Grow first, clean up later? Studying the growing traffic emissions in Latin America and exploring future possibilities.

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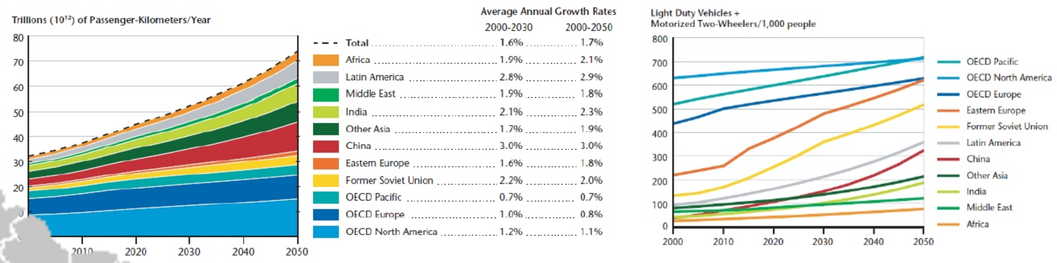
General Context: Latin America

RESUME

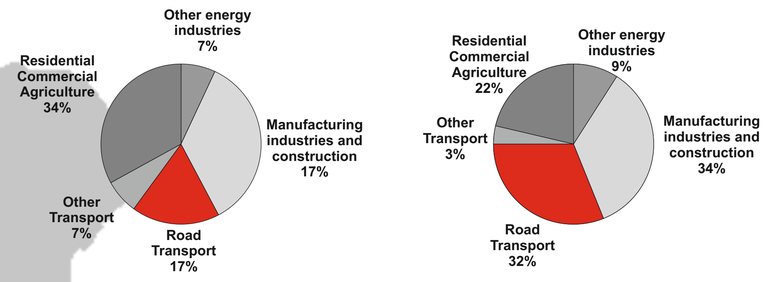
Latin America is facing a decisive period in its history. Economic growth and fast development hit most of the countries. Closely related to these facts is the increasing number of motorised vehicles in urban areas, mainly private cars. Concerned with the negative impacts that this fast change is causing, this paper firstly explores the current situation of emissions in this region of the world, especially CO_2, relating the numbers with actual concepts and good practices. After that it focuses on the specific case study of Santiago *de* Chile, in order to make an analytical and methodological contribution.

The actual situation of CO2 emissions in Latin America

In everyday life, is already an ordinary subject for Latin Americans to talk about the each time longer hours spent in traffic, the lack of public transport and the high indexes of pollution. Magazines and newspapers report scary numbers, as for example the 180km longer traffic jam in the morning in São Paulo, Brazil, where drivers can take two hours for small distances . In Santiago, Chile, the increase of air pollution in a short period is reported constantly. The graphs on the right can ilustrate the actual and future situation regarding transport and the consequent emissions.



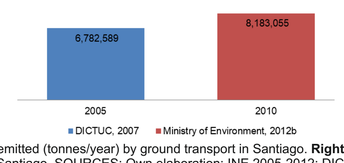
Personal activity by region and projected growth in light duty vehicles (LDV) ownership. SOURCE (WBCSD, 2004)

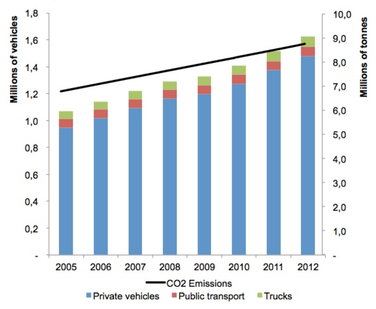


Shares of CO_2 emissions in the WORLD and LATIN AMERICA, respectively. SOURCE: Schipper et al, 2009

Case Study: Santiago de Chile

Santiago de Chile is a vibrant capital city of about 6,03 million inhabitants , located in the long but narrow country of Chile. The country has a minor participation in global greenhouse emissions (0,2%), holding the place 61º of emissions per capita with 4,35 tons of CO2/habitant in 2006 (International Energy Agency, 2010). Nevertheless, as many of other developing cities in Latin America, it has witnessed in the last five years a rise in CO2 emissions of mobile sources by more than 23%. Between 2005 and 2012 motorized vehicles increased from 1.050.744 to 1.597.762, leading cars and trucks with an annual growth of 6,61% and 4,36% respectively (INE, 2005-2012). That is around 500 new cars every day from last year . Accordingly, the participation of private vehicle trips in Santiago's modal split has increased from 18,5% to 38,1% only between 1991 and 2001 . This dramatic increase is related both with the fast economic and the total trip growth that the households are experiencing.





