



Design of a GHG mitigation MRV system for the Colombian electric bus fleet

Methodological proposal

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Introduction

- The electrification of the fleet is of national interest
 - Green Growth Strategy (Conpes 3934 de 2018)
 - Electric Transport National Strategy 2019
 - Colombian NDC 2020
- There are instruments to promote the use of electricity in transportation
 - Tariff reduction: 0% for electric fleet
 - Tax incentives: 5% IVA
 - Income tax reduction
 - Exemption from circulation restrictions
- The electrification of the public transport segment has advantages over other segments
 - Intensive mode
 - Cobenefits in reducing air pollution

Introduction

- Electricity in public transport systems

Bogotá



- 1,485 buses
- BRT Articulated buses
- BRT Feeder buses
- Zonal service

Medellín



- 64 buses
- BRT Articulated buses
- Zonal service

Cali



- 35 buses
- Zonal service



Introduction

- Potential to electrify other public transport systems.

16,000 buses in 15 public transport systems in 2020



Integrated Mass Transportation Systems - SITM

Cities: >600,000 inhabitants



Strategic Public Transport Systems - SETP

Cities: 250,000 -600,000 inhabitants

Objective of this study

Develop technical guidelines for GHG mitigation MRV system for a national electric bus program.

- Requisites to report at the National Registry for the Reduction of GHG (RENARE).
- The minimum set of indicators required to apply to international funding(v.g., CGF).

Participation of different actors

- During the project: 3 workshops + surveys + bilateral meetings:
 - Representatives from the local public transport systems.
 - Ministry of Transport, Ministry of Environment and Sustainable Development.
- In terms of the methodology proposed:
 - Identification of local capacities: technical resources, data monitoring practices in place.
 - Stakeholder feedback on the MRV proposal.
 - Trainings in general MRV topics for the representatives of the local public transport systems.

Scope of the guidelines proposed

Effects identification

Mapping the causal chain

- GHG effects
- Non-GHG effects – Benefits on air quality
- Definition of the boundaries

Effects estimation

Standardization of the estimations

- Calculation of the baseline scenario GHG emissions
- Calculation of the mitigation scenario GHG emissions
- Calculation of the ex ante mitigation potential

Monitoring of the program

Indicators to monitor the program

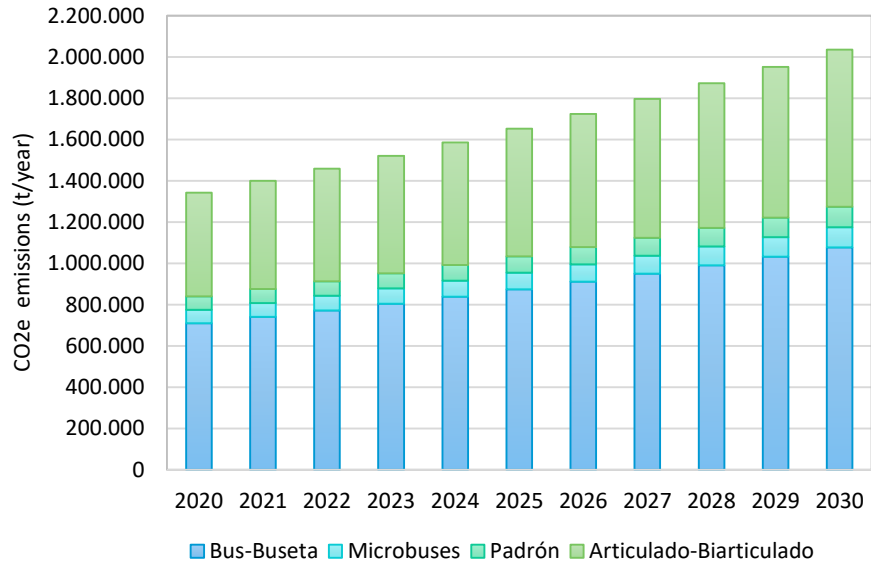
- Identification of the indicators - implementation and impact indicators
- Calculation of the indicators for the baseline year
- Database and recommendation of default values

