

Barcelona Metropolitan Transport Authority
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Subject: Monitoring climate change through local « Mobility Plans »

1. Introduction

During the last decade the European countries have developed many mobility legal frameworks which have set goals for guaranteeing public accessibility to everybody, thus improving the efficiency of logistics and goods distribution by reducing transport unit costs and achieving safer road and railway networks, all of it in a sustainable way.

With regard to pollutants, the European Union (**EU**) established levels which all regions and countries must achieve by 2010. In terms of safety, there was a European agreement to reduce 50% of casualties by 2010 with regard to 2000 levels. All these agreements seemed an impossibility, but now many European regions can state they are close to materializing them.

Nevertheless, one threat stands out as having a major impact on environment and our sons' and grandsons' life: climate change. The EU committed to reducing 10% Green House Gases (**GHG**) emissions by 2012 with regard to 1990. By 2005 the reduction was only 2% with regard to 1990.¹

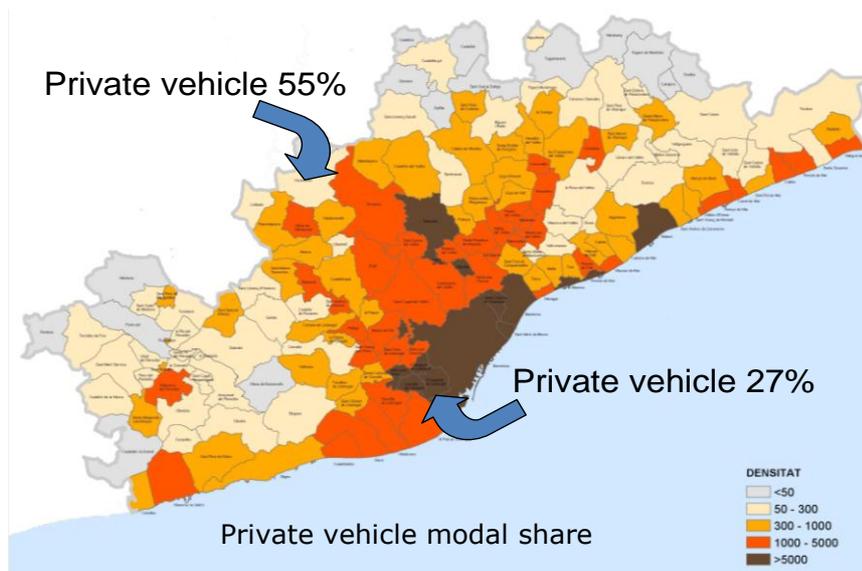
In 2009 the EU launched the Action Plan on Urban Mobility, which will help reach the EU goals for fighting climate change, creating an efficient European transport system and strengthening zone cohesion.² Most of the EMTA members themselves have made sustainable urban mobility plans or mobility master plans with the same goals we can see summarized in the EMTA mobility plans brief.³

The time has come to combat climate change, and this is an issue that businesses, governments and civil society must undertake together. Although Mobility planning has shifted over the last years towards a more environmental awareness, it is still not enough. There is no doubt that the action of European regions is an efficient and very important tool for improving the quality of the environment and contributing to climate preservation in their territories.

Regarding Spain's GHG emissions, the EU allowed an increase of 15% with regard to 1990. Nevertheless, the Spanish emissions had grown more than 50% by 2005. Considering these figures, the Catalan Government determined that the transport sector should reduce GHG emissions by 20% in 2012¹, and the mobility plan must be managed by the Barcelona Metropolitan Transport Authority (**ATM**) in the Barcelona metropolitan region (**BMR**) as stated by the law.

