BESTRANS

Newsletter 2 February 2004

BENCHMARKING OF ENERGY AND EMISSION PERFORMANCE IN URBAN PUBLIC TRANSPORT OPERATIONS

BESTRANS Welcome

Welcome to the second BESTRANS newsletter. In this edition we will provide you with more information about energy and emission benchmarking within the BESTRANS project, sponsored by the SAVE programme of the European Community.

At the moment a benchmarking exercise has been carried out with the participation of 22 European Urban Public Transport operators.

The outcomes were presented and discussed during a final Seminar, which took place in the offices of the STCP, the public transport operator of Porto in Portugal in December 2003.

Within this newsletter we will update you on the proceedings within the BESTRANS Project, including:

- The BESTRANS benchmark analysis; an insight in the quantitative and qualitative methods used, comparison, analyse and first interpretation of the performance of 22 European operators
- Good practice examples of energy and emission performance improving measures
- Coverage of the technical visit in Porto, including a visit to the CUTE Hydrogen fuel cell bus facilities
- Structured energy management and its gains for PT operators
- Setting-up a continuous BENCHMARK Club after BESTRANS

TIS.PT ISIS ENVIROS ATAF

BESTRANS Publications

The BESTRANS outcomes will be published more thoroughly in the following documents:

1. Rough benchmark results in the BESTRANS Synthesis report (March 2004)
2. Overall outcomes in the BESTRANS Final Report (August 2004)
3. The BESTRANS Benchmark guide, How to set up an energy and emission performance benchmarking yourself (April 2004)
4. The presentations of the final seminar in Porto can be downloaded from the BESTRANS Website:

www.tis.pt/proj/bestrans/bestrans.htm

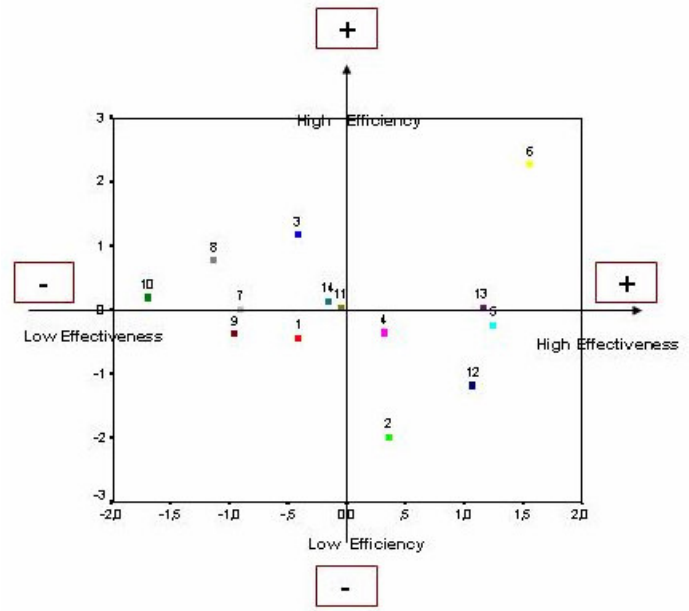
Quantitative benchmark analysis

The objective of this exercise was to compare the energy and environmental performances of European PT companies, while taking into account the main internal (e.g. managerial) and external (e.g. physical, institutional) aspects. Within this article we present some outcomes of the data analysis. The exercise mainly focused on the bus mode. However, the tram mode and other electric traction modes, operated by 6 of the 24 participating operators, will be taken into account in the final interpretation.

The analysis is based on several performance indicators, such as energy consumption per passenger-km, per vehicle-km and per vehicle type, occupancy rate, average age and density. For the moment this set of indicators does not cover the emission data due to the lack of measured or observed values. Furthermore, for the moment, only 14 operators (of 24) were able to provide a complete and consistent set of data.

Using a technique called Principle Component Analysis, the performances of each operator have been translated into two components which reflect the effectiveness (energy related to movement of passengers) and efficiency (energy related to movement of vehicles) of each operation.

