



ACCESS CONFERENCE

POLICY INTO ACTION

**Creating the link between local and European mobility policy
26-27 November 2002, Barcelona**

Introduction of Electric Buses in Portuguese Public Transportation Fleets

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Abstract

The action “Introduction of Electric Buses in Public Transportation Fleets” aimed to demonstrate the capability of using electric buses in urban public transport fleets and to test the available vehicles and their market in Portugal.

The demonstration was conceived in two phases. The first one ran throughout 2001 in two modalities: presentation of a bus for 1 month in some 16 cities (partly integrated in a National EV rally), and longer-term (one week to one month long) experiences in 3 cities. Preparatory activities included the following tasks: market research and terms of references for buses, definition of pilot experience profiles, case studies and selection of cities and transport providers, leasing agreements (only two manufacturers are in condition to propose the demanded buses) training, launching events, information and promotion campaigns. The second phase is running for all of 2002 with 2 acquired mini buses applied in the second modality: medium term experiences in seven towns.

The paper reports the philosophy of this action, results from its first phase and activities planned for the second one.

The use of electric mini-buses allows lines in historical centres of narrow streets or to create feeder lines for already established public transport networks in zones where the public transport network is less developed. In this way, complementary public transport help today to satisfy urban mobility needs in a sustainable manner. The action shows that transport authorities and fleet operators can be involved to assume such solutions, demonstrating their engagement with environmental problems.

Without trying to forget all the difficulties to put such kind of operation in running, it is possible to verify that actions like the presented one can help the creation of the necessary market for electric vehicles. *Copyright* © 2002 EVS19



1. Introduction

Following other agreements signed between the Portuguese General-Directorate for Surface Transportation and the Portuguese Electric Vehicle Association, it was agreed to develop a demonstration action regarding the introduction of Electric Buses in Public Transportation Fleets in Portugal, during the last four months of 2001 and all the 2002.

This demonstration program is the first initiative implemented in the framework of the “Lisbon Undertaking: Mobility and Technology: What policies for tomorrow?”, claimed by eight Portuguese General-Directorates (Customs, Energy, Industry, Land Use and Urban Development, Surface Transportation, Traffic, Environment, Patrimony), the Science and Technique Foundation, the Energy Agency, Lisbon and Oporto Metropolitan Boards, Lisbon Mayor, Lisbon Energy Agency and the Portuguese Electric Vehicle Association.

These entities assumed that the transport sector must be deemed as one of the fundamental areas where urgent intervention regarding aspects of energy, environment, and technology is considered necessary in order to foster:

- an improvement in air quality through reduction of harmful emissions,
- a diminution of emissions linked to global warming,
- a reduction of an excessive dependency on oil fuels,
- an overall increase in energy efficiency,

With the “Undertaking” the involved entities assumed the believing that the time is ready to *prepare and implement actions, programs and projects* which are largely recognized as acceptable in Portugal and the European Union and which aim, inter alia:

- To coordinate the relevant issues pertaining to urban mobility and transport under social conditions which may allow for the success of the above targets;
- To gradually support measures which may strategically diminish an excessive dependency on oil-based fuels and increase an efficient and sustainable diversification of primary energy sources, as recommended by the Kyoto Protocol;
- To facilitate the gradual but firm introduction of renewable forms of energy which may also, directly or indirectly, be used in road transport under national and/or European programs and projects, in order to increase the benefits associated to low emission vehicle;
- To support the national industry in a key sector of our economy, under the perspective of sustainable development
- To create synergies from the awareness resulting from this debate, in the framework of a more general consideration of the sustainable city of tomorrow



having assumed that it is necessary and appropriate to:

- implement a horizontal working group including all participants;
- design and create policies for mobility and technology in Portugal, including advanced and sustainable transport solutions, in relation to low emissions vehicles;
- facilitate the design, the development and the monitoring of exemplary pilot-projects for electric vehicle applications, in *partnership with municipalities and public and private entities*, as deemed adequate and sustainable;
- Notwithstanding all tax and fiscal measures already approved and a future analysis of their effects, to consider the design and implementation of integrated incentive programs, including direct or indirect monetary and non-monetary incentives related to the acquisition and use of low emission vehicles in Portugal, in order to create a sustainable and efficient market for such vehicles;
- develop policies aiming at creating technical competence related to low emission vehicles, which may render industrial investment attractive in Portugal and may allow the country to implement programs and projects in this domain.