2. Metropolitan Region and GHG transport emissions trends

The **Barcelona metropolitan region (BMR)** has a population of nearly 4.8 million; in the central area, density is over 5.000 inhabitants per square kilometre and in the outskirts it is less than 1.000 inhabitants per square kilometre. The motorization rate is 424 vehicles per 1.000 inhabitants, but over 500 in the lower-density zones. In the last decade people and businesses have moved from central to external and lower-density zones, which are also the worst connected areas. In the central area, 30% of personal mobility is done by private vehicle, while in the outskirts the figure surpasses 55%.



As in most European regions, transport is responsible for more than 22% of carbon dioxide (**CO₂**) emissions in the BMR, which, in 2006, equated to 6.9 million, a figure that indicates a slight improvement with regard to 2004.

CO ₂ Emissions	2004	2006	Variation
Passengers transport	3.201.054	3.060.183	-4,40%
Goods transport	3.876.737	3.885.653	0,23%
TOTAL	7.077.791	6.945.837	-1,86%

3. Outline of the local Mobility Plan

The Metropolitan Transport Authority of Barcelona (**ATM**), as responsible for the mobility planning of the BMR, developed the master mobility plan (MMP)⁴, based on an integrated approach taking into account all means of transport, passengers and goods and fostering non-motorised forms of journeys and aims at guaranteeing a high level of accessibility while reducing the environmental impacts of transport.

The various aspects of mobility, the many agents affected, conflicting interests advice to establish a global policy on mobility and to do so through a dialogue between all those concerned. ATM fostered a participation process so a mobility council was set up for professional groups and social entities interested in the problems of mobility in the aim of achieving a master mobility plan agreement.

During two years studies of the current mobility and their trends were carried out for more than 50 people, all of them specialist in different mobility matters and it was estimated that mobility in public transport could grow by 12% over the 8 years of the projection but this figure would not be sufficient to gain a share in private sector, which could grow also by 12%. Regarding consumption of fossil fuels would continue to rise, 17 % over the 8 years, despite the efficiency of engines. However, emissions of pollutants given off by transport will be reduced over the coming years to around 30% thanks to improved vehicle engines except in the denser zones. Regarding GHG, the trend scenario does not manage to reduce CO₂ emissions as the Catalan mobility national directives state. Instead, they have grown by 16.8%.

CO2 emissions (Tn)	2004	Trend escenario 2012	Variation	Target
Total CO2 emissions	7.077.791	8.266.936	16,80%	-20%

According to the ATM proposal and with the mobility council agreement, the following targets must be attained:

- Evolution of modal split so that sustainable transport means support 2/3 of the total mobility in the region,
- increase of total share of public transport by 5 % points by changing trips from private cars to public transport,
- Decrease of energy consumption per inhabitant linked to transport activities by more than 7.5 %,
- Decrease of CO₂ emissions by 20.5% and of pollutant particles (PM10) by 48%,
- Decrease of casualties which should be 25% below the 2005 level.

4. Core actions to reduce GHG

The MMP established 93 measures in 9 Axis. All of them work together in a synergic way to attain the MMP targets, but some of them are core actions to reduce CO₂ emissions. Stakeholders from the different mobility sectors agreed that some measures should be emphasized for their contribution to reduce short-term carbon emissions by 2012 in accordance with the Catalan Government directives.

Main measures:

- 50 municipalities and 64 mobility-generating centres have to draw up a local mobility plan, and a new mobility assessment regulation for new logistic spaces must be established, all of it with the aim of coordinating urban development with mobility **and** stopping the rise in the average distance of journeys in the BMR.

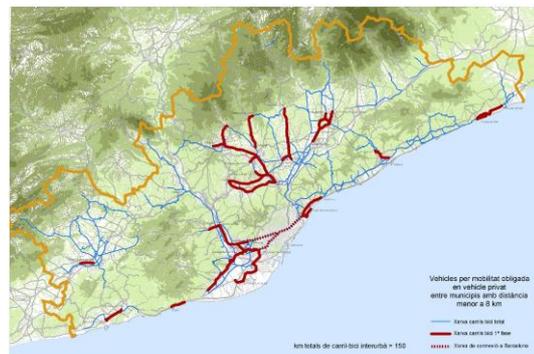
- New 250 Km of rail network with 78 new stations and 150 Km of interurban cycle lanes must be built with the aim of fostering a safe and well-connected network of mobility infrastructures for all means of transport.

