Sustainable Bus System
IEA – Advanced Motor Fuels Implementing Agreement

Feasible Propulsion and Vehicle Technologies vs Political Visions Conference

Vienna. October 18th, 2016

Gianni López

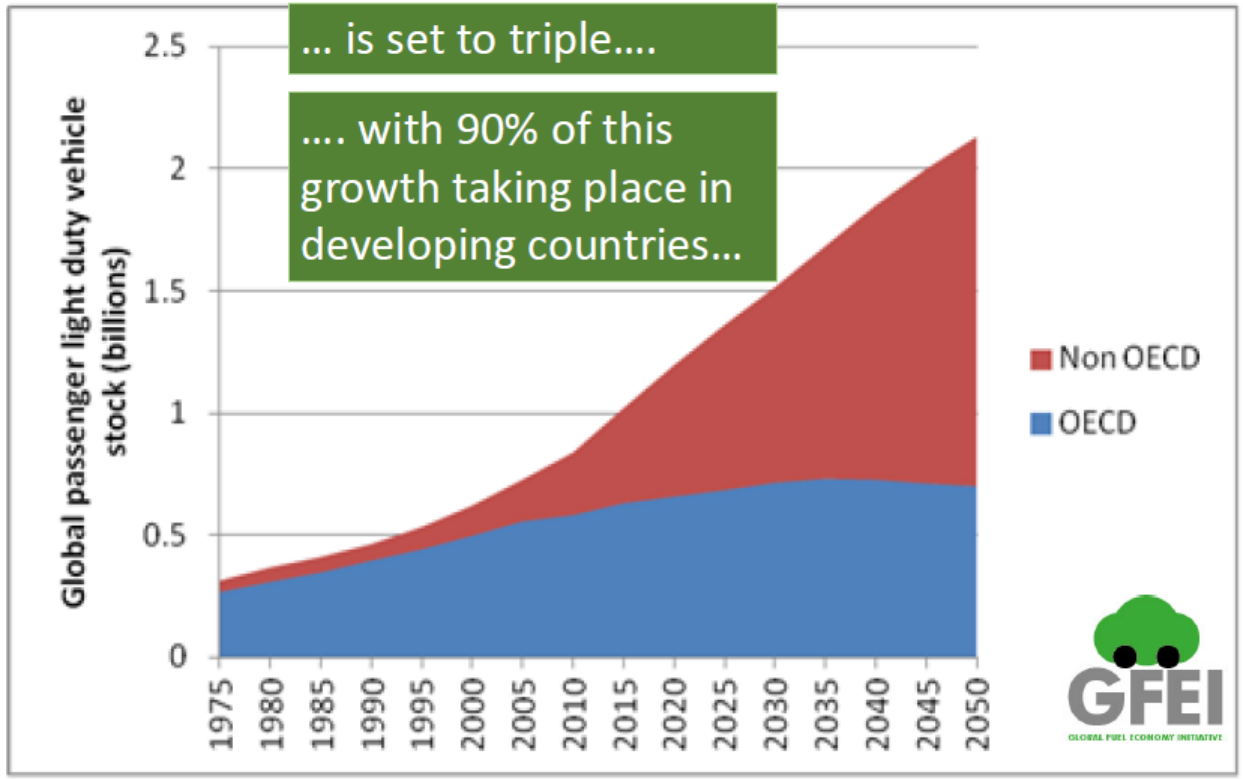
Centro Mario Molina Chile

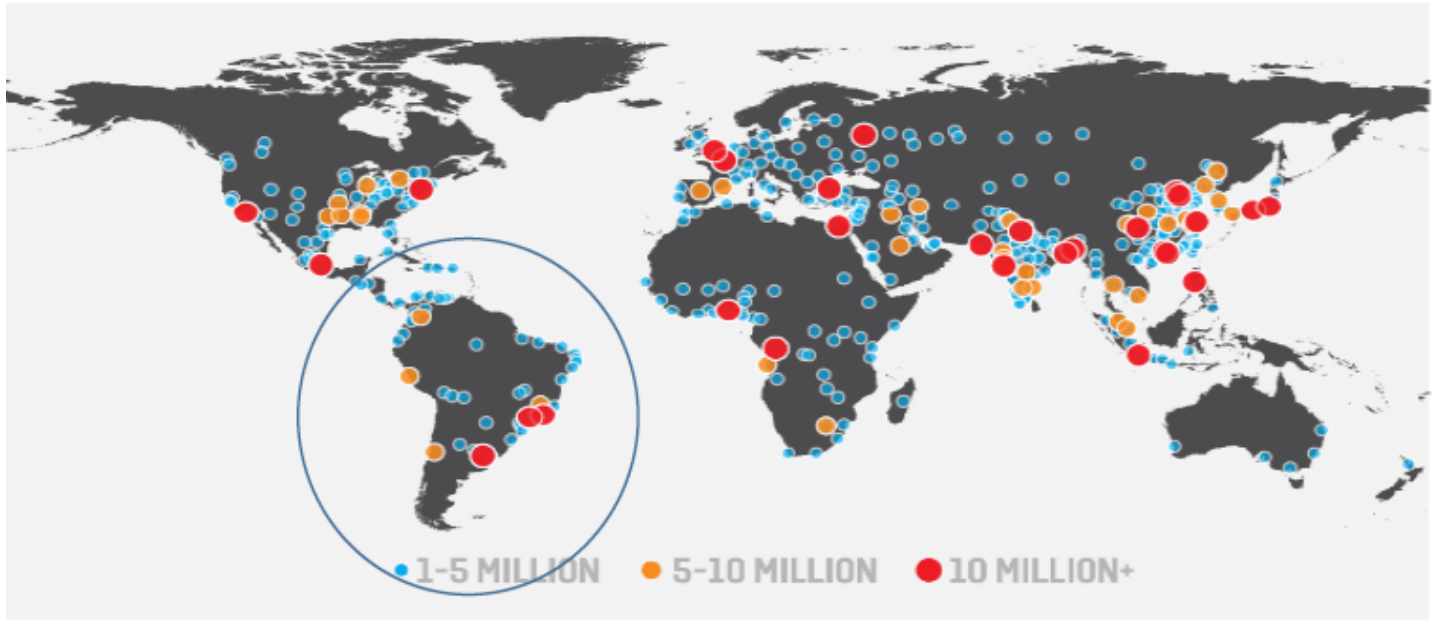
in cooperation with Ministry of Transport and Telecommunications of Chile

