European Commission

New Solutions in Energy Utilisation

Electric Vehicle Deliveries in Postal Services

Final Report

ENERGIE

ENERGIE

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F I N A L   R E P O R T

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January 1998 – December 2000

EVD-POST

Electric Vehicle Deliveries in Postal Services

TR 0140/97

A project for the Rational Use of Energy in Transport jointly conducted by

Deutsche Post
Posten Sverige
Finland Post
Easy Km
Elcat
City of Turku
La Poste
Belgian Post Group
CITELEC

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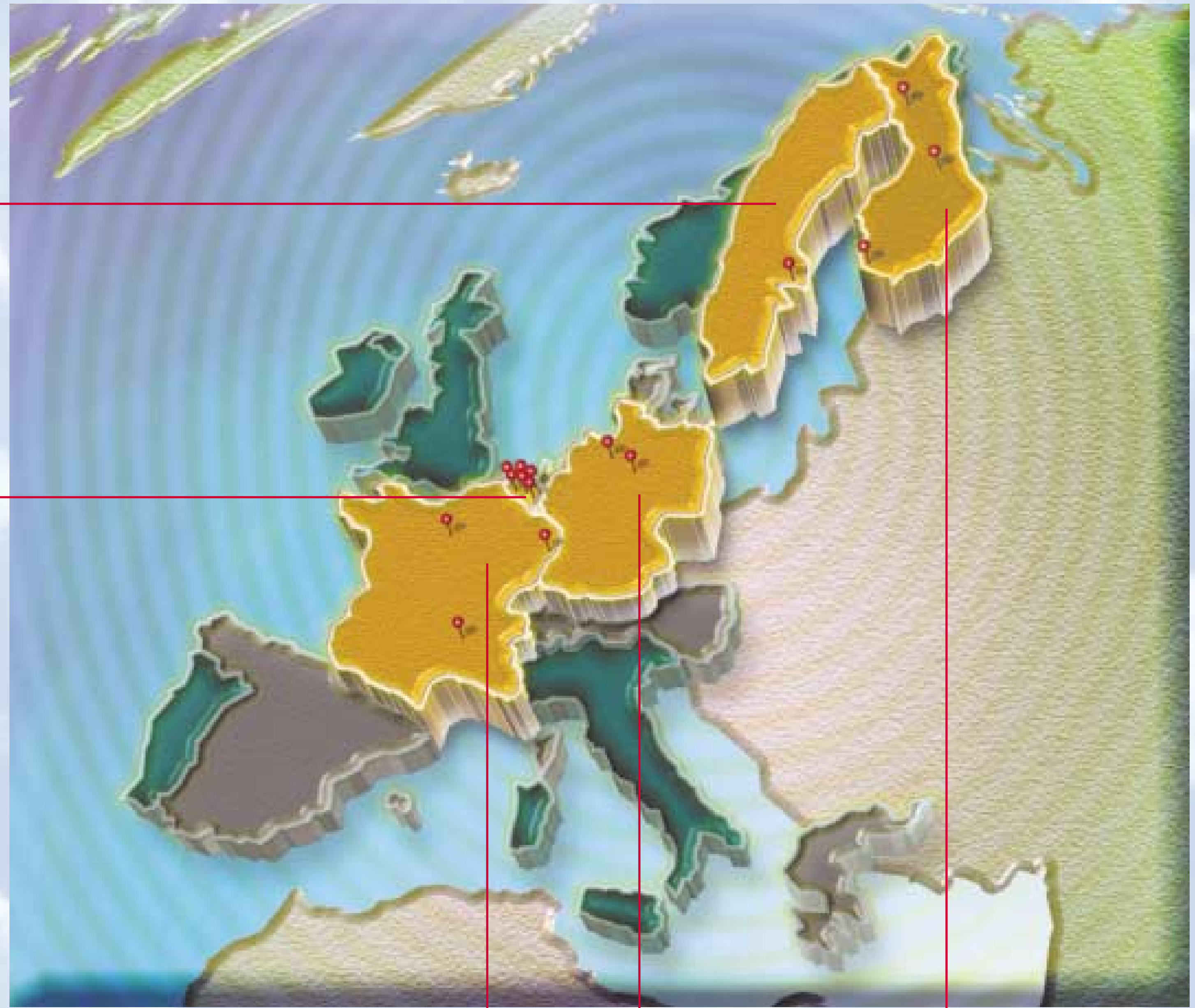

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Posten Sverige	SE
Finland Post	FI
Easy Km	FI
City of Turku	FI
Elcat	FI
La Poste	FR
Belgian Post Group	BE
CITELEC	BE

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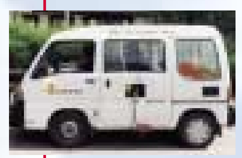


Executive Summary

Air pollution from road traffic has become a focal issue of concern for urban areas throughout Europe. With growing traffic volumes and congestion problems, effective and viable solutions are called upon to ensure the future mobility of passengers and goods. Electric vehicles (EVs) that can operate emission-free in city centers and other sensitive areas can play a major role in this process. Among commercial transport operators, postal services constitute an important potential user group for these vehicles.

The overall objective of the EVD-POST project was to demonstrate the technical and economic viability of EVs in the regular operations of postal services in Europe. It is expected that a successful performance in the particularly demanding stop-start operating cycles of postal deliveries will provide a strong recommendation to other operators for the use of EVs. In this sense, EVD-POST was set up to address the following objectives:

1. to test advanced battery technologies under different operating and climatic conditions;
2. to compare different battery systems with regard to technical and economic criteria;
3. to establish a comprehensive knowledge of electric vehicles and battery types in Europe;
4. to promote the wider use of electric vehicles in postal services and other applications.

The project involved five postal organisations from Germany, Sweden, Finland, France, and Belgium, three non-postal partners from Finland including the City of Turku as a further EV operator, CITELEC, the association of cities interested in electric vehicles, and a group of five observers comprising the postal services from the UK, Portugal, Italy, Ireland, and Norway. The project was coordinated by Deutsche Post in Bonn, Germany.

A total of 59 EVs were deployed among the six operators between 1998 and 2000. During the initial year, 49 vehicles were deployed in France, Belgium, and Finland. These vehicles are standard models operated with established battery systems, i.e. Nickel-Cadmium and Lead-Acid, and thus could be procured directly from the market. The vehicles of Posten Sverige entered into service during the first half of 1999, bringing the total number of vehicles in the project to 54. Finally, the 5 EVs of Deutsche Post powered by the advanced Sodium-Nickel-Chloride (ZEBRA) battery system were deployed from late 1999 until fall 2000.