- Speed and toll management in the main road network to modify the excessive use of private vehicles in interurban journeys and to minimize the emissions given off by vehicles.

- New 12.000 Park & Ride spaces and 50 community bicycle services in the railway stations to favour modal transfer.

- A new local train scheme and incorporation of 100 new metros to provide an improved railway service and guarantee the integration of networks

- 320 new interurban buses and 80 new lines (express, connexions and ring lines) to provide surface public transport in all the metropolitan routes.



- 7 new bus lanes at access points to medium size cities and 3 new bus lanes to Barcelona City and 100% of the fleet with incorporated communication system to guarantee quality surface public transport that competes with private vehicles in terms of journey time.



- 8 new heavy car parks and a new good transport management to foster an efficient logistics system and minimise its environment impact.

- To achieve 1.735 hybrid and gas natural buses and a quicker renovation of the private fleet to reduce energy consumption from fossil fuels, of greenhouse effect gas emissions and air pollutants produced by the transport system.



- Increase new fuels consumption from a consumption of 2.8 ktep in 2004 to 500 ktep in 2012.

- Over 14.000 efficient driving courses and 185.000 people participating in private vehicle and lorry efficiency measures to incorporated people in achieving the targets of the MMP

5. Methodology to assess GHG emissions

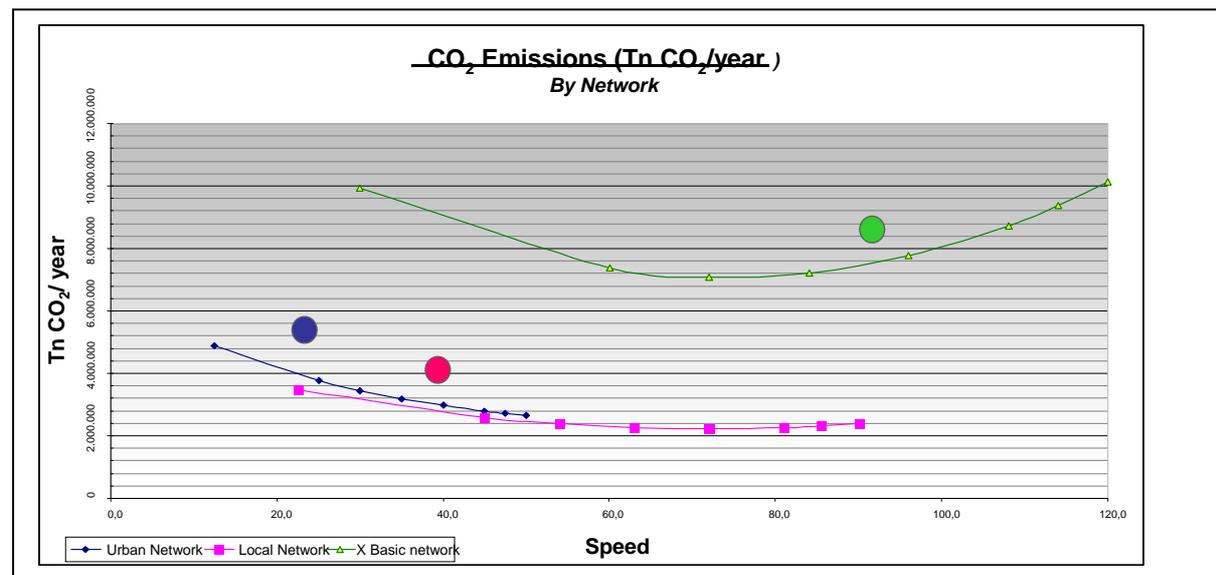
Nowadays we know that there is a strong relationship between fossil energy consumption and CO₂ emissions in the transport sector. Thus it is possible to assess with an acceptable accuracy the transport CO₂ emissions in a large territory such as Europe or Spain by applying chemical and mathematic principles to fossil fuel consumption. Nevertheless, in a smaller area like the BMR it is harder to establish CO₂ emissions due to the lack of consumption data and the influence of external mobility in the zones known as border effect.