The Global Fleet…

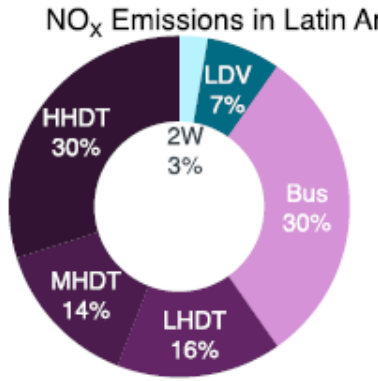
… is set to triple….

…. with 90% of this growth taking place in developing countries…

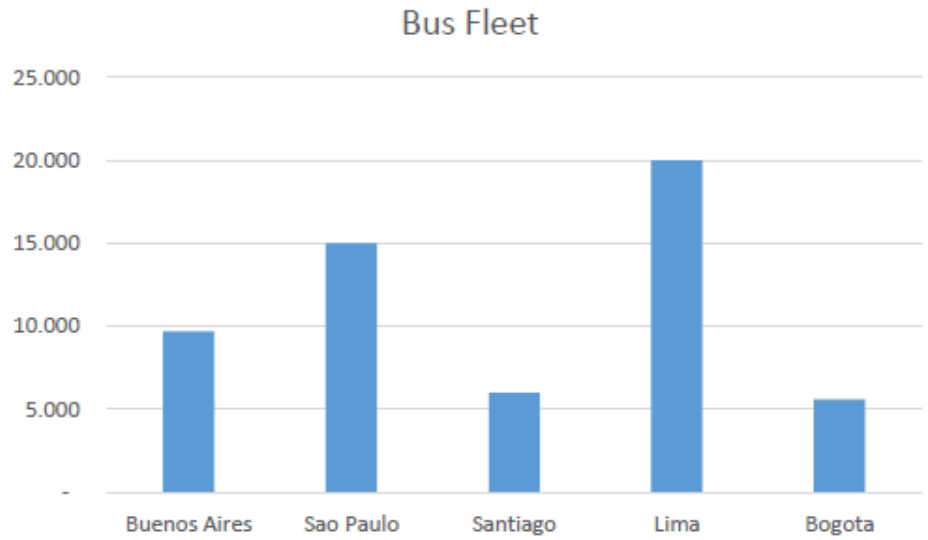


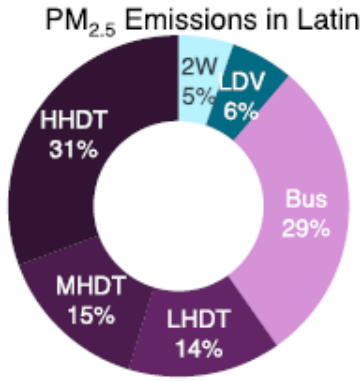


Heavy-duty share of emissions



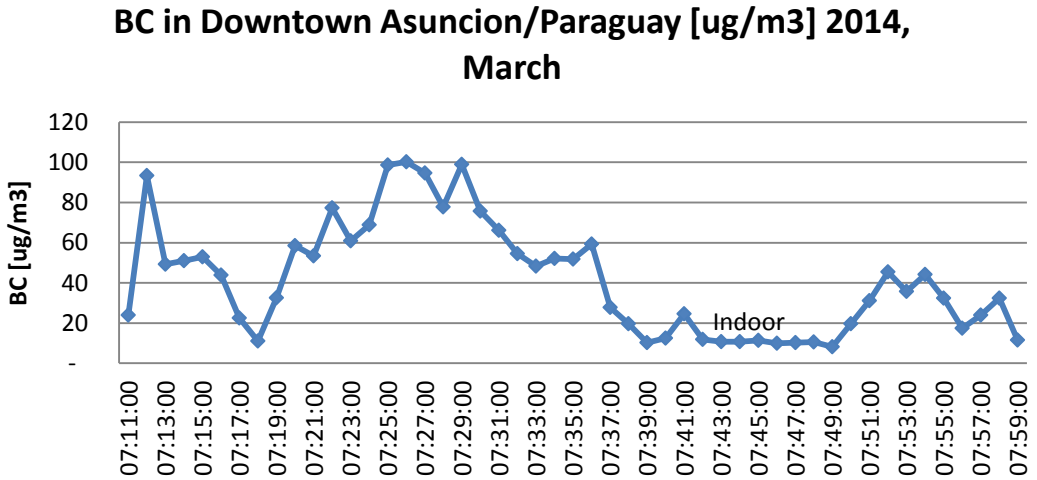
Heavy-duty vehicles = 90%

