Sustainable mobility in a greater metropolitan area: the experience of CTP in Naples

CTP, one of the oldest public transportation companies in Italy, operates primarily in the suburban transport sector, in an area measuring more than 1000 Km², between the provinces of Naples and Caserta.

In recent years, CTP has followed sustainable development principles with increasing conviction. One of its main objectives is to see emissions and consumption fall by at least 10% over a three-year period, while maintaining the same level of service. This reduction is made possible by the use of alternative fuels, especially natural gas, along with fleet management techniques and the development of clean energy production systems. CTP has built three photovoltaic plants, plus an equal number of thermal solar plants, and has used a portion of the energy produced to power a recharging station for four hybrid methane-electric buses.

The main plant has an installed power of 87 kWp, while the two smaller plants have an installed power of 20 kWp each. All three plants are connected to the national distribution network (ENEL) for on-site exchanges, though the power produced is entirely consumed by CTP users. The total electrical energy produced by the three plants was 139,000 kWh in 2006 and 132,000 kWh in 2007, and energy savings for all three over a 30-year lifespan will be approximately 5,300,000 kWh. In terms of protecting the environment, the plants will prevent approximately 3,620 tons of CO₂ emissions over the same time period.

The cost of the photovoltaic energy produced, though higher than the cost of the energy procured from the public system, is reduced through Green Certificates (which demonstrate the production of renewable energy and can be resold on the energy market). In two years of activity, 2006 and 2007, CTP has already obtained four Green Certificates, with an overall value of EUR 17,000.

In addition to the photovoltaic plants, through NaMet, a subsidiary company established for the purpose, CTP has built and is operating a fleet of 125 buses fuelled by natural gas (Diagrams 1 and 2).

The use of vehicles fuelled by natural gas, as opposed to traditional diesel vehicles, is noteworthy. Natural gas (at least in its “Italian” version) always falls within the EEV (Environmentally Enhanced Vehicle) limits, a voluntary benchmark level even more restrictive than the levels commonly referred to as EURO V (Table 1).

Vehicle manufacturers have recently made available EEV vehicles with diesel-fuelled engines as well. The extremely low level is reached through simultaneous use of particle filters (CRT) and urea catalysts (SCR) for the reduction of nitrogen oxides. Hence the question posed with increasing frequency: does this mean that gas vehicles – and especially those fuelled with natural gas (methane) – no longer present any advantages? Certainly not!

For example:
- Today’s diesel engines fall within nitrogen oxide emission limits (1.99, as opposed to the limit of 2.0 g/kWh). Methane emits a third or a quarter of this amount (0.5-0.6);
- Volatile polycyclic aromatics and organic compounds: these are virtually non-existent in methane, which still does not present the characteristic odour of diesel;
- CO₂ emissions for natural gas are lower and present potential for further reduction;
- The noise level of a methane-fuelled vehicle is at least 3-4 dB lower than for a diesel vehicle (the acoustic impact is more than halved);
- Methane is “piped”, which eliminates the need for transportation via tanker trucks, along with the resulting environmental and noise pollution, plus traffic congestion.

The key to the advantage presented by methane is the lower emissions “at source”, which minimise the need for reduction systems. Last but by no means least are the noteworthy cost savings offered by natural gas as a result of Italy’s fuel tax policy (Diagram 3).
The emission-reduction systems used with methane engines (three-way catalyst) have been proven performers for some time now. In contrast, particulate filters and urea catalysts— the latter a product originating from methane—constitute technologies that have not yet been fully “validated” for large-scale use, nor have they proven themselves in terms of “endurance”.

The ongoing development of the CTP fleet is illustrated in diagram 2, while the improvement obtained after 10 million km by using natural gas is shown in diagram 3.

