Proposal for a Sino French cooperative project on CO2 evaluation of a THNS investment

JANIN, Jean-François, BOUHOT Claire
MEEDDAT, RATP
jean-francois.janin@developpement-durable.gouv.fr , *claire.bouhot@ratp.fr*

Abstract

Sustainable urban development is highly dependent on improvement of transport system. Evaluation of the effects of changes in the organization of transport modes on emissions and pollution need appropriate tools tested on real case studies. This papers makes a review of existing methodologies and proposes a cooperative research program to be the framework of theoretical and practical actions focused on the provision of simple tools helping the different stake holders of transport and land planning to take consistent decisions.

1. Introduction

Sustainable urban development is the theme of the Sino-French intergovermental agreement signed on November 27 between French Ministry of Ecology, Energy, Sustainable Development and Spatial Planning and Chinese Ministry of Construction (now Ministry of Housing and Urban and Rural Development) Sustainability implies minimization of energy consumption and CO2 emissions. In spite of the increasing awareness on protection of climate, very few works has been done to provide simple tools to decision makers to evaluate the consequences of investments in urban transport systems. This papers gives a review of the available documentation on existing methodologies and proposes a field operational test them in a real context.

2. Needs of evaluation tools

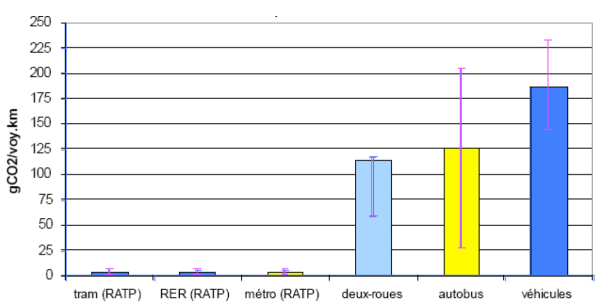
The importance of transport in the CO2 emissions is generally recognized, but one must also say that this sector could be the first responsible of the increase of emissions in the next years. [1] Among the measures recommended by Yvo de Boer, Executive Secretary of Framework UN Convention on Climate Change, are initiatives to facilitate the formulation of a political agreement on data to be collected, indicators to be produced to evaluate, communicate and verify the impact of actions taken to reduce impacts of transport on the climate. What is at stake is the ability of all the participants to the transport system to take individually and collectively consistent decisions to lessen climate change. This issue is particularly hard to figure out for urban areas, where there is a large number of interactions between all the different systems : transport, urban planning, housing, etc. and between transport systems themselves. But this challenge is extremely important to take up, because more and more people are living in cities (in fact more than half of the world population from 2008 onwards [2]) and because urban transport already represents a significant part of transport. In France, urban mobility represents 40 % of the flows and 53% of GHG emissions liked to the whole transport of passengers. The common intuition on these questions, especially on the effect of congestion on GHG emissions, is not a satisfactory guide to make decisions.
The results obtained from previous research projects and tools settled to help stakeholders to make decisions need to be confirmed by experiments on real case studies. (There is a need to disseminate the results of previous research projects and to validate by experiments on real case studies the effectiveness of existing recommendations and tools.)

3. Available results

In the ARTEMIS project (Assessment and Reliability of Transport Emission Models and Inventory Systems [3]), closed in 2005, tests of light and heavy vehicles were made to create a data base on emissions in relation with driving conditions. With the model issued in the project, one can forecast emissions of vehicles taking account of their EURO class (from 1 to 4), the slope of the road, the weight of the vehicle and type of fuel used. Recommendations were made on data collection about fleets and traffic conditions. It is possible to develop simulation tools based on these results at various level (macroscopic to microscopic).

Considering that the transport sector represented in 2005 more than 25% of emissions in France, the French Agency for Environment and Energy Control (ADEME) asked Deloitte company to evaluate the energy efficiency and GHG emissions of transport modes, with a well-to-wheel approach : from energy production to energy combustion. This study [4] is based on data collected within different transport companies for the tank-to-wheel approach and within electricity and oil producers for the well-to-tank part. The results are given for year 2005. The goal is to compare the efficiency of different transport modes, taking into account the whole chain of energy involved in mobility of persons and goods. Simulations have been made to examine the impact of electricity production**.** The French situation, with a large part of electricity produced by nuclear and hydraulic energy, results in emission of 48 gCO2/ kwh, to be compared to an European average of 344 gCO2/ kwh.