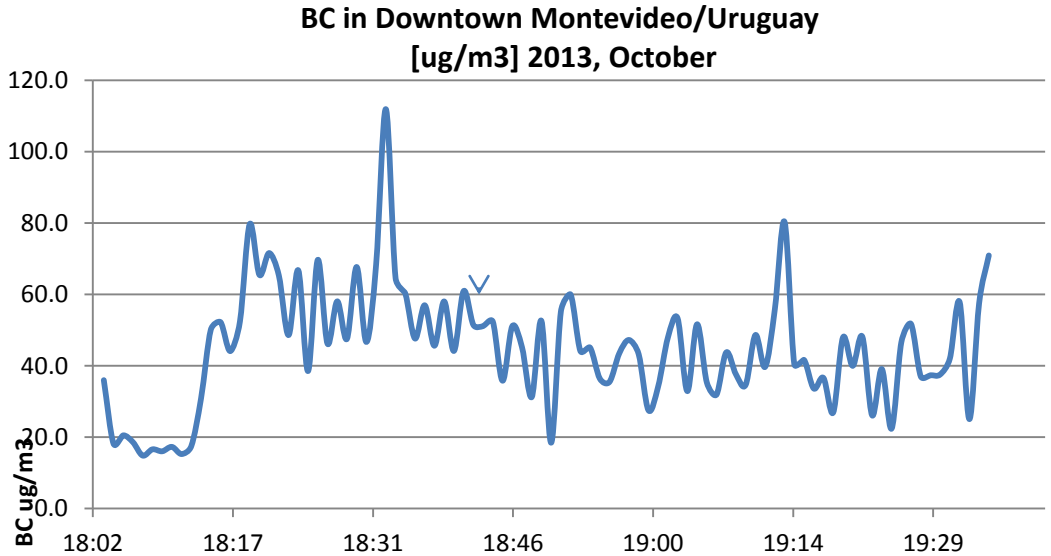




Heavy-duty vehicles = 89%

BC in Downtown at Latinamerican Cities (Sniff with microaethalometer)





UNEP

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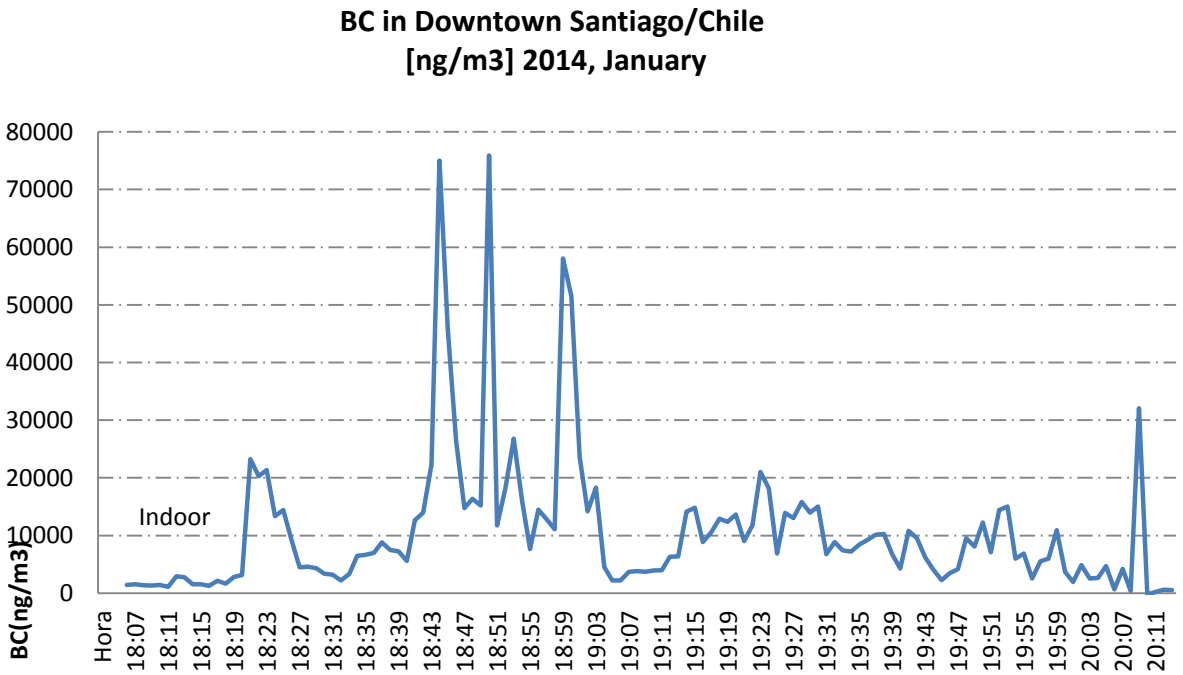
CLIMATE AND CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