Above: Total Co2 emitted (tonnes/year) by ground transport in Santiago. **Right:** Co2 emissions versus vehicle number in Santiago. SOURCES: Own elaboration; INE 2005-2012; DICTUC, 2007; MoE, 2012

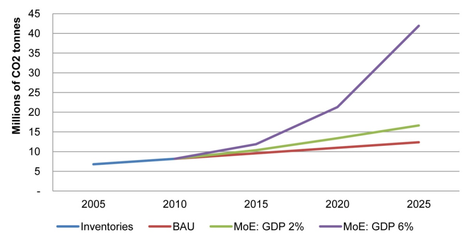
Modelling objectives

In a first moment the research tries to understand the context for Santiago's snowballing transport-related emissions and examine the newly released **"Santiago 2025 Transports Master Plan"**. With that in mind, different CO_2 emission inventories were analysed in comparison to the national reduction goals. With the collected data was possible to develop adaptations to aggregated models to estimate forecasts consistently, according to the main future scenarios. With the calculations was possible to achieve preliminary results, propose ideas on methodology and how to achieve reduction goals, so that in the end some conclusions for whole Latin America could be proposed.

BAU scenario and the projections for GDP growth

The Business as usual was defined as a scenario in the future that results from the projection of the tendencies we see today. In this case, we formulate the 2025 BAU scenario of CO2 emissions as the result of the growth rate of 2005-2010 emission inventories only.

On the contrary, the graph in the right shows the contrast of BAU with different projections forecasted in the emission inventory of 2010. Both the 2% and 6% annual GDP growth scenarios are used in the study as baselines for then suggest some CO2 reduction measures



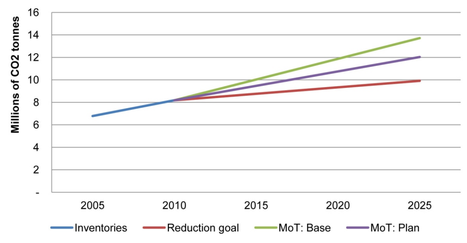
2025 BAU and GDP based forecasts (own elaboration and Ministry of Environment, 2012)

Santiago 2025 Transport Master Plan

Santiago 2025 Transport Master Plan (STMP) was launched midst of 2012 to be a guide for strategic investments in infrastructure and management in the long term, for mobility of persons and goods in Santiago.An evaluation of these strategic projects is made via two full described possible futures that are then compared:

Base Scenario: consists in the current network and the projects that are already in construction or the planning is finished.

Plan: Includes additional projects that may be prioritized from the agenda or are a result of new ideas.



STMP emissions forecast and the emission goal (own elaboration and Ministry of Transport, 2012)

Aggregated estimation models

After the analysis in the future scenarios and the data available it was possible to speculate *how should the different and relevant components of the system change in order to diminish emissions to achieve environmental ambitions?*

F1. Based on passenger-kilometer

$$Q = \frac{365 \cdot P_T \cdot R \cdot (S_{PT} \cdot d_{PT} \cdot q_{PT} + S_{PV} \cdot d_{PV} \cdot q_{PV})}{10^{12}}$$

Where:

Q = Annual quantity of total CO_2 emitted [$MtCO_2$/year]
P_T = total population of Santiago [hab]
R = motorized trip generation rate
$d_{PT, PV}$ = distance travelled by Public transport or private vehicle [pax-km/hab-year]
$q_{PT, PV}$ = quantity of CO_2 emitted for passenger for public transport or private vehicle [gCO_2/pax-km]

Scenario	Mot. trip/ per-day	Popul. (MM)	E. factor (g/pax-km)	Modal split (%)	Dist. (pax-km/trip)	Result (MM t CO_2)
2025 Base	1,63	7,300	420 & 23	58,4 & 41,6	12,4 & 13,1	**13,708**
2025 Plan	1,63	7,300	380 & 18	55,7 & 44,3	12,6 & 13,6	**12,026**
2005	1,42	5,652	420 & 23	40,2 & 59,8	12,0 & 13,2	**6,625**
2010	1,44	6,027	420 & 23	48,3 & 51,7	12,0 & 13,2	**8.959**
2025 Fit to red. goal	1,63	7,300	380 & 18	45,0 & 55,0	12,6 & 13,6	**9,908**