Average emissions by mode (France 2005)



The results (in Gram of Carbon Dioxyde per passenger-km) are given in the above graph for tramways, suburban trains and subways for RATP company in Paris area and for 2 wheelers, buses and light vehicles in urban area. The efficiency depends on the number of passengers in the vehicle. It appears that the efficiency of a bus can compete with light vehicles in average circumstances, but in some periods of the day (off-peak hours for instance), a bus can be less efficient than a private car driving 5 persons.

Modeling traffic is of great importance for such issue. Microscopic models can help to identify and evaluate situation on a small scale: for instance, evaluation of crossroad impacts on congestion for the immediate surrounding roads. Macroscopic models can be used for calculation of emissions of a whole urban area under average conditions of traffic demand and infrastructure availability. The key factor for accurate modeling is the quality of the data used to run the model. The costs of the collection and processing of the data can be easily justified if they are shared by several operators on the city's network. Modeling is in fact at the same time the necessary condition and the visible result of an effective cooperation between stakeholders to manage mobility in a city. An example of such cooperation can be seen in Toulouse, where all the bodies in charge of systems of transport (infrastructure managers, public transport, taxis ...) have decided to put their control centers in the same building (called CAMPUS TRAFFIC) and to share a common electronic platform (CLAIRE SITI) to have at any time global and relevant views on the situation about different aspects of mobility.

Evaluation is also necessarily linked to several factors limiting at a certain moment the possible choices of individuals and organizations. The morphology of the city is the most important one. Density, diversity and design are the main indicators of the internal organization of buildings, spaces and activities at various levels. Comparative analysis of Asian and European cities concerning energy and bioclimatic efficiency of urban morphologies have been launched by French scientific center for building science CSTB in cooperation with Tongji University. The distance between housing places and various activities, the dissemination of services in the urban areas are in relation with the development of mobility. The urban growth is linked with the increase of speed in urban transport, which increases the number of activities accessible for inhabitants in the constant time devoted to daily travel.

Motorization effects on China's urbanization over the last decades have been described by several authors. Allaire [5] also mentioned the space consumption due to cars development. Generally speaking, the level of emissions for a district or a city depends on its morphology, the regulations applied about the use of public spaces and the investments made in transport infrastructures and services. Comparisons between two projects localized in different cities, particularly if they are in different regions of the world need to take into account of these existing situations as well as of other factors like the image of different transport modes, taxes and funding systems, organization of working time ... which can also play a role in mobility choices.

Comparision of emissions between different districts in the same city can be more significant, as will also be the analysis of the evolution of the whole city, with the final objective of reducing the global environmental footprint of the whole transport system.

4. Principles of a cooperative research program

The existing methods and tools to evaluate private cars and public transport emissions are not commonly applied simultaneously on a specific territory to evaluate the global performance of different scenarios of mobility.

The objective of the program is to demonstrate the feasibility and reliability of such approach, in order to provide an help to decision makers in the following situations:

- Case 1: considering a project aiming to improve the quality of service in a district, evaluation of the consequences in terms of emissions of the city, assuming that the rest of the transport system will not be substantially modified.
- Case 2: considering a project of development (housing, industry, service...) in a district, whose transport organization will have the best results in terms of emissions to satisfy the new needs of mobility generated by the project.

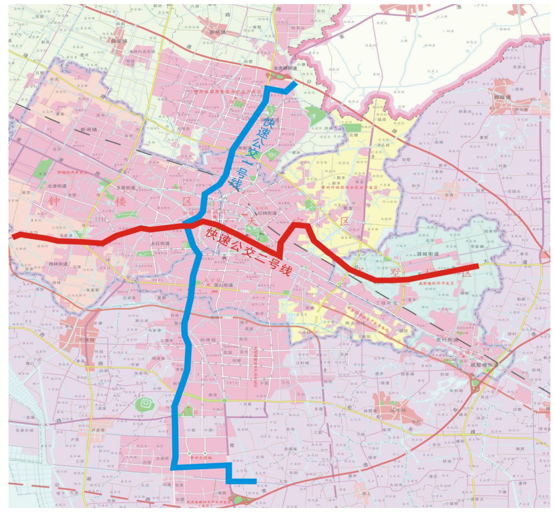
The main objective of this research program is to propose robust methods and tools to make decisions considering the environmental impacts in the issue of transport and urban planning. Absolute values of emissions should also be compared to other cases and projects. As well as cost, environmental performance of a transport system should be a taken into account in the choice of the transport system.