Centro Mario Molina Chile

BC in Downtown at Latinamerican Cities



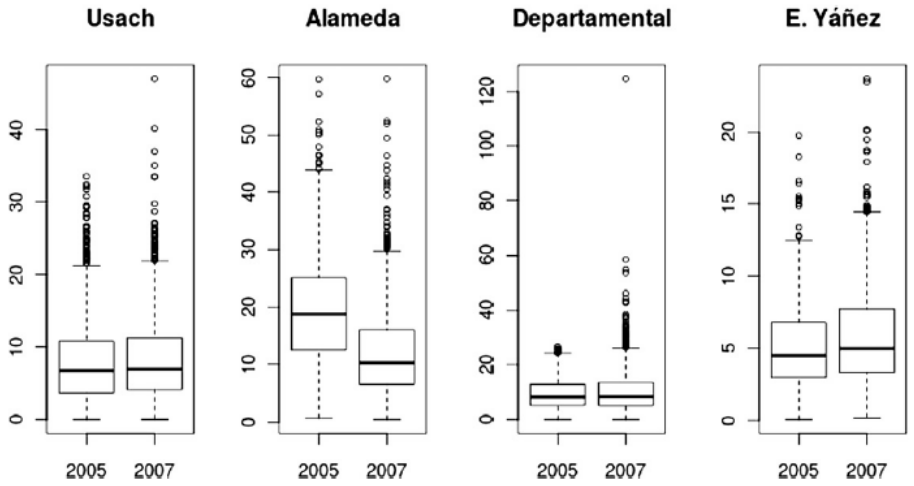


Fig. 8. Box plots of the 2005 and 2007 observed black carbon (BC) concentrations.

Atmospheric Environment 65 (2013) 153–163

Contents lists available at SciVerse ScienceDirect

Atmospheric Environment

journal homepage: www.elsevier.com/locate/atmosenv

Influence of large changes in public transportation (Transantiago) on the black carbon pollution near streets