GHG emissions estimation

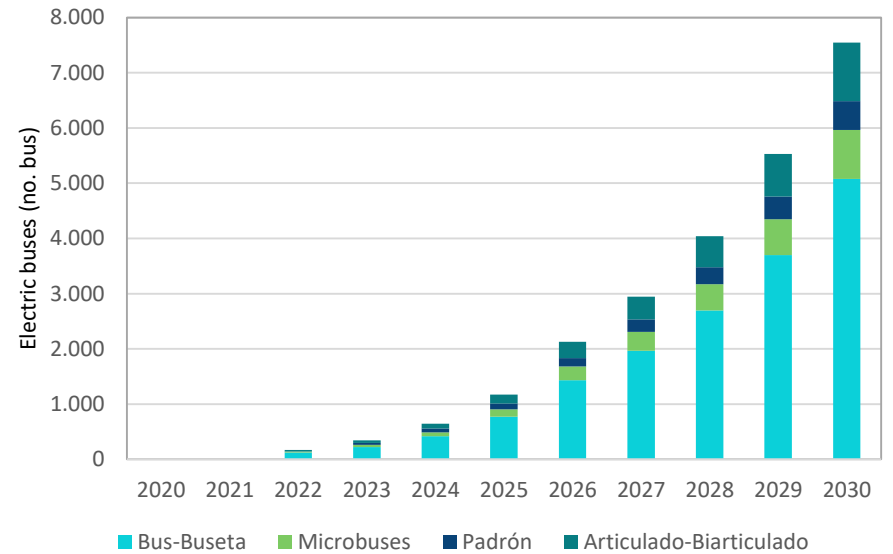
Program's objective: Substitution of buses operating with fossil fuels with electric buses.

	TIER 1	TIER 2	TIER 2
Phase LCA	Operation Use of energy by the fleet	Operation Air conditioning use	Upstream Fuels and electricity Production, transport/transmission, and distribution
Origin of the emissions	Combustion	Fugitive	Fugitive and combustion
Pollutant	CO ₂ e: CO ₂ , CH ₄ , N ₂ O Cobenefits: BC, PM _{2.5}	CO ₂ e: HFC	CO ₂ e: CO ₂ , CH ₄ , N ₂ O Cobenefits: BC

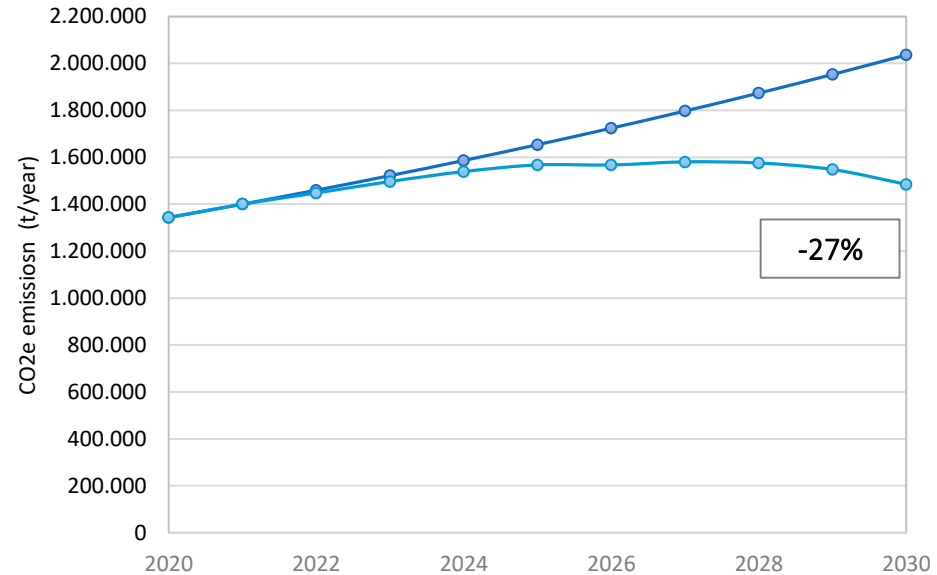
Reference scenario



Mitigation scenario



CO ₂ e emissions	Cumulative impact 2020-2030 CO ₂ e (million tonnes)	
Operation fleet	Reduction	- 1.83
Electricity	Increase	+ 0.22
Fossil fuels – upstream	Reduction	- 0.16
AC systems	Reduction	- 0.03
Total	Reduction	- 1.80