The position of the operators relative to each other is shown on a performance map (below).



Looking at the figure, it is possible to see that 8 operators out of 14 are positioned on the upper half of the diagram (higher efficiency: from 490 to 520 grams of fuel per vehicle) and the others occupy the lower part of it (from 520 up to 813 grams of fuel per vehicle). In the same way 8 (but different) operators are located in the left part of the diagram (from 73 to 27 grams of fuel per person) and 6 in the right part (higher effectiveness: from 27 to 11 of fuel per person). Only one, the number 6, is located in the (relatively better) high efficiency and high effectiveness position.

This data representation allows for an easy comparison of the operators' relative performances, and an important step in understanding if a given result is due, for example, to the driving style, or to the land conformation rather than to a low average speed. The influence of these factors has to be interpreted qualitatively. This will be done on the basis of the data and information provided for the Bestrans quantitative analysis and on the basis of feedback from practice experiences.

ATAF's Good Practices

The BESTRANS Partner ATAF is a good example of an operator that is continuously working hard to improve their environmental performance. It not only aims to increase the environmental-friendliness of transport services, but also to decrease its operating costs, while increasing the service quality to both customer and citizen.

Qualification schemes are considered an important tool when improving environmental performance. They structure in a consistent manner the energy and emission information and decision flows and it increases the energy-sensitivity of managerial decision making.

By using ISO 9001 and ISO 14001 Standards (Quality and Environmental Management System) and SA8000 (July 2003), ATAF created an integrated sustainability-focused management system. These standardisations favour increased energy and environmental performance, as they steer corporate policy towards sustainable development in general, and promotes the adoption of environmental objectives, projects and monitoring indicators.

As a reference model, these standards help to manage and integrate all the components of the company's organization. Human resources, infrastructure management, communication, marketing, supply management, planning and production of services are not only linked with each other, but also integrated and aim for improved environmental performance.

All related activities, such as network planning, new services development, conventional service provision, bus maintenance, services operating, work organization, personnel training (driver, workers, transport staff, office workers) and recruitment (resources), are carried out in accordance with the defined quality levels and environmental standards.

ATAF is investing seriously in new technologies and vehicles that improve the environmentally-friendliness of its fleet. As of November 2003 its bus fleet counted 438 buses with an average age of 8 years and 8 months. It includes 348 (280 + 68) Diesel + GECAM, 64 CNG and 26 Electric buses.

Since 1995 ATAF has renewed its diesel fleet from EURO 0 and EURO 1 to EURO2 and EURO3 engines. This year the average age will be reduced to less than 8 years, as the diesel fleet will be renewed. The CNG bus fleet will grow from 64 to 105 CNG buses.

Aiming at the improvement of its environmental performance, ATAF adopted several technical programs. Focusing on the oldest diesel buses, an acoustic treatment program reduced the sound emissions of its bus fleet. The introduction of sulphur-free diesel oil for its diesel buses aims at a further reduction of the negative environmental impacts. When comparing fuel sulphur-free diesel

oil with the conventional one, the sulphurous anhydride and the sulphuric acid produced have decreased with 97%.

Without engine modification, injector change, or pump change, a 15% reduction in particulate emissions will be achieved by installing optimized CRT filters (anti-particles filters) in its Euro 2 and 3 buses. In terms of maintenance, only a change of the filters at predetermined intervals and a simple cleaning of the tanks to remove any water and other residual presence will be sufficient.

The introduction of the PersonalBus /DRT service, an on-demand bus service, not only reduced operators' costs, for instance in terms of operational staff, but also improved the environmental performance of the services provided. It decreases the total fuel consumption of the involved bus fleet, below the level of energy consumption and emission output of otherwise necessary private car use.

In collaboration with the operators CTP (Naples) and ATCM (Modena), the University of Florence and ENEA, ATAF is involved in the project "Driving Style". By installing on-board emission and energy monitoring devices, the drivers' behaviour will be assessed. Through the installation of these devices, it is possible to influence directly the driving behaviour in stop-and-go situations.

