



**Towards a More Sustainable
Passenger Transport:
Management of Disutility Related
to Environmental Impacts***

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AGENDA

- Objective/Introduction
- Methodology
- Urban Bus Emissions Simulator (UBES)
- Environmental Impacts of Urban Mobility Actions Simulator (EIUMAS)
- Simulations
- Results and Discussions
- Conclusions and Outlook

OBJECTIVE

To suggest ways to manage the disutility related to environmental impact of CO₂ emission from Passenger Transport vehicles, by:

- *Consumption reduction of fossil fuels in Public Transportation vehicles (substitution of buses/ engines); and*
- *Changes of modal-split (modal share), for example, with Public Transportation assuming part of the trips carried out by individual modes.*

INTRODUCTION

- Passenger Transport imposes disutilities (disadvantages) related to:
 - (i) passengers: time wasting, money spending, insecurity and discomfort; and
 - (ii) society: consumption of urban areas devoted to infrastructure and noise, water, soil and air pollution.
- Passenger Transport vehicles (automobiles, motorcycles, buses and trains) consume 50% of the energy of all world transport and produce 20% of global warming caused by CO₂ emissions.

METHODOLOGY

- The methodology to simulate the combined effect of CO₂ emission reduction in Brazilian cities by the substitution of bus fleets and changes in its modal-split is:
 - *PHASE 1 - To collect, to inform or to adopt the required information;*
 - *PHASE 2 - To perform the simulations (scenarios), in two simulator tools, generating its results and, if it is needed, to apply the necessary adjustments and to redo the simulations; and*
 - *PHASE 3 - To consolidate the results of each scenario and their respective analysis.*

URBAN BUS EMISSIONS SIMULATOR (UBES)*

- UBES assists decision-makers to estimate the emissions reduction potential of pollutants from the replacement of diesel-powered buses by new units powered by clean energy or other technological alternatives.

* *Developed by Associação Nacional de Transportes Públicos – ANTP
(National Association of Public Transportation), in partnership with Volvo*

UBES

- <http://www.antp.org.br/simulador/simulador-de-emissoes-de-onibus-urbanos/>

ENVIRONMENTAL IMPACTS OF URBAN MOBILITY ACTIONS SIMULATOR (EIUMAS)*

- EIUMAS estimates environmental impacts produced by a given city when its modal-split is changed. It allows users to select a city and change the proportion of trips from a transport mode to another one, in terms of: (i) time change for displacement; and (ii) energy consumption and urban space consumed, in addition to local emissions and emissions of GHG (CO₂)

* *Developed by Associação Nacional de Transportes Públicos – ANTP
(National Association of Public Transportation), in partnership with WWF-Brasil)*

EIUMAS

- <http://www.antp.org.br/simulador/impactos-ambientais/>

SIMULATION - UBES

- SCENARIO 1 (conservative), replacement of diesel fleet to B20 for vehicles manufactured before 2011 and maintaining buses manufactured after 2012 in EUR5;
- SCENARIO 2 (intermediate), consisting in ELB for Mini-Micro and in maximizing the successful experience with B20, E95, TRO and HBR carried out in the city of São Paulo in recent years, adopting: Mini-Micro (B20 for buses manufactured from 2005 to 2011 and ELB beyond 2012); Midi-Basic (E95 from 2005 to 2011 and ELB beyond 2012); Padron (E95 from 2005 to 2011 and TRO beyond 2012 - equivalent to the current fleet); Articulated and Biarticulated (all HBR); and
- SCENARIO 3 (radical), with 100% of ELB (electrical battery vehicles).

SIMULATION - EIUMAS

- **CO₂ reductions were simulated**, carrying out in a progressive way degrees of trip transfers ranging from 10% to 90%, with intervals of 10%, in the following format: (i) from motorcycle to walking, motorcycle to cycling and from motorcycle to bus; and (ii) from automobile to walking, automobile to cycling and from automobile to bus.
- Another simulation was tested, adopting trip transfers from walking, cycling, motorcycle and bus to automobile, resulting in **additions in CO₂ emissions**

RESULTS AND DISCUSSIONS - UBES

- Even in SCENARIO 1, probably representing low investment and a short deployment term, with little technical difficulty, a **15% reduction of CO₂ emissions** was achieved;
- It is encouraging to note that SCENARIO 2 shows a CO₂ emission of 0.15 million tons, resulting in an expressive **reduction of 89%**; and
- In SCENARIO 3, the consequence of a complete fleet renewal with the introduction of electric battery buses, indicates, obviously, the biggest contribution to CO₂ emission with a **100% reduction**.
Certainly, this could impose investments impossible to be completely obtained and applied in the short term (economically and socially feasible?)

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Passo 3 - Resultado

Simular

Mini/Micro	CO	HC	NOx	MP	CO2
Diesel (t/ano)	130.59	15.88	565.61	10.31	93401.70
Alternativas energéticas (t/ano)	0.00	0.00	0.00	0.00	0.00
Redução (t/ano)	130.59	15.88	565.61	10.31	93401.70
Redução (%)	100.0%	100.0%	100.0%	100.0%	100.0%

Básico/Midi	CO	HC	NOx	MP	CO2
Diesel (t/ano)	1035.72	183.79	5754.99	102.23	816700.64
Alternativas energéticas (t/ano)	0.00	0.00	0.00	0.00	0.00
Redução (t/ano)	1035.72	183.79	5754.99	102.23	816700.64
Redução (%)	100.0%	100.0%	100.0%	100.0%	100.0%

Padron	CO	HC	NOx	MP	CO2
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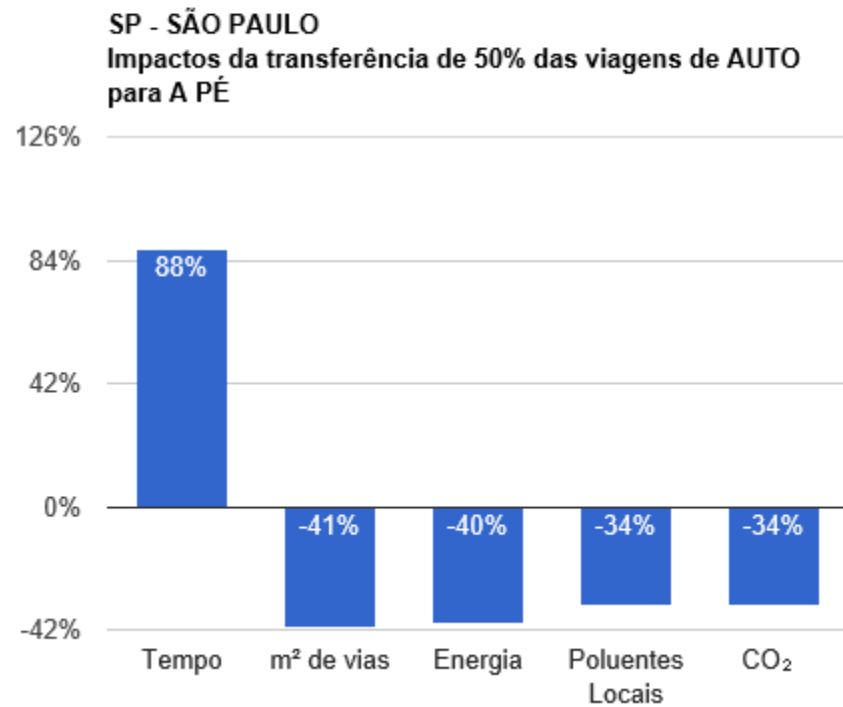
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RESULTS AND DISCUSSIONS - EIUMAS

- The modal-split transfer trips from motorcycle to walking, motorcycle to cycling and from motorcycle to bus gave **little help in reducing CO₂ emissions** (*from zero to 3%*);
- The modal-split transfer trips from automobile to walking, automobile to cycling and from automobile to bus **helped considerably the reduction of CO₂ emissions** (*from 3% to 61%*); and
- The modal-split transfer trips from walking to automobile, cycling to automobile, motorcycle to automobile and from bus to automobile reinforce the harmfulness to society, resulting in **additions in CO₂ emissions**, especially when it refers to the cases of walking to automobile (*from 8% to 70%*) and of bus to automobile (*from 2% to 20%*).

Transferir % **De** **Para**



CONCLUSIONS AND OUTLOOK

- The two simulator tools tested, even with limitations, represent a suitable disutility management instrument regarding CO₂ emissions. It is a quick and inexpensive way to assess the magnitude of environmental impacts, resulting from management in transport supply (change of the bus fleet) and in transport demand (change of modal-split).
- The paper has contributed to reveal levels of CO₂ emissions in Brazilian cities (reductions or additions), which could be adopted in every city of the world.
- According to simulations of bus replacement fleets combined with new modal-splits, it may be possible to encourage, with scientific support, more non-motorized transport modes and less automobile usage.

THANK YOY

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