Monitoring based on indicators

Type	Indicator	Description	Units	
GHG (Cobenefits)	Monitoring	Annual CO _{2e} emission reduction	Reduction of CO _{2e} emissions generated by the buses of the SITM and SETP in comparison with the baseline scenario.	$\frac{\text{tonnes } CO_{2e}}{\text{year}}$
	Monitoring	Annual BC emission reduction	Reduction of BC emissions generated by the buses of the SITM and SETP in comparison with the baseline scenario.	$\frac{kg \text{ BC}}{\text{year}}$
Program management	Implementation	Number of electric buses in the program	The total number of electric buses in the SITM and SETP systems linked to the Program.	$\frac{\text{No. electric buses}}{\text{year}}$
	Implementation	Annual resources leveraged by international climate change funds	Percentage of investment obtained from CC international funding, from the total investment.	Percentage of international resources - climate change funding.
Cobenefits	Monitoring	Annual PM _{2.5} emission reduction	Reduction of PM _{2.5} emissions generated by the buses of the SITM and SETP in comparison with the baseline scenario.	$\frac{kg \text{ PM}_{2.5}}{\text{year}}$
	Monitoring	Annual PM ambient air concentration (PM _{2.5} / PM ₁₀)	Annual ambient air concentration of PM according to the air quality network of each city.	$\frac{\mu g \text{ PM}_{2.5}}{m^3} ; \frac{\mu g \text{ PM}_{10}}{m^3}$

Data collection

Indicator	Monitoring variables	Data sources	Other data required*
Annual CO _{2e} emission reduction	<ul style="list-style-type: none"> • Annual fleet quantity by type. • Annual fleet activity. • Annual fuel consumption. • Fuel efficiency factors. 	Operators	<ul style="list-style-type: none"> • GHG fuel emission factors according to FECOC • Emission factors for energy production/generation/distribution/transport • GHG electricity emission factor (national grid) • HFC emission factors
Annual BC emission reduction	<ul style="list-style-type: none"> • Annual fleet quantity by type. • Annual fleet activity. 	Operators	<ul style="list-style-type: none"> • Local emission factors • Electricity generation mix • Emission factors for electricity generation
Number of electric buses in the program	<ul style="list-style-type: none"> • Number of electric buses operating by year. 	Operators	
Annual resources leveraged by international climate change funds	<ul style="list-style-type: none"> • Resources financed by CC funds to purchase the electric buses and the charging infrastructure. • Net resources to purchase the electric buses and charging infrastructure. 	Program leader	
Annual PM _{2.5} emission reduction	<ul style="list-style-type: none"> • Annual fleet quantity by type. • Annual fleet activity. 	Operators	<ul style="list-style-type: none"> • Local emission factors
Annual PM ambient air concentration (PM _{2.5} / PM ₁₀)	<ul style="list-style-type: none"> • Annual PM ambient air concentration by air monitoring station. 	Institute of Hydrology, Meteorology and Environmental Studies -IDEAM.	

Tools for monitoring GHG reduction from the electric buses in Colombia

1) Guidelines

- Set of indicators to monitor the program (implementation, operation, GHG effects and BC).
- Technical guidelines to collect data and do the estimations.
- Guidelines to report at the National Registry for the Reduction of GHG (RENARE).
- Guidelines with the minimum set indicators required to apply to international funding (v.g., CGF).

2) Databases

- Characterization of the fleet and its operation by city.
- Fuel consumption values by type of bus.
- Emission factors by type of fuel (CO₂e, CH₄, N₂O, PM_{2.5}, and BC).
- Emission factors by type of bus (HFCs).

3) Calculation sheet and estimations

- Emissions for the baseline scenario and mitigation scenarios by type of pollutant, life cycle stage, and city.
- Indicators estimated for the baseline year.
- Ready to use calculation Excel sheets to estimate the indicators.

4) Templates

- Templates to collect monitoring data by city and to compile data the national level.

Next steps – Capacity building

- Broad differences between local transport systems.
 - Monitoring practices in place.
 - Methods to capture the data required.
- Need for a flexible MRV system.
 - Respond to existing capacities.
 - Identification of opportunities for improvements.
 - Adoption of better information gradually.
- The generation of information requires local and national efforts.
 - Fuel efficiency measurement standardization at the national level.
 - Standardization in emission estimation will facilitate the process.

GRACIAS

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Picture: Alcaldía de Bogotá.

Fuente: <https://bogota.gov.co/mi-ciudad/movilidad/primer-lote-de-483-buses-electricos-en-bogota>

This presentation is based on the study:

GIZ, Hill, 2020. Design of the GHG Mitigation Monitoring, Reporting, and Verification (MRV) system for the replacement of bus fleets for public transport by electric vehicle technologies in Colombia. Final Report.

Sources of images:

Slide 1, 13 <https://bogota.gov.co/mi-ciudad/movilidad/primer-lote-de-483-buses-electricos-en-bogota>

Slide 3 <https://www.busscar.com.co/es/primer-bus-electrico-en-bogota-EV115>
<https://www.elcarrocolombiano.com/noticias/64-nuevos-buses-electricos-llegaran-a-las-calles-de-medellin>
<https://occidente.co/cali/la-flota-electrica-del-mio-es-una-realidad/>