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Table 1: Limit values from tests etc (Directives 2005/55/EC, 2005/78/EC and 2006/51/EC)

<table>
<thead>
<tr>
<th></th>
<th>(CO) g/kWh</th>
<th>(NMCH) g/kWh</th>
<th>(CH4) g/kWh</th>
<th>(NOX) g/kWh</th>
<th>(PT) g/kWh</th>
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<tr>
<td>A (2000)</td>
<td>5.45</td>
<td>0.78</td>
<td>1.6</td>
<td>5.0</td>
<td>0.16</td>
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<td>B1 (2005)</td>
<td>4.0</td>
<td>0.55</td>
<td>1.1</td>
<td>5.0</td>
<td>0.35</td>
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<tr>
<td>B2 (2008)</td>
<td>4.0</td>
<td>0.55</td>
<td>1.1</td>
<td>2.0</td>
<td>0.03</td>
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<tr>
<td>C (EEV)</td>
<td>3.0</td>
<td>0.40</td>
<td>0.65</td>
<td>2.0</td>
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Sustainable development
Latin America: Public transport and sustainable development

Eleonora Pazos, Head of Latin America Division Office, UITP

Latin America is a region of great contrasts, in both social and economic terms. While some regions of the continent have already achieved a degree of social organisation and economic development comparable to certain parts of Europe, most Latin Americans still live in precarious conditions. This disparity in the level of development has an influence on how society, companies, authorities and operators view environmental issues. Countries with the highest level of industrialisation, human development and awareness, such as Mexico, Brazil, Chile, Argentina and Uruguay, have better-developed environmental legislation.

It was only in the mid-1980s that environmental issues began to be discussed in greater depth in most Latin American countries. At the time, we were witnessing an increase in environmental problems caused by the concentration of people in large cities, such as the issue of access to water and transport. On the other hand, there was also a greater focus on the consequences of environmental damage caused by various economic activities such as agriculture (monoculture devoted to exports) and industrial activity. Urban transport accounts for a significant portion of global emissions of air-polluting agents. Latin America is responsible for less than 15% of global emissions and the transport sector accounts for 70% of carbon monoxide emissions in the majority of cities in the region.

For example, in São Paulo, Brazil, the vehicle fleet produces 37% of all pollution, according to the local authority. Others local studies in São Paulo have shown that cars are responsible for more than 90% of carbon monoxide and hydrocarbon emissions and more than 60% of nitrogen oxide emissions. Buses are the biggest emitter of sulphur oxide and particulate matter. The principal conclusion of the study is that cars are the main source of air pollution. If we also consider the efficiency of each mode, we can see that, per passenger, cars pollute 28 times more than public transport.

Several experiments are underway with a view to reducing sulphur oxide emissions from diesel vehicles. Sulphur oxide is the main element polluter emitted by buses. In Porto Alegre, a special fuel policy has been adopted. The “Metropolitan Diesel” contains 75% less sulphur and results so far have been excellent. It is estimated that the use of this fuel in the urban bus fleet has caused emissions of sulphur dioxide to fall by approximately 70%. Of course, this experiment could also be extended to many other cities in the region.

In Curitiba, two buses using ethanol are currently being tested. The main problems caused by using ethanol are the high level of fuel consumption and the need for special additives to be used to ensure the smooth running of the engine. Obviously, these problems result in a greater distance cost for this technology, which constitutes a major barrier to investment and to gaining operator backing.

Another major experiment in the urban public transport sector is the use of (natural gas vehicles) NGVs in bus fleets. The main difficulties facing business operators are: high maintenance costs; low levels of vehicle autonomy; long refuelling times and the lack of a resale market for used buses. The Brazilian fuel company Petrobras has developed a project called “Buses on Gas”, to encourage the use of NGVs in the urban public transport sector. The project involves a partnership with two local associations, Rio Bus and Fetranspor. For the pilot project, Petrobras provided one bus, a Mercedes-Benz OH-1623 LG, with a Comil Svelto body, air conditioning, electronic management and air suspension. A NGV refuelling station was provided in the garage of a local operator, with a compressor and high-flow dispenser, meaning that the refuelling time could be equivalent to that needed to refuel with diesel (5 minutes). After one year, a comparison was made with the other buses in the fleet:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>NGV</th>
<th>Diesel</th>
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</thead>
<tbody>
<tr>
<td>Model</td>
<td>OH-1623 LG</td>
<td>OH-1621 LE</td>
</tr>
<tr>
<td>Engine</td>
<td>M-366 LAG</td>
<td>OM-366 LA</td>
</tr>
<tr>
<td>Autonomy</td>
<td>370 km</td>
<td>520 km</td>
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<tr>
<td>Volume of tank</td>
<td>240 m³</td>
<td>210 litres</td>
</tr>
<tr>
<td>Passenger cap-</td>
<td>85 to 115</td>
<td>85 to 115</td>
</tr>
<tr>
<td>Standard</td>
<td>Euro-II</td>
<td>Euro-II</td>
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</table>

A hydrogen bus pilot project is another local initiative redesigning transport systems to maximise energy conservation and energy conversion efficiency in order to reduce harmful emissions.