2. Electric Mini-buses: a complementary approach

Environment problems related to mobility and transportation policies are nowadays one of the basic troubles considering the city's quality of life.

Clear consequences of automobile use in cities, with related traffic jams, anarchical parking, impossibility of a correct development and maintenance of road infrastructures and the inapt land use, impose that alternative solutions be promoted most urgently.

Solutions imply certain alternatives such as public transports, transference from motorized modes to non-motorized ones and a more adequate use of cars in the city, in order to find a new balance of means of mobility.

Electric rail transports are already a successful solution, in middle and large size cities. However, other alternatives are needed and mini- and midi- electric buses must be considered (standard electric buses are not available in the market; also no performing hybrid bus is presently available on the European market).

The use of this kind of buses will allow lines in historical centers with narrow streets or to create feeder lines for already established public transport networks, in zones where the public transport network is less developed. In this way, complementary public transport can help today to satisfy urban mobility needs in a sustainable manner.

Transport authorities and fleet operators should assume such solutions, which, more costly than traditional ones, demonstrate their engagement with regards to environmental problems.



3. Objectives of the action

The action “Introduction of Electric Buses in Public Transportation Fleets” aimed to demonstrate the capability of using electric buses in urban public transport fleets and to test the available vehicles and their market in Portugal.

The demonstration was conceived in **two phases**. The **first** one ran throughout 2001 and part of 2002, in two modalities: presentation of a bus (MINI bus Gulliver, hybrid) for 1 month in some 16 cities (partly integrated in a National EV rally), and longer term (one week to one month long) experiences in 3 cities (MIDI bus OREOS 55, hybrid). Preparatory activities included the following tasks: market research and terms of references for buses, definition of pilot experience profiles, case studies and selection of cities and transport providers, leasing agreements (only two manufacturers are in condition to propose the demanded buses) training, launching events, information and promotion campaigns. The **second phase** is running for all of 2002 and part of 2003 with 2 acquired mini buses applied in the second modality: medium term experiences in cities, this time integrated in programs containing other components such as experiences with electric and natural gas passenger vehicles in taxi or car pooling services and other sustainable mobility measures.

4. Available electric buses

The two buses being tested were the *Gulliver* from *Tecnobus* (Italy) and the *Oreos* from *Gépébus* (France).

The MIDI bus *Gulliver* is 5,3 m long and 2,07 m wide, pure electric or hybrid version bus manufactured in Italy, transporting 22 passengers, 8 of which can be seated. It can run at a maximum speed of 33 km/h. Its autonomy in urban circuit allows it to run for 4 to 5 hours, after which the batteries are exchanged, in a few minutes. Two packs of batteries assure a whole day operation. Some 300 of them are already running in Italy, France (6) and England (8 + 6).



Figure 1 – Gulliver from Tecnobus and Oreos 55 from Gépébus

The MIDI bus *Oreos* from Gépébus is a French 7-meter long bus used by RATP as Montmatrobus in Paris, electric version, transporting 55 passengers. During trips, this bus is recharged with a four minutes fast charge after each run. Powered by a 75 kW induction motor drive includes an updated control system and IGBT power electronics converter.



5. Phase 1 – September 2001 to February 2002

The Gulliver bus was tested during the last three weeks of September 2001. Integrated in the first National EV Rally with more other 40 EV's, involving 25 entities; it ran through 410 km and 12 cities, connecting Aveiro-Leiria-Évora and Beja. For the first time, it was possible to present EV's in several Portuguese small and medium sized cities and this hybrid-electric mini-bus was a major star of the rally. Several national and local responsible for the transportation policies participate in the road shows, video-conference and other activities. Also responsible from public transport operators were involved, figure 2.



Figure 2 – First National EV Circuit

September 21st and 22nd, the Gulliver was integrated in the activities promoted by the Portuguese Electric Vehicle Association in the European Day “In the City Without My Car!”. After being at the Alternative Propulsion Vehicles Exposition organised at Lisbon centre, figure 3, the Gulliver bus visit Almada, Oeiras and Sintra, three major cities of Lisbon suburbs.



Figure 3 – European Day “In the City Without My Car!” 2002

Several tests related to Gulliver performance were developed and Gulliver from Tecnobus gave a good first impression. A first impact in TV and press was achieved.

In October 15th, it was time for the arrival of OREOS 55 H of Gépébus. Coinciding with its arrival, a public session at Lisbon involved more than 80 participants from 18 different towns and operators, figure 4. The strong adhesion to this meeting showed the expectative created and the initiative interest.



Figure 4 – Launching of the demonstration action: October, 15th public session

The Gépébus Oreos 55 H has been tested in Lisbon, Aveiro, Guimarães and Braga till February 2002, figure 5. As much as possible, the bus has been integrated in the public transportation fleet making urban service.



Figure 5 – Oreos 55 H in test in several Portuguese cities

The bus presence in different towns was the opportunity for several promotional initiatives. Promotion began before the bus arrival at the town with bills stacked at bus stops. Several promotional materials were produced in order to motivate public adhesion to the initiative. Also it was tried to involve press and TV, figure 6.

Presentations at schools were also developed. Promotion near young population is considered strategic. Visits to the schools including dedicated presentation sessions were performed, figure 7. After the bus visit, several schools work the subject during classes.



Figure 6 – Some of the produced promotional materials and activities with press



Figure 7 – Activities at schools

In each town, experience has been accumulated about the way to carry out the initiative. Involvement of the public transportation operator is fundamental and technicians' enthusiasm is a key point. Aspects like transportation between cities, garage adaptability, electric recharge availability must be considered.

Period in each town allows analysing and studying the status of public transportation in each town and a definition of the adaptability of electric buses to the service. Also public questionnaires were performed and some conclusions were already achieved. Figure 8 + 9 shows questionnaire results related to the acceptance level of the vehicle by Aveiro users of Oreos bus and Braga of the Gulliver. Design and noise where the two aspects with better favourable opinion. Comfort and security were the worst aspects. Being an opportunity for other kind of questions, we also knew the users motivation for bus travelling and distribution by ages, figure 10.

Buses technical performance was also analyzed. Figure 11 shows speed evolution and consumed electric power by Oreos 55 during a travel in a typical Lisbon bus line. Due to the hilly characteristic of Lisbon center, important slopes must be wined during the travel. Collected data allows technical and economical projections about the two buses and different bus lines.

Based in the acquired experience, in November 2001, it was decided to buy two electric mini-buses from Tecnobus, the Gulliver one. After the order, it was verified that these buses were only available in end of May 2002, period when phase 2 begins.

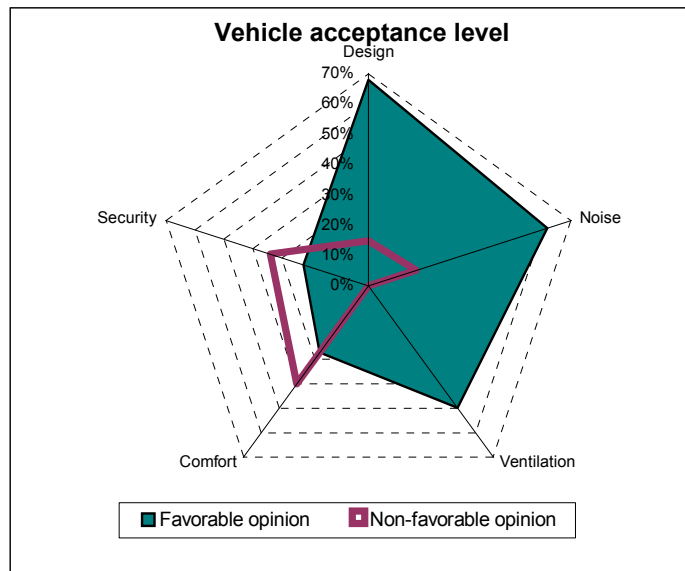


Figure 8 – Acceptance level of the Oreos 55 H MIDI bus, in the city of Aveiro (November 2001)

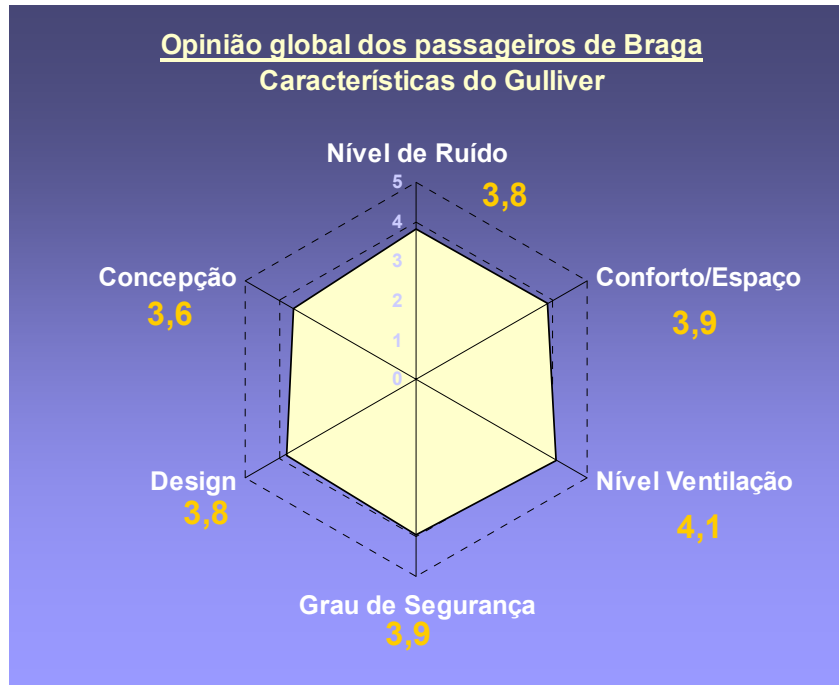


Figure 9 – Acceptance level of the Gulliver MINI bus, in the city of Braga (October 2002)

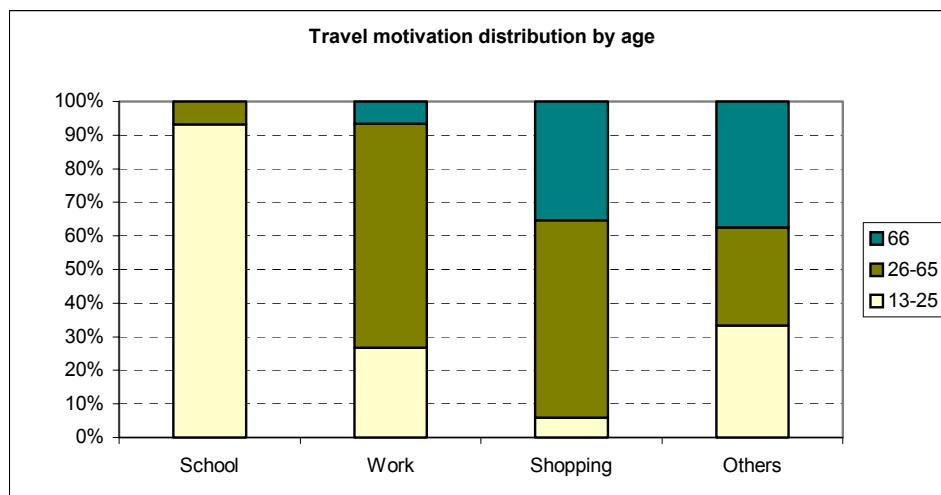


Figure 10 – Travel motivations: age distribution

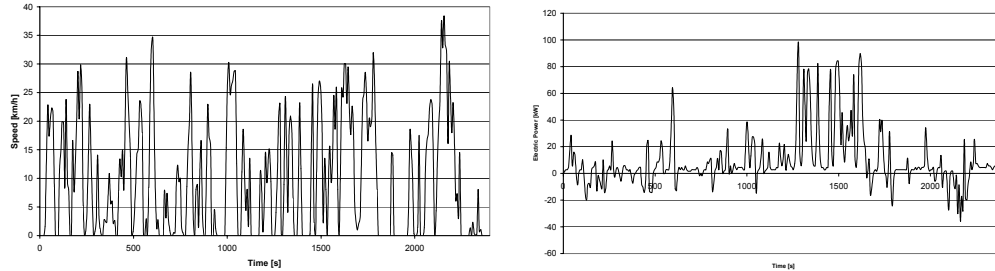


Figure 11 – Speed evolution and consumed electric power by Oreos 55 H

6. Phase 2 – Year 2002

In June 2002, the two electric mini-buses Gulliver from Tecnobus arrived in Portugal. After an official reception at Coimbra, the electric buses were the major attraction of an environmental dedicated exposition “Portugal Ambiente 2002”, that happened at Oporto international fair centre. One of the buses was exposed at the APVE stand and the other was the exposition shuttle. A reasonable media impact was achieved with this participation.



Figure 12 – The two buses arrival and participation as an exposition shuttle



The demonstration program, till February 2003. Buses, is illustrated in figure 13, and probably the period for experimentation will be extended, with the buses being integrated in normal service in other towns and their performance will be tested.

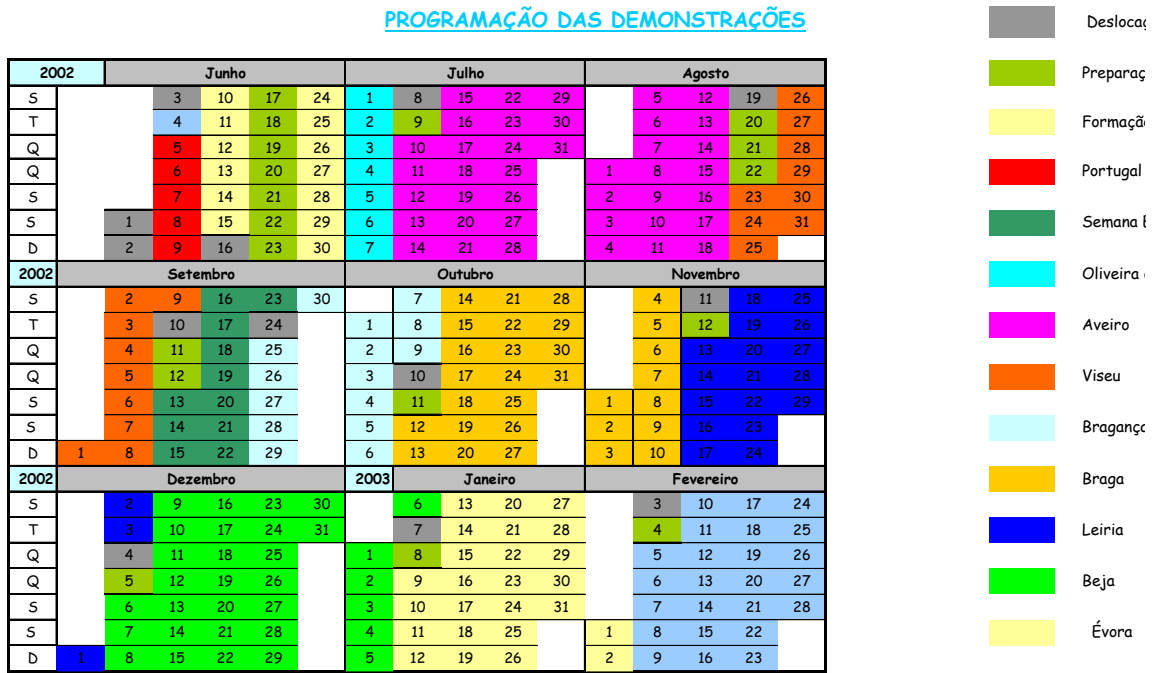


Figure 13 – Planning of the electric buses use during demonstration action

Until now, the two electric mini-buses visited 5 towns and results are very satisfactory. At least, one town has already decided to buy three electric buses in order to explore a new urban line. Estimative allow concluding that the potential short/medium term market for electric buses in Portugal may account for, at a least, 50 units.





7. Conclusion

The action “Introduction of Electric Buses in Public Transportation Fleets” has been active for the last 10 months. Aimed to demonstrate the capability of using electric buses in urban public transport fleets and to test the available vehicles and their market in Portugal, allows already to perspective their potentialities at short-term.

The use of this kind of buses will allow lines in historical centers of narrow streets or to create feeder lines for already established public transport networks in zones where the public transport network is less developed. By the way, this solution for a complementary public transport can help to satisfy urban mobility needs in a sustainable manner. The action also shows that transport authorities and fleet operators can be involved in this kind of operation and they are able to assume such solutions, demonstrating their engagement with environmental problems.

Without trying to forget all the difficulties that appear when such kind of operation are running, it is possible to conclude that actions like the presented one can help the creation of the necessary market for electric vehicles.

8. References

- [1] APVE, *Demonstração de Autocarros Electricos Amigos do Ambiente Urbano* (in Portuguese), Report from the action “Introduction of Electric Buses in Public Transportation Fleets”, phase 1, February 2002.

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