The program could consist on work packages selected and managed by a steering Committee. Some work packages could try to solve theoretical problems but the main efforts will be focused on case studies.

5. Case study : BRT of CHANGZHOU

Changzhou City, located in the south of Jiangsu Province, close to Shanghai, Nanjing, Suzhou, Wuxi and other cities, is an important center city of the Yangtze River Delta. Changzhou municipal government has always attached a great importance to the development of public transport, and won the title of "model city in the national priority of development of urban public transport ".

Changzhou is the third city to operate a BRT after Beijing and Hangzhou.



BRT Line 1 is in operation since New Year's Day of 2008, with a main line and three lateral lines since May 8th 2008. The main line runs from north to south on 24.5 km, with an average operating speed of 23 km /h. The four lines are used by more than 15,000 people every day, which represents 14% of the bus passengers of the city.

BRT Line 2 is now under construction, from East to West on a length of 21.2 km. It will be opened in May 2009. Synergy between the 2 lines could result in a total traffic for the whole BRT network as high as 50 000 passengers per day. BRT line will be staffed with about 60 18 meters-articulated buses, as well as dozens of 12 meters stand-alone buses. These vehicles in operation will reach on average the Euro 3 emission standards.

The completion of BRT line 2 will have positive effects on energy and environment. The objective of the case study will be to quantify these effects as far as possible with the best available methods. Three kind of effects can be described:

5.1. Energy saving

The number of conventional buses will be reduced and the large capacity of 18 meters articulated buses will also reduce the number of vehicles running for an even higher number of passengers. Reductions of delays, idle operations and dwell time at stops will improve the energy and carbon efficiency of the BRT company. These effects could be evaluated analysing the operation data from this company.

5.2. Change the traffic pattern along the lines

One can anticipate less congestion, because BRT operates on dedicated lanes, and because there should be less car traffic and traffic jams along the line due to a modal shift from travellers attracted by modernity, quality of service, stability, lower price than car transport, and velocity of the BRT.

These effects can be measured through processing of traffic data and household travel surveys in the concerned area.

5.3. More intensive pattern of land use along the BRT lines

The BRT will stimulate high-density mixed development, effective control of the cities spreading, reduction of the average trip distance, thus reduction of transport energy consumption. These effects can be evaluated by household travel surveys and survey of the main changes in activities along the BRT lines and (large scale) modelling of the traffic in the city.

5.4. Reduction of pollution

Emissions of local pollution and GHG will decreased due to reduction of the number of vehicles with a higher standard of emissions. Evaluation of this effect can be based on analysis of operation data from the BRT company, traffic modeling and also through direct measures of the local pollution on the field.

6. Conclusions

Improvements of the decision process in transport organization and land planning is certainly needed to reduce the consumptions of energy and emissions due to urban mobility. The tools to evaluate these elements for a simple project, for a new district or for a whole urban area are not yet completely available, but there are already a lot of preliminary results available for realistic evaluation.

A methodology can not become a guide for real decisions if it is not supported by a permanent action of interested parties (in this area, public authorities in charge of sustainable urban development) to maintain a long term cooperation on best practices sharing, research on appropriate level so as to include new factors,, standardization and verification of the validity of the results. The cooperative program will have to prepare the organization of the maintenance of the methods and tools provided.

7. References

[1] Yvo de BOER, UN Framework Convention on Climate Changes, http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/20080529_press_release_leipzig_french.pdf.

[2] *State of the World's Cities report 2008-2009*, UN-HABITAT, www.unhabitat.org

[3] ARTEMIS project synthesis web page http://www.inrets.fr/js/ur/lte/publi-autresactions/fichesresultats/ficheartemis/artemis.html.

[4] Eric VIDALENC, *Efficacités énergétique et Environnementale des modes de transport,* ADEME, Deloitte, January 2008

[5] Julien ALLAIRE, *Forme urbaine et mobilité soutenable, Enjeux pour les villes chinoises*, Thèse UPMF Grenoble, Octobre 2007 http://upmf-grenoble.fr/iepe/textes/JA_These.pdf