The Brazilian Government, through the Ministry of Mines and Energy and EMTU/SP, and with the support of the United Nations and the GEF (Global Environmental Facility), decided to support a programme to encourage the development and use of hydrogen fuel cell buses. As part of this programme, an operational test involving five hydrogen fuel cell buses will be carried out using a hydrogen production and supply station. In this way, minimum technical requirements can be established and assessed to ensure the durability of the vehicle and to make them economically competitive.

The project is divided into four steps:

- **Step I**: feasibility study and proposal for development of Step II. Completed in December 2000.
- **Step II**: the project itself, involving construction of the hydrogen production and supply station in the EMTU/SP garage and the test operation of a fleet of five buses, for four years, over 1,000,000 km.
- **Step III**: operation of a fleet of 100 to 200 buses.
- **Step IV**: further roll-out in the metropolitan region of São Paulo and other Brazilian metropolitan areas and large-scale commercial bus production. For this phase, it is expected that fuel cell buses will be able to compete with diesel buses in economic terms, based on the life cycle.

At the moment, EMTU/SP is working on step II.

The two fuel experiments presented above could well become Clean Development Mechanism (CDM) projects. In Latin America,
BRT systems and Metro/light rail systems also offer potential for involvement in the CDM. Several projects are in the process of preparing for incorporation in the CDM. The most advanced are TransMilenio in Bogotá and Insurgentes BRT in Mexico D.F.

In terms of financial contributions, a BRT emissions project can be carried out via the sale of emission reduction certificates for between USD300,000 to USD4 million per year for 10 years or more. For metro or light rail projects, the emission reduction can be higher depending on the size of the project.

Latin Americans see their life expectancy reduced by up to 11 years due to causes related to environmental problems, according to a study by UNEP. For now, despite the efforts and promises of governments, the environmental map of the region is hardly encouraging, as Latin America remains a world leader in terms of the unequal distribution of wealth. However, it is important to stress that Latin America now has new legal and institutional resources in place to address these issues, and that society as a whole is becoming more involved.

For new technologies such as NGV and ethanol to become viable in Latin America, we need some financial incentives to offset the increased costs. This could include:

- long-term financing with lower interest rates to compensate for the high cost of the buses;
- depreciation of vehicles using a lower residual value to compensate for the lack of a resale market;
- larger technical reserves to offset the excess time spent on maintenance and supply;
- adjustment of rates of consumption and costs when considering fare pricing.

The transport sector is once again called upon to meet these challenges. Although this may initially lead to an increase in costs for users, in the longer term these measures will help to foster sustainable development and create a better quality of life for the population.

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<table>
<thead>
<tr>
<th>Project</th>
<th>City</th>
<th>CO₂ reduction per year</th>
<th>Project status</th>
<th>Methodology</th>
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<tr>
<td>BRT, Transmilenio phases II to IV</td>
<td>Bogotá, Colombia</td>
<td>340,000</td>
<td>Operational</td>
<td>NM0105</td>
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<tr>
<td>BRT, Insurgentes</td>
<td>México D.F., México</td>
<td>30,000</td>
<td>Operational</td>
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<td>BRT, Cartagena</td>
<td>Cartagena, Colombia</td>
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<td>BRT, Megabus</td>
<td>Pereira, Colombia</td>
<td>30,000</td>
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<td>Under construction</td>
<td>To be approved</td>
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<tr>
<td>LRT</td>
<td>Lima, Perú</td>
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<tr>
<td>BRT, Transantiago</td>
<td>Santiago, Chile</td>
<td>370,000</td>
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La mobilità sostenibile in una metropoli: l’esperienza della CTP a Napoli

Marcello Turrini - Direttore Generale CTP
Velio Bellini - Amministratore Delegato NaMet

CTP, una delle compagnie di trasporto pubblico più antiche d’Italia, opera prevalentemente nel settore del trasporto suburbano, in una area di oltre 1000 Kmq tra le province di Napoli e Caserta.