For a region or a city the MMP proposes the process of calculating emissions and energy consumption in a bottom up methodology that is based on a methodology developed by the Catalan Government named EMIMOB which evaluates transport emissions and is executed as proposed in CORINAIR for all of Europe. EMIMOB was created in accordance with the COPERT program methodology that establishes that ground mobility emissions depend on vehicle fleets and distances traveled but adding some specific characteristics to represent better the behavior of the mobility system.

The CO₂ emissions for each vehicle type are calculated with fleet and mobility data and applying the corresponding emission factor, which then depends on the energy consumption factor (previously calculated by each vehicle type and by mobility in each network), and as such, depends on speed.

Because speed is very different according to road categories, the total emissions calculation has been divided in three types of network: urban, local and basic and furthermore basic network has been divided by service levels or speed levels. The railway network has been added to these three emissions.

$$E_{\text{totals}} = E_{\text{urban}} + E_{\text{local}} + E_{\text{basic}} + E_{\text{rail}}$$



Emissions for each vehicle type by urban, local and basic network are obtained with the following equation:

$$E_j = \sum F_{eijm} * N_i * D_{ij} \quad j = \text{urban, local and basic} \quad i = \text{vehicle type}$$

where:

F_e = emissions factor, which is a function of speed for each vehicle type and fuel (m), which, in the case of CO₂, depends on the fuel consumption factor.

N = number of vehicles

D = average travel distance of each vehicle (km)

To calculate the trend scenario emissions, fleet and mobility must be predicted using the trends observed in the last years, but also forecasting which could be the main changes regarding fleet and mobility patterns. This will allow us to know which means of transport will be responsible for the emissions (fleet) and how much will be given off to each mean (mobility).

Then we can apply the core actions to reduce GHG emissions over the trend scenario and estimate the value of the proposed targets for the MMP scenario.

6. Main results

By performing an environmental assessment of GHG emissions in the different scenarios, the results can be considered, with or without execution of planned actions. The improvement of the proposed scenario can easily be proven and demonstrated.

Modal transfer

- Mobility grows, yet does it in a more sustainable way and decreases sprawl throughout the territory. Therefore, with regard to the trend scenario, we notice a remarkable decrease in vehicles*kilometer traveled (20%) and a less accentuated reduction in tons*kilometer (5%).

- Public transport trips increases by 27.7% in the eight years of the projection and gains a significant share of private transport, more than 4%.