E. Gramsch [a,*], G. Le Nir [b], M. Araya [a], M.A. Rubio [c], F. Moreno [d], P. Oyola [e]

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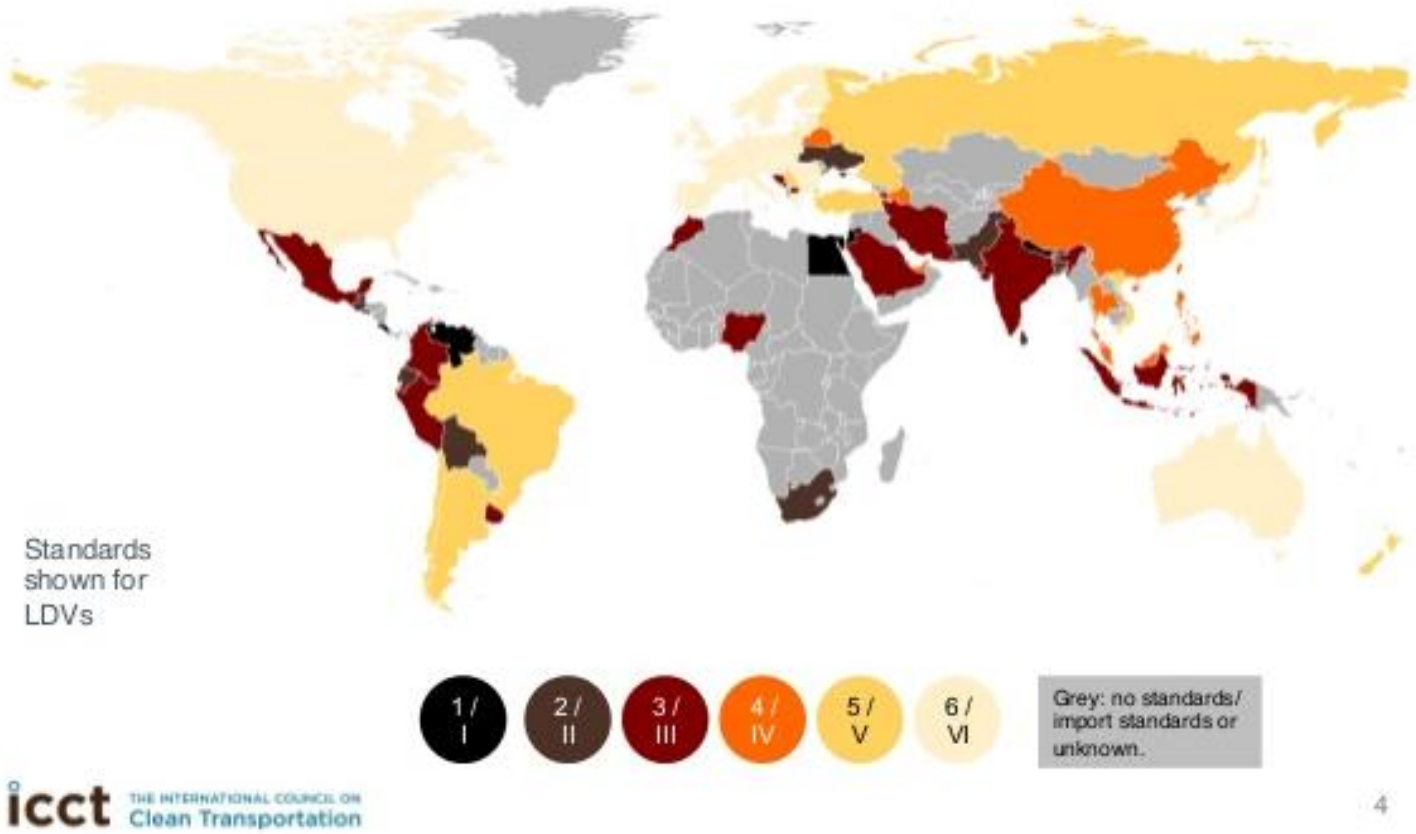
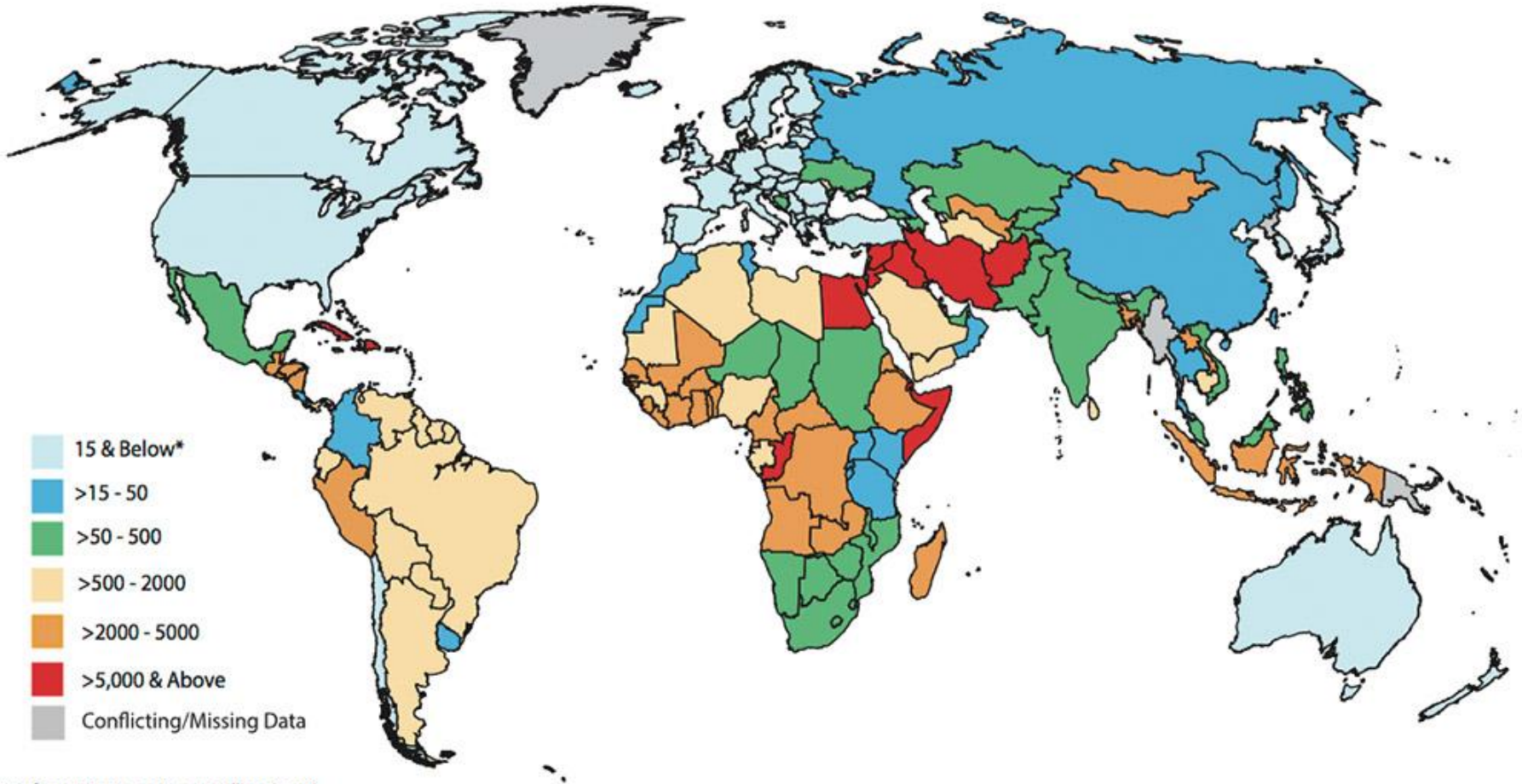
Emission standards



Partnership for Clean Fuels and Vehicles

UNEP

Diesel Fuel Sulphur Levels: Global Status
February 2015



* Information in parts per million (ppm)

For additional details and comments per country, visit www.unep.org/transport/pcfv/