Negli ultimi anni CTP ha aderito con sempre maggiore decisione ai principi dello sviluppo sostenibile e ha posto tra i suoi obiettivi principali la riduzione delle emissioni e dei consumi di almeno il 10% in tre anni a parità di servizio prestato, sia attraverso l’utilizzo di combustibili alternativi, in particolare di gas naturale, per la gestione della flotta, che attraverso lo sviluppo di sistemi per la produzione di energia pulita. Infatti CTP ha realizzato tre impianti fotovoltaici ed altrettanti impianti solari termici utilizzando parte dell’energia prodotta per alimentare una stazione di ricarica per 4 autobus ibridi metano-elettrici.

L’impianto principale ha una potenza installata di 87 kWp; i due impianti minori invece, hanno una potenza installata di 20 kWp ciascuno. Tutti e tre gli impianti sono collegati alla rete di distribuzione ENEL per lo scambio sul posto, ma la produzione viene interamente consumata dalle utenze CTP.

La produzione di energia elettrica ottenuta dai tre impianti è stata di 139.000 kWh per il 2006 e 132.000 kWh per il 2007, il risparmio energetico derivante dai tre impianti nei 30 anni vita, sarà di circa 5.300.000 kWh; dal punto di vista ambientale essi eviteranno complessivamente l’immissione in atmosfera di circa 3.620 tonnellate di CO$_2$ nello stesso arco di tempo.

Il costo dell’energia prodotta da fotovoltaico, anche se più alto rispetto a quello dell’energia prelevata dalla rete pubblica, viene ridotto attraverso i certificati Verdi (attestano la produzione di energia rinnovabile e sono rivendibili sul mercato dell’energia). Per i due anni di attività, 2006 e 2007, CTP ha già ottenuto n.4 CV, per un valore complessivo di 17.000 €.

Oltre agli impianti fotovoltaici CTP ha costruito ed esercisce, mediante una società di scopo da essa controllata, NaMet, una flotta di 125 bus a gas naturale.

Il vantaggio per l’ambiente dei veicoli a gas naturale rispetto a quelli diesel tradizionali è rilevante. Infatti il gas naturale (almeno nella sua realizzazione “italiana”) rientra da sempre nei limiti EEV (Environmentally Enhanced Vehicle), un livello di riferimento volontario ancora più restrittivo dei livelli comunemente denominati EURO V (vedere tab 2 d…….).

I costruttori di veicoli hanno di recente messo a disposizione motorizzazioni EEV anche diesel. Tale basso livello è raggiunto grazie all’impiego contemporaneo di filtri del particolato (CRT) e di catalizzatori ad urea (SCR) per l’abbattimento degli ossidi di azoto.

Da qui la domanda sempre più ricorrente: ma allora i veicoli a gas – in particolare quelli a gas naturale (metano) – hanno esaurito i ogni vantaggio?…non è così! Ad esempio:

- Le motorizzazioni diesel odierne rientrano “al limite” delle emissioni di ossidi di azoto (1,99 contro il limite di 2,0 g/kWh). Il metano emette un terzo / un quarto di tali valori (0,5-0,6);

- I policiclici aromatici e composti organici volatili: sono virtualmente assenti nel metano che continua a non avere il caratteristico odore del diesel;

- Le emissioni di CO$_2$ del gas naturale sono inferiori e presentano un potenziale per ulteriori riduzioni;

- La rumorosità di un mezzo a metano è inferiore di almeno 3-4 dB (potenza acustica più che dimezzata) rispetto a un diesel;
- Il metano viaggia "via tubo", evitando passaggi di autocisterne, e il relativo inquinamento ambientale, acustico e di congestione del traffico;

In definitiva, a vantaggio del metano “giocano” le minori emissioni “alla fonte”, che minimizzano i sistemi d’abbattimento. Infine, ma non meno rilevante, va sottolineato il notevole risparmio economico derivante dall’impiego del gas naturale, risultato dell’attuale politica fiscale italiana sui carburanti.

I sistemi di abbattimento emissioni utilizzati nei motori a metano (three way catalyst) sono sperimentati da sempre. Viceversa, i filtri del particolato e i catalizzatori ad urea – peraltro prodotto che ha origine dal metano – sono espressione di tecnologie non ancora completamente “validate” da impiego su larga scala e “endurance”.

L’evoluzione della flotta CTP è illustrata nella figura … mentre il miglioramento ottenuto con l’impiego del gas naturale dopo 10 milioni di Km è illustrato in figura..

Ringraziamenti: Si ringrazia l’Ing Renato Gaudio per la preziosa collaborazione