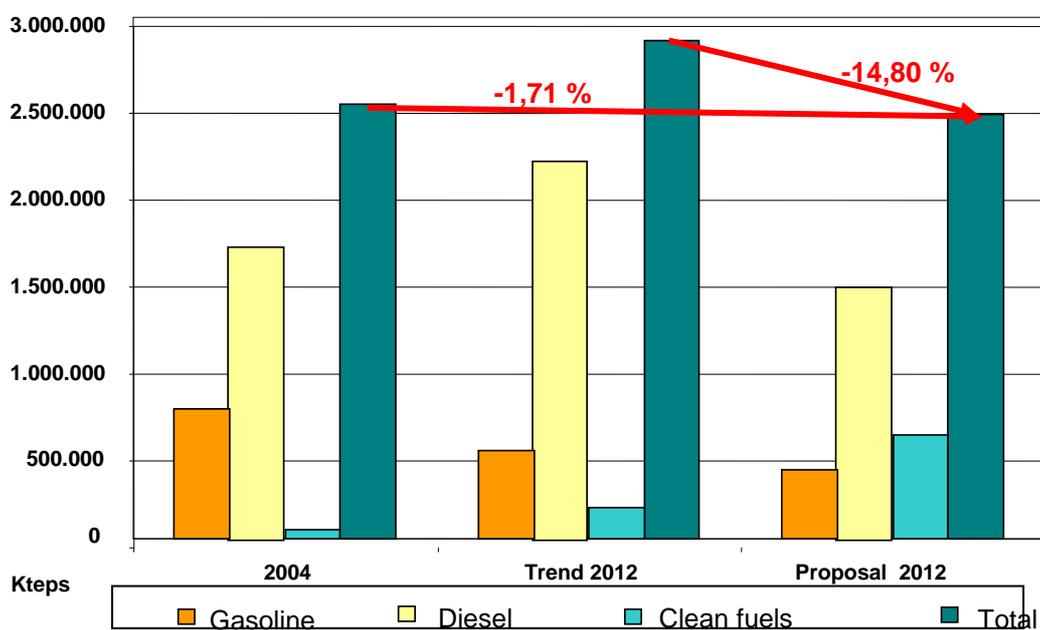
- Total trips on foot and by bicycle are also growing more than they do in the trend scenario, although not significantly, with a 5.3% increase with regard to 2004, even if they are the most efficient means to achieve the Plan's goals.

Mean	2004 Passenger trips	Trend 2012 Passenger trips	PDM 2012 Passenger Trips	2004 Share	Trend scenario Share	Proposal Share
Public transport	985.624.268	1.092.863.387	1.246.471.387	29,55%	30,08%	34,31%
Privat transport	1.299.075.960	1.456.840.000	1.280.032.000	38,95%	40,10%	35,24%
Walking & Bicycle	1.050.222.600	1.083.040.000	1.106.240.000	31,49%	29,81%	30,45%
Total Mobility	3.334.922.828	3.632.743.387	3.632.743.387	100,00%	100,00%	100,00%

Fuel consumption

- Total fuel consumption in tons equivalent to petroleum per year decreases a small 1.7% with regard to 2004 but nearly 15% with regard to 2012 trend scenario.

For cars, consumption is drastically reduced thanks to a combination of revamp more efficient vehicles, with diesel engines and new fuels to substitute gasoline, and a decrease in mobility in line with the measures put in place by the Plan

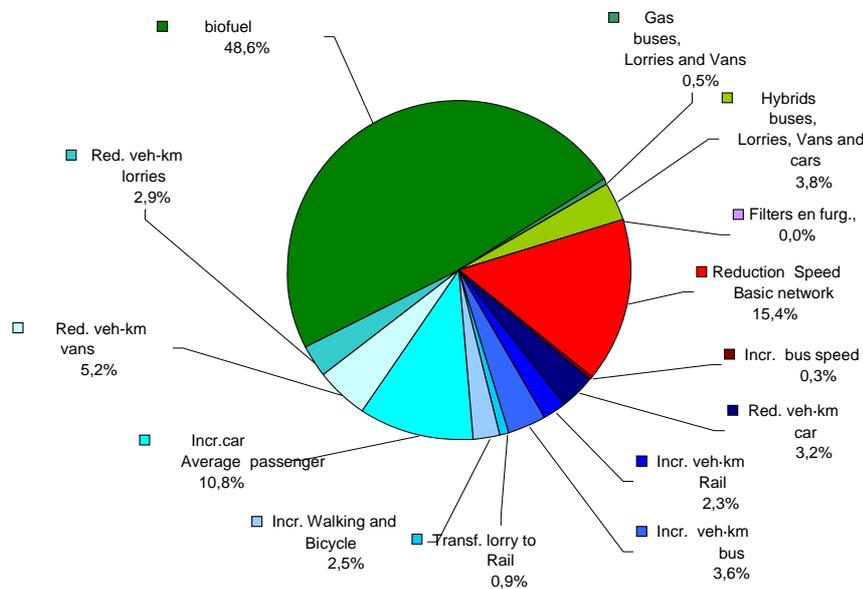


CO₂ emissions

- The table below shows how the proposed measures allow achieving the MMP goal and how emissions are reduced to 5.8 million tons of CO₂, well below the 7.3 million tons in 2004.

