

appear to have varying user attitudes associated with risk. The majority of the interviewed drivers in Stockholm consider both biogas and CNG vehicles very safe compared to petrol/diesel vehicles, while in London, the opinions about additional risks associated with CNG and LPG vehicles are equally divided (33% and 40% respectively). Professional drivers interviewed feel secure while driving CNG, LPG and RME vehicles in all cities except Stockholm. For electric vehicles, however, the opinions are split. 50% of the professional drivers in Stockholm feel secure, compared to 73% in Bremen.

Concerning risk associated with each engine type, biogas and electric driven vehicles are considered by the mechanics to have the least additional risk compared to conventional vehicles (100% and 70% respectively) while LPG and RME are thought to imply the highest additional risk (67% and 62% respectively). However, responses varied by city; in Stockholm and Copenhagen all interviewed mechanics believe there is no additional risk in using alternative power sources, while in Helsinki 100% think the opposite. At the same time, the majority of the mechanics stated that they feel secure while carrying out maintenance work on electric, biogas, and LPG-driven vehicles, and insecure when working with RME and CNG engines. More experienced mechanics (working for over 20 years) feel more secure than do less experienced mechanics.



COMFORT

With respect to comfort, the majority of the drivers interviewed (both private and professional) find all types of alternative vehicles the same or better than conventional vehicles. For almost all alternatively fuelled vehicles this percentage approaches 100%. The exception is electric vehicles in Stockholm, where most professional drivers (83%) find electric vehicles less comfortable than the conventional ones.

The majority of passengers find the low emission buses they are riding in "as comfortable" as or even "more comfortable" than standard buses. This is true for electric, ethanol, and gas fuelled buses. The majority of mechanics think that the zero and low emission vehicles are as comfortable (for both drivers and passengers) as conventionally fuelled vehicles, while the "better" and "less good" answers share almost the same percentage.

PERFORMANCE

Drivers perceive electric vehicles as having acceleration and speed inferior to that of petrol or diesel vehicles, while braking ability is viewed as equal. It should be noted that acceleration and speed issues are associated

TOP: OFFICE POOL ELECTRIC VAN IN SUTTON, LONDON. BOTTOM: VOLUNTEER CREW CNG BUS IN SUTTON.

with specific vehicles; electric vehicles are not inherently slower or more sluggish.

Braking ability is perceived to be no different for biogas, ethanol, CNG and LPG vehicles. Acceleration is considered to be worse for CNG and ethanol vehicles. No clear conclusion can be drawn in the case of biogas and LPG, as driver responses in Stockholm and London differed. Finally, according to the private drivers, the speed of CNG, LPG and biogas vehicles was considered the same as their conventional equivalents, but ethanol vehicles were perceived as having inferior speed. Professional drivers reported inferior speed for all types of alternative fuels. As with drivers, mechanics consider the braking ability to be the same as for conventional vehicles, while speed and acceleration are

worse (50% and 68% respectively) or the same (44% and 24% respectively).

Most of the passengers find the performance of alternatively fuelled buses the same or better than the standard buses. However, a large percentage of the passengers stated that they do not feel qualified to judge vehicle performance.

ENVIRONMENTAL ASPECTS

As for pollution and exhaust emissions, the vast majority of private drivers consider all alternative vehicles better than their conventional equivalents; for biogas, ethanol and LPG vehicles, this percentage reaches 100%. Professional drivers also consider alternative vehicles more environmentally friendly than the conventional ones with the highest rates observed in the cases of LPG and CNG. The majority of the passengers also believe that alternatively fuelled buses cause less pollution than conventional buses, with a percentage ranging between 46% (in Luxembourg) and 68% (in Helsinki). The majority of the mechanics interviewed (59%) think that the alternative fuelled vehicles cause less pollution than do standard vehicles.

ODOUR

Most of the drivers find odours from zero and low emission vehicles to be the same or better than odours from conventional vehicles. Most bus passengers find the smell of the zero and low emission vehicles to be the same as those on conventionally fuelled buses. Odour, and the perception of odour, varies by fuel.

AWARENESS OF RIDING IN AN ALTERNATIVELY FUELLED BUS

Most of the bus passengers, with the exception of those in Stockholm, did not notice anything special about the bus they were riding in and they were not aware of what type of bus it was. This attitude was more pronounced in women than in men.

ACCESSIBILITY

Most bus passengers consider the accessibility of the zero and low emission buses to be as good or better than standard buses. In Helsinki, 72% of the passengers find the accessibility of the CNG buses better. This is probably due to the fact that the CNG buses are newer and have a low floor that makes boarding easier.

UNDERSTANDING RESULTS

The results of the ZEUS survey, though they are presented in aggregated form, are mainly useful for individual cities in assessing their own vehicles. This is because most vehicles, even of the same fuel type, are not directly comparable across cities. Even using a common questionnaire, the consistency of the data cannot be guaranteed when applied by different operators. Attributes noted in the surveys about particular fuel types are therefore not necessarily indicative of that fuel's potential, though they can provide important information about perceptions of specific models in specific cities.

CONCLUSIONS FROM THE ZEUS SURVEY

The public at large, here represented by bus passengers, seems to be very positive about the vehicles used within the ZEUS project, and information campaigns have succeeded in raising awareness and promoting a positive attitude towards the vehicles. However, the results of this survey note a need for better "in-house" information in some areas, for mechanics and drivers. This includes a greater emphasis on training and information about the vehicles before they are used. The survey also shows that from a technical point of view, almost all vehicles have perceived drawbacks, particularly in performance and ease of maintenance, in comparison to their petrol and diesel counterparts.

ATTITUDES OF PRIVATE COMPANIES

Stockholm produced an attitude survey of private companies that had indicated a strong interest in environmentally friendly vehicles. Four out of ten interviewed companies report using them. The majority of the companies interviewed (90%) define environmentally friendly vehicles as those powered by alternative fuels.

To the question "How interested are you in procuring (additional) environmentally friendly vehicles for your company?" half of all respondents indicated interest and one fifth were very interested. As expected, this share was even higher among companies already using environmentally friendly vehicles. Marketing and environment department heads expressed the greatest interest. Three quarters of those interviewed felt that awareness of the company's environmental policy is important for its profitability. The obstacles to the introduction of environmentally friendly vehicles were identified as high prices, poor performance and maintenance difficulties. Supporting infrastructure is



USER SURVEYS, VISIBLE SIGNAGE, AND INFORMATION CAMPAIGNS CAN INCREASE MARKET ACCEPTANCE FOR NEW VEHICLES AND FUELS.

considered sub-standard. On the other hand, survey findings do not indicate widespread misinformation or prejudice. As far as advantages are concerned, nine out of ten respondents spontaneously named fewer emissions, but only one in seven gave examples of specific environmental problems. The survey has identified a number of companies which:

- Are interested in receiving more information about environmentally friendly vehicles (131 companies);
- Would like to co-operate with the City of Stockholm (56 companies);
- Would like to attend an information day about environmentally friendly vehicles (57 companies).

HOW CAN CITIES INCREASE USER ACCEPTANCE?

Increasing user acceptance is a long process, but there is much that cities can do. The ZEUS experience also shows that private citizens as well as companies are very curious about zero and low emission vehicles, but lack information. Cities often have access to channels of information in all media that can be used to spread accurate information.

Sometimes, simple information can overcome practical barriers. In Bremen, for example, a basic manual, including pictures, helped the staff at public petrol stations understand the specific refuelling procedure for CNG vehicles used by car sharing clients.

INCREASE VISIBILITY

Perhaps the single most important thing that cities can do to increase the acceptance of zero and low emission vehicles is to increase their visibility. As urban dwellers start to notice vehicles in use, or ride in an alternatively powered bus, the technology becomes more familiar and therefore more acceptable. In the ZEUS cities, zero and low emission vehicles are picking up rubbish, transporting sewer workers, providing transport for the elderly, and carrying thousands of bus passengers.

Most alternatively fuelled vehicles look almost exactly the same as their conventional counterparts. Therefore, in order to be visibly identified as environmentally friendly, vehicles should be clearly marked. It should be noted, however, that when using vehicles which cannot guarantee quality service, high visibility may have a negative effect.

SURVEYS AND INTERVIEWS

Regular attitudinal surveys and interviews can help cities identify user perceptions and concerns about zero and low emission vehicles. It may be particularly useful to survey users before, during, and after a vehicle demonstration programme or information campaign to gauge its effectiveness. Most of the ZEUS cities already produce transportation surveys, so that in many cases special questions regarding zero and low emission vehicles can be used to augment the survey at a very low additional cost. When assessing survey results, it is important to understand that they only provide information about one specific vehicle in a certain situation. For instance, a negative perception of comfort on a CNG bus may be due to the fact that the bus is dirty or because it is an outmoded model – it may have nothing to do with CNG buses in general.

INFORMATION CAMPAIGNS

Because knowledge about zero and low emission vehicles is limited, there is a need to produce and disseminate factual information. Information can be spread widely, but it is more cost effective when targeted at a group likely to accept environmentally friendly vehicles. This could include companies with environmental profiles, or those who drive and use company cars. Taxi drivers are also “multipliers”; they

are very visible, and are often considered experts on which cars are most reliable. Seeing an environmentally friendly taxi can therefore be a powerful persuader for other individuals to purchase them.

Carefully planned information campaigns may convince company leaders to invest in cleaner vehicles, or encourage their employees to use them. Concrete factual information about the costs and benefits of owning and running these vehicles could aid this process. Some reluctance among companies seems to be due to a lack of just such reliable information. As noted earlier, campaigns should be directed first and foremost to companies actively seeking an environmental profile, either directly or through media channels frequented by these companies. Information about zero and low emission vehicles could be offered to all companies when they seek environmental certification, or when they are evaluating which vehicles to purchase. Environmental accountants, motoring organisations, or government agencies could be sources of this type of information. It is difficult to estimate precisely the effect of information as an incentive. In any case, it could lead to a decision to purchase a low emission vehicle, to delay purchase of a new car until they are better developed, or may even dampen interest in these vehicles.

The ZEUS UK team has arranged many events across all cities, invited people to attend demonstration days and allowed people from other organizations to



Survey of electric car users in Palermo

In Palermo, electric cars have been assigned to a number of Municipal staff who are considered “testers”. Six months after delivery of the cars, the overwhelming majority interviewed think that the decision to introduce electric vehicles into the City fleet is excellent. The “testers” did not notice any operational problems due to the substitution of traditional vehicles with electric ones. The limited range and the length of time needed to recharge the cars were

the only “defects” noticed. The noiselessness of the cars – both inside and outside – was seen as a great advantage. Six months of using electrical cars has dispelled much of the wariness expressed by the testers during training.

Testers also reported that the vehicles generated great interest, especially among young people. All the electric cars are covered with stickers which clearly draw attention to the ZEUS project and indicate that the cars are zero emission. Even though the vehicles are electric versions of a body type also sold as a petrol car, (the Fiat

Seicento), at almost at every traffic light people were asking the testers questions, such as: “What is this? What is the maximum speed? How much does it cost? Is it comfortable?” This attention makes testers feel important and proud to be using an electric car. This feeling is heightened when Palermo city centre is closed to traditional vehicles because of pollution emergency or during special events, like the recent Car-Free Cities Day.



TAXIS AND RENTAL CARS HELP
USERS TEST NEW TECHNOLOGY



test drive the new vehicles. This has been an important part of “spreading the word.” However, it is possible that the same individuals attended several of the events, and that most of these were not in the position to buy or use the cars. London’s experience underscores the difficulty in reaching decision-makers, and spreading information beyond a few interested parties. London and other ZEUS cities have been most successful in reaching decision-makers when local or national politicians have been directly involved in information campaigns.

When introducing CNG vehicles, Bremen held a series of seminars for taxi drivers. This experience showed that information campaigns can make a difference, but only when the vehicles themselves are working well. CNG taxis are now showing positive technical and financial results in Bremen.

ENABLING DIRECT EXPERIENCE

To increase the effectiveness of such information campaigns, a city can also maintain a demonstration fleet to lend or lease for short periods to companies interested in testing them. In particular, this incentive supports the need for functional information about

performance, comfort, and operation. As long as the vehicles live up to expectations, this could be a powerful incentive.

In the summer of 1999, Stockholm started a pool of five zero or low emission vehicles for the business sector to borrow and use for a maximum of two weeks. The aim was to give private businesses an opportunity to try the vehicles for more than just an hour – so that they can find out how the vehicle operates in their businesses. The five available vehicles are an electric Citroen Berlingo, a biogas BMW 316 g, an ethanol Ford Taurus, two biogas Volvos (one V70 and one S70) and an electric Peugeot scooter. There has been a great interest from businesses to borrow vehicles. They pay about 35 Euro for one week as an administration fee and are requested to answer a survey afterwards. Currently, the waiting list for these vehicles is a few weeks.

SCHOOL PROGRAMMES

– EDUCATING TOMORROW’S TRAVELLERS

Helsinki (HKL) carries out an education programme for schools. HKL has a bus driver who, for several years, has visited schools and day-care centres to tell school-



EDUCATING TOMORROW'S TRAVELLERS IN HELSINKI

children about public transport. He tells them about how to use public transport and why it is a good thing, how to behave in a bus, where to get information, and so on. Recently this has included information about gas buses and other alternatively fuelled vehicles and the ZEUS project in general.

In general Helsinki's experience with the introduction of alternatively fuelled vehicles is that the more information provided to interested parties, the better the new vehicles are accepted. Helsinki's experience shows the effectiveness of providing information well before the first vehicles are put into service.

▶ Summary recommendations



SWEDEN'S MINISTER FOR THE ENVIRONMENT
ON AN ELECTRIC SCOOTER

INCREASING USER ACCEPTANCE IN YOUR CITY

1. **Conduct regular surveys**

in order to assess information needs and monitor the effectiveness of information programmes.

2. **Mark demonstration vehicles and infrastructure**

with clear signage so that they are visible on city streets. Complement this with informative, awareness-raising material such as flyers or brochures.

3. **Focus on providing direct experience**

with vehicles through loaner or demonstration fleets. These can be offered to special groups such as companies, who may be important early users.

4. **Work for high level of political involvement**

to secure a firm political view and improve the dissemination of information to decision-makers.

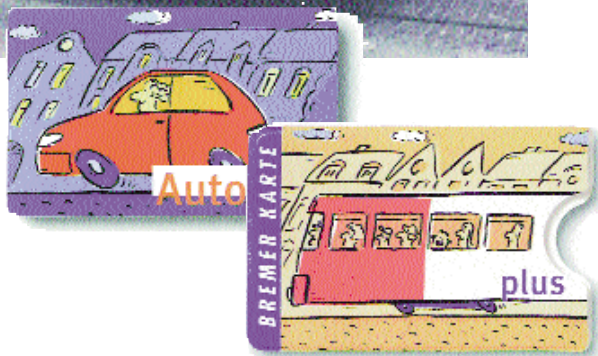
Section 2

Complementary measures supporting cleaner mobility



Intermodal interchanges

Intermodal interchanges make public transit more accessible. The European Commission's Green Paper "Citizens Networks" emphasises the role of intermodal door-to-door-chains for an environmentally friendly and economically efficient transport system. However, there are real market barriers to intermodality, as transport providers often work in discrete sectors and sometimes work in competition. Integrated information and ticketing are key elements of the intermodal door-to-door chain. Within ZEUS there are several examples of planning for better intermodal interchanges.



PUBLIC TRANSPORT SEASON TICKET + CAR-SHARING AUTOCARD

A major project in Bremen is the *Bremer Karte plus AutoCard*, combining car sharing and the public transport services of the local operator, BSAG, to offer a full mobility service. The new intermodal service started on 1 June 1998 with a common StadtAuto/BSAG smart card as a monthly or annual pass for public transport, but which also includes the "car-on-call", with electronically controlled access (described in a following chapter).

Once again, there was much scepticism to overcome. In fact, ZEUS had a key role in opening minds to this innovative idea. Subsidies from the ZEUS project reduced financial risk, and the fact that ZEUS was a European project was important in convincing decision-makers in the public transport company of the project's value. Since the initial period in 1997/98, the project has become more self-sustaining, and has even won some awards. Bremer Karte plus AutoCard won the 1998 "environmentally friendly product of the month" from Climate Alliance and first prize in the "Königliche Verhältnisse in Bus und Bahn" ("Best of the Best in Public Transport" – combined transport category) awarded by the Verkehrsclub Deutschland.

As a result of the publicity given to this scheme in Germany, car sharing organisations in other towns have begun negotiations with local transport companies. Consequently, the combined public transport/car sharing offer is now available throughout the Bremen region.



BREMEN'S AWARD
WINNING COMBINED
TRANSPORT PROGRAMME

The originality of the collaboration established in Bremen lies in its association with the rental branch of an automobile dealer. This means that up to 30 additional vehicles can be integrated into the system during periods when the demand for car sharing is particularly high (for example weekends and holidays). There are almost 100 vehicles at more than 45 locations for the 2 000 participants (of StadtAuto and AutoCard, October 99). The short distance to these decentralised locations is a crucial element in making car sharing convenient and attractive.

The Bremer Karte plus AutoCard gained almost 500 new members in its first 12 months. Aspects of the service important to new members include the following:

- No need to worry about maintenance, insurance etc. - 72% of participants
- Hourly based rental – 69%
- Convenience of locations and 24 hour services – 50%.
- An alternative to the car – 33%
- Concern for the environment – 29%

The survey shows that a win-win cooperation is possible between public transport operators and car sharing organisations. 16% of *Bremer-Karte plus AutoCard* clients are new holders of public transport season tickets. There is additional shift from monthly season tickets (used most often in winter) to annual season tickets (12 months validation). Previously, only 54% of new clients had annual season tickets – this figure has increased to 78%.

The pay-as-you-drive-system is based on the mileage driven and the duration of the trip. The monthly basic fee is 63 DM (about 32 Euro) for the season ticket – including access to the vehicles. Except for an initial fee of 60 DM (about 31 Euro) for the AutoCard there is no additional basic fee. The use of the smart-card-technology has removed the need for a deposit (as is usual for car sharing systems). There is no membership fee or deposit. Whereas "ordinary" car sharers (without the combined public transport season ticket) pay a deposit and monthly fees, the *Bremer Karte* members do not. Instead, they pay slightly higher fees per kilometre and hour, using debit smart cards.

PARK&RIDE FACILITIES

Park&Ride is a strategy to shift commuters from private to public transport. Commuters can typically access either rail or bus services adjacent to parking facilities. ZEUS cities with Park&Ride facilities include *Coventry* and *Luxembourg*.



IN OCTOBER 1999, THE 46TH STADTAUTO LOCATION WAS OPENED. MOST STATIONS ARE IN DENSE CITY NEIGHBOURHOODS.

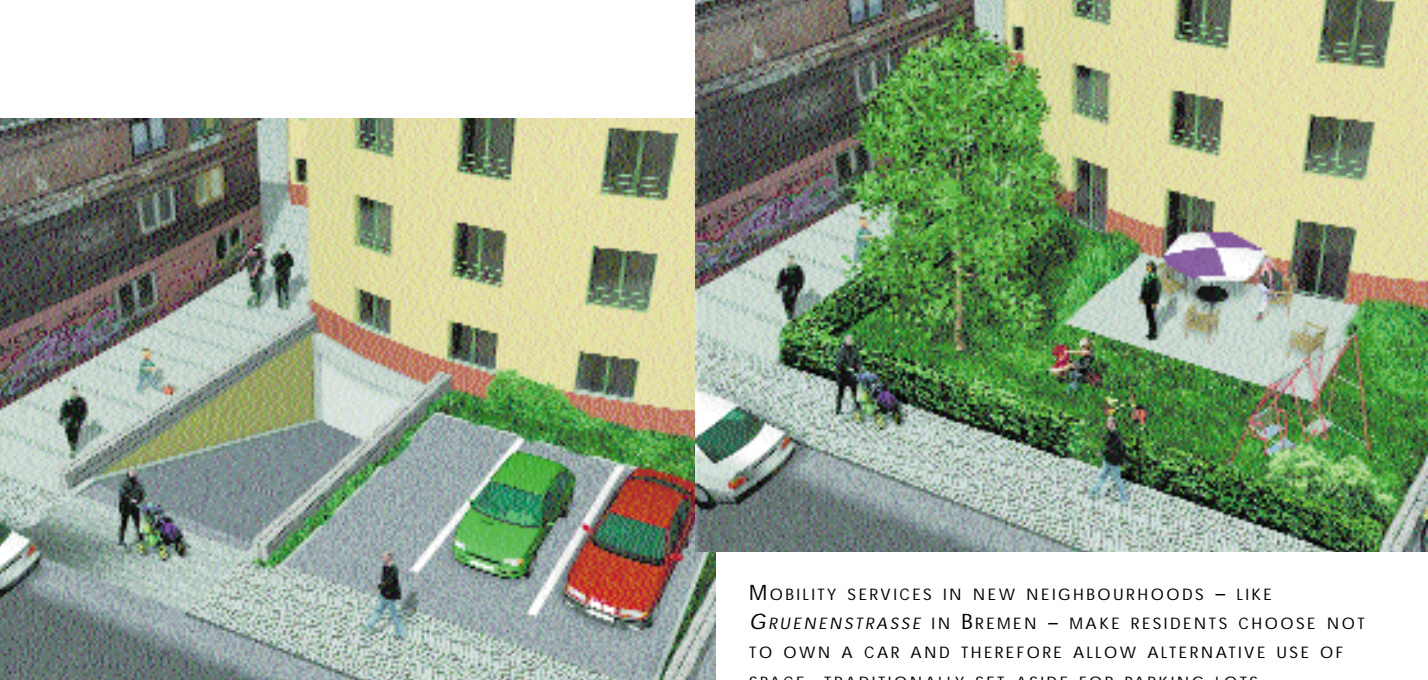
In a low-density residential area, Park&Ride may be a very efficient way to help commuters access public transport into the city centre. It also helps reduce parking congestion on inner city streets. However, experience shows that sometimes, Park&Ride schemes attract "pure" public transport users to shift to



Park&Ride in Coventry

The City of Coventry has introduced two Park&Ride schemes with a total of over 500 free parking spaces. The Northern Park and Ride facility (opened in April 1999) has 163 parking places next to a bus stop. Coventry estimates that the bus serves about 2 000 trips which equates to about 80 parking places in daily use. The 44-seat bus runs every 15 minutes. The journey is about 3 km, and the fare is ~1.60 Euro for a return trip. All day parking in the city centre costs ~4.7 Euro. The Southern Park and Ride facility was expanded in 1997 to accommodate about 400 cars.





MOBILITY SERVICES IN NEW NEIGHBOURHOODS – LIKE *GRUENENSTRASSE* IN BREMEN – MAKE RESIDENTS CHOOSE NOT TO OWN A CAR AND THEREFORE ALLOW ALTERNATIVE USE OF SPACE, TRADITIONALLY SET ASIDE FOR PARKING LOTS.

intermodal private/public journeys. This problem is most marked when use of the Park&Ride facility is in peak hours and in one direction only.

PROMOTING A CAR-INDEPENDENT LIFESTYLE

Many ZEUS cities are attempting to plan new developments without adding more traffic. In some cases, this has meant planning new neighbourhoods with such superior mobility services that residents

choose not to own a car. Within ZEUS, a car-free site development on *Gruenenstrasse* in Bremen has been evaluated, and the *Beginenhof*, a housing and working project for women, has received aid in integrating mobility and information services instead of providing parking facilities. One car sharing location will also include a terminal providing on-line trip planning information. These examples show how urban development can make cities more attractive and how site development may become more efficient.

► Summary recommendations

SOUND INTERMODAL PLANNING

Sound intermodal planning helps make public transport more attractive and accessible. Walking trails, cycle paths leading to storage racks at public transport stations, and transport/car sharing cooperation are all good examples. Specific recommendations include:

1. **Build on existing transport modes,** then identify critical links among them: Often, intermodal planning does not require expensive new infrastructure. Rather, it builds links between existing systems.
2. **Improve coordination** among transport operators, planners, and administrators of different transport modes. Public transport operators can be

important partners in improving intermodal mobility – build on their expertise and experience. Identify the inherent barriers to cooperation, and be persistent; operators may be initially resistant to common plans.

3. **Share experiences with other cities** to identify effective programmes and benchmark results, including decreased inner city traffic and pollution.

Telematics

Telematics can make both public and private transport more efficient, for example by improving driver and passenger information and smoothing traffic flows. Several telematics applications are in use in ZEUS cities, and a few new applications have been tested as part of the ZEUS project. An integrated telematics system can provide signal timing, fleet management, global positioning, and real-time passenger information.

TRAFFIC SIGNAL TIMING

City buses often have trouble negotiating urban traffic, and constant traffic light stops slow bus journeys. Many ZEUS cities have therefore introduced traffic light timing systems that give buses priority, allowing for smooth crossing at junctions. Traffic signal priorities are in place in Bremen, Copenhagen, Helsinki, Luxembourg, Palermo, and Stockholm.

The success of signal timing in mitigating bus or tram interference depends on the type of lane used; buses or trams with dedicated lanes benefit most from traffic signal priority systems. In Bremen, where buses share road surfaces with regular traffic, a device providing information on the approach and departure of buses as well as the density of traffic is needed at junctions. This is produced using a beacon/radar system that can even register individual transport routes. In Helsinki, traffic signal priority requests are sent directly from the vehicle to the signal controller cabinet at each junction. Helsinki's system gives priority to any bus sending the right message on the right frequency to the traffic signal controller, allowing for future system expansions. Helsinki's system (the 423 system), is still being evaluated, but early results show a very positive experience for users. Enough journey time has been saved to justify taking out one bus from route no. 23. In Copenhagen, signals at junctions along a 4-kilometre road section give priority to city buses. 12 bus routes pass through this corridor, carrying 25 000 passengers per day. 6 of these routes, with 114 buses, are equipped with the signal priority system. The goal is to increase passenger volumes by 5% and regularity by 50%.



Bus priority reduces time at crossings by 30%

Stockholm Transport produced a study which showed that junctions are the dominating factor slowing buses in city transport services. The introduction of a bus priority system shortened waiting time by 20 to 30 seconds at each junction. Bus speed increased from 13 km/h to 15 km/h even in rush hour traffic, despite an increase in city traffic at peak times. On some routes speed increased to 18 km/h.



REAL-TIME PASSENGER INFORMATION
IN HELSINKI

REAL-TIME PASSENGER INFORMATION

Real-time passenger information is available to public bus and tram riders in Bremen, Copenhagen, Helsinki, Palermo, and Stockholm. Most of these systems use some type of global positioning system (GPS) to locate vehicles and then transmit location information to information signs at bus stops. Bremen's system uses infrared beacons to send bus position information by radio to a central computer. This position information is compared with the schedule to highlight discrepancies. Within 30 seconds of a noted deviation, information is sent to controllers and passengers. In Copenhagen, the PrioBus system, which controls buses, uses GPS to pinpoint the location of buses; information on when the next bus will arrive is then transmitted to passengers at bus stops. A similar system is used in London. Helsinki and Stockholm also provide information to passengers at bus stops, increasing passenger satisfaction with public transport. In Stockholm, the system is updated every 13 seconds and gives correct information accurate to the minute. Studies in Stockholm have determined that red LED displays are easiest for passengers to read in a variety of weather and light conditions. Within ZEUS, Palermo is testing a satellite control system called SATURN on eight CNG buses, which helps to pinpoint buses in the urban area.

TELEMATICS FOR FLEET MANAGEMENT

Telematics can also be used to reduce "dead" mileage associated with medium to large fleets working together. London gained experience using an AVL satellite linked to a computerised fleet management system when taking part in the European ASTI project. Within ZEUS, 19 vehicles running in an accessible minibus network have been equipped with driver terminals which send information on passenger entry and exit to be sent to and from vehicles. Called Passenger Event Telemetry, the system helps drivers to indicate, to a central depot, when scheduled pickups and drop-offs actually occur. This provides dispatchers with a better understanding of how each vehicle is producing scheduled trips and helps them handle customer enquires more efficiently.

The use of Passenger Event Telemetry will make it easier to gather accurate passenger kilometres and trip time information for future analysis. In the selection of the technical solution, strong emphasis has been placed on providing information to the driver, minimising driver effort to convey accurate information.

Within ZEUS, in-vehicle display units have been fitted to Camden Community Transport's fleet, and one unit installed at the base station. The booking and scheduling software is now complete, along with the software to "capture" messages/data from the base station. Camden can now track vehicle positions; on-screen mapping is provided at least as far as the M25 (London's orbital motorway) and beyond in some cases. Training for drivers has started and will continue on an incremental basis. Drivers have access to selected activities via key pads.

TELEMATICS APPLICATIONS IN CAR SHARING

Bremen has introduced smart card access for car sharing within ZEUS. StadtAuto clients receive a smart card with a PIN number – like a plastic credit or debit card. First, a pre-test was carried out with a limited number of clients, to gain technical experience. In Spring 1999, the system was gradually extended to all StadtAuto vehicles in Bremen.

There are two different systems:

1. The "station manager system" for stations with several vehicles, where the car-keys are stored in a locker at the station. The client gets access to the locker with his or her smart-card and PIN-code and finds the car key for the booked car there.

2. The "stand-alone-system" for stations with a few cars only. Here, access is directly to the car. An on-board-computer is in contact (via mobile-phone) with the booking office. A transponder field at the windscreen accepts user identification from the contactless smart card. The driver enters a PIN code into a manual at the dashboard to release the immobiliser. Inside the vehicle, the user finds the car key in the glove compartment.

The use of innovative telematics is a prerequisite for improving service because it offers a higher level of security, easier access and an automatic billing procedure. Also, for special offers, it is necessary to have an expiry date, which is only possible with modern electronics.



TOP: CAR SHARING STATION IN BREMEN.
BOTTOM: CAR SHARE PANEL INSIDE OF CAR. THE USER IDENTIFIES HIMSELF WITH HIS PIN-CODE (MANUAL AT THE DASHBOARD). IF PIN IS RIGHT THAN THE IMMOBILISER IS RELEASED.

▶ Summary recommendations

SHOULD YOUR CITY INVEST IN TELEMATICS?

Telematics has a wide range of applications in transport, including many uses not described here. However, cities wishing to use telematics to promote sustainability may find that telematics is best applied as a tool to increase the efficiency and attractiveness of public transport and car sharing rather

than private transport. Specific recommendations include:

1. Pre-trip and real-time information

increases public transport customer satisfaction.

2. "High tech" solutions like GPS and "low tech" planning

initiatives such as dedicated bus lanes and better bus stop

facilities should be combined to achieve the maximum benefits of telematics for public transport.

3. Telematics are critical

to the success of car sharing schemes, to make booking, access, and billing easier.

4. Don't forget about pedestrians and cyclists

while optimising the traffic flow of vehicles.

Cycling

A cycle is the ultimate zero emission vehicle – its inexpensive technology may have even higher impacts than very sophisticated technological developments. Various studies have shown a great potential for cycling in cities, as a high percentage of inner-urban trips are short. In Germany, for example, about 40% of all inner city journeys are less than 4 kilometres. For such trips, the bicycle is an excellent alternative to the car, and even to public transport. Cycling is fast, healthy, and convenient, and cities that support cycling save urban space and reduce emissions.

CYCLING INITIATIVES

Cities can do much to support cycling, by building infrastructure such as dedicated cycle paths or lanes and ensuring that cyclists can cross road junctions safely. Low floor buses and trams in *Bremen* allow for easy carriage of cycles, and in *Stockholm* bikes are allowed on certain commuter trains. A new residential community in *Southwark* plans to set up a cycle-sharing scheme, and *Helsinki* have similar plans. However, most ZEUS experience with cycling is in *Copenhagen* and *Coventry*, described below.

THE ZEUS EXPERIENCE IN COPENHAGEN

The City of Copenhagen is well known as a bicycle-friendly city. One third of all commuters cycle to work. This, combined with high car prices, restrictions on car parking in the inner City, and the absence of motorways into the City centre, has contributed to car traffic in Copenhagen remaining at the same level since 1970.

Cycling in Copenhagen is supported by one of Europe's best-developed cycling infrastructures. Cyclists enjoy over 300 kilometres of bicycle tracks along major roads and thousands of public bicycle stands. The first "green cycle route" in Copenhagen was developed as part of ZEUS, and now an entire network of such routes has been planned. They will offer long distance commuters and leisure cyclists a safer and more

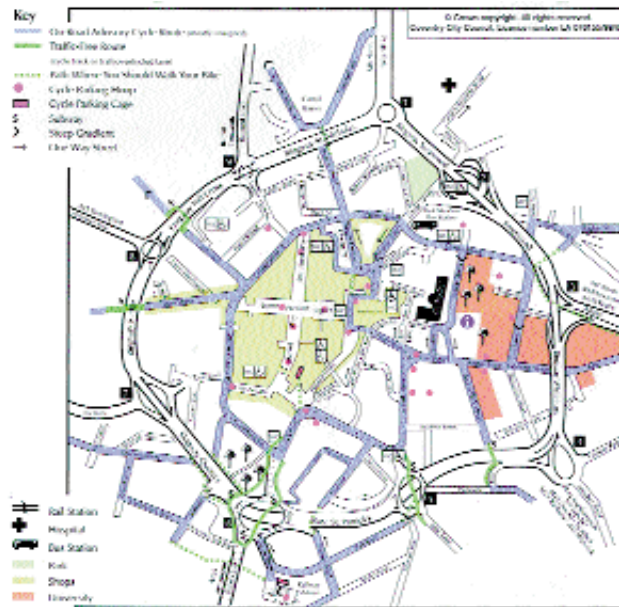
pleasant environment. The routes mostly pass through green areas, but sometimes also along minor roads.

In the inner City, cycling conditions have been improved by increasing bicycle parking at public transport terminals. Bicycle lanes have also been established along major roads. Response to these initiatives has been positive, the only major associated problem being the control of car parking. The core of the inner City, the Medieval City, will be further opened up to cyclists, with the lifting of many one-way restrictions on cycling.

Within ZEUS, Copenhagen's famous City Bike programme was further developed. 600 City Bikes were added to the fleet, and efforts were made to better link the City Bikes to public transport. City Bikes can be borrowed from special stands for a refundable deposit of a DKK 20 coin (approx. 2.7 Euro). The City Bike is specially designed for public use and low maintenance – the tyres are solid rubber, which guarantee no punctures. The City Bike scheme is co-financed by public funding and private sponsoring, including advertising on the bicycles.

An evaluation of the City Bikes shows that the main user groups are Danish teenagers and tourists. The City Bikes do not play a significant role in commuting, as commuters cannot rely on the availability of a City Bike at the station or the bus terminal. However, the City Bikes have added to a positive attitude towards cycling in Copenhagen.

FLYERS AND A PRACTICAL MAP HELP TO INCREASE THE USE OF BICYCLES IN COVENTRY.



THE ZEUS EXPERIENCE IN COVENTRY

Cycling and walking are zero emission transport modes and have formed part of the Coventry ZEUS programme. A comprehensive approach has been taken to encouraging more cycling, encompassing facilities, training and promotion.

The first cycling map was published in summer 1999. It shows cycle routes throughout the City and provides valuable tips and advice for safer and more enjoyable cycling. Additional secure cycle parking facilities have been provided within the City centre and more than 250 cycle spaces are now available. The Green Travel Plan, drawn up in partnership between the City Council and major employers, is encouraging

more commuters to cycle to work. Measures include improvements to cycle parking and changing facilities at offices, provision of a mileage rate for cycling commuters, and free pool bikes.

An innovative cycle training scheme has been established in which adults and children learn cycling skills together. One-day courses are organised on summer weekends covering all aspects of cycling, from basic skills and maintenance to more advanced techniques for city cycling. Other promotional activities have included bookmarks available at libraries, free cycle check-up and maintenance available from "Dr. Bike" during the Coventry Summer Festival, and free breakfasts for everyone cycling into the city on National Bike to Work Day.

► Summary recommendations

MAKING CYCLING WORK IN YOUR CITY

The bicycle has an enormous potential for urban transport. Cultural and social conditions are at least as relevant as geographic and climatic conditions. Recommendations based on the ZEUS experience include:

1. Cycling needs a change of attitude
Campaigns and smaller, practical measures like cycling maps, safe

paths, and bicycle parking racks create a better climate for cycling and gradually make cycling socially acceptable in cities without a cycling tradition.

2. Cycling needs infrastructure
Making cycling an important part of city traffic will not succeed without an overall plan, demonstration projects, sufficient resources, and the political will to establish bicycle routes/lanes even on major roads where space is limited.

3. Cycling should be linked to public transport
Plenty of secure parking facilities at railway stations and bus terminuses, and provision for carrying bikes on buses and trains, establish cycling as an intermodal alternative to the car for long and short distances alike.

Car sharing

Car sharing offers passenger vehicle flexibility without the private, social and environmental cost of individual car ownership. Organised car sharing (often called a CityCarClub) is in effect a mobility insurance policy for all cases when public transport, walking and cycling are not adequate: at night, when public transport is not available or convenient, when bulky or heavy objects have to be carried, and so on. Though many cities fear that car sharing will shift passengers from buses and rail to cars, surveys show that car-sharers use public transport more often – and not only during peak hours. There are many possibilities for further co-operation, including partnerships with public transport operators.*

CAR SHARING – WHAT IT MEANS AND HOW IT WORKS

Car sharing has been in existence for over ten years. Instead of using a privately owned car for perhaps only one hour a day, you share a car with others. This not only takes a load off both your bank account and the environment, but also can provide you with the right car for your needs, if different types of vehicles are available. Cities with car sharing facilities in residential areas can reduce the land area used for parking.

In Europe, the term "car sharing" has come to mean

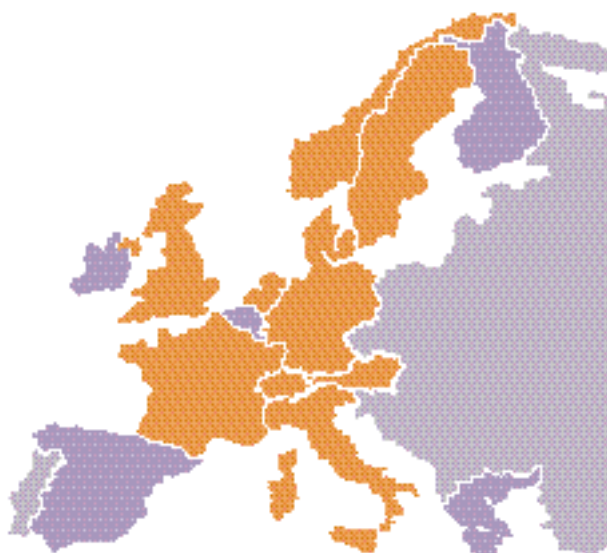
the organised and professional sharing of cars. Car sharing is the logical development of the car rental concept into a convenient and realistic substitute for car ownership. Its users have 24-hour access to the vehicles in a car sharing fleet.

The system can be easy and reliable. In Bremen, for example, clients of the car sharing organisation StadtAuto receive a "smart card" with a PIN number which gives access to the vehicles. A handbook gives an overview of the different vehicles available, the location of the stations, and other information relevant to use of car sharing. Members typically pay a low monthly fee plus a tariff per kilometre when they use a vehicle.

Local car sharing organisations have established coordinated policies across Europe through the European Car Sharing network (ECS). If the car sharing organisation is a member of ECS, clients can enjoy access to over 2 500 cars in 300 European cities.**

Another impact of car sharing is that fewer cars are needed to meet the mobility needs of a given number of people and so the city becomes a more attractive place to live in. One study shows that every car sharing vehicle replaces between four and ten private cars and saves at least five parking spaces. This creates space on the streets and improves life in the city – every member

CAR SHARING ORGANISATIONS IN EUROPE. EXISTING ORGANISATIONS IN RED, PLANNED IN BLUE



* Car sharing is used here to describe the common use and ownership of a pool of vehicles, whereas car *pooling* usually refers to ride sharing and is not discussed here.

** Bremen and Copenhagen are members of the ECS network.

of the urban “flora and fauna” benefits. The cost of parking can be reduced. Keeping people in the city means there is less need to commute long distances, and less energy wasted travelling to and fro.

CAR SHARING IN PRACTICE: THE ZEUS EXPERIENCE

BREMEN

Established in 1990, Bremen’s StadtAuto organisation has over 2 000 clients and uses a fleet of almost 100 cars, including three natural gas vehicles. Members are charged a low monthly fee of about 6 Euro, while most costs are calculated on the basis of actual car use. The less you drive, the more you save. This tariff structure improves awareness about the real costs of each and every trip, and is an incentive to drive cars as little as possible.

To book a car, a member needs only a booking number and a telephone. The member simply phones the booking office and reserves the car he or she wants. The booking may also be for immediate use – about one third of the bookings in Bremen are made less than one hour before the trip.

The cars are kept at various stations in the city, in easily accessible residential areas – and many are close to public transportation stops as well. Members use a smart card to access the car directly or open a locker holding the car key. Within ZEUS, the smart card access system has been further developed and implemented.

Studies in Bremen have shown that about 80% of car sharing clients do not own a car. For 6% of users, car sharing membership has replaced a second car in the household.

Within ZEUS, Bremen instituted the Bremer Karte plus AutoCard scheme, which offers a joint public transit card/car sharing membership. Already, the scheme’s 600 clients have reduced CO₂ emissions by almost 480 tonnes (taking into account the whole vehicle life-cycle). The entire car sharing community in Bremen saves about 4 million car kilometres annually – equivalent to about 800 tonnes of CO₂.

PALERMO

Palermo is introducing a comprehensive car sharing scheme for occasional, associated, and collective users. Thirteen locations near major public transport stations at strategic city centre and interchange points will offer



CAR SHARING IN COVENTRY

Setting standards for car sharing

Through its participation in the European umbrella organisation of car sharing (ECS), Bremen took the initiative to mark car sharing with the well known official German eco-label Blue Environmental Angel (*Blauer Umweltengel*). This certification recognises “qualified environmentally friendly car sharing” in the public sector. The Independent Jury “Umweltzeichen” (Eco-Label) defined criteria for certification as:

- 24-hour service and accessibility
- A fee-structure which encourages clients to drive only when necessary – a pay-as-you-drive structure with no free mileage allowed
- Environmentally friendly vehicles are encouraged as at least part of the fleet

The first “Blue Angel” eco-labels for car sharing have been awarded to Bremen, Halle, Berlin-Hamburg and Göttingen, and should stimulate the market. Certification also helps solve the legal problems related to giving over dedicated public space to reserved parking for car sharing.



access to electric vehicles for getting around in the City centre. Features of the system include automatic booking from remote locations, service sixteen hours a day, and permission to drive in bus lanes and any limited access area (ZTL) in the City. Access to the vehicles will be via a smart card with a PIN code, as with Bremen's scheme.

Palermo will use zero emission vehicles for car sharing; 54 small electric cars have been purchased for this purpose (Fiat Seicento Elettra and Citroën Berlingo Electricque). The scheme is designed to support a fleet of over 100 vehicles, implemented in three phases. Furthermore, photovoltaic cells will deliver some of the electricity without CO₂ emissions.

LONDON

The London Boroughs of Camden and Southwark are using the car sharing experience of Bremen to check the suitability of car sharing as an option for their communities. In 1998, Sutton hosted the national launch of Green Transport Week with a seminar and exhibition of zero and low emission vehicles. A town centre car park was temporarily turfed with grass to show delegates and residents how space normally given to cars can be beautiful again. Bremen displayed one of their cars to show how car sharing can free up space for everyone's benefit. In 1999, Camden hosted a seminar of the European Car Free Cities network, noting the experience of Bremen and the new scheme in Edinburgh.

COVENTRY

Coventry will introduce a car sharing scheme later in 2000, recognised by the UK Department of the Environment, Transport & the Regions (DETR). System design has been planned in cooperation with a local car sharing company called Smart Moves Ltd. The company hopes to sell their expertise and gain contracts to set up car clubs.

In 1999, Coventry sponsored the Second National Conference on car sharing held in the City. Positive experience and public notice of this conference set in motion the Earlsdon Car Share Club in suburban Coventry.

Other ZEUS cities

Copenhagen is following the Bremen ZEUS car sharing experience with great interest and the car rental company Hertz started to build a car sharing scheme in Copenhagen and three other Danish cities in 1998. 600 members share 52 cars. *Stockholm* is planning a car sharing scheme using the existing municipal fleet, including low emission vehicles. Demand for municipal fleet vehicles is mainly on working days whereas the main demand for private use of car sharing vehicles is in the evenings and at weekends. Currently, the locations for keeping cars available for private use are being defined and other organisational questions clarified.

Stockholm recently organised a workshop on car sharing with the participation of the business director of StadtAuto Bremen.

LEFT: A CAR PARK IN SUTTON WAS TEMPORARILY TURFED WITH GRASS TO SHOW HOW SPACE GIVEN TO CARS CAN BE TURNED INTO A GREEN AREA. RIGHT: MAYOR OF PALERMO GIVES THE CAR SHARING SCHEME A TRY.



Costs	Due when	Minimum	Typical	Maximum	Remarks
Fixed					
admission	upon admission	free	51 to 77 Euro	128 Euro	
investment/ deposit	once at time of admission	153 Euro	409 to 512 Euro	614 Euro	reimbursed upon cancellation of membership
membership/ ongoing access to cars	monthly to yearly	free	61 to 123 Euro	294 Euro per year	
Use-dependent					
booking	for each booking	free	free	1 Euro	
distance travelled	for each journey	0,10 Euro	0.15 to 0.26 Euro	0.36 Euro per km	for small buses and transport vans
time	for each journey	1 Euro	1.5 to 2.5 Euro	4.60 Euro per hour	more for small buses and transport vans

TYPICAL CAR SHARING CHARGES IN EURO

IS CAR SHARING AN OPTION FOR YOUR CITY?

While car sharing may not be suitable for all cities, it often works as a lower emission, low energy alternative to the private vehicle. Car sharing may be introduced on a small or large scale, in a variety of forms. Some key issues involving the decision to invest in car sharing are noted below.

PUBLIC OR PRIVATE?

Car sharing may be operated by a local authority or a private concern, and can be open to the general public or restricted to a specific group of people. It may or may not receive a subsidy from public authorities. The most effective choice varies by city and depends upon a variety of framework conditions, including other transport options, land ownership and property rights, liability issues, and local regulations.

COSTS AND FINANCING

Car sharing can operate successfully under market conditions, with no public subsidies. However, public financial support may be required in the early stages of

implementation to ensure rapid and steady growth. This is because car sharing offers an economical alternative for private car users. Giving up a private car saves fixed costs, which according to the type of vehicle vary from 300 to 1 000 DM (153 to 510 Euro) per month. Typical car sharing charges are noted above.

TAXES, REPAIRS AND MAINTENANCE

The costs of taxes, repairs and servicing are usually included in the user charges. Exceptions are repairs needed after accidents for which the driver was at fault, which often demand an additional contribution. Some car sharing organisations give members the chance to clean the cars themselves. These members then receive a credit note. Most car sharing organisations in Europe offer a vehicle maintenance standard which includes a maximum mileage of 100 000 km, bi-weekly checks of the physical and technical condition of the cars, and timely resolution of customer complaints. ECS car sharing organisations also offer a mobility guarantee: in case of breakdown or accident, the cost of the onward journey (by rail or taxi) is covered.

INTEGRATION WITH DIFFERENT OPERATORS FOR INTERMODAL CHAINS

Most cities with a well-developed public transport system will wish to use car sharing as a mobility complement rather than developing a competing mode. Cooperation between car sharing and public transport may be formal and direct, or less formal. Public transport companies may be efficient administrators for car sharing due to their experience with maintenance garages and staff, and having headquarters that may serve as booking centres. Cooperation could be in the form of common public awareness campaigns or public relations. Finally, an innovative programme offering combined car sharing membership and public transport tickets is discussed in the section of this report dealing with intermodal interchanges.

LOW EMISSION VEHICLES FOR CAR SHARING

Within ZEUS, Bremen hosted an international expert seminar on car sharing. The number of participants was limited to allow an intensive exchange of ideas. The 40 participants came from various countries – not only from ZEUS cities but also from other countries, including the USA. Much discussion centered on the use of alternatively fuelled vehicles in car sharing fleets. Our experience with alternatively fuelled vehicles is that

they can supplement, but not replace, conventional vehicles as long as the costs, vehicle performance, range and boot space compares badly with conventional cars. This is because cars are used intensively and their reliability of service and performance must be guaranteed.

Electric vehicles used for car sharing cannot be booked as soon as they are returned, as the battery may have to be recharged. Therefore, systems relying on electric cars may need more vehicles and locations to serve the same user needs as with conventional cars.

For cities without an existing car sharing scheme, it may be more appropriate to begin car sharing with conventional vehicles, then add low emission vehicles as experience is gained with car sharing and its logistical issues of booking, servicing, accessibility, and billing.

► Summary recommendations

CAR SHARING

1. Car sharing can provide mobility and efficiency at a low capital cost

and may therefore be an ideal complement to public transport systems. Car sharing can help retain passengers on public transport, deter people from buying their own private car, and reduce land use for parking, especially in residential areas.

2. Car sharing can work in a variety of administrative forms

Schemes may be open to the general public or restricted to public fleet users, and may be run by public or private operators. The most efficient administrative form depends on the city.

3. Harmonised booking systems across cities and countries

are important to the success of

car sharing, which must maintain high standards of service, accessibility, and reliability. Examples of successful systems can be drawn upon, including the European ECS network. The standards of the German eco-label provide a benchmark for car sharing which serves both the market and the environment.

Fleet management

While fleet management was not a major issue within ZEUS, most vehicles were introduced within municipal and public transport fleets. Fleet management experience within ZEUS includes traditional fleet management "best practice" as well as the use of zero and low emission vehicles. Most ZEUS vehicles serve municipal fleets and not the public at large, although RME, ethanol, CNG, LPG and electric hybrid buses have been used in public transit systems in Bremen, Helsinki, London, Luxembourg and Stockholm as part of ZEUS.

FLEET MANAGEMENT TECHNIQUES

Fleet managers can achieve significant energy and emissions savings by applying best practice management to their fleet, even without using alternative fuels. Best practices include:

- Periodically, re-examine the existing fleet and the services it is expected to provide. How have the needs of the fleet changed in recent years? Are vehicles sitting idle for long periods? Any reduction in fleet vehicle numbers while providing the same level of service represents an environmental gain and a cost saving.
- Optimise routes and monitor vehicle use continually; this will increase the fuel efficiency of the fleet.
- Train drivers in fuel and energy efficient driving techniques. "Softer" acceleration and braking, and defensive driving, both save fuel and reduces accidents. Fuel savings for petrol vehicles can be 5% – 15% and maybe as high as 25% for other fuels like electricity.
- Make service and maintenance provision as efficient as possible, to reduce waste and down-time. One strategy may be to negotiate long term contracts with single vehicle suppliers which include service and maintenance provision.



TOP: OVER 30% OF STOCKHOLM'S MUNICIPAL FLEET RUNS ON ELECTRICITY, BIOGAS OR ETHANOL. BOTTOM: A CNG ADDITION TO SUTTON'S REFUSE FREIGHTER FLEET.



Planning for low emission fleets in Helsinki

Helsinki City Transport (HKL) operates buses, trams, the metro and the Suomenlinna ferry. HKL has introduced policies and guidelines that influence the operations and procurement of new buses. The City of Helsinki has approved a general policy that gives priority to environmental factors over economic issues in decision-making. In the mid 1990's, the Board of Public Transportation in Helsinki decided to gradually shift to gaseous fuels as much as possible in city centre bus operations. The HKL bus fleet consists of about 370 buses, of which 31 are alternatively fuelled. In 1998 and 1999, about one third of the new buses procured annually were powered by CNG.

HKL's activities have a significant impact on the air quality in Helsinki. Therefore, HKL has

established an environmental policy and an energy savings plan. HKL – Bus Traffic was the first municipal public transport company to receive an ISO 9002 quality certificate and an ISO 14001 environmental certificate in January 1998. HKL's environmental policy includes the following objectives:

- HKL is involved in developing and using clean fuels and propulsion technologies to the greatest possible extent
- HKL's own transport operations are as environmentally friendly as possible
- HKL personnel are aware of and motivated by environmental issues and sustainable development
- Supporting services (e.g. procurement, infrastructure) take environmental issues and sustainable development into account.

To achieve these objectives, concrete goals for bus traffic are as follows: NO_x and PM emissions/km will be decreased 5% annually, and bus noise must not exceed 78 dB. Also, the diesel fuel consumption per 100 km (50.4 litres in 1998) will be decreased by 1% annually. Actions to achieve these goals include driver training, procurement of fuel efficient and low emission buses, and fuel consumption monitoring. Participation in the National Energy Savings week, and awards to bus drivers with efficient driving habits also help to keep energy consumption down. HKL is also actively involved in both domestic and international projects, which support cleaner fuels, lower energy consumption and new technologies for more sustainable transport.

ZERO AND LOW EMISSION VEHICLES IN FLEETS

WHY LOW EMISSION VEHICLES MAY BE WELL SUITED TO PUBLIC FLEETS

Zero and low emission vehicles are often well suited to public fleets, for several reasons. First, maintenance and refuelling for fleets is often provided at common, central locations, minimising costs for the provision of special refuelling or servicing infrastructure for alternatively fuelled vehicles. Also, in many European countries, public fleets are subject to increasingly stringent environmental standards; low emission, low energy vehicles may allow public fleets to maintain service levels while reducing emissions. Finally, as noted earlier, public fleets may be able to take advantage of regional and national subsidies for the

procurement of low emission vehicles. Low emission vehicles used in public fleets may also be easier to monitor for emissions and performance.

WHY LOW EMISSION VEHICLES MAY NOT BE WELL SUITED TO PUBLIC FLEETS

Throughout Europe, local authorities are under increasing pressure to provide superior mobility at low costs. This has forced many public transport authorities to reduce the cost of buying and running vehicles, or contracts to service public transit routes have been extended to private companies. Therefore, fleet operators may be reluctant to invest in alternatively fuelled vehicles which are often more expensive to purchase and for which maintenance and service needs may be difficult to estimate.

FLEET MANAGEMENT ISSUES IN ZEUS CITIES

In most cases, the procurement, maintenance and running costs of zero and low emission vehicles are covered by municipalities, or by municipal enterprises. Criteria for the selection of zero and low emission vehicles have been environmental rather than financial, though subsidies have been critical in order to minimise the added cost of buying them. The majority of procured buses are integrated within the existing transportation network without any design that could employ the special features of these vehicles. Despite pressures to cut costs, most ZEUS cities plan to expand their alternatively fuelled vehicle fleets, because these vehicles often offer the only solution to fleets required to reduce emissions while maintaining service levels. In addition, these vehicles can be used in sensitive urban areas where pollution threatens to destroy older buildings and infrastructure. In some cases the vehicles are quieter, as with most electric vehicles. In Stockholm, quieter biogas refuse freighters allow the local waste service company to work during hours earlier forbidden due to noise problems. Hybrid vehicles that can be run solely on low emission fuels in the inner city are also attractive fleet options for many European cities.

The ZEUS experience suggests that fleets may be an ideal environment to test and introduce zero and low emission vehicles. Fleets can achieve significant emission reductions, and vehicles are kept within a controlled environment for refuelling and maintenance. However, fleet managers may find it more effective to first employ a range of traditional management techniques before adding less polluting, low energy vehicles to the fleet.

CNG or diesel for refuse freighters in Sutton?

Sutton has been using five CNG freighters in the refuse collection service. Unfortunately, the CNG freighters were out of service for long periods in 1999, often due to delays in obtaining spare parts. This is particularly inconvenient and costly for a local authority, which must keep the service going even when vehicles break down. Sutton was forced to hire in external vehicles to cover long periods of downtime, and delayed selling older, "surplus" vehicles to cover for the increased chance of breakdown among the new CNG freighters. Overtime claims from the refuse contractor, for time spent repairing vehicles, also mounted. This put a financial burden on the fleet operator. Also, the limited number of fuelling points leads to delays for other CNG users, who may have to wait up to 40 minutes to refuel. This has added about 45 minutes to the daily shift of refuse crews. Early in 2000, the Borough decided to purchase modern diesel vehicles during the next purchase period so that comparisons between diesel and CNG freighters are possible. This dilemma illustrates barriers not necessarily related to the new vehicle technology, but rather to the lack of spare parts and adequate infrastructure. Also, maintenance time will have to be cut to make these vehicles more suitable for an essential urban service like refuse collection.

► Summary recommendations

FLEETS IN URBAN TRANSPORT PLANNING

1. When combining fleet applications with alternative fuels

choose reliable models that can withstand constant use and a variety of users. This may mean only limited use of alternatively fuelled vehicles, until these vehicles have better developed technology.

However, CNG, LPG, biogas, ethanol, electric, and RME vehicles are all being used in ZEUS fleets successfully.

2. Fleets are especially sensitive

to operations and capital cost implications of new vehicles. Therefore, policies that support or regulate their use are important to their success.

3. Fleets can be appropriate testing grounds

for zero and low emission vehicle technologies. However, do not dismiss the gains that can be made using traditional fleet management best practice.

Annexes

GLOSSARY

AFTERMARKET

In this report, refers to the market for used vehicles

ALTERNATIVE FUEL

In this report, defined as fuels that can be used to replace petrol or diesel. Alternative fuels in ZEUS are ethanol, (pure or mixed with gasoline or other fuels), CNG, biogas, LPG, RME and electricity

ALTERNATIVE FUEL VEHICLE

Any vehicle fuelled or powered by the alternative fuels described above

AVL-SATELLITE AUTOMATIC VEHICLE LOCATION

a system used to externally monitor vehicle locations

BATTERY CAPACITY

Amount of electrical energy stored in a battery, expressed in ampere-hours

BI-FUEL VEHICLE

A vehicle with two separate fuel systems designed to run on either an alternative fuel or conventional fuel, using only one fuel at a time (see also Flexible fuel vehicle and Multi fuel vehicle)

BIODIESEL

Automotive fuel consisting of esterified vegetable oils like rapeseed methyl ester

BIOGAS

A methane gas derived from renewable sources such as organic waste

C

Carbon

CAR SHARING

Car sharing (often through a City Car Club) is the organised sharing of car ownership. (see also ECS)

CATALYTIC CONVERTER

Component of a vehicle's exhaust system that uses a

catalytic reaction to chemically change harmful exhaust products into less harmful gases

CCM

Cubic centimetres

CHARGING

See Recharging

CLEAN THERMIC ENGINE

Any combustion engine releasing heat, only zero emission if running on hydrogen

CNG

Compressed Natural Gas

CO

Carbon monoxide

CO₂

Carbon dioxide

COMPRESSOR

Mechanical device used to increase the pressure of gas

CONVERSION

In this report, the process of converting a vehicle originally configured to use petrol or diesel to use another fuel. Also called a converted vehicle

DME

Di-methyl ether

DUAL FUEL VEHICLE

A vehicle running on a combination of alternative fuels such as natural gas and diesel – typically with two separate fuel systems that inject both fuels simultaneously into the engine fuel chamber

E85

A blend of 85% ethanol and 15% petrol

EC

European Commission

ECS

European Car Sharing network, serving over 50 000 members in 300 cities and towns across Europe

EMF

Electric Magnetic Field

ENERGIE

An energy research, technological and demonstration programme supporting projects contributing to sustainable development, jointly managed by the European Commission's Directorates General VII and XVII

ENERGY DENSITY

A batteries rated energy per unit volume, measured in units of watt-hours per liter (WH/l)

ETHANOL

An alcohol compound; C_2H_5OH , similar to methanol (CH_3OH)

EU

European Union

EURO STANDARDS (1-5)

European Union exhaust emissions limits

FLEXIBLE FUEL VEHICLE

A vehicle with two separate fuel systems designed to run on either an alternative fuel or conventional fuel, using only one fuel at a time (see also Bi fuel vehicle, Multi fuel vehicle)

GIS

Geographic Information System

GJ

Gigajoule; unit of energy; $1 \text{ GJ} = 1 \times 10^9 \text{ Joule}$

GPS

Global positioning system that can pinpoint vehicles and transmit location information to a passenger or driver information system

HC

Hydrocarbon

HYBRID VEHICLE

Vehicles that have two or more sources of energy. Within ZEUS, hybrid diesel/electric and ethanol/electric buses were used

H_2

Hydrogen in its molecular form – gas or liquid

INFRASTRUCTURE

Everything except the vehicle itself that is necessary for the utilisation of vehicles, including the fuel distribution network, access to parts, and maintenance and service facilities

ISO 9002

For certification of a company's quality system. An independent body determines if the organisation's quality system meets the requirements of one of the international standards, ISO 9001, ISO 9002 or ISO 9003

LOW EMISSION VEHICLE

In this report, defined as a vehicle with exhaust emissions lower than comparable petrol and diesel vehicles

LPG

Liquefied petroleum gas which consists mainly of propane (C_3H_8) and/or butane (C_4H_{10})

MIRA

Motor Industry Research Association

NiCd

Nickel cadmium, used for batteries in some electric vehicles

Nm^3

Norm cubic meters. $1 Nm^3 = 4 \text{ L}$ (water volume equivalent)

NO_x

Nitrogen oxides

OZONE

Tropospheric ozone (smog) is formed when volatile organic compounds (VOC), oxygen and NO_x react in the presence of sunlight. Though beneficial in the upper atmosphere, at ground level, ozone is a respiratory irritant and considered a pollutant

PHOTOVOLTAIC

Photovoltaic technology is used to transform solar energy into electric energy

PM

Particulate matter; airborne particles, such as soot and dust

POWERSHIFT PROGRAMME

Vehicle monitoring project that investigates obstacles to sustainable markets for alternatively fuelled vehicles in the UK

PURPOSE BUILT VEHICLE

A vehicle produced by an original equipment manufacturer and designed so that the vehicle may be propelled by a specific propulsion system

RECHARGING (OR CHARGING)

The process of providing electricity to storage batteries in electric vehicles. Slow recharging can provide about enough power to drive a car ten kilometres in one hour; semi fast recharging can provide the same amount of power in 5 – 10 minutes, and fast or rapid recharging in one minute

RME

Rapeseed methyl ester, an esterified form of rapeseed oil

SOLAR RECHARGING

Recharging electric vehicles using electricity generated from photovoltaic cells (see also photovoltaic)

TANK TO WHEEL

Vehicle exhaust emissions only, fuel generation not taken into account

THC

Total hydrocarbons

THERMIE

A programme within the European Commission's Directorate-General for Energy and Transport, promoting the rational and efficient use of energy for housing and transport (see also ENERGIE)

WELL TO WHEEL

From the entire chain of fuel production and use in vehicles. In this report, principally tail pipe emissions plus fuel generation emissions

VOC

Volatile organic compound, which contribute to depletion of the ozone layer

ZERO EMISSION VEHICLE

In this report, defined as a vehicle with no exhaust emissions

ZEUS

Zero and low Emission vehicles in Urban Society

CURRENCY RATES

of exchange used in this report.

The table below notes national currency per 1 Euro. SEK, GBP, DKK, and GRD are calculated as an average for the first two months of 2000. Other EU member state currencies have a fixed exchange rate against the Euro (since January 1999). Except where indicated, prices in this report have been rounded to the nearest ten or one hundred Euro.

Year	SEK	GBP	DKK	ITL	DEM	FRF	BEF	FIM	IEP	LUF	NLG	ATS	PTE	ESP	GRD
2000	8,6	0,62	7,45	1936	1,96	6,56	40,34	5,95	0,79	40,3	2,2	13,8	200,5	166,4	333,4

ATS	Austrian schilling
BEF	Belgian franc
DEM	German mark
DKK	Danish krone
ESP	Spanish peseta
FIM	Finnish mark
FRF	French franc
GBP	Pound sterling
GRD	Greek drachma
IEP	Irish pound
ITL	Italian lira
LUF	Luxembourg franc
NLG	Dutch guilder
PTE	Portuguese escudo
SEK	Swedish krona

COUNTRY ABBREVIATIONS

Greece	– GR
Italy	– I
Germany	– D
Sweden	– S
Finland	– SF
Denmark	– DK
Luxembourg	– L
United Kingdom	– UK

ZEUS VEHICLE LIST

City	Vehicle type	Fuel	Manufacturer	Model	Engine size	Total number of vehicles	Number monitored	Test results
Sutton	Car/Van	Electric	Citroën	Berlingo	28kW	9	5	SU1
	Car	Electric	Peugeot	106	20kW	5	5	SU2
	Car	Electric	Peugeot	106	20kW	2	0	
	ForkliftTruck	Electric	?	?	?	1	0	
	Car/Van	CNG	Ford	Courier	1.3litre	16	15	SU3
	Van	CNG	Ford	Transit	2.0	24	18	SU4
	Minibus	CNG	Iveco	Turbodaily	2.5	17	18	SU5
	Refuse truck	CNG	Dennis	Eagle	6.0	5	5	SU6
Stockholm	Car	Ethanol/petrol		Ford	Taurus FFV	3	23	23 ST1
	Bus	Electric/Scania Ethanol hybrid		DAB	2.3/ 75kW	6	0	
	Car	Electric	Fiat	Seicento	30kW	6	6	ST2
	Car	Electric	Citroën	Berlingo	28KW	3	3	ST3
	Car	EL	Renault	Clio	20KW	38	37	ST4
	Car	EL	Renault	EL-Express	21KW	10	10	ST5
	Car	Biogas/petrol	Volvo	855 HGV S70 and V70	2.5	92	71	ST7
	Car	Biogas	BMW	316 G Compact	1.6	58	58	T8
	Transporter	Biogas	VW	Transporter	2.5	19	20	ST9
	Van	Biogas	VW	Caddy	1.6	19	19	ST10
	Car	Biogas	VW	Golf/Golf 3D	1.8	15	15	ST11
	Car	Biogas	BMW	518G	1.8	10	10	ST12
	Minibus	Biogas	VW	Caravelli/Transporter	2.5	7	6	ST13
	HGV	Biogas	Scania	114	11	1	1	ST14
	HGV	Biogas	Volvo	F7	7	2	0	ST15
Southwark	Car	LPG	Ford	Mondeo	1.8L	1	0	SO1
	Car	LPG	Ford	Escort	1.4L	8	4	SO2
	Car	LPG	Vauxhall	Combo	1.4L	53	43	SO3
	Car	LPG	Ford	Focus Estate	1.8L	5	0	
	Van	LPG	Ford	Transit		69	18	SO4
	Car	Electric/petrol	Toyota	Prius		1	0	
	Car	Electric	Peugeot	106	20KW	5	1	SO5
	Van	Electric	Citroën	Berlingo	28KW	4	1	SO6
Palermo	Car	Electric	Fiat	Seicento	30KW	88	5	PA1
	Van	Electric	Citroën	Berlingo	28kW	7	0	
	Car	CNG	Various	Panda		210	0	
	Bus	CNG	Breda Menarini			11	8	PA2
Merton	Van	CNG	Ford	Courier	1.3	13	9	ME1
	Refuse truck	CNG	Iveco	B469TCNGMT	9.5	7	5	ME2
	Minibus	CNG	Iveco	59.12	2.8	5	3	ME3
	24 seat							
	Van	CNG	Ford	Transit	2.0	1	1	ME4
	Car	CNG	Ford	Mondeo /Ultima	2.0/2.3	3	2	ME5
Minibus/ Van	CNG	Iveco	49.10	2.8	16	13	ME6	
Luxembourg	Bus	RME	MAN	SG242	10.0	6	6	LU1
	Bus	RME	DB	0405NG	12.0	6	6	LU2
	Bus	RME	MAN	A11/NG312	12.0	8	8	LU3
	Bus	RME	DB	0405N	12.0	5	5	LU4
	Bus	RME	MAN	NL202	6.9	7	7	LU5
	Bus	RME	DB	0405N2	12.0	9	9	LU6
	Bus	RME	MAN	A10/NL202	10.0	4	4	LU7
Helsinki	Bus	LPG	Volvo/MAN	B10M(Volvo)	12litre,177kW	5	5	HE1
	Bus		Volvo	B10L	10litre,180kW	11	0	

ZEUS VEHICLE LIST

City	Vehicle type	Fuel	Manufacturer	Model	Engine size	Total number of vehicles	Number monitored	Test results
Coventry	Van	LPG	Ford/LDV	Transit/Convoy	2.0l	84	0	
	Car	Electric	Peugeot	106	20kW	7	6	COV1
	Van	Electric	Peugeot	106	20kW	2	2	COV2
	Van	Electric	Citroen	Berlingo	28kW	3	2	COV3
	Van	Electric	Peugeot	Partner	28kW	8	8	COV4
Copenhain	Car	Electric	Citroen	Saxo	20kW (max)	19	19	COP1
	Van	Electric	Citroen	Berlingo	28kW (max)	25	23	COP2
	Street cleaners	Electric	Taylor Dunn			6	6	
Camden	Van	LPG	Ford	Escort 55	1.4	4	4	CA1
	Car	LPG	Ford	Escort estate	1.8	3	2	CA2
	Van	LPG	Ford	Transit 100	2.0	9	9	CA3
	Van	LPG	Ford	Transit 150	2.0	1	1	CA4
	Van	LPG	Ford	Transit 190	2.0	4	4	CA5
	Car	LPG	Ford	Fiesta Courier		1	1	CA6
	Car	Electric	Peugeot	106	20kW	5	5	CA7
	Van	Electric	Peugeot	106	20kW	5	5	CA8
	Van	Electric	Citroen	Berlingo	28kW	5	3	CA9
Bremen	Bus	Diesel/electric	Neoplan	N4121	191kW	1	1	BR1
	Bus	Diesel/electric	Neoplan	N4121	205kW	1	1	BR1
	Van	CNG	Ford	Courier	1.3	15	17	BR2
	Car	CNG	Opel	Astra	1.6	17	9	R3
	Van	CNG	Opel	Combo	1.3	2	0	
	Car	CNG	Ford	Fiesta	1.3	15	13	BR4
	Minibus	CNG	Mercedes	Sprinter	2.3	8	3	BR5
	Van	CNG	Ford	Transit 100	2.0	1	0	
	Van	CNG	Ford	Transit 150	2.0	3	1	BR7
	Car	CNG	BMW	316G	1.6	5	1	BR8
	Car	CNG	Ford	Escort	1.3	4	4	BR9
	Car	CNG	Volvo	V70	2.5	3	1	BR10
	Van	CNG	VW	Transporter T4	2.0/62kW	2	1	BR11
	Van	CNG	VW	Caddy	1.4	3	3	BR12
	Car	CNG	VW	Golf		1	0	
Car	CNG	VW	Polo Variant		1	0		
Car	CNG	Mercedes	S 230	2.3	1	0		
Car	CNG	Mercedes	E 230	2.3	2	2	BR13	
Athens	Car	Electric	Fiat	Seicento	30	15	0	
	Bus	CNG	Neoplan	N4416			2	0

OTHER ZEUS PUBLICATIONS

The following publications are available:

FLEETS, CAR SHARING AND PARK&RIDE

Full report and summary

NATIONAL INCENTIVES AND BARRIERS TO CLEANER MOBILITY

Full report and summary

LOCAL INCENTIVES AND BARRIERS TO CLEANER MOBILITY

Full report and summary

TELEMATICS FOR TRANSPORT

Full report and summary

VEHICLE PERFORMANCE

Full report

COORDINATED PROCUREMENT OF ELECTRIC VEHICLES

Full report and summary

USER ACCEPTANCE

Full report and summary

REFUELLING INFRASTRUCTURE

Full report and summary

VEHICLE AND FUEL EVALUATION

Special issue

TRAVEL LOW ENERGY

Brochure

see also

www.zeus-europe.org

NOTICE TO THE READER

Extensive information on the European Union is available through the EUROPA service at internet website address <http://europa.eu.int/>

The overall objective of the European Union's energy policy is to help ensure a sustainable energy system for Europe's citizens and businesses, by supporting and promoting secure energy supplies of high service quality at competitive prices and in an environmentally compatible way. European Commission DGXVII initiates, coordinates and manages energy policy actions at transnational level in the fields of solid fuels, oil & gas, electricity, nuclear energy, renewable energy sources and the efficient use of energy. The most important actions concern maintaining and enhancing security of energy supply and international cooperation, strengthening the integrity of energy markets and promoting sustainable development in the energy field.

A central policy instrument is its support and promotion of energy research, technological development and demonstration (RTD), principally through the ENERGIE sub-programme (jointly managed with DGXII) within the theme "Energy, Environment & Sustainable Development" under the European Union's Fifth Framework Programme for RTD. This contributes to sustainable development by focusing on key activities crucial for social well-being and economic competitiveness in Europe.

Other DGXVII managed programmes such as SAVE, ALTENER and SYNERGY focus on accelerating the market uptake of cleaner and more efficient energy systems through legal, administrative, promotional and structural change measures on a trans-regional basis. As part of the wider Energy Framework Programme, they logically complement and reinforce the impacts of ENERGIE.

The internet website address for the Fifth Framework Programme is <http://www.cordis.lu/fp5/home.html>

Further information on DGXVII activities is available at the internet website address <http://europa.eu.int/en/comm/dg17/dg17home.htm>

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