F2. Based on kilometer/vehicle

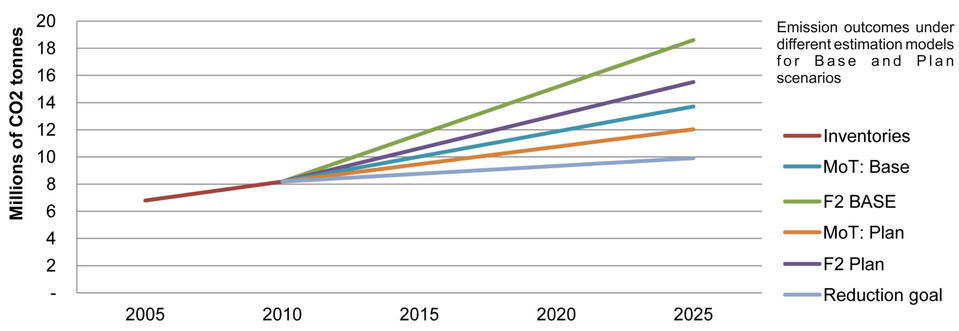
$$Q = \sum_{i=1}^{m} N_i \cdot D_i \cdot Q_i$$

Where:

Q = Annual quantity of total CO_2 emitted [$MtCO_2$/year]
N_i = vehicle by type
D_i = mean distance travelled [km/vehicle]
Q_i = tailpipe emission factor [$MtCO_2$/km]

Scenario	Vehicle number			Activity (km/veh-year)			Result (MM t CO2)
	Cars	Buses	Trucks	Cars	Buses	Trucks	
2005	930.706	24.488	52.539	15.931	42.828	34.880	**6,940**
2010	1.252.737	17.867	62.878	16.452	42.570	36.020	**8,379**
2025 Base	3.272.119	21.267	119.264	16.973	42.312	37.161	**18,605**
2025 Plan	2.700.000	21.267	119.264	17.247	43.698	37.761	**15,512**
2025 Fit to red. goal	2.439.734	23.394	155.797	14.807	42.570	32.418	**9,908**

Results



·All scenarios announce a growth of emission above the BAU, mainly because vehicle and activity grow faster while emission factor reduction targets are softer than what has happened in previous years.

·To achieve the reduction goal for transports in Gran Santiago, around 8,70 million tonnes of CO2 have to be reduced by 2025.

·It is needed a decrease of around 10 points for the motorized modal split of cars in the proposal, according to F1 calculation.

·More comprehensively, using F2 calculation the goal would be met if there is:

- o 10% decrease of car and 10% increase in bus numbers, based on MoE 2% GDP growth projected fleet.
- o Significant reduction of emission factors of the whole fleet, similar to European average requirement for the new fleet in 2015-2020.
- o 10% reduction of car and truck km/year by land use, urban renovation and efficiency in logistic chain policies.

CONCLUSIONS

The ambitious idea of analysing CO_2 emissions in Latin America through different perspectives (from a general view to a deep look into a case study) had as main objective to provide a perception about the future problems to be faced by latin american cities on the topic and explore possibilities about how to deal with this challenge. The analysis presented here could be extended to other cities in different countries in order to have a more complete scenario. Nevertheless, important conclusions can be already stated:

- Cities are becoming more conscious about the impacts of transport emissions in the quality of urban life. The actions to change the actual trends, however, are still punctual and cannot reverse the increasing private motorization.
- As analyzed in the paper, the accuracy of some results offered by official sources can be questioned. This can result in misleaded solutions and investments.
- The lack of communication of different agencies, as thos related to transport, environment and urban planning, can have negative impacts. Alternatives in cooperation could generate positive synergies.
- Aggregated formulas can provide reasonable estimations about emissions in cities at low cost. This is an important starting point, especially for cities where data and analysis are a limitation. It also provides a valuable analysis tool, which further develop could be useful for a study across Latin America.
- As explored in the different scenarios, the objectives in emissions reductions, despite difficulty to be reached, can be achieved by concentrated and joint efforts, especially combining restrictive measures to private car and incentives to public and non-motorized transport.

Despite the difficulties that have to be faced, a future with a better scenario is possible. In order to reach that in the bigger scale, not only problems have to be shared among the countries, but also the knowledge and experiences have to be combined.