CO ₂	2004	2012	2012 Prop.	Variation Prop. / 2004	Variation prop. / tend
Total	7,3	8,3	5,8	-20,5%	-29,6%

With regard to GHG, it was necessary to analyze the percentage of the main measures. The 19 measures evaluated from the MMP scenario contribute to CO₂ emissions savings with the following percentages:



According to the analysis results, the measures for greater CO₂ emissions savings include an increase in the use of biodiesel (49% of the total reduction of the 19 measures), a decrease in speed on the basic network (15%) and an increase of average passengers in cars (11%). Therefore, the main measures that contribute to reducing emissions fall on biofuel and there is a lot of uncertainty whether the amount of 2nd generation biofuels will be enough by 2012.

On another level of emissions reduction we find the measures for transferring to more environmental-efficient modes and the net decrease in vehicle*Km, headed by the net reduction in vehicle*Km for light goods transport (11%), the increase in bus service (4%) and the decrease in private car vehicles*Km (3%).

Interpreting each strategy, it is perceived that the strategies for reducing vehicles*Km will have a greater effect than fuel strategies, except in the case of biodiesel. The reason for this is that fuel strategies are applied to limited fleets (public fleets) or rather have a still non-wider penetration (for example, natural gas or a hybrid system).

Within the reduction strategies in vehicles*Km, the measure expected to make the most impact is the increase in the number of passengers in cars, a measure that does not imply a transfer to motorized modes, and therefore, no indirect increase in emissions from other modes. This is a net decrease through an effort to organize private mobility.

7. Conclusions and recommendations

- The current patterns regarding mobility do not stop the growth of GHG emissions in the BMR. Planning actions, as well as doing it with a broad vision, is necessary to change this behaviour.

- The MMP of the BMR contemplates specific, budgeted measures with sectorial follow-up values that have been drawn up taking into account the conclusions of the trend scenario and with which the established aims can be achieved

- With the Plan's measures we can achieve reduced fuel consumption and CO₂ emissions, surpassing even the National Guidelines on Mobility values. This is achieved through a combination of 19 measures affecting all action items of the Plan.

- There are still some uncertainties about the real contribution of some of the measures put forward by the MMP. Therefore, it is necessary to establish a monitoring process during the MMP execution.

- As reducing GHG needs local and metropolitan participation it is necessary to extend the MMP goals to all regional and functional areas where it is required. Therefore, the MMP must include the commitments the other plans need to contain.

- The MMP was carried out with the participation of many institutions that work in close collaboration to reduce GHG. The process must strengthen the ability of all the stakeholders to bring about a change regarding the GHG threads.

- EMTA cities are committed to achieving a new mobility paradigm that is expressed in all the mobility planning fostered in their regions. Thus EMTA is a relevant institution with regard to combating climate change in the EU.

Links

1 The Framework Plan for Climate Change Mitigation 2008-2012 for compliance with the Kyoto Protocol approved:

http://mediambient.gencat.net/eng//el_medi/C_climatic/nov/aprovat_pla_marc_mitigacio_cc.jsp?ComponentID=158882&SourcePageID=112595#1

2 Action plan on urban mobility:

http://ec.europa.eu/transport/urban/urban_mobility/action_plan_en.htm

3 EMTA Brief n°2 : Mobility Plans: the way forward for a sustainable urban mobility

http://www.emta.com/IMG/pdf/EMTAbrief_2_basse_def_.pdf

4 Barcelona Mobility master plan:

http://www.atm.cat/cast/apartado3/ap3_01.htm