Furthermore it provides indications for the determination of the most environmentally-friendly vehicle speed. Through intensive co-operation and in-depth study by the consortium, it was possible to relate driving style with recorded consumption data.

Technical Visit

During the morning of the third conference day, our host STCP organised a technical visit. The group of operators visited the brand new hydrogen fuel cell bus facilities. These facilities are developed and installed within the European CUTE (Clean Urban Transport for Europe) project. This project is the first large demonstration project with fuel cell vehicles.

STCP Porto is one of the nine European Public Transport operators that participate in this pilot project. During 2 years STCP will test the performance of these buses and deal with issues like security standards, vehicle licensing, normalisation, formation, fuel and material supply and filling of the vehicles.

Porto received three Mercedes Benz Citaro buses, which are now running on its line 20. This is a circular central urban line, which permits presentation of the vehicles to the largest number of passengers and citizens. The buses are equipped with a fuel cell engine with a capacity of 200 kW. The compressed hydrogen is stored in fuel cells located at the roof of the vehicles with a maximum pressure of 350 bars. The stored amount of hydrogen, 44 kg, provides an operation range of more than 200 km, yet in Porto with its hilly and congested urban centre this might be a little less.

From a safety point of view the location of the fuel cells on the roof is seen the most suitable location, as damage on the roof is less likely and hydrogen, lighter than air, in the rare, unexpected occasion of leaking will escape and vanish quickly in the open air. At the moment of the visit, STCP had already installed the filling station, yet was still working on the maintenance facilities.

STCP Porto, together with EFACEC S.A, developed and installed a Fleet Management and Public Information system (SAEI) at the STCP facilities. This system enables STCP to manage in real time its operations, resources and planning, and monitors the vehicles in terms of maintenance. Through a large set of on-board equipment, TETRA communication system and dispatch centre, it is able to control directly the vehicle location, to provide real-time information to drivers, dispatchers, clients and police, and regulate and secure the services.

Afterwards, departments, like planners, maintenance and customers services, can check and monitor both vehicle and service performance. Primarily this system is used to provide the best and safe services to its customers. However it can

also easily be used to increase the environmental performance of the STCP's bus fleet.

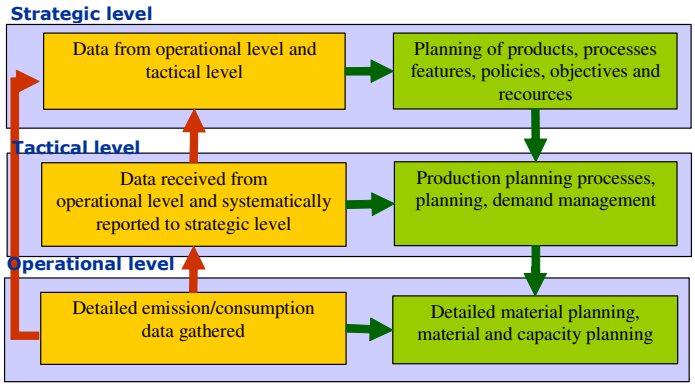
Qualitative benchmark analysis

The analysis of the information gathered in the qualitative questionnaire allowed the set up of an operators' managerial and institutional profile. To this end two methods have been used: SWOT analysis and an Information-Decision Cycle analysis.

The first method allows each company to systematise information related to its own performance and the related context. Distinguishing between internal factors and external factors and categorised in Strengths, Weaknesses, Opportunities and Threats, the energy management behaviours, procedures, opportunities, barriers and risks related to each operator were analysed.

With the information-decision making cycle the operators' information and decision flows were analysed based on the spectrum of three basic managerial patterns:

- Pattern 1 - A feedback cycle for "environmentally friendly" decision-making is in place: information flows from the operational to the strategic level, where most energy and environment-related policies are planned.
- Pattern 2 - A feedback cycle of the information system into the decision making procedure exists, but it is not "complete": information flows from the operational to the tactical level, where most of energy and environmental related policies are planned.
- Pattern 3 – A feedback cycle for "environmentally friendly" decision-making does not exist at all.



The analysis of the operators' situation offered a remarkable insight into their energy management. Scrutiny of energy and environmental awareness and importance among the different actors of the company seems to point out first that the role of the technical staff and management in influencing energy and environmental performance is often only partly understood, especially concerning the impact of driving style.

Secondly, little attention is given to energy and environment training of non-technical staff. Energy consumption monitoring, rather than environmental performance, is often the primary goal of the monitoring systems in place, followed by general technical and quality control. Moreover, it appears that (expensive) technological measures rather than (relatively cheap) organisation and management strategies have been implemented in the last five years in order to reduce energy consumption and emissions.

Concerning the perception of relative importance of internal and external energy performance determinants, the large awareness of the influence of drivers' behaviour does not translate into systematic driver training policies. Low average speed, the 'stop and go' deriving from difficult traffic conditions, and network design are considered the main external factors influencing energy.

Energy Management

For many years, energy-intensive process industries such as the chemical, textile and food and drink sectors, have been developing methods to manage their energy use effectively and drive down their specific consumption. The motivation for this is primarily economic – saving energy through low-cost "housekeeping" measures (i.e. not involving capital expenditure) has a direct impact on profitability. The environmental motivations for energy saving, which have come to the fore since the Kyoto Agreement, have pushed more companies down this route, but have not negated the ensuing economic benefits

One technique developed and successfully implemented in a wide range of companies is Monitoring and Targeting. This consists of monitoring the energy consumption of a specific process or equipment on a regular basis (usually weekly) and comparing it against one or more determinants, generally a production-related variable, but also integrating factors such as

external temperatures for heating or cooling systems.

Once a statistically significant set of data has been collected, a regression analysis is carried out to identify the relationship between the energy consumption and the variable(s). This represents the "normal" performance of that process or equipment. Individual targets are then set, which generally consist of two steps;

- Reducing variability in the "normal" performance, such that for a given output, the energy consumption can be predicted, (variations from this indicate a problem with the process.)
- Achieving a step reduction in energy performance.

This regular monitoring of energy performance and comparison with the target allows the operators and management to fully understand the factors which affect it, identify any problems early and take remedial action quickly. Involving process operators in the information loop also increases energy awareness, providing an incentive to improve energy housekeeping (turning off equipment that is not in use) as well as to identify improvement opportunities.

The experience in industry has shown that savings of 10-15% can be achieved through the low-cost measures, provided that the manpower is invested in setting up and managing the information system.

There is no reason why the monitoring and targeting system cannot be transferred to the public transport sector. Indeed, one of the main difficulties in industry lies in identifying and measuring the exact consumption of a process or piece of equipment. In public transport, especially bus fleets, the equipment is a unique vehicle and its fuel consumption is easily monitored. Unlike a continuous manufacturing process, it is equally simple to record the output (mileage) at the same moment as the consumption as the vehicle must be stationary for re-fuelling.

These two pieces of data, if collected on a regular basis and analysed, can provide valuable information on the performance of the vehicle; which vehicles of the same type are the most efficient and possibly identifying maintenance requirements; and which types of vehicle achieve the best performance (leading to questions of vehicle selection). If this data is supplemented by other information, such as vehicle running time, driver and route, it is possible to build up a comprehensive understanding of the energy performance of each vehicle, as well as the other contributory factors. The data can be used to analyse, for example, which drivers are able to get the best performance from a vehicle or which routes are the most efficient in energy terms.

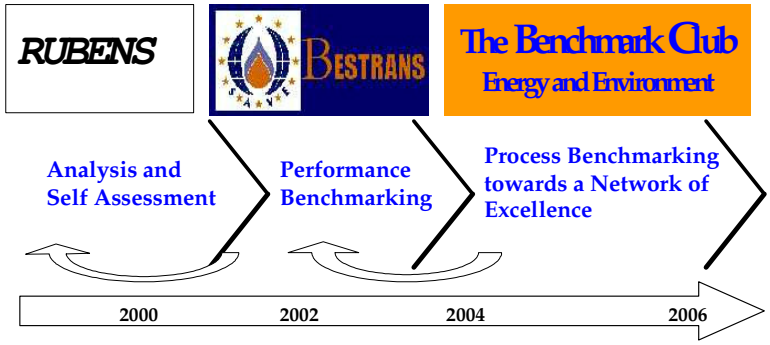
Having this level of data available is a powerful means of monitoring the results of any changes made to the system, and feeding into cost-benefit analyses to justify new equipment or training needs.

One of the identified weaknesses in the Bestrans project has been the availability of data. It is an aim of an envisaged BENCHMARK Club to assist companies to set up energy monitoring and targeting systems, to help achieve the level of savings already made in other sectors.

The BENCHMARK Club

In the RUBENS project the transport energy field was explored and specific energy-efficient technologies were assessed in-depth and a self-assessment methodology was developed for urban public transport operators. In the BESTRANS project the performance of the Urban Public Transport operators were benchmarked.

A next step will be a full-scale energy management benchmarking, through monitoring and targeting and transfer of best practices. The BESTRANS Consortium is at the moment working on the set-up of a BENCHMARK Club.



Several BESTRANS operators have already indicated to be interested in joining this Club and confirmed by a writing manifestation of interest.

If you are a public transport operator, and interested in saving energy and improving environmental performance, please fill out the attached manifestation of interest. For more

information about BESTRANS and/ or the envisaged BENCHMARK Club please contact the BESTRANS project manager.

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BESTRANS partners

The BESTRANS project is led by TIS.PT (Portugal), in co-operation with ISIS (Italy), ENVIROS (UK) and ATAF (Italy)

TIS.pt (Transport, Innovation and Systems S.A.)

TIS.pt is the BESTRANS project co-ordinator. It has experts in policy, planning and design of transport and mobility related systems, whose experience covers virtually all forms of transport and includes issues such as regulatory frameworks, quality systems, evaluation of social costs and benefits, restructuring of transport services networks, energy and benchmarking. Clients include the EC, government agencies, municipalities, transport operators, infrastructure management companies and investment banks.

ATAF (Azienda Trasporti Area Fiorentina)

ATAF S.p.A., a joint-stock entity since the 1st of January 2002, runs the local public transport network in the Florence area. Together with a number of private partners, ATAF has created a network of joint ventures involved in mobility. During 2001/2002 it obtained the Quality System Certification UNI EN ISO 9001 Vision 2000.

ENVIROS (ENVIROS Limited UK)

Experts in the fields of environmental protection and energy efficiency, Enviros has pioneered the development of monitoring and targeting techniques to manage resources and has produced a range of Energy and Environment Good Practice Guides for the UK's Best Practice Programme. Enviros is a world leader in the development of programmes to reduce greenhouse gas emissions. Clients include Industry, Government, the EC and the UN.

ISIS (Institute of Studies for the Integration of Systems)

ISIS is a research and consulting firm active on the national and international levels in the areas of information science and decision support systems, mathematical modelling and operational research. ISIS has accrued particular expertise in the areas of transport, energy, environment and local finance.

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Manifestation of Interest to participate in a New Energy and Emission Benchmarking Exercise to be carried out within the Framework of the RUBENS and BESTRANS projects

Name and surname of the contact person for the benchmarking exercise: ……

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Company: ……

Mailing address: ……

Tel. + …… Fax + ……

E-mail: ……

Signature Date

…… ……

Form to be sent to Patrick van Egmond, TIS.PT, Av. 5 de Outubro 75, 7º, 1050 049 Lisbon, Portugal, fax 00351-21 359 3021, e-mail patrick.egmond@tis.pt