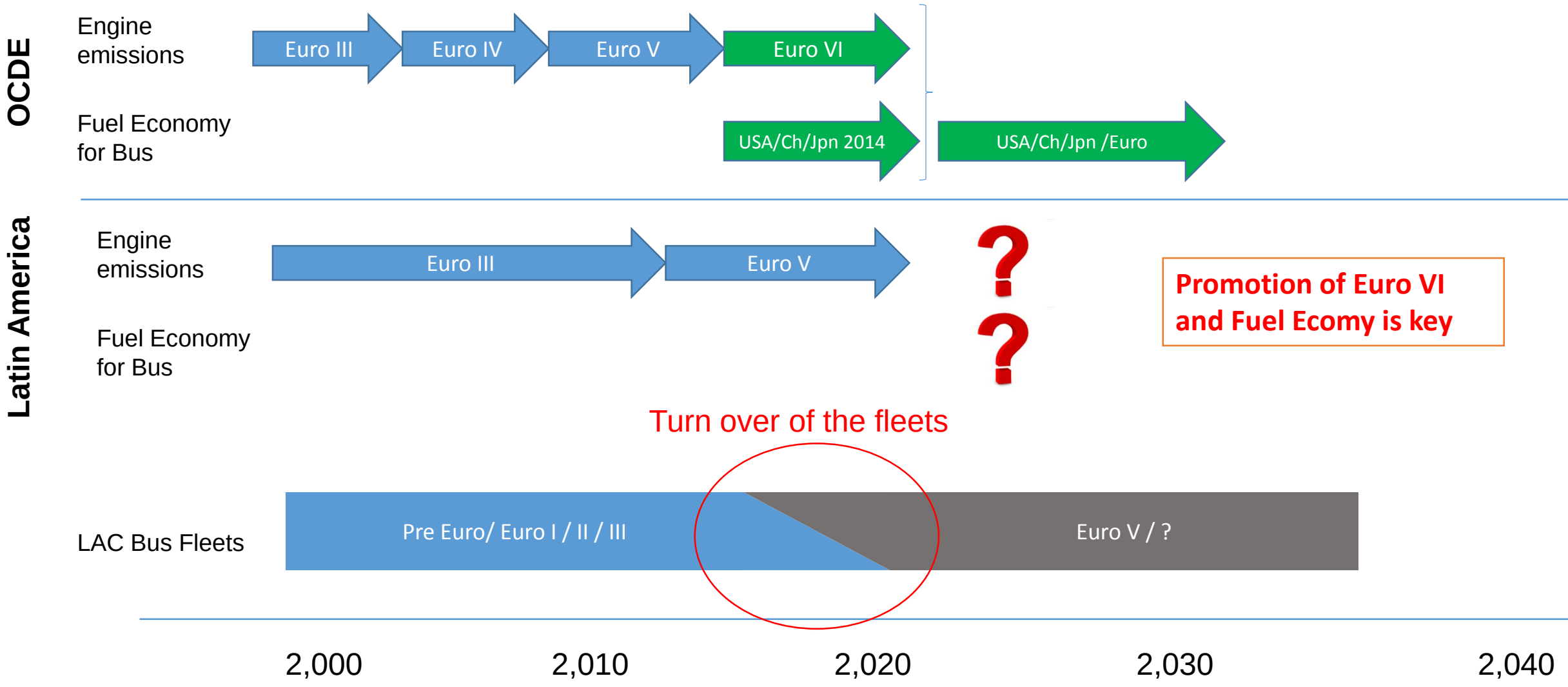
End of existing contract of bus operators companies in Santiago

Empresa	Unidad	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RED BUS	6											
METROPOLITANA	5											
VULE	3											
SUBUS	2											
STP	7											
ALSACIA	1											
EXPRESS	4											

- US$ 250 millons per year in diesel cost;
- Around 1,2 US$ billions in investment to turn over the fleet in Euro V diesel buses.

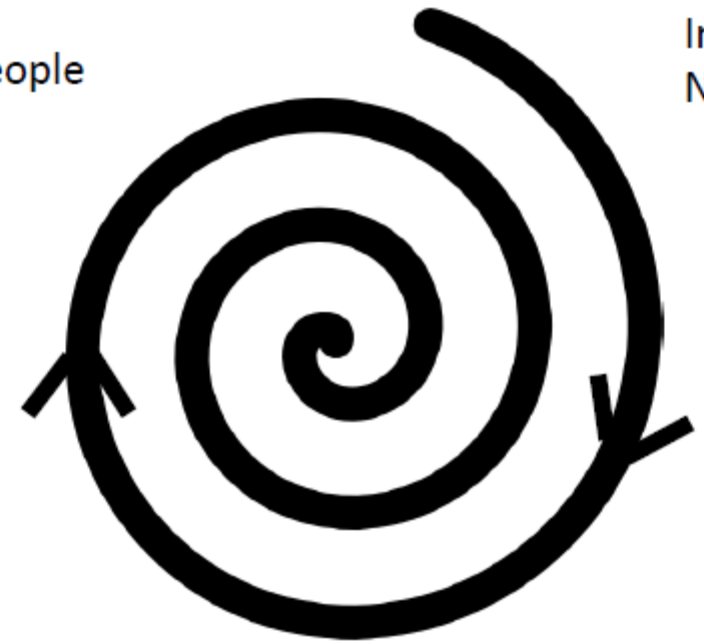
- Several cities in Latin America in similar process before de ending of the decade.
- This process is crucial for the sustainability of transport in the region in the next two decades

Emissions and Fuel Economy Standard for HDV



Deterioration of public transport systems

How the advance technologies can help to face this problem?