In the course of the project, the demonstration vehicles logged a total mileage of over 930,000 km. The average direct energy consumption was found around 45 kWh per 100 km, ranging from 35 to 60 kWh per 100 km depending upon the respective duty pattern and EV model. The associated primary energy consumption of the EVs was found 10-25% less than a petrol or diesel vehicle of the same size. Maintenance records showed no particular disadvantages in reliability against petrol or diesel models, though for some EVs the maintenance process had to be adapted or amended. Range limitations were usually not a problem as the vehicles had mostly been assigned to duties well within the performance limits of the respective EV model.

All in all, the project succeeded in verifying some principal merits of EV operations in postal and other delivery services, i.e. the provision of reliable transport services without adding to local air pollution and noise emissions. The vehicles were well received by both drivers and the general public, despite the impression of performance reductions against conventional petrol or diesel vehicles for some of the EVs, especially those powered by lead-acid batteries.

As for the newer battery technologies such as ZEBRA or the emerging Lithium-type batteries, these offer the promise of substantially higher performance but to date are still in the process of gaining sufficient maturity to have a true market impact. The fate of the Nickel-Cadmium battery, the other widely used battery type next to lead-acid, has recently become uncertain in light of an emerging directive on Cadmium use in automotive applications. This may imply a setback in the use of EVs depending on NiCd battery technology.

On the downside, EVs still show a remarkable lack of economic maturity epressed as high procurement costs, limited product diversity, and little or no aftersales support. Overruns in delivery dates and costs are a frequent experience rather than exceptions. This leaves EVs highly unattractive to potential users, especially those exposed to commercial competition.

Acquisition costs remain a key problem for a more widespread use of EVs in commercial services. On average, vehicle prices were around twice the cost for a corresponding petrol or diesel model. This difference was offset only in part, if at all, by lower operating costs.

In conclusion, despite the generally good performances of electric vehicles in demonstration projects, there are still substantial barriers for wider deployment that leave EVs - and indeed clean fuel technologies in general - ill-prepared to compete with the acting market champions petrol and diesel. Of the broad diversity of alternative drivetrain options under research, there are very few examples where technology advances are translated by vehicle manufacturers into commercialisation including serious product management, sales and aftersales support. Infrastructure deployments remain equally unfocused and further contribute to a general undermining of user confidence in clean fuel technologies.

Industrial parties, on the other hand, cannot be expected to continuously sponsor technical options without the prospect of commercial return. The apparent reluctance of most vehicle manufacturers, utility companies and fleet operators to extend the use of EVs or other clean fuel technologies beyond the stage of demonstration projects much reflects the dominating role of petrol and diesel cars in the present market situation. The challenge is for the public authorities to effect changes towards sustainable mobility by backing policy objectives with durable incentives that offer lasting and tangible economic benefits to clean fuel vehicles without obstructing existing transport operations. Such incentives may include subsidies or tax exemptions but should equally take into account the possibility of privileged access rights and times e.g. to reserved lanes and loading zones for clean fuel vehicles, as part of a comprehensive urban mobility management devised in consultation with the stakeholders.

1 PROJECT SCOPE

1.1 Promoting Sustainable Mobility

European cities are struggling with persistent increases in traffic volumes and congestion, and the subsequent degradation of local air quality from roadside pollution. Effective solutions to remedy the present situation, and ensure sustainable mobility for passengers and goods in the future, are demanded by transport stakeholders and the general public alike. Electric vehicles (EVs) that can operate in city centers and other sensitive areas with little noise and without creating hazardous emissions, might play a major role in this process.

Postal services constitute a major group of potential customers to employ EVs in commercial transport operations, given adequate performance and economy. Being dependent on reliable access to their customers, postal services have a vital interest to support sustainable mobility. Alternative fuel vehicles are but an integral part of this approach. Postal services provide an excellent platform to assess the true potential of such technologies, including EVs. Not only does successful performance in the the particularly demanding stop-start operating cycles of postal deliveries provide a strong recommendation to other operators. In addition, their broad variety of usage patterns usually allows postal services to arrange for operating environments designed to highlight the advantages and shortcomings of any new system. This provides vital feedback for improvement and encourages both development and fresh applications of the technology. In addition, the global everyday presence of postal services allows innovative vehicles to feature prominently in daily street life, thus attracting attention and increasing public awareness.

1.2 EVD-Post - a European Initiative

Following the experiences from various domestic trials of postal EVs, the EVD-POST (Electric Vehicle Deliveries in Postal Organisations) project was set up a concerted effort by postal services across Europe and was approved for funding under the Energy Programme of the European Commission.

The overall objective of the EVD-POST project was to demonstrate a set of light and medium electric vans with different traction battery systems in regular postal transport, with a view to testing performances under a range of operating and climatic conditions, and to assess the overall technical and economic viability of EVs for postal services in Europe.

The project involved five postal organisations from Germany, Sweden, Finland, France, and Belgium, three non-postal partners from Finland including the City of Turku as a further EV operator, CITELEC, the association of cities interested in electric vehicles, and a group of five postal observers from England, Portugal, Italy, Ireland, and Norway. The project was coordinated by Deutsche Post in Bonn, Germany.

Among the six operators, a total of 59 EVs were deployed in 15 sites between 1998 and 2000, comprising both standard vehicles with established battery systems readily available from the market, and new designs with advanced batteries seeing maiden commercial service.

EVD-POST formed part of the Transport Targeted Projects (TTP) cluster combining seven demonstration projects on the rational use of energy in transport, and also collaborated closely with ELCIDIS (Electric Vehicle City Distribution Systems), another demonstration project on commercial electric vehicles under the Energy Programme of the European Commission.

Links with the EU Energy Programme

„Energy, Environment and Sustainable Development“, or EESD, is one of the four thematic programmes of the 5th Research, Technology Development and Demonstration (RTD) Framework Programme of the European Commission (1998-2002). While objectives relating to energy, environment and sustainable development are reflected throughout the Framework Programme, the EESD specific programme focuses directly on a number of pressing environmental and energy concerns.

In order to meet the goal of the programme, a set of key actions identify targets and deliverables to be addressed through an integrated, multidisciplinary, problem-solving approach. The RTD activities associated with each key action should be seen as a coherent grouping of small and large, basic, generic and applied research

and demonstration activities directed towards a common European challenge or problem identified through the key action, not excluding global issues. Implementation of RTD activities is through calls for proposals launched according to a well-established time schedule.

The strategic goal of the ENERGIE part of the EESD specific programme is to develop sustainable energy systems and services for Europe and contribute to a more sustainable development world-wide, leading to increased security and diversity of supply, the provision of high-quality, low-cost energy services, improved industrial competitiveness and reduced environmental impact. Key actions in this area relate to cleaner energy systems, including renewables, and economic and efficient energy for a competitive Europe.

The EVD-POST project gratefully acknowledges the financial and political support received from the European Commission through the ENERGIE sub-programme and its predecessor, the JOULE-THERMIE programme.

Suggested links on the Internet:

http://www.evdpost.com
http://www.elcidis.org
http://www.thermie-transport.org
http://www.cordis.lu/eesd/home.html
http://europa.eu.int/comm/energy_transport/en/cut_en.html

2 ELECTRIC VEHICLES FOR THE POST

2.1 Historic applications

Electric vehicles are by no means unknown but indeed have a history of more than 100 years in the postal services. Experiments with EVs and even fleet deployments are recorded since the dawn of motorised postal transport in Europe in the late 19th century. Deutsche Reichspost in 1899 and French La Poste in 1901 were among the first services to introduce EVs in their respective fleets. In France, a second EV generation was deployed in 1904 but discontinued in 1912 in favor of petrol and diesel vehicles. In Germany, electric vehicles enjoyed a more successful development following a major trial in 1908–12 that resulted in the procurement of 57 EVs for postal duties in Berlin and Leipzig. The popularity of postal EVs in Germany continued to rise as new designs with improved reliability, lower energy consumption, and easier handling and maintenance became available. By 1930 for example, 696 out of 1,010 postal vehicles operating in and around Berlin were electric, i.e. nearly 70% of the local fleet. In 1938, the use of electric vehicles in Deutsche Reichspost reached its peak with 2,648 vehicles. In the following years though these numbers declined sharply as petrol and diesel vehicles gradually replaced the electrical units.

Despite several attempts between the 1940s and 1970s especially of La Poste and Deutsche Bundespost to revitalise the use of electric vehicles with more modern designs, none of these advanced beyond technical studies as the range and cruising speeds attainable with existing battery technologies consistently failed to match the rapid evolution of petrol and diesel vehicles in terms of performance, versatility, and economy.

A vision from 1899

„Gasoline vehicles are a complete failure. Although they fulfil all our expectations regarding the performance there is one major obstacle that must be overcome: the sickening odor from the burned gasoline. I can foresee that the cities will forbid their use if there should be any number of them running on our roads.“

Barton Peck
Car builder and motoring industry pioneer
Detroit MI, U.S.A.

2.2 Renewed interest

Interest in electric vehicles among postal services was renewed in the 1980s in the wake of growing problems and concern about traffic induced air pollution especially in urban areas, and the growing need for motorisation of postal deliveries to cope with increasing mail and parcel volumes. The principal problems experienced in previous decades, specifically limited performance, high battery weight, and prohibitive costs for procurement, operations and maintenance however persisted in respective trials of Deutsche Bundespost (1981), Royal Mail (1984–88), Finland Post (1980 and 1988–89), or La Poste (1990). Yet in the mid 1990s, emerging new battery technologies and vehicle designs promised a breakthrough to overcome the aforementioned drawbacks, and to provide a true alternative for professional fleet operators to conventional fossil fuel vehicles.

Initial tests of the Nickel-Cadmium (NiCd) battery conducted by La Poste with the Citroën AX and Renault Express in 1996, and by Belgian Post and Royal Mail with the Peugeot 106, showed quite promising results. Deutsche Bundespost meanwhile conducted a major project in 1995–98 with the Israeli Zinc-Air battery system, and demonstrated the technical feasibility of an electric van running distances of more than 400 km though the technology ultimately failed to deliver sufficient reliability and economy for routine fleet operations. In the Nordic countries, operators such as Posten Sverige or Finland Post kept relying on the inexpensive lead-acid technology that, despite its principal performance limits, proved quite suited for the application of light electric vehicles (LEVs) or small vans in the harsh Northern climate.

In 1996, a group of European postal organisations combined their respective domestic efforts with electric vehicles in a joint proposal to conduct the EVD-POST project, that was approved in 1997 for co-funding under the energy programme of the European Commission. Some of the postal partners and observers within EVD-POST in parallel also operate or test other clean fuels such as liquified petroleum gas (LPG) and compressed natural gas or biogas (CNG).

2.3 Key requirements

Vehicles to be considered for postal deliveries must comply with a broad set of requirements representing the diversity of corresponding tasks and surroundings. Between but also within postal services, these requirements may differ considerably. A payload capacity between 500 and 600 kg will be suitable for most delivery vehicles, however actual payloads on individual duties may vary from less than 50 kg to more than 1 ton. Likewise, the annual mileage may be anything between 10,000 to 25,000 km depending on the utilisation pattern of a given vehicle. Consequently, fleet procurement and management will usually aim to obtain vehicles with maximum versatility to best cover the respective user needs with a minimum of different types and sizes. This global objective applies equally to petrol and diesel vehicles and any alternative among the clean fuel vehicles, including EVs. In other words, electric vehicles would need to perform like a normal petrol or diesel car to be seriously considered by professional operators. Other key aspects in this direction relate to reliability, ergonomy, running costs including energy consumption and maintenance, and

the availability of leasing and full service arrangements.

Previous experiences however advise not to lightly assume EV designs present in the market or in research laboratories to be capable of matching one to one the vast competitiveness bred into petrol and diesel vehicles over the past decades. It is hence quite imperative for any serious and practical attempt at employing EVs or other alternative fuel vehicles in commercial operations to ensure optimum conditions by making certain concessions from standard practises, such as restricting operations to suitable niche applications or using a larger than normal vehicle.

Nevertheless, such concessions can only apply to pilot trials and must be taken into account when planning widespread adoption within professional fleets. Any such limitations against competing vehicles in the market must be compensated by other tangible benefits or gradually eliminated by applying the lessons of industrial vehicle design, development, production and marketing to this class of vehicles.

3 Germany

Deutsche Post

3.1 The Actor

Deutsche Post World Net is one of the largest and most powerful logistics companies in the world. With over 300,000 employees, the three power brands Deutsche Post, Postbank and Danzas generated a revenue of € 32.7 bn in 2000. Deutsche Post World Net offers comprehensive solutions for national and international customers. This includes worldwide mail, parcel, express and logistics services, innovative e-business solutions and a broad range of financial services. Deutsche Post World Net successfully went public in autumn 2000. The Aktie Gelb was quoted for the first time on 20 November, 2000.

3.2 The Vehicle

The Mercedes-Benz Vito 108 E employed by Deutsche Post is converted from conventional to electric drive at the DaimlerChrysler center for low emission vehicles (KEN) in Mannheim. Each vehicle is fitted with two units of the ZEBRA Sodium-Nickel-Chloride battery system. This advanced battery is characterised by its high operating temperatures of 260–340°C. The present model Z5C is produced since mid 2000 in Stabio, Switzerland, and has replaced the former Z5B series manufactured in Ulm, Germany and Derby, United Kingdom.

3.3 The Project

The original workplan of Deutsche Post devised in late 1996 called for the demonstration and testing of electric vans powered by the Zinc-Air battery system with energy contents of about 100 kWh per vehicle. Experiences gained in a domestic Zinc-Air project prior to the launch of EVD-POST however were discouraging, leading Deutsche Post in February 1998 to abandon this technology and launch into a search for other advanced battery systems. Promising results were obtained in intial tests with the ZEBRA Z5B system, which was adopted by Deutsche Post in September 1998 as chosen technology for its ongoing EV trials.

Mercedes-Benz 108 Vito E	
Manufacturer	DaimlerChrysler
Weight w/o batteries	1,760 kg
Weight with batteries	2,200 kg
Rated payload	600 kg
Rated top speed	135 kph
Rated range	90-130 km
Battery type	ZEBRA
Battery producer	MES-DEA
Regenerative braking	yes
Price w/o batteries	app. € 45,000
Price with batteries	app. € 85,000

Demonstration sites	
Bremen	3 vehicles
Bremervörde	2 vehicles
EXPO 2000, Hannover	

In October 1998, with final arrangements being made for the procurement of ZEBRA batteries by Deutsche Post, the manufacturer AEG Anglo announced the imminent closure of the main production facility in Ulm, Germany, due to withdrawal of its main investor. With the search by AEG Anglo for a new partner remaining unsuccessful, and continuity of battery supplies and services being compromised, the order for the batteries was eventually cancelled. Further market research for an advanced traction battery system was conducted in early 1999. The few systems found to possibly suit the specific requirements of Deutsche Post, however, were still in (pre-)prototyping stages or available only at prohibitive costs.

The acquisition of the vacant ZEBRA technology by MES-DEA, a major automotive supplier based in Stabio, Switzerland in March 1999 allowed the stalled activities at Deutsche Post to be restarted in accordance with the amended workplan. Deliveries were negotiated to include in 1999 two sets of handmade Z5B batteries from the Beta research facility in Derby, UK, and in 2000 another three battery sets of the new Z5C series from a newly constructed production line in Stabio. The batteries were to be delivered to Daimler Chrysler/KEN for integration into the Vito electric vans.

Deutsche Post received its first two MB 108 Vito E with Z5B batteries in November/December 1999 at the test site in Bremen, to start trials after a delay of 10 months against original plans.

Operations were first disturbed in January 2000 by a technical breakdown of Vito 2 caused by erroneous failure indications from the battery management system (BMS). Diagnostics, spare part acquisitions, and damage to one battery during testing at KEN forced the vehicle out of service for eight weeks. At the same time, MES-DEA announced delays of further deliveries due to problems with the new production line in Stabio.

A further technical failure occurred in February 2000. Vito 1 was out of service for about one week due to humidity problems in the Siemens motor inverter box. Problems with the initial vehicles gradually subsided, however, with increasing reliability succeeding in reclaiming lost confidence. Both vehicles were transferred to regular postal tours in and around Bremen, and between June and November were assigned to the postal service operated at EXPO 2000, the millenium world exhibition in Hannover.

As for the Z5C, MES-DEA reported in March 2000 further delays in the development of the associated new BMS. Problems were intensified by a lack of suitable testbeds to support the integration of the Z5C and the Vito electric van. Since no such vehicle could be acquired on short notice, Deutsche Post transferred its designated Vito 3 to Stabio in April to be used as temporary platform for the ongoing battery testing and BMS software development.

Vito 4 and 5, both fitted with Z5C batteries, were delivered in July 2000 to Bremen, finally allowing to begin tests with the new system. A score of teething problems sprang up in these tests, effectively keeping the vehicles out of postal operations as numerous modifications to the system were introduced at the test site. The situation essentially remained unchanged until September 2000 when both vehicles were ordered back to the KEN plant in Mannheim with a view to establish decisive modifications, specifically to the BMS.

Vito 4 and 5 from Mannheim and Vito 3 from Stabio were returned to Bremen in November 2000. The former problems could no longer be reproduced during initial test cycles, indicating a stable solution to have been found at last. The fundamental operational problems, apparently caused by the beta-version of the new BMS control software for the Z5C, have definitely been resolved with release of BMS v1.0 in February 2001.

All five Vitos that constitute the present EV fleet within Deutsche Post continue operations in the Bremen area to monitor long-term effects on vehicle performance and reliability.

Route characteristics	
BREMEN:	
Route type	urban/suburban
Distance	25 – 45 km
Stop-starts	50 – 250
Payload	120 – 500 kg
BREMERVÖRDE:	
Route type	residential
Distance	35 – 70 km
Stop-starts	200 – 350
Payload	100 – 550 kg

4 Sweden

4.1 The Actor

Posten AB is a state-owned, commercial company and one of Sweden's main employers. In 1999, Posten Sverige AB employed an average of 41,800 persons with a turnover of over 24 billion SEK. Posten AB's business concept is to offer clients means to communicate quickly, safely and cost-effectively via messages and goods, both physically and electronically. Posten AB serves 4.1 million households and 500,000 companies. Daily sales of products and services total 90 million SEK, and 22 million items of mail are processed per day. The delivery fleet on average comprises 5,900 motorised vehicles running 110 million km per year.

4.2 The Vehicle

The Club Car Carryall 2 is a light electric utility vehicle used in multiple roles for industrial and leisure applications including personnel carriers at airports and golf carts. Posten Sverige is using a modified version of the US-made base car with a purpose-built body from Walter Mauser Fahrerkabinen in Breitenau, Austria providing secure storage of letter containers in the rear, and easy access to mailboxes from the driver's seat.

Driving the vehicle is simple and straightforward. The high starting torque of the series motor gives good acceleration well suited for stop and go traffic. The maximum speed of the vehicle is limited, however, and the Carryall is not really to be considered a road-going vehicle. In the residential areas where it is deployed, this is presenting no problem however.

4.3 The Project

Posten Sverige originally intended to use electric vehicles with Zinc-Air battery systems as follow-up on a cooperative venture with Vattenfall and Deutsche Post. The results obtained in this project were discouraging, however, and Posten Sverige abandoned all activities with Zinc-Air in May 1998 to instead focus on the possible use of light electric vehicles (LEVs) as alternative to electric derivates from larger petrol or diesel vehicles.

Club Car Carryall 2

Manufacturer	Club Car
Weight w/o batteries	600 kg
Weight with batteries	780 kg
Rated payload	410 kg
Rated top speed	45 kph
Rated range	40 km
Battery type	Lead-Acid
Battery producer	Trojan
Regenerative braking	no
Price w/o batteries	app. € 10,000
Price with batteries	app. € 12,000

Demonstration sites

Nacka/Stockholm	5 vehicles

Many delivery tours operated by Posten Sverige in urban and residential areas can be served with LEVs despite their rather low speed and action radius. Their versatility also supports the introduction of design modifications aimed at increasing the overall ergonomy of the vehicle for postal operations involving some 400 stop-starts per day. Right-hand steering is mandatory for direct deliveries into kerbside mailboxes through the side window or door.

First tests with LEVs were to be carried out on an electric vehicle developed by a contractor in Trelleborg. 13 such vehicles were to be tested in different sites across Sweden. The prototypes were delivered for trials in autumn 1998, but as the company was subsequently unable to assure the quality of future deliveries of the vehicle, and at the same time raised prices by 25%, it was impossible to further pursue these tests.

Plans were also made in autumn 1998 to launch tests in Stockholm with a Mercedes-Benz 108 Vito E powered by ZEBRA batteries. After only a few months this proposal also foundered, it being impossible to obtain batteries from the supplier AEG Anglo in Ulm, Germany, which eventually terminated its activities in December 1998.

Posten Sverige had by now selected a supplier for future deliveries of light electric vehicles, and in early 1999 tests commenced with five Club Car Carryall 2 in Stockholm. The vehicles are used for daily deliveries in Nacka, a community of 56,000 inhabitants located about 8 km southeast of Stockholm. Its green location amidst lakes and sea lakes is making it a premier residential area of high affluence, mostly consisting of detached housing. The delivery routes to the villas are all on hills or hillsides, with paved roads accounting for only 10-50% of the total distance. The selection of these routes was made deliberately to seriously test the vehicle in hilly districts with a lot of 'stop-and-go' operations.

In the course of the project, some adaptations were made to increase the overall performance of the Carryall. Battery capacity was increased 40% by replacing the original 6 monobloc 8V batteries with 8 monobloc 6 V batteries. The standard on-board charger of simple design was replaced in one vehicle with a more sophisticated external C-pac charger taking into account the respective charging status of the battery. Tests suggested this device to halve charging costs for this particular vehicle. Some vehicles in hilly areas were also tested with 8" wheels instead of the regular 10" wheels to facilitate uphill starts on steeper slopes.

Further procurements since increased the number of Club Car LEVs to 200 within a total fleet of 500 electric 3- and 4-wheelers in service with Posten Sverige by late 2000.

Route characteristics

NACKA:	
Route type	residential
Distance	15 – 20 km
Stop-starts	350 – 450
Payload	70 – 150 kg

5 Finland

5.1 The Actors

Finland Post Corp. is the leading service company in Finland for the conveyance of messages and goods. The Post offers messaging and logistics services to companies, organisations and households in Finland, and to an increasing extent also internationally. In 2000, the Post conveyed a total of 2.6 billion postal items, and the number of personnel was 24,763. The net turnover of the Finland Post Group was FIM 6,355 million for an operating profit of FIM 547 million. Finland Post Group uses over 5,500 vehicles for delivery and transport, which cover approximately 100 million kilometres per year.

❑ Easy Km Ltd. (formerly PT Automotive Services Ltd.) is a subsidiary of Finland Post Group and owns the whole vehicle fleet used by Finland Post Corp., Sonera Group (former Telecom Finland), and Finnish Broadcasting Company. Easy Km has approximately 5,900 vehicles in total. In 2000 the net turnover amounted to FIM 368 million, of which 58 % was generated with the Group. The personnel totalled 347 at the end of 2000. Easy Km has 16 workshops in different parts of Finland that also offer repair services for various vehicle brands and models outside the Group.

❑ Fortum is one of the leading energy companies in the Nordic countries. Its business covers the entire energy chain, from production of oil, gas, power and heat to refining, distribution and marketing to energy related engineering, operations and maintenance. Fortum´s core expertise also covers environmental management issues and use of new technologies. Fortum Power and Heat Oy, one of four business units of Fortum Group, has a long tradition in research of electric vehicles also displayed in its ownership of Elcat, established in 1985 with the aim of developing a commercial electric vehicle for urban delivery traffic.

❑ The City of Turku is the oldest town in Finland. The origin of the city goes back to 1229 when Finland was still part of Sweden. The first university in Finland and third in Northern Europe was established there as early as 1640. Today, the City of Turku is the lively centre of South-Western Finland with 170,000 inhabitants, three universities, and modern business life.

Elcat Cityvan 200

Manufacturer	Elcat
Weight w/o batteries	1,030 kg
Weight with batteries	1,400 kg
Rated payload	285 kg
Rated top speed	80 kph
Rated range	60 – 70 km
Battery type	Lead-Acid
Battery producer	Oldham or Sonnenschein
Regenerative braking	yes
Price w/o batteries	app. € 20,500
Price with batteries	app. € 23,000

Demonstration sites

Turku	13 vehicles
Kajaani	2 vehicles
Rovaniemi	1 vehicle

5.2 The Vehicle

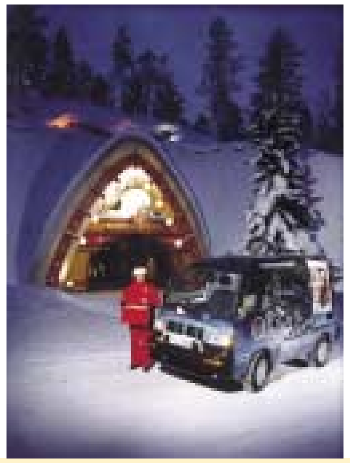
The Elcat Cityvan 200 adopted for EVD-POST Finland is the second generation model of its kind. The Cityvan builds on a conventional Subaru Domingo utility van converted to electric drive. Elcat has produced approximately 200 electric vans of the Cityvan type, all of which are circulating in normal traffic all over the world and have covered over three million kilometers in day-to-day commercial use.

The first commercial Elcat, Elcat Cityvan, was introduced in 1990, and production of its successor, Elcat Cityvan 200, began in 1995. The third generation, Elcat Cityvan 202, was introduced in August, 1999. The Cityvans deployed by Finland Post are equipped with right-hand steering to allow delivery into kerbside mailboxes directly from the vehicle.

5.3 The Project

Within EVD-POST Finland, Finland Post and the City of Turku both introduced EVs in their respective operations, allowing for a direct comparison of the vehicles in postal and municipal deliveries.

Finland Post leased 11 Elcat EVs, and put them into service between May and October 1998 using a new introduction method devised by the vehicle manufacturer. The vehicles were placed in two different climates, i.e. a coastal (Turku) and a continental site (Kajaani). The EVs are used in standard daytime mail delivery except for one vehicle in Kajaani running in a combination of early morning newspaper and subsequent mail delivery. One of the vehicles in Kajaani was later transferred to Rovaniemi near the Arctic Circle, where it is used for various transport duties at SantaPark, an amusement park with Christmas theme; also this EV was airbrushed in special SantaPark colours.



Driver Satisfaction Programme

The EV drivers in EVD-POST Finland were coached by the vehicle manufacturer Elcat using a special method termed 'Driver Satisfaction Programme'. The method was devised to ensure the EVs had the right routes and drivers, the drivers had proper training, and finally the motivation of drivers was kept up after the introduction. The expected result was that a trained and motivated driver would be willing and able to drive longer distances per charge, and due to adequate treatment the maintenance costs of that EV would decrease.

The Driver Satisfaction Method includes four phases:

1. Route design

This part is to verify by simulation the compatibility of tour and EV. A computer program (EV-Data) for testing the suitability of EV routes for the Elcat Cityvan 200 was completed in December 1997. EV-Data estimates the energy consumption [kWh] from the battery on the basis of given basic data, taking into account also the effects of slopes and snow.

2. Driver selection

A standardised selection procedure was devised to help foremen to choose the most able and motivated driver candidates. Experienced EV drivers of the Post were interviewed in order to define the profile of a good EV driver. The results of these interviews were incorporated in a standardised form sheet to assist in the actual driver selection process.

3. Driver training

The two-day training courses comprised lessons on environmental backgrounds, properties of electric vehicles in general, and the specific features of the Elcat Cityvan 200, as well as some practice sessions to help drivers familiarise with their new vehicles and develop an economic driving style. A training video was made to also teach temporary drivers acting as deputies for the regulars who did not participate in the training course.

4. Up-keeping of motivation

Driver satisfaction was reviewed in periodic feedback meetings to upkeep motivation after introduction of the EVs. The meetings also provided an important opportunity for the drivers to discuss with each other and share valuable hints related to an economic driving style, as the postal and municipal EV drivers in the project had not been able to meet each other after the training course. It appears that since the amount of EVs and EV drivers is very limited today, regular reunions among drivers but also with foremen, service staff, and management are of considerable importance for improving and upkeeping the drivers' motivation to drive EVs.

Public displays and regular participation of postal and municipal drivers in EV competitions such as the annual „1000 Lakes EcoRun“ in Jyväskylä also helped in maintaining driver skill and motivation.

The impacts of the Driver Satisfaction Programme were reviewed by a survey in winter 2000. Compared with other Elcat customers, the EVD-POST driver group turned out to be significantly more satisfied with the EVs, even if driving longer distances per day. This indicates clearly that the introduction method met its goals - to improve and sustain motivation and skill of the drivers, and increase vehicle performance and cost efficiency as improved treatment extends the range of the vehicles while reducing maintenance and repair efforts. The project showed that, when introducing new technology such as electric vehicles, adequate attention should be given to proper coaching of drivers and foremen, and the introduction method piloted in EVD-POST will be standard procedure in the future.

Another five EVs were acquired by the City of Turku under a three-year leasing contract for the use of five municipal units, i.e. Turku Energy Ltd., the Department of Environmental Protection, the Health Bureau, the Social Welfare Centre, and the Estate and Building Services. These vehicles were deployed in May 1998 and are being used in various roles including transport of internal mail, medicine, equipment and technicians, and upkeeping of parks in the city centre.

The plans for support measures included the installation of public charging stations and the provision of free access for zero-emission vehicles to certain restricted areas or street sections.

For political reasons, however, it turned out impossible to grant privileged access for EVs to areas closed for other motorised traffic. Eventually it was thus decided to retain only the charging stations as support measures.

Public charging stations in Turku

A special aspect of EVD-POST Finland was the setup of a public-private partnership (PPP) to offer a local network of public charging stations in and around the City of Turku.

Electricity and parking during the recharging period is free for all registered EV users at least for the time being, with each charging station comprising a power outlet and a special traffic sign. The stations are available to both EVs and electric bicycles.

A key aim of the activitiy was to demonstrate how cheap it is to implement a network of public charging stations under prevailing conditions in Finland. The costs for each of the wall-mounted charging stations of Finland Post were between € 250 and 420. The kerbside stations provided by the City of Turku were more expensive due to the need of roadworks, but at € 2,000 were still at reasonable price levels, especially when compared to infrastructure investments required for other clean fuel vehicles.

After negotiations in January 2000 with several organisations, an initial network of 15 public charging stations was implemented in the framework of EVD-POST:

City of Turku	3 stations
Finland Post	2 stations
Turku Airport	1 station
Prisma Supermarkets	3 stations
Turun Sanomat (regional newspaper)	2 stations
Eskelin Pysäköintilaitos (parking facility)	1 station
Scandic Hotel Marina Palace	1 station
Sokos Hotel Hamburger Börs	1 station
VR Group Turku (Finnish Railways)	1 station

Most of the charging stations are located in the city centre, except for the airport and two of the supermarket sites that are situated in suburban areas.

Workshop services for all electric vehicles deployed within EVD-POST Finland are provided by Easy Km. Workshop managers and mechanics of Easy Km were trained during April 1998 before the first EVs were put in service in Turku. The five-day long training course arranged by the vehicle manufacturer comprised a thorough approach to the properties of Elcat models. The level of service of the workshop was also redefined in accordance with normal delivery vehicles to reduce unnecessary idle days from lack of spare parts.

The foremen and mechanics attended the regular driver meetings to discuss current problems and matters with the users. Moreover, a study was conducted in 1999 to analyse the attitudes of EV mechanics. The survey confirmed among others that the motivation of an EV mechanic was better if the mechanic had proper training as well as a considerable number of regular EV customers, instead of only a couple of EVs.

In the course of the project, the original lead-acid batteries supplied by FIAMM developed an excessive need of periodic take-down maintenance for watering, and were replaced in 1999 and 2000 with maintenance-free lead-acid batteries from Oldham and from Sonnenschein that did not exhibit such problem. In addition to the use of advanced lead-acid batteries, the testing of a new high-performance air-hydride battery was also foreseen in the objectives of Finland Post. Due to technical problems, however, further development of the air-hydride battery was terminated in spring 1999, and the manufacturer Hydrocell Ltd. instead began with the design and construction of a hydrogen-based fuel cell.

A demand study on EV based transport services ('green transports') was conducted on behalf of Finland Post in winter 2000 to help determine the future prospects of this technology in the postal community. The study showed a possible customer demand for green transport but only at competitive costs compared to conventional services. About half of the respondents to the initial inquiry nevertheless indicated a principal willingness to pay 5-10% extra for such kind of environmentally friendly transport.

The total number of EVs in service with Finland Post peaked at 61 in 1998, however more recently the decommissioning of older Elcat models reduced that number to 42 by January 2001. The options for acquisitions of new EVs are presently constrained as production of the base vehicle for the Elcat Cityvan 202, the Subaru Domingo, has ceased in the meantime, and other manufacturers appear reluctant to introduce electric vehicles into the Finnish market.

Route characteristics

TURKU (post):	
Route type	suburban
Distance	15 – 45 km
Stop-starts	75 – 220
Payload	100 – 400 kg
TURKU (city):	
Route type	urban/rural
Distance	25 – 50 km
Stop-starts	10 – 20
Payload	50 – 110 kg
KAJAANI:	
Route type	suburban
Distance	25 – 60 km
Stop-starts	150 – 300
Payload	50 – 250 kg
ROVANIEMI:	
Route type	residential
Distance	15 – 20 km
Stop-starts	30 – 50
Payload	10 kg

6 FRANCE

6.1 The Actor

La Poste today is one of Europe's leading services groups. Its activities center on mail, parcels, logistics, and financial services. They are backed by a unique network of 17,071 contact points. Operating in an increasingly competitive environment in which new technologies play a key role, the La Poste group continues its international expansion, particularly in Europe and the United States. La Poste is committed to actively enhancing quality and responsiveness, to ensure that its services match the needs of its customers, both private and corporate, in terms of efficiency and safety, particularly in the field of electronic data interchange.

6.2 The Vehicle

The Peugeot Partner and Citroën Berlingo Electrique represent a dedicated EV design rather than a petrol or diesel vehicle converted to electric drive. The two models are virtually identical and produced in the same manufacturing plant of PSA Group in Vigo, Spain. The design debuted in April 1997 at the first European Forum for Electric Vehicles, and is sold in the commercial market since 1998. The vehicles are powered by Nickel-Cadmium batteries supplied by SAFT in Bordeaux, France. The batteries are hidden under the bonnet and rear floor area to maintain the standard payload capacity of the vehicle.

6.3 The Project

La Poste received initial offers for electric utility vehicles out of serial production from two domestic manufacturers. The Renault Express Electrique was offered with an optional five-years leasing contract for traction batteries and an optional five-years maintenance contract. PSA offered the Berlingo-Partner Electrique with a seven-years maintenance contract and a leasing arrangement for the batteries covering the full actual lifespan of the vehicle.

Trials were conducted with both vehicles on a power workbench at the testsite of La Poste in Villeneuve St. George near Paris using a normalised cycle in conformity with postal delivery. The Berlingo-Partner in these tests achieved a longer range with 66 km than the Express with 50 km, and was eventually adopted for deployment under the EVD-POST project.

PSA Berlingo-Partner Electrique	
Manufacturer	PSA Group
Weight w/o batteries	1,460 kg
Weight with batteries	1,960 kg
Rated payload	500 kg
Rated top speed	95 kph
Rated range	60 km
Battery type	Nickel-Cadmium
Battery producer	SAFT
Regenerative braking	yes
Price w/o batteries	app. € 11,500
Price with batteries	app. € 15,000

Demonstration sites	
Paris	10 vehicles
Lyon	5 vehicles
Strasbourg	3 vehicles

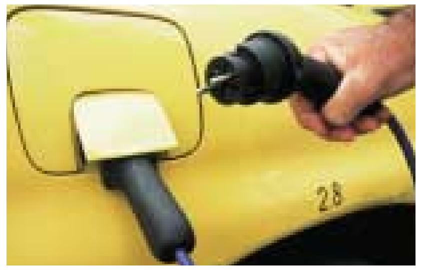
The technology of these vehicles necessitates special maintenance by competent service staff. All maintenance for the EVs of La Poste is thus provided by the manufacturer under a unique contract including vehicle and battery servicing for a fixed monthly price. The final decision for the Peugeot or Citroën model was left to the local management of La Poste depending on their usual garage.

Prior to the introduction of the vehicles, La Poste identified suitable delivery tours complying with the maximum range of the EVs, and selected volunteers from among its regular local drivers. All drivers were briefed by postal management and the vehicle manufacturer over half a day. The first five vehicles entered service in Lyon on 23 March, 1998. The remaining vehicles for Paris and Strasbourg were gradually phased in between July 1998 and July 1999.

The vehicles are used for either delivery of letters, delivery of parcels, or mail collection from postboxes and from major customers. All tours are operated in urban areas between 08:00 and 18:00 with a known and constant trip length between 15 and 75 km per day. For the longer of these tours, the EVs need an extra recharge between 11:00 and 13:00.

The vehicles exhibited some teething troubles after deployment. The first technical stops were to refit all vehicles with a new fixing motor stub axle in July 1998. A second major problem developed in 1999 concerning the premature deterioration of the right transmission bellows on the wheel side. This problem appeared after a distance of only 1,500 to 2,000 km, especially on the vehicles in Paris. The manufacturer changed the type of bellows in September 1999. In both cases, no further problems were encountered after the respective modifications.

In Lyon, the batteries were replaced in all vehicles in November 1999 after the batteries failed to upkeep charge levels, and liquid was spotted escaping the battery trunks. After replacing the old batteries, these were sent to SAFT for inspection. The analysis revealed the deterioration of insulating material separating the plates inside the batteries. PSA subsequently requested all batteries in the 1998 vehicles to be exchanged.



Some vehicles were involved in accidents during the second half of 2000. Although the crash rate for electric vehicles at La Poste is 10% lower than for conventional cars, presumably due to reduced stress from driving as well as higher motivation and attentiveness of the voluntary drivers, collisions with electric cars were found more expensive than with a gasoline or diesel vehicle because of secondary shock damage to the batteries and higher costs for spare parts.

La Poste also observed accelerated wearout of the pneumatic suspension, deteriorating driving performance on snow and freezing rain, and the burnout of several wallplugs not designed for multiple couplings per day. All in all though, the vehicles grew quite reliable after the initial troubles, and received very good perception among both drivers and the general public.

The demonstration project allowed La Poste to organise a new corporate policy to increase the number of EVs in its fleet. By the end of 2000, approximately 560 electric light vans were in service with La Poste in over 50 French cities. Further acquisitions planned in 2001 have been put on hold, however, under the impression of cutbacks in public funding for this technology.

Route characteristics	
PARIS:	
Route type	urban
Distance	15 – 35 km
Stop-starts	150 – 250
Payload	100 – 350 kg
LYON:	
Route type	urban
Distance	40 – 75 km
Stop-starts	150 – 250
Payload	100 – 350 kg
STRASBOURG:	
Route type	urban
Distance	25 – 30 km
Stop-starts	150 – 250
Payload	100 – 350 kg

7 Belgium

LA POSTE

DE POST

7.1 The Actor

The Belgian Post Group (BPG) forms a constellation of companies including De Post-La Poste around the intricate Belgian distribution network of 12,000 post rounds and 1,400 post offices. On the basis of a Royal Decree dated 17 March 2000, De Post-La Poste was transformed from an independent state-owned company to a public law based public limited company. BPG aims to become market leader in providing high quality communication services to enterprises and private individuals in Belgium and the surrounding countries, and has initiated a thorough modernisation process to facilitate strong growth and noticeable improvements in profitability.

7.2 The Vehicles

The Peugeot Partner Electrique selected by Belgian Post Group is identical technically to the electric vehicles deployed by La Poste in Lyon. Like these, the BPG vehicles are built to a dedicated EV design in the Vigo plant of PSA Group, rather than being converted to electric drive from a petrol or diesel vehicle, with power supplied by Nickel-Cadmium batteries from SAFT that are hidden under the bonnet and rear floor area to conserve payload space.

7.3 The Project

Belgian Post Group issued an invitation to tender for its electric vehicles in July 1998, and opted for a three-years rental contract with Peugeot Belgium covering both the vehicles and batteries. The offices and drivers to conduct the project were selected next, and the designated EV drivers received special training and a technical follow-up from the logistics department of BPG and the manufacturer. At the end of the training, each driver was given a special badge and diploma.

Peugeot Partner Electrique

Manufacturer	PSA Group
Weight w/o batteries	1,460 kg
Weight with batteries	1,960 kg
Rated payload	500 kg
Rated top speed	95 kph
Rated range	60 km
Battery type	Nickel-Cadmium
Battery producer	SAFT
Regenerative braking	yes
Price w/o batteries	app. € 11,500
Price with batteries	app. € 15,000

Demonstration sites

Deurne	1 vehicle
Brugge	2 vehicles
Gent	2 vehicles
Oostende	2 vehicles
Brussels	4 vehicles
Wavre	4 vehicles

The vehicles were handed over to BPG in November 1998 in a launch ceremony attended by national TV and print media. The vans were then transferred to their respective sites and entered into service in December 1998.

Fifteen vehicles were deployed across the three main regions in Belgium, i.e. in Flanders with sites in Deurne near Antwerp, Brugge, Gent, and Oostende, in the capital region of Brussels, and in Wavre representing the region of Wallonia. The exposure to different conditions such as dense traffic in Brussels and hillside terrain in Wavre allowed for a comparative assessment of vehicle performances to judge the most appropriate postal applications for this technology.

The vehicles are operated in various roles including delivery of standard and registered mail and mail collection from postboxes. For longer distances an intermediate idle period is required to partly recharge the traction batteries.

Performances and experiences with the EVs in Belgium have been similar to those recorded by La Poste in France, except for driving performance on snow that in Belgium was perceived to be very good. During the second half of 2000, BPG experienced major problems with three of the vehicles in Wavre necessitating a replacement of the corresponding batteries. Delivery of the new traction batteries was delayed for several months though, rendering the EVs unusable and requiring the respective postal services to be operated with conventional backup vehicles.

In early 2000 a questionnaire was distributed among all EV drivers to determine their level of satisfaction with the vehicles. In overall terms the drivers appeared to be quite pleased with the performance of the EVs, in particular the lack of noise, good driving comfort, and braking power. Some drawbacks were noted as well, especially regarding the limitations in terms of range and to a lesser extent acceleration and top speed.

As final question in the questionnaire the drivers were asked if they would be interested in buying an EV for private use, and 15 out of 24 drivers replied they would be interested in replacing their conventional vehicle with an electric vehicle if the range were greater and the price were lower.

Belgian Post Group will continue operations with its EV fleet of 15 Peugeot Partner Electriques until expiration of the three-years rental contract in late 2001.

Route characteristics

FLANDERS:	
Route type	urban
Distance	25 – 45 km
Stop-starts	50 – 150
Payload	50 – 200 kg
BRUSSELS:	
Route type	urban
Distance	25 – 35 km
Stop-starts	150 – 300
Payload	50 – 150 kg
WALLONIA:	
Route type	rural
Distance	40 – 45 km
Stop-starts	150 – 250
Payload	50 – 150 kg

8 OBSERVERS

Activities with electric vehicles among postal organisations are by no means restricted to the partners within EVD-POST. An observer group was thus established to allow other postal operators with an interest in the subject to follow up and communicate with the project. Five postal services from Europe accepted the offer to become members of this observer group, i.e. Consignia plc (Royal Mail) in the United Kingdom, CTT Correios de Portugal, Poste Italiane, An Post Ireland, and Norway Post.

Although the observers did not pursue EV demonstrations under the framework of the EVD-POST project, they nevertheless are conducting a variety of domestic studies and tests on the possible use of electric vehicles for postal deliveries. Two examples of such activities are given in the following section.

CTT Correios de Portugal launched a test with electric vehicles in 1999. Two Citroën Berlingo Electriques were deployed in Évora, a small but historic Portuguese town, in cooperation with University of Évora and the Portuguese Energy Conservation Centre.

The project aimed to assess the capability of EVs to contribute to the diversification of energy resources used for postal transport, and the reduction of air pollutant and noise emissions from postal vehicles. Investment, operating, and maintenance costs of the electric and conventional petrol or diesel vehicles for different use patterns and mileages were compared in a study of their economics. Another aspect of the project was to review the promotion of the company image through the use of environmentally friendly technologies.

The range of the vehicles was quite sufficient for postal deliveries in the historic centre of Évora, even trip lengths up to 80 km per day were possible with an intermediate recharge of 2.5 hours. The number of daily stops varied between 50 and 80.

Light Electric Vehicles

Royal Mail began evaluating six Bradshaw Carryall 2 electric vehicles in Oxford in December 1999. The same base vehicle is used by Posten Sverige. In the same year Oxford City Council introduced a transport strategy designed to improve access for pedestrians and encourage public transport, whilst restricting vehicle traffic. After 10:00 am access to certain parts of the city centre was restricted for general trade vehicles. The electric vehicles however were not subject to these restrictions. Environmental and operational performance has been recorded from the vehicles in order to establish whether they could fill a gap in the existing equipment line up between cycles and conventional diesel vans.

On an operational basis the vehicles demonstrated significant improvements on certain cycle routes. Against conventional diesel van deliveries, the case was less clear-cut. For the majority of diesel routes, longer distances and large mail volumes made the vehicles less suitable, however there are clear niche applications for them in congested city centres.

Electic Vans

The density of mail operations in many urban areas demands collection and delivery vehicles that are larger than the Peugeot Partner Electrique. The Wavedriver LDV Convoy, with a gross vehicle weight of 4,050 kg and a payload of 825 kg plus the driver, could therefore provide an effective fit for many sensitive urban vehicle operations in Royal Mail. In addition, the technology which is currently at prototype stage, incorporates some significant innovations to enