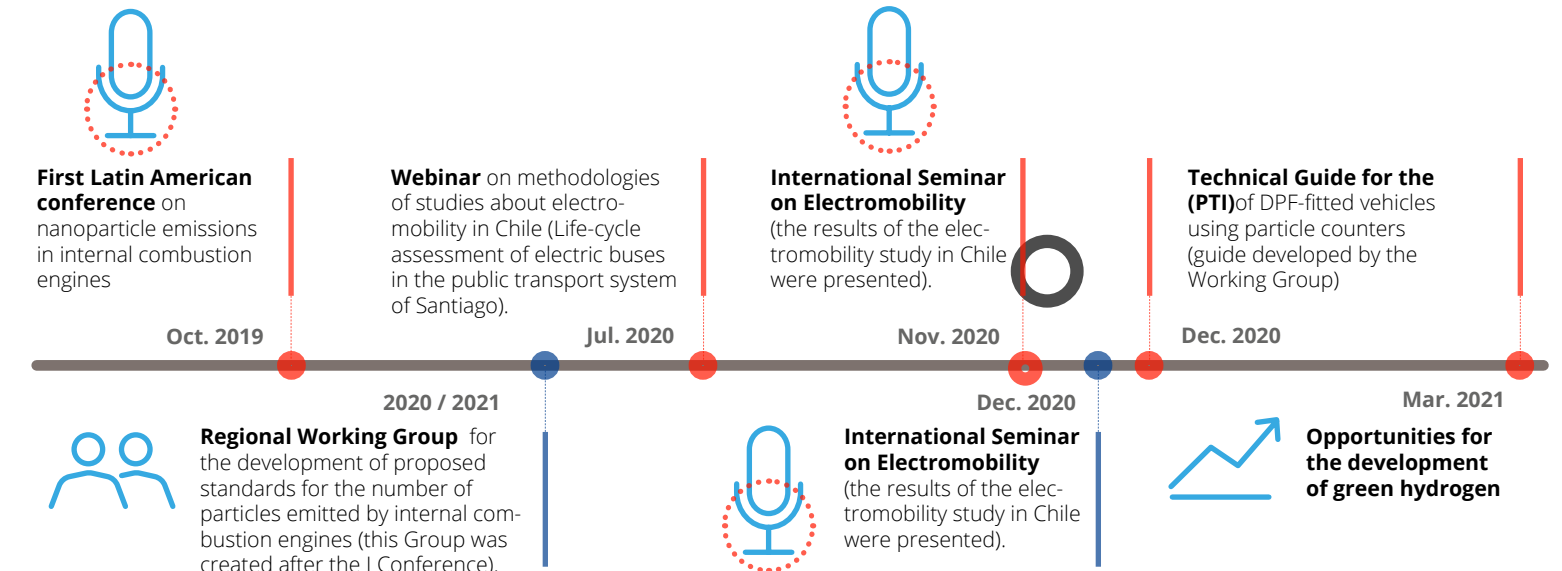


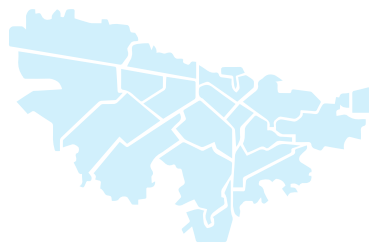
- Technical guide for the Periodic Technical Inspection (PTI) of DPF-fitted vehicles using particle counters.

- Technical guide on instruments for measuring vehicle exhaust particulate number emissions - Part 1: Metrological and technical requirements.

- Technical guide on instruments for measuring vehicle exhaust particulate number emissions - Part 2: Metrological Controls and Performance Tests.

CALAC+ ACTIONS OUTCOME #1





Bogota



OUTCOME 1



OUTCOME 2



OUTCOME 3



Preparation of a proposal for a Euro V and Euro VI vehicle fleet inspection and system

In 2019, based on international experience, CALAC+ recommended to move from an opacity measurement to a particle number measurement for the Euro V buses fitted with DPF that had just entered the TransMilenio fleet, and those with Euro VI technology would be fitted with these filters from the factory. This is because the opacity measurement does not detect failures or malfunctions of this particulate matter emission control system.

After performing a few measurements of the number of particles present in the emissions of TransMilenio buses, using the District Secretariat

of Environment (SDA) equipment, an unexpected result was found in one of the buses that had entered in 2019, suggesting a possible failure in the particulate filter. Likewise, after recognizing that the inspection and control system in Colombia was highly fragmented, it was recommended to review other experiences that considered more centralized approaches to this inspection and control scheme.

The work concluded with an inspection and control **proposal** based on the number of buses present and programmed with this technology in the system and on the institutional structure of the city and the country. ☁



Proposal for an inspection and control system for the Euro V and Euro VI fleet for Colombia.

Support to the preparation of the Regulatory Impact Analysis for the draft regulation on Environmental Vehicle Labelling

In support to the Ministry of Environment and Sustainable Development (MinAmbiente), CALAC+ hired expert consultants to develop a vehicle environmental labelling scheme that will allow environmental authorities to design traffic control measures in cities, based on the environmental performance of vehicles. CALAC+ also assisted in the preparation of the regulatory impact analysis for the regulation of this scheme and in the development of the guidelines that environmental authorities must follow for the proper design of traffic control measures. ☁



Particle number measurement of TransMilenio buses

CALAC+ measured the particle number in 1474 TransMilenio buses, based on the procedure described in the Technical guide for the Periodic Technical Inspection (PTI) of DPF-fitted vehicles using particle counters, with the support of the University of Antioquia. The purpose of this action was to generate a baseline for the solid particle concentration in the emissions of TransMilenio buses, taking into consideration the different technologies (Euro VI - NGV, Euro VI - Diesel, Euro V+DPF, Euro V, Euro IV, Euro III, Euro II) and typologies (articulated, bi-articulated, buses and coaches) used in this mass passenger transport system.

In addition to providing experience in measuring the particle number, this project generated information that can be used by the Ministry of Environment and Sustainable Development to formulate a standard that regulates the periodic technical inspection of new technologies based on this parameter. ☁



Mexico City



OUTCOME 1



OUTCOME 2



OUTCOME 3



Technical support for Euro VI technology

The Mexico City government seeks to improve air quality by reducing particulate matter emissions from public transport through the use of particulate traps in diesel vehicles, either by introducing new Euro VI technology vehicles (already fitted with DPFs) or by retrofitting these systems to vehicles currently in service.

In this regard, with the support of CALAC+, a policy for introducing DPFs in the public transport bus fleet was promoted, both in the services under concession of the *Red de Transporte de Pasajeros* (RTP) and

Metrobús. Considering the economic limitations for the renewal of the fleet and the need to introduce clean technologies, the filters will be a viable alternative.

Additionally, public transport in Mexico City has incorporated other soot-free technologies. In 2019, the management of 2 Cablebus lines (cable cars) was initiated, which were inaugurated in 2021. CALAC+ provided information on international prices and procurement processes in the region to optimize the technology acquisition process. ☁

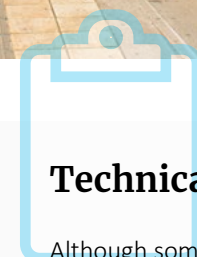


NPTI Standard

Although this is a regional effort, it is laying the groundwork for updating the regulations in Mexico regarding the type of tests to measure particulate matter, equipment and maximum limits. **This CALAC+ initiative** can be fully implemented at both the local and federal level in the country. The particulate number standard is the one that has taken the most effort and will have a major effect in the long and medium term. In this effort there is active participation of SEDEMA and the Ministry of Environment and Natural Resources (SEMARNAT), which are involved in the technical issues. ☁



This type of regulation has also been promoted through actions under **Outcome 3** of the programme, such as the organization of the First Latin American Conference on nanoparticle emissions in internal combustion engines (2019).



Technical training

Although some cities are acquiring vehicles with particulate traps, many of them end up breaking down over time. In view of this, CALAC+ has conducted a series of trainings to technicians on the proper maintenance of DPF-fitted units and has offered courses to mechanics on injection and after-treatment systems.



This type of training and courses designed for technicians are part of **Outcome 3** of the programme.

The results of these **trainings** revealed that some maintenance practices need to be improved. To achieve this, CALAC+ is working with the Ministry of Environment (SEDEMA), the Ministry of Mobility (SEMOVI) and the Red de Transporte de Pasajeros (RTP), in order to establish preventive maintenance

(over corrective maintenance) to ensure the proper operation of emission control systems in state-of-the-art buses. CALAC+ is not only focusing on the adoption of new technologies, but also on how to keep them working optimally in the future. ☁



Policies on cargo vehicles

Since 2021, under NOM-044-SEMARNAT-2017, all diesel vehicles must comply with the Euro VI exhaust emission standard. That is, they must be fitted with DPF. Unfortunately, the heavy-duty vehicle manufacturers were able to postpone the entry into force of the standard by SEMARNAT, which is why Mexico City is

seeking to encourage Euro VI/EPA-10 technology by restricting vehicle circulation.

Although the volume of cargo vehicles in Mexico is low —about 6% of the vehicle fleet—, their pollutant emissions are significant, representing more than half of all particulate matter emitted. It is of

utmost importance to have a policy on cargo vehicles and CALAC+ contributes to this objective by providing technical support for its design. This policy will limit the circulation of this vehicle category between 7:00 a.m. and 10:00 a.m. during periods of high pollutant concentrations (environmental liabilities). ☁



Technical assistance in the adoption of the Euro 6/VI emission standard

MINAM published the draft regulation to adopt the Euro 6/VI emission standard, through Ministerial Resolution No. 062-2021-MINAM. CALAC+ was instrumental in coordinating the preparation of the **Cost-Benefit Analysis Study for the implementation of the Euro VI Standard**. In addition, technical assistance was provided to justify in the explanatory memorandum of the draft regulation, the reasons for making the leap from Euro 4/IV to Euro 6/VI without going through Euro V and the cost-benefit rationale for the implementation of the standard. ☁



As a contribution to capacity building, in October 2019, face-to-face training sessions were held on the cost-benefit analysis for the Euro 6/VI standard and the use of the Excel tool for its estimation. The meeting was held in coordination with MINAM and included government representatives from the transport, energy, economic, health and local government sectors.

On the other hand, the adoption of Euro 6/VI technology was also promoted through technical capacity building on the technology. Thus, in 2019 and 2021, training modules (face-to-face and virtual) were provided for public officials and the academia.

Promotion of electromobility

GEF Project. MINAM, as the lead agency in environmental matters and focal point of the GEF, is coordinating an initiative to promote electromobility as a response to the air pollution problem and as a contribution to the fight against climate change, pursuant to the Paris Agreement. **CALAC+ supported MINAM** in the technical and logistical coordination



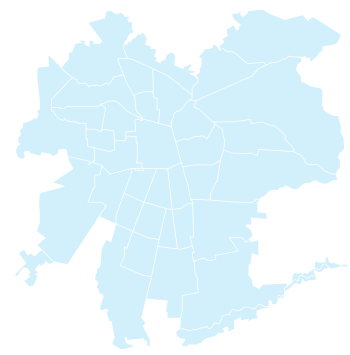
In addition to the regional and international webinars organized by the programme, the harmonization of knowledge on the fundamentals of electromobility was identified as a need for Peru. Therefore, collaboration with academia was pursued to provide a certified course for government officials. Thus, about 25 officials participated in the course on basic principles of electromobility, certified by Pontifical Catholic University of Peru (PUCP) (January 2021).

during the formulation of the GEF Project “Improving the sustainability of electric mobility for low-carbon urban transport and REP approach in batteries and vehicle components”. Approved in June 2021, under the Global project to support countries with the shift to electric mobility, this project has allocated US\$ 2 million for Peru. ☁



Support for the ATU. The Autoridad de Transporte Urbano (Urban Transport Authority) for Lima and Callao, whose creation in 2019 represents a milestone in the country's transport system, prioritizes the need to promote the renewal and retrofitting of the urban transport system fleet and considers electromobility as a technology that mitigates emissions of local pollutants and GHGs. CALAC+ supported the ATU in the process of defining the Technical Specifications for the Standardization of the physical and motor characteristics of the Electric Passenger Bus, which were approved and published following a dissemination and consultation process in early August 2021. With this, the first steps are being taken to reorganize and revolutionize the transport system in the capital.

CALAC+ supported this process by providing specialized technical assistance through a consultancy with the Federico Santa Maria Technical University of Chile. It also provided technical support in the formulation of the diesel and NGV Bus for passenger transportation. It is expected that in the coming months the standardization technical specifications for these vehicles will be approved. ☁



Santiago de Chile



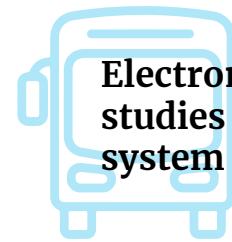
OUTCOME 1



OUTCOME 2



OUTCOME 3



Electromobility studies in RED system buses

Through a cooperation agreement, **CALAC+ joined the Sustainable Route Project**, tendered by the Ministry of Energy and implemented by the Energy Centre of the University of Chile. This initiative seeks to streamline the development of electric vehicle fleet projects, through the promotion of a methodology to determine the baseline energy consumption and operational characteristics of a vehicle fleet to compare the efficiency between internal combustion vehicles and electric vehicles. It also seeks to generate information for the State so it can develop and promote public policies in this area. The study was completed in June 2021.

The main results of the study “Life-cycle assessment of electric buses in the public transport system of Santiago (RED)” show that the environmental impact of this bus technology depends largely on the type of energy source. If the electricity supply source is considered to be 100% renewable (a requirement in the tender contracts for electric buses circulating in Santiago), during the use phase, emissions decrease to less than a quarter of the emissions of diesel technology, resulting in lower pollutant emissions throughout their life cycle. Electric fleets are more energy efficient and from an economic point of view, despite having a higher price, they have lower operating and maintenance costs, which translates into a lower total cost of ownership compared to diesel fleets. ☁



CALAC+ has promoted this topic through actions under **Outcome 3**, such as the webinar on Methodologies of studies about electromobility in Chile (July 2020) and the International Seminar on Electromobility (November 2020).



Support to the process for developing the Particle Number Measurement Standard for DPF-fitted buses

The Ministry of Environment (MMA) and the Ministry of Transport and Telecommunications (MTT) are working on the standard for measuring the Particle Number (PN) in DPF-fitted buses. CALAC+ technical assistance was provided as part of the I Latin American Conference on nanoparticle emissions in internal combustion engines. This support continued in the following months with the implementation of the Technical Working Group for particle number measurement in Periodic Technical Inspections (PTI), which aimed to develop technical guides for the region in terms of characteristics of the equipment needed to measure the particle number in internal combustion engines, as well as measurement/operational verification protocols and the maximum permissible limits.

Additionally, a General Analysis of Economic and Social Impacts (AGIES, by its acronyms In Spanish) was conducted to support the process of developing the PN measurement standard for public transport buses with DPF. In Chile, each standard must have an AGIES in order to validate if the benefit is higher than the standard. ☁



Further work on this topic has been carried out through actions under **Outcome 3**, such as the organization of the International Seminar on Electromobility (November 2020).



Analysis of the economic and environmental impact

of the measures implemented by the CALAC+ programme to reduce emissions of soot and other pollutants.

The objective of the study was to develop tools for evaluating cost/benefit scenarios (assessing the impact on the environment and health of the population) for the implementation of actions to reduce emissions in the transport (new diesel, natural gas or electric buses) and non-road mobile machinery (construction) sectors in all the countries of the programme. In the case of Chile, it was also possible to evaluate **electromobility scenarios**, due to the large fleet of electric buses in the city of Santiago.

OUTCOME 2

Urban Policy Incubator for Non-Road Mobile Machinery

Development of policies to significantly reduce ultrafine particulate matter, black carbon and GHGs from non-road mobile machinery (construction and industry sectors)

In terms of the provision of technical inputs and machinery regulation initiatives, the Swiss Cooperation has played a decisive role in Latin America, as it is one of the first players in the region to highlight the problem and promote its incorporation into government plans. It has generated **recognition and awareness of the need to reduce emissions from the non-road mobile machinery sector (NRMM)**. In the region, unlike Chile, this was an issue that was not so present in government agendas and, consequently, it was not possible to develop adequate and effective policies in this regard.



- Actions under **Outcome 3**, such as the organisation of the Interactive Intensive Course on Preparation of Non-Road Mobile Machinery Emissions Inventories in November 2020.

Awareness of the issue began with a visit to Switzerland in 2018, which allowed us to meet government stakeholders from the four countries and learn about the problem from different perspectives: from the technical components, through academia and research institutions, as well as from the private and public sector in the generation and implementation of policies. Part of these contributions have been summarised in a series of technical documents produced by the CALAC+ programme, and their understanding of the issues and progress in the field has been further enhanced through two international seminars held in person and online.



- Actions under **Outcome 3**, such as the organisation of the Interactive Intensive Course on Preparation of Non-Road Mobile Machinery Emissions Inventories in May 2020, and the elaboration of the Guide for developing technical terms of reference for the acquisition of DPF systems for NRMM retrofitting in June 2020, have contributed to further develop this area.

As a result, government partners **requested the support of the CALAC+** programme to improve the diagnostics of actual NRMM fleets and quantify their pollutants. To this end, seven technical guides were developed as baseline material with a pragmatic approach.

The level of regulatory and policy development for NRMM has varied across different cities; therefore, consideration was given to providing a unique compilation of international regulatory experience **based on best practices and lessons learned** to support the formulation and implementation of local roadmaps.

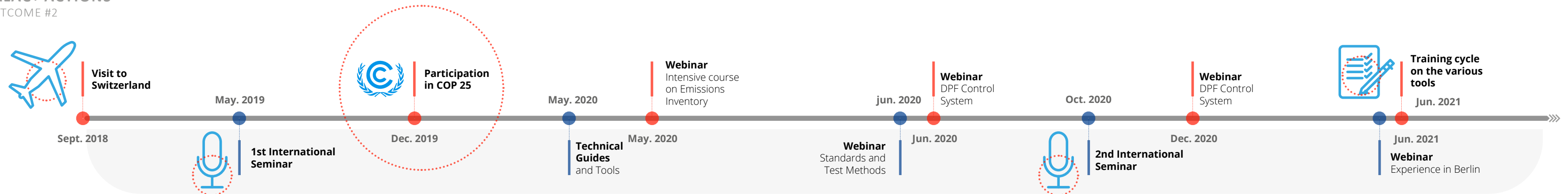


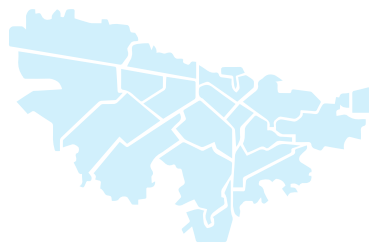
- The various webinars and online events developed by the programme, which are part of **Outcome 3**, as well as the webinars on Berlin's experience in reducing emissions from NRMM (July and December 2021) have also contributed to this effort.



CALAC+ ACTIONS

OUTCOME #2





Bogota



OUTCOME 1



OUTCOME 2



OUTCOME 3



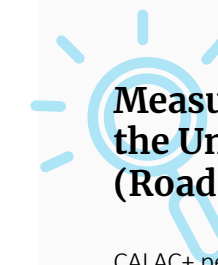
Development of the national non-road mobile machinery emissions inventory

In collaboration with the Ministry of Environment and Sustainable Development, CALAC+ developed the first national inventory of non-road mobile machinery operating in Colombia in 2018. This inventory considered information from the *Registro Nacional de Maquinarias Agrícola, Industrial y de Construcción Autopropulsada (RNMA)* (National Register of Agricultural, Industrial and Self-propelled Construction Machinery) and LegisComex, related to machinery in the agricultural, mining, construction and industrial sectors. The information obtained in this inventory has been used by the Ministry of Environment and Sustainable Development for preparing its NDC for 2020 and by the District Secretariat of Environment of Bogota for its 2018 emissions inventory, which was published in the Strategic Plan for the Comprehensive Management of Air Quality in Bogota 2030. ☁



Support to the Colombian Sustainable Construction Council in the inclusion of guidelines under CASA certification

CALAC+ presented to the *Consejo Colombiano de Construcción Sostenible* (Colombian Sustainable Construction Council) a series of guidelines related to the environmental performance of the NRMM, which will be used in sustainable construction projects to obtain the CASA certification, issued by this organization. This action is part of the component related to private sector initiatives. It is expected to expand and replicate this experience to other countries in the region during the second phase of the programme. ☁



Measurement of the machinery operated by the Unidad de Mantenimiento Vial (Road Maintenance Unit) in Bogota

CALAC+ performed 50 opacity measurements and 66 solid PN measurements to the machinery operated by the *Unidad Administrativa Especial de Rehabilitación y Mantenimiento Vial (UMV)* (Special Administrative Unit of Road Rehabilitation and Maintenance), with the support of the District Secretariat of Environment of Bogota and the University of Antioquia. This made it possible to ascertain the level of emissions from the machinery operated by UMV, and to generate a first baseline in Colombia to provide support and operational experience in terms of machinery measurement. Through this action, it will be possible to develop a protocol for measuring the particle number and/or opacity for the monitoring and control of emissions from these mobile sources. This experience is of great value for the country and Latin America because it is one of the largest fleets measured and whose learning and results can be transferred to other countries in the second phase of the CALAC+ programme. ☁



Support to the Ministry of Environment and Sustainable Development in the inclusion of NRMM emission standards in the draft standard for mobile sources

CALAC+ supported the Ministry of Environment and Sustainable Development in the drafting of the standard that will environmentally regulate off-road mobile sources, through the requirement of the first emission standards for mobile machinery entering the Colombian territory as of 2023 that uses diesel as fuel and that is used in construction, mining or industrial activities. ☁

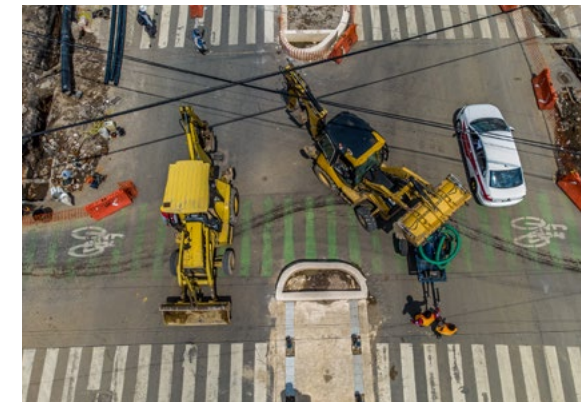


Mexico City



Relevance of pollutant emissions from the non-road mobile machinery sector and involvement of SEDEMA and SEMARNAT

One of the main actions of CALAC+ was to bring to the discussion table the need for a standard, as well as the measurement of NRMM emissions. In Mexico, some efforts have been made, such as the pilot measurements of SEMARNAT, through the project developed with the *Instituto Nacional de Ecología y Cambio Climático* (National Institute of Ecology and Climate Change). CALAC+ has strived to incorporate these technical developments into its contribution and give them a new impetus in order to translate this knowledge into regulations and policies for reducing emissions in the machinery sector. 🌱



Review of the non-road mobile machinery sector within the CDMX 2018-2024 emissions inventory

Mexico City had an emissions inventory for non-road mobile machinery and, following the first workshop held by CALAC+ in Santiago de Chile, opportunities were identified to improve the methodology to increase the accuracy of the emissions calculations.

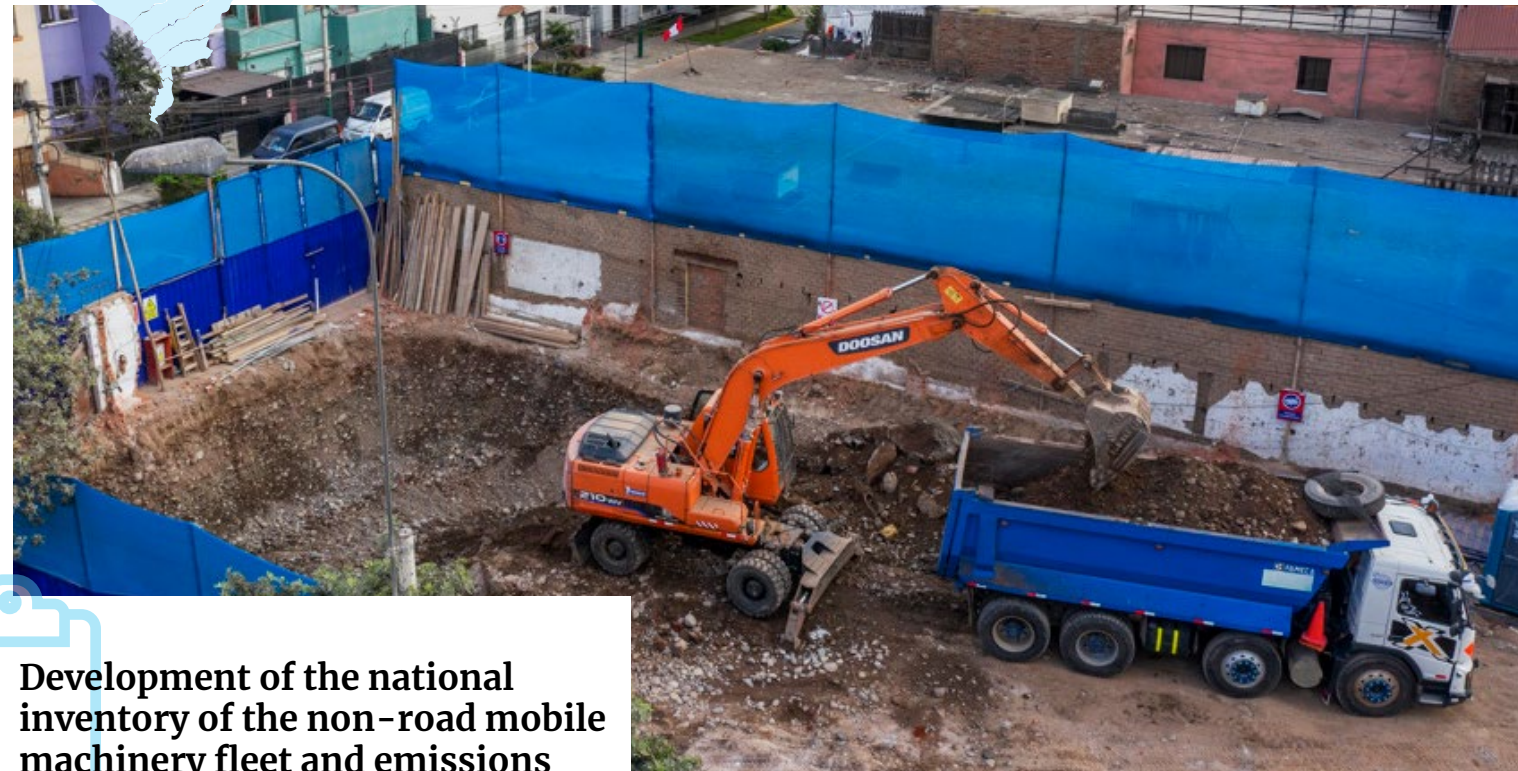
The HEMAQ tool, developed as part of the consultancy on the cost-benefit of the measures supported by CALAC+, was used to support the revision of the emissions inventory of Mexico City. This inventory (PROAIRE) has been published this year. As a result, awareness on the use of these tools has been raised in the country through training sessions in which the environmental authorities of the 32 states have been invited to participate through SEMARNAT. 🌱

Review of the imports database of the non-road mobile machinery sector and review of the emissions inventory of the ZMVM

A technical specialist has been hired to carry out a thorough review of the database of non-road mobile machinery imported into the country. The result will be used to adjust the emissions inventory of the *Zona Metropolitana del Valle de México* (ZMVM) (Metropolitan Zone of the Valley of Mexico). 🌱

Ongoing work with SEMARNAT to build the databases for updating the 2018 national emissions inventory for non-road mobile machinery

At the request of SEMARNAT, support was provided for the review of the database of non-road mobile machinery imported into Mexico. As a result, the country's 2018 emissions inventory has been updated to determine its size and importance and will be published shortly. 🌱



Development of the national inventory of the non-road mobile machinery fleet and emissions

CALAC+ has worked on the first database of non-road mobile machinery in the country based on imports information from Customs. In coordination with MINAM, this effort has led to the introduction of two measures of the Action Plan for the Improvement of Air Quality in Lima and Callao 2021 - 2025 (MR N° 142-2021-MINAM). Based on this, the *Dirección General de Calidad Ambiental del MINAM* (General Directorate of Environmental Quality) of MINAM integrated the validation of the first inventory and its periodic elaboration in the aforementioned plan.

In November 2020, the inventory report and calculation templates, which explain the methodology and contain the process for estimating emissions using the HEMAQ tool, were officially submitted.

In addition, the CALAC+ inventory preparation guide has been adapted to local conditions and included as part of the methodology chapter for both the fleet and the emissions inventory. Government stakeholders have participated in face-to-face **capacity-building activities** on inventory development. These activities have been extended virtually to the private sector and academia during the development of an open training on the use of the tools (specifically HEMAQ).



Through the Interactive Intensive Course on Preparation of Non-Road Mobile Machinery Emission Inventories (May 2020), and the I and II International Seminar on Soot-Free Construction Machinery (May 2019 and October 2020), which are part of **Outcome 3**.

Technical documentation for managing NRMM pollutants

Based on the results of the inventory and as the region moves towards regulating NRMM emissions, the need to implement an associated regulation becomes evident. In this regard, **CALAC+ has generated several guides for the management of NRMM pollutants** and has shared them with public sector officials. At the same time, CALAC+ has elaborated a cost-benefit analysis of introducing MPLs for the NRMM as part of a study to evaluate measures to improve air quality in Lima and Callao.

In July 2021, the Action Plan for Improving Air Quality in Lima and Callao 2021-2025 was approved, which includes the measure "Preparation of regulations establishing maximum permissible limits for mobile machinery emissions entering the country".



The promotion of a NRMM regulation has been supported by actions under **Outcome 3**, such as the visit to Switzerland for the exchange of North-South experiences (September 2019) or the events for disseminating the series of 7 technical documents developed by CALAC+ to promote knowledge and environmental management of machinery emissions reduction in Latin America.



Awareness raising and capacity building of decision-makers

During Phase 1, CALAC+ has systematically introduced the background and problems of non-road mobile machinery into the public and private sector discussion forums. In addition to the regional meetings, and in coordination with the MTC, **two face-to-face meetings were held** to combine capacity building and discussion sessions on the roadmap for NRMM regulations.

In November 2019, a meeting was convened in Lima to share the guides for managing NRMM emissions, which was followed by a discussion that led to the following conclusions: 1) The NRMM environmental problem has been invisible. 2) There is a need to do a diagnosis of the emissions and fleet of machinery that is operating in the country, since there is a problem related to road safety, informal mining, among others. 3) The regional experience should serve as a basis to draw on the best practices and experiences.



In July 2019, along with the elaboration of the NRMM inventory, the first Webinar on International Policy Context for NRMM Air Emissions Management and Regulation was convened, which was followed by a working meeting for the Development of the NRMM Policy Roadmap, in which representatives from MINAM, MTC, MVCS and the local government participated.



Santiago de Chile



CHILE



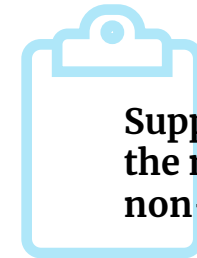
OUTCOME 1



OUTCOME 2



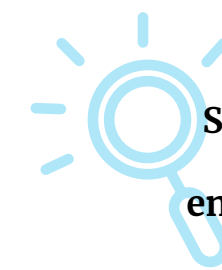
OUTCOME 3



Support for updating the national inventory of non-road mobile machinery

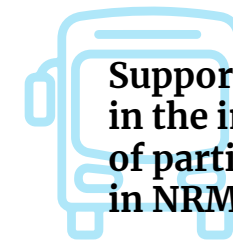
The update of the inventory of the non-road mobile machinery fleet with a base year of 2018 was completed in July. This was a joint work with the MMA, based on the database provided by Customs. With this input it was possible to complete the machinery emissions inventory, as part of the study on the Analysis of the economic and environmental impact of the measures implemented by the CALAC+ programme to reduce emissions of soot and other pollutants.

One of the findings of the study is that construction is the industry with the highest amount of emissions. It was estimated that 48% of the fleet would meet the Stage IIIA emission standard by 2018. The most frequent power range is between 56 and 75 KW. In addition, it was noted that 90% of the machinery that entered the country in 2018 was new and that the Metropolitan region (Santiago) is the one with the largest number of machinery in the country. ☁



Study on the Analysis of the economic and environmental impact of the measures implemented by the CALAC+ programme to reduce emissions of soot and other pollutants

The objective of this study was to formulate tools for the evaluation of cost/benefit scenarios and the assessment of the environmental and health impacts in the population through the implementation of actions to reduce emissions from the transport (buses with diesel, natural gas or electric technology) and non-road mobile machinery (construction) sector. In the case of Chile, this study evaluated the implementation of emission standards for non-road mobile machinery that are expected in the near future. ☁



Support to the MOP in the implementation of particulate filters in NRMM

The *Plan de Prevención y Descontaminación Atmosférica de la Región Metropolitana (PPDA RM)* (Prevention and Atmospheric Decontamination Plan of the Metropolitan Region) of Chile provides for the implementation of particulate filters in construction machinery. CALAC+ supported the Ministry of Public Works in this process, providing

technical support for the completion of this task. One of the main actions that were carried out is the development of the Guide for Retrofitting NRMM with DPFs (translated and adapted from a guide applied in Berlin) and an external consultancy for the preparation of technical terms of reference for the acquisition of DPF filters (nanoparticles filter that most affect health). ☁

OUTCOME 3

Global Knowledge Management Network

Exchange of systematized experiences on successful policies, cost-effective actions and technologies to reduce fuel consumption, air pollution and carbon emissions at the urban level.



This component, which is cross-cutting and drives the other two major pillars of the program (soot-free and low-carbon buses, and support to the formulation of urban policies for non-road mobile machinery) has fostered an important regional dynamic of consultations and exchanges between public officials in Colombia, Mexico, Peru and Chile with the aim of improving air quality.

Several events have been organised for the transfer and scaling up of valuable experiences generated in the countries, in coordination with organizations and associations that promote

the decontamination of the transport sector, and the positioning of the NRMM issue in the various environmental strategies and agendas.

Due to the health emergency, from the beginning of 2020 onwards, a new approach to information and experience sharing had to be adopted: a shift was made from the face-to-face environment to a virtual one, successfully organizing regional events with a good turnout in terms of participants. In this regard, one of the key aspects for the promotion of policies and technological changes, both in the transport and in the NRMM sector, has been to

assess the health and environmental benefits, as well as the cost-benefit ratio.

The main actions at the regional level of component 3 of the programme are described below. It should be noted that in each of the four cities specific actions for this component were developed, which are mentioned throughout the first two pillars.

Conferences and seminars

22 events have been organized, both open to the general public and those reserved for programme partners, with a total of 1506 attendees from all over the world (around 66% men and 34% women). Those carried out during the last year and a half were virtual, which allowed for the participation of other countries in the region, such as Argentina, Bolivia or Costa Rica.

Among the main regional events held were the I Latin American Conference on nanoparticle emissions in internal combustion engines, the International Seminar on Electromobility, the I and II International Seminar on Non-Road Mobile Machinery for the

Region and the International Seminar on Opportunities for the Development of Green Hydrogen.

It is worth mentioning that, as a result of the I Latin American Conference on nanoparticle emissions in internal combustion engines, a technical working group was created as a regulatory committee, which has worked on the regional technical guides for the introduction of the particle number measurement test in the Periodic Technical Inspection (PTI) of vehicles. In 2021 all meetings were bilingual, which allowed the participation of professionals from the United States of America and Europe.



Prior to 2020, all events were face-to-face. Due to the health emergency, we have migrated to the virtual environment.

Publications

Thirty-six communication pieces have been produced (20 studies carried out as part of the programme in Spanish and English, and 16 audio-visual materials of the events held or thematic videos of the programme). All publications are available on the programme's website (<https://program-meacalac.com>) and some of them on the CCAC platform.

Presence at COP25

The programme was present at COP25 in 2019, with officials in the Chilean and Colombian pavilions, who presented, as part of the Transport Day, the initiatives being promoted in Latin America in this sector and in the NRMM sector to contribute to healthier cities.

Participation in events in collaboration with other organizations

Cities with soot-free diesel engines. At this event, organized by the Climate and Clean Air Coalition (CCAC), the progress of the programme was presented.

Workshop on Electric mobility in the context of a green recovery: towards the adoption of electric buses in LAC. Co-organized with LEDS LAC, Sustentar of Argentina and CAF.

Joint Regional Event "Climate Action in Times of Crisis". Organized by LEDS LAC, EUROCLIMA+, IDB and UNDP.

Course AIRQ+ quantification of health effects due to exposure to air pollution. In coordination with WHO/PAHO.

1.506
people from all
over the world

have participated in the
22 events organized by
CALAC+.



A greener state every day



COLOMBIA

CONPES 3943 of 2008: “Air quality improvement policy”
Elaboration of the Technical Guide for the Periodic Technical Inspection (PTI) of DPF-fitted vehicles using particle counters by the working group, which will allow environmental authorities to regulate the procedure for verifying the proper functioning of diesel particulate filters in vehicles.
Particle number measurement of TransMilenio buses, to verify the functioning of the particle filters that some of these buses use to reduce particulate matter emissions.

National Air Quality Strategy (ENCA)
Elaboration of the study that evaluates the implementation of an **environmental labelling scheme** for road mobile sources, in order to generate vehicle restriction guidelines that can be used by environmental authorities to prevent exceptional states of air quality.

Resolution 910 of 2008: regulates the permissible levels of pollutant emissions to be met by land mobile sources, regulates Article 91 of Decree 948 of 1995 and adopts other provisions.
Support in the review of European and U.S. regulations to include emission standards that apply to mobile sources subject to regulation in the amendment of Resolution 910 of 2008. For the first time in the country, off-road mobile sources (mobile machinery) are included.



CHILE

Particle Number (PN) Measurement Standard for buses with diesel particulate filters
Technical advice to the MMA and MTT for the development of the standard under the Ad Hoc Committee for Standardization of particle number measurement in internal combustion engines; in addition, the study on **Elaboration of the general analysis of economic and social impacts for the particle number measurement standard** was carried out.

Promoting electromobility for the decarbonisation of transport
Development of the studies: Sustainable Route Project and **Life-cycle assessment of electric buses in the public transport system of Santiago (RED)**, in coordination with the MMA and the Ministry of Energy.

Implementation of diesel particulate filters (DPF) in MOP’s own machinery
A technical visit was made to Switzerland to learn about the wide experience of the public and private sector in machinery retrofitting. A DPF procurement guide was generated to support the MOP in the filter bidding process.

Part of CALAC+ activities are focused on generating enabling conditions for policy and regulatory frameworks to incorporate cleaner urban transport. Since its inception, the programme has assisted governments through consultancies and research studies that support the legal framework. The following are the main actions carried out during Phase 1 that promote this type of regulations.



MEXICO

Emissions Reduction Plan for the Mobility Sector in Mexico City (by reducing traffic schedules).
Permanent participation in technical discussions and expert support to SEDEMA, in negotiations with representatives of heavy-duty vehicle manufacturers, to present the advantages of retrofitting in-service diesel vehicles with DPFs in Mexico City.
Executed by SEMOVI and negotiated with SEDEMA and ANPACT.

Emissions Reduction Plan for the Mobility Sector in Mexico City, implemented by SEMOVI, through RTP
Preparation of a study for RTP, as part of the maintenance service for public transport vehicles (injector cleaning).

Immediate measures to improve air quality in the Metropolitan Zone of the Valley of Mexico (Government of Mexico, 2019)
Interaction with SEMOVI to define a proposal for a **soot-free public transport transition programme** in Mexico City.

Update of the NRMM emissions inventory of the CDMX, through SEMARNAT.
Recognition of the importance of NRMM emissions by requiring DPF-fitted machinery in the city’s public works. However, there has been little progress on this issue.

SEMARNAT, together with the CDMX, is preparing a standard for NRMM.



PERU

Publication of the draft standard that modifies the Maximum Permissible Limits of atmospheric emissions for motor vehicles to Euro 6/VI standards
Technical assistance and elaboration of the Analysis of the economic and environmental impact of migration to EURO 6/VI emission standards in Peru.

Promotion of electromobility
Support to the ATU on the elaboration of specifications for the **Electrical Passenger Bus**.
Support to MINAM in the coordination and elaboration of the **electric mobility project** document for the GEF.

Participation in INACAL’s **Technical Committee for Electric Transport Standardization**, led by MINEM.
Air quality improvement plan for Lima and Callao, under the Multisectoral Management Committee of the Clean Air Initiative for Lima and Callao, chaired by MINAM

Increased awareness of the NRMM problem through the elaboration of the first inventory of emissions and capacity building for government officials in MINAM and MTC.
The Plan considers measures related to machinery: approval of the first inventory and its periodic elaboration, as well as the proposed LMP for this emission source.

Overview of a great experience

After more than three years of CALAC+ activities, **one of the greatest strengths of the programme** has been working simultaneously in four Latin American countries.

CALAC+'s work has contributed to the exchange of valuable experiences and knowledge (of cross-cutting actions at regional, national and sub-national levels in each country), by building the capacities of various government stakeholders, and engaging the private sector and academia. South-South exchanges (including Mexico in this case) have been largely favourable due to the high socio-political and cultural similarity.

This leads to better decision making when designing measures for the adoption of clean technologies, as well as for the identification of global experiences that can translate into processes that are in line with local realities.

Throughout the implementation of Phase 1, and especially towards its last stage, we have noted a steady increase in the commitment and participation of officials from partner agencies. At CALAC+ we are constantly looking for experts who can meet the demand and expectations of our partners. On the other hand, the formation of the working group focused on measuring the particle number in emissions and its subsequent regulation has been very useful for the officials, since it allows them to address concerns, based on the knowledge of technical experts, about the measurement technologies available in the market and the regulations that have been implemented for their control.





Because of the COVID-19 pandemic, many people in Latin America have adopted sustainable transport systems, such as the use of bicycles. In Lima, for example, there are now more kilometres of bicycle lanes in the city.

Bogota



CALAC+ supported the Ministry of Environment in the preparation of the Regulatory Impact Analysis of the draft standard for environmental vehicle labelling, as well as the guidelines for the design of traffic control measures using this labelling. In addition, a pilot programme was developed to measure the particle number in buses, based on the Technical Guide for Periodic Technical Inspection (PTI) of DPF-fitted vehicles, which was developed by the regional group.

Regarding non-road mobile machinery, CALAC+ provided support in the elaboration of the technical support document, regulatory impact analysis and regulation of the machinery that would enter the country from 2023. Support was provided in the development of the first national inventory of emissions and a pilot programme for measuring the machinery used by the UMV. The experience of the measurement pilot is of great value for the country and Latin America as it is one of the largest fleets measured in the region and whose learning and results can be transferred to other countries in the second phase of the CALAC+ programme.

Mexico City



Progress continues to be made on CALAC+ objectives such as the fleet renewal process with Euro VI/EPA-10 vehicles for RTP and Metrobus. With regard to non-road mobile machinery, both the local and federal governments are working to improve their emissions inventories.

On the other hand, there is still no regulatory framework, so it is difficult to regulate the use of DPFs. However, SEMARNAT is planning to generate a standard to regulate this machinery. Mexico City continues in the line of encouraging the use of DPFs by giving better scores to bid proposals for works in the city, which have these devices to reduce emissions, as a result of the advocacy conducted by CALAC+ through SEDEMA.

Lima



The promotion of new technologies such as electric mobility has had a preliminary breakthrough; however, with the recent publication of the technical specifications for the Electric Passenger Bus and the upcoming implementation of the GEF project, the prospects for the widespread use of electric fleets and the coordinated work needed to disseminate this technology are promising. On the other hand, with the publication of the draft regulation for the adoption of vehicles with Euro 6/VI standard, the initial step has been taken for its official approval. In parallel, the natural gas option has renewed the interest of some government stakeholders.

Regarding non-road mobile machinery, having completed the first inventory of the machinery fleet and emissions, coordination is underway with MINAM to support the process of validating and updating the inventory, in line with the contents of the Action Plan for Improving Air Quality in Lima and Callao 2021-2025. Similarly, it is expected that based on the results of the inventory and a forthcoming study on the technical and regulatory aspects of the environmental framework for machinery, the regulatory framework for mobile machinery will be reviewed and updated, in close coordination with the MTC.

Santiago de Chile



The fleet of electric buses in the RED system continues to grow, so the information that will be obtained from the studies that are being supported will be of great relevance for the MMA and MTT. In addition, this will lay the groundwork for future studies of electric buses in the other cities of the programme. On the other hand, an increase in the number of electric and Euro VI buses will follow as a result of the current bidding process for buses in Santiago.

In addition to the technical support provided to the MMA and MTT, the work done in the Working Group to generate the guidelines for measuring the particle number in internal combustion engines has made it possible to jointly advance with the other CALAC+ countries towards a new standard. The cost-benefit

scenario evaluation tools on environmental and health impacts resulting from the study will undoubtedly become an important asset for the country. They will be used to evaluate scenarios for electromobility and the implementation of a particle number standard for vehicles with diesel particulate filters.

Regarding non-road mobile machinery, the technical visit to Switzerland in 2018 allowed MMA and MOP to validate their pilot experience in the implementation of filters; as a result, DPF filters have currently been acquired for the MOP machinery fleet. The MMA has also received support in the development of a national machinery standard and the updating of the emissions inventory.

Lessons learned

- Adapting to the new reality quickly and without blinking an eye. The pandemic forced the team to work remotely and virtually. It should be noted that all the planned sessions for the transfer of experiences and regional exchanges were carried out through virtual sessions.
- Flexibility and openness to the demand of the partners. The willingness of the cities to achieve common ground in their demands, without losing the focus of the program, has led to greater exchange and involvement of the institutions.
- There is always room for discussion and exchange among experts when the product is key. Coordination between institutions in the countries is gaining momentum in the technical areas promoted by the programme, such as the nanoparticles working group. This has also been the case for issues such as non-road mobile machinery, particle number measurement in mobile sources and environmental labelling, where greater coordination and cooperation between officials has been generated.

The challenge of moving forward

At the regional level, during Phase 2 of the programme, capacity building for technical experts and decision makers will continue, with special emphasis on virtual sessions.



In its Phase 2, CALAC+ is planning to organise the synergies event with the Association of Southeast Asian Nations (ASEAN) in coordination with the Climate and Clean Air Coalition to showcase the programme's experience, in addition to facilitating the participation of other experts in the field.

Similarly, capacity building will be promoted through South-South (among CALAC+ member countries) and North-South (with countries such as Switzerland) knowledge sharing. Support will continue to be provided in the evaluation of diagnostics and cost-benefit analysis of policies, and the scope will be strengthened in the search for economic incentives and synergies with the private sector, to promote the replacement and technological upgrades of bus fleets and machinery.

Finally, country-specific actions will be carried out in the four countries, such as providing continuity and monitoring the implementation of the regulatory initiatives, to ensure the success of the final goal of significantly reducing polluting emissions.

Bogota

- **Assist MinAmbiente in the development of the standard for particle number measurement**, based on the Technical Guide for the Periodic Technical Inspection (PTI) of DPF-fitted vehicles using particle counters.
- **Support the SDA in the design of traffic control measures**, based on the environmental vehicle labelling to be regulated by MinAmbiente.
- **Continue supporting MinAmbiente in the dissemination of the results obtained and the methodology used in the non-road mobile machinery inventory to different environmental authorities**, such as, for example, the Metropolitan Area of the Aburrá Valley, so that emissions from this type of mobile sources are included in the inventories that are carried out by these organisations.
- **Support MinAmbiente in the environmental regulation** of the periodic technical inspection of non-road mobile machinery.
- **Assist the SDA in the implementation of the periodic technical inspection of non-road mobile machinery** once MinAmbiente regulates the measurement protocol and the maximum permissible limits.
- **Provide technical assistance to MinAmbiente and the SDA in actions to reduce polluting emissions from mobile sources**, based on policies already implemented, such as the National Air Quality Strategy, the National Electric Mobility Strategy, the CONPES 3943 of 2018 and the Strategic Plan for the comprehensive air quality management in Bogota 2030.





Mexico City



- **Continue providing technical assistance in the implementation of Mexico City's public transport reform policy**, as reflected in the *"Plan de Reducción de Emisiones del Sector Movilidad"* (Emission Reduction Plan for the Mobility Sector) and the *"Medidas inmediatas para mejorar la calidad del aire en la Zona Metropolitana del Valle de México"* (Immediate Measures to Improve Air Quality in the Metropolitan Zone of the Valley of Mexico). We will also continue to support the introduction and implementation of policies that favour freight transport fitted with particle traps. In addition, we plan to continue supporting the CDMX with training courses on the maintenance and operation of vehicles fitted with particle traps.
- **Continue to monitor the proper operation of DPF-fitted vehicles**, through the implementation of a monitoring programme with a clear definition of the regulations, authorized equipment for measurement and measurement procedure. Collaborate with SEMOVI in the introduction of electric buses in the CDMX, through the elaboration of Technical Specifications for electric buses and trolleybuses, as well as the monitoring of their operation.

- **Propose the implementation of an NRMM registry** to have updated and quality emission inventories, as well as prepare a regulatory mapping to identify the regulatory stakeholders for NRMM.
- **Conduct pilot programmes to measure particulate matter from NRMM, in order to ascertain the current status of the fleet**; and to identify local strengths and weaknesses, and supply chains for fitting DPFs to this machinery.
- **Propose a NRMM standard indicating Maximum Permissible Limits**, measurement procedures and technical characteristics of measurement equipment. This action will draw on the experience of Colombia and Peru, which are on the same line.

Lima



- **Continue to provide technical assistance and support in the areas led by MINAM, MTC and ATU**, which aim to adopt soot-free technologies and clean fuels, such as collaboration under the GEF electromobility project during its implementation, technical support for the

implementation of the Action Plan for Improving Air Quality in Lima and Callao 2021-2025, the development of technical support to generate regulations related to the adoption of Euro 6/VI, among others.

- **Support the government in the validation of the first inventory of NRMM emissions** and its update using the HEMAQ tool.
- **Strengthen knowledge and generate technical and regulatory strategy inputs** that will allow the government to establish the regulatory framework for non-road mobile machinery.
- **Ensure the sustainability of the measures**, such as the integration of academia and private sector stakeholders in the program's activities, capacity building of technical government staff and development of public policies and management documents.

Santiago de Chile



- **Continue to support the MMA and MTT** in the development of the particle number measurement standard for vehicles with DPFs.
- **Technical support to the bidding process of filters in MOP's own machinery.**
- **Finalize and disseminate the machinery guide** for DPF retrofitting with the MOP, MMA and other stakeholders.
- **Support the MMA and SMA to implement the machinery standard** and to establish protocols for the verification of certificates of new machinery entering the country.

In its Phase 2, CALAC+ will focus on capacity building through South-South (among the countries participating in the programme) and North-South (with countries such as Switzerland) knowledge sharing.



**CALAC+'S WORK FOCUSES ON
BUILDING THE CAPACITY OF
GOVERNMENT OFFICIALS AND
PROMOTING PUBLIC POLICY
FORMULATION.**

**DURING ITS PHASE 2, BOTH
ASPECTS WILL SUSTAIN THE GOAL
OF ACHIEVING HEALTHIER CITIES
THAT REDUCE EMISSIONS AND
IMPROVE AIR QUALITY.**

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