More incentives to the people
To switch to private cars

Incomes of the system depens on
Number of Passenger

Less incomes produce a
services deterioration and/or
a strong pressure for more
subsidies

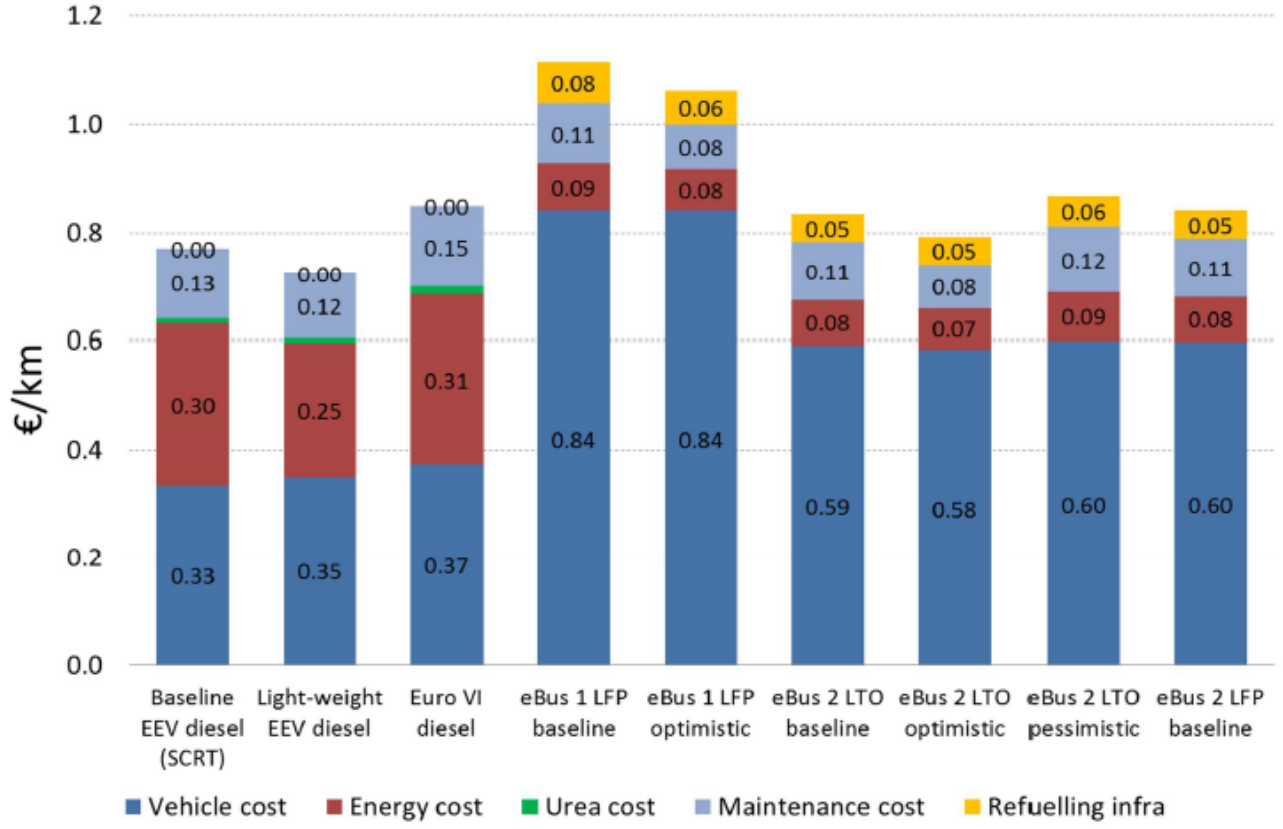
In growing economies people
switch form public transport
To private cars

Fuel cost increase due to
International prices and
deterioration of operational conditions
due to congestion of private cars

The income of the system
Decrease

Are there real chances for eBuses in developing countries?

Total ownership costs of electric buses – Espoo case (note: the results do not apply generally)



Ref: M. Pihlatie et al, Fully electric city buses – the viable option, IEEE IEVC 2014, Florence 17-19 December, DOI: 10.1109/IEVC.2014.7056145

Different approach coming to the bus market in Latin America

Main Barriers:

- Lack of information on performance of different bus technologies in real bus driving condition of a developing city.
- Technical solutions for plugin bus recharging and business model of the services.
- Operation of buses in commercial bus services, including fleet management under similar conditions of diesel buses.
- Incremental costs of buses and investment cost in recharging infrastructure.
- Improvement of different regulations to allow the participation of BEV.

Approach in Santiago City

- Three kind of actions:
  - Governance. Public-private consortium that will implement an strategy to solve the actual barriers, including the creation of a business ecosystem around electric bus services.
  - Information about technologies. Development of information about performance, energy consumption and emission of buses under operational conditions that represents Latin American cities.
  - Finance aspects. Use of Green Climate Fund opportunities to cover incremental costs of eBuses and recharging infrastructure.

Ministry of Transport of Chile has a state of the art HDV laboratories at 3CV Center

AMF Annex 53 Sustainable bus system

Purpose and Objectives

- to develop a methodology for setting requirements for clean and energy efficient busses for use in tendering process for public transport operators in developing regions
- The requirements shall be adopted to local conditions and verify the effects in real driving conditions in developing cities. Also methodology to assess emission stability over time should be considered.

Participants

- Chile:
    - 3CV Center of Ministry of Transport and Telecomunications (operating agent)
    - Centro Mario Molina Chile
- Finland:
    - VTT Center
- Sweden:
    - Trafikverket
- USA:
    - DOE
- Canada:
    - Enviroment Canada

Financial support from Santiago electric Company (ENEL) and Chilean Economic Development Agency (CORFO)

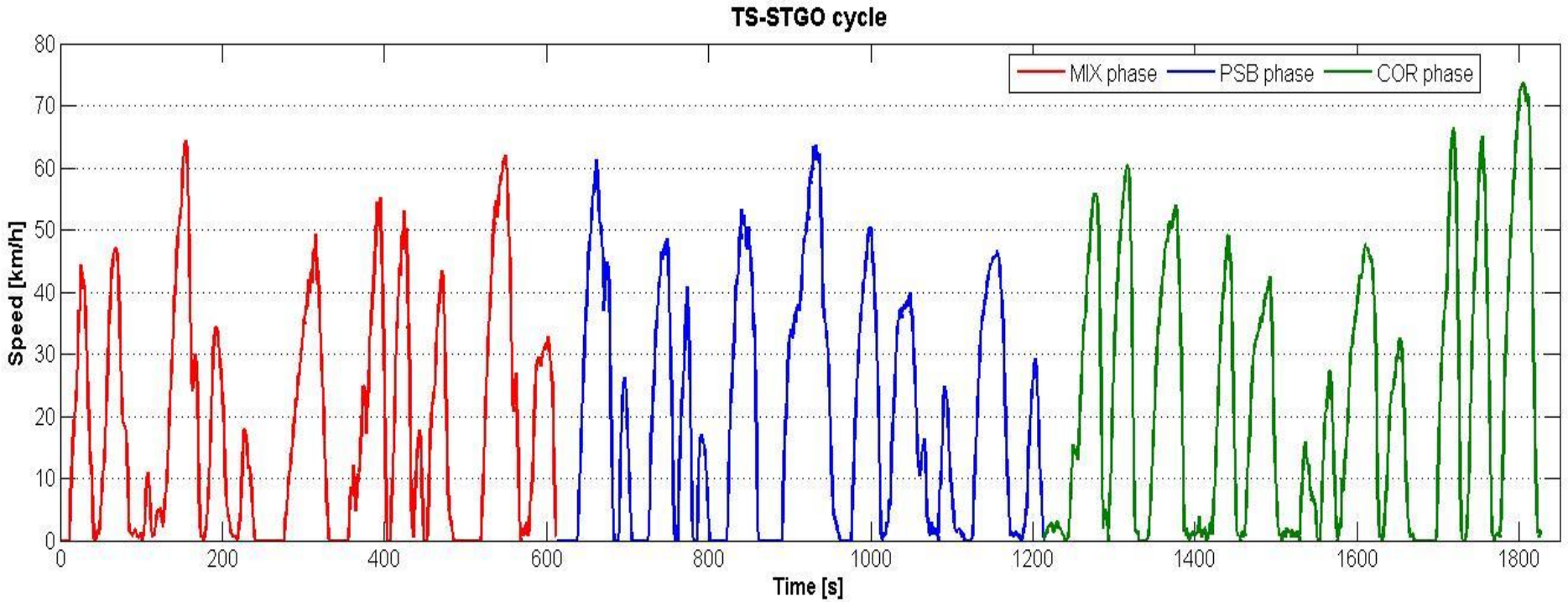
Activities

- WP 0. Collection of data from exiting buses
- WP 1. Evaluate operational conditions in cities in developing countries. City of Santiago is the first target as a pilot for other cities.
- WP 2. Analysis of existing test cycles versus local operation conditions in developing cities.
- WP 3. Development of a common test methodology and protocols for reporting of data.
- WP 4. Selection of bus technologies (Euro III and later) and fuels to considered for the test.
- WP 5. Execution of tests according to developed methodology on vehicles and fuels selected.
- WP 6. Bus performance modelling under different test conditions using Autonomie Model.
- WP 7. Analysis of data from both the own measurements and the collated existing data.
- WP 8. Development guidelines for busses in sustainable bus transport system, including certification, tendering and periodic inspection.
- WP 9. Work exchange of researchers between Europe and South-America
- WP 10. Co-ordination of the project, synthesis and reporting

Progress at October, 2016

- First driving cycle for city buses in Latin American (Santiago City).
  - Selection of representatives routes
  - Instrumentation of several buses
  - Development of a first version of the cycle based in micro trips methodology and different phases representing different bus routes infrastructure.
  - Cooperative process in the definition of final cycle (Chilean institutions, VTT, Trafikverket).
  - Training of chilean profesionals at VTT, Finland.

Final Micro-Trip Selection. TS-STGO Cycle



Next steps

- Tests program at VTT and 3CV, considering european Euro VI buses, (including conventional diesel and alternatives fuels), plug in buses (BEV) availables in Europe, and conventional and HEV/BEV availables at latinamerican bus market.
- Recomendation for use of the information in next tendering process for private bus operators. Ministry of Transport of Chile already informed to bus operators and manufactures that this driving cycle will be use for the certification of energy consumption of new buses in Santiago.
- International Conference in Santiago on next January to present results and recommendations.
- Expansion in 2017 to include other cities, possible Buenos Aires, Sao Paulo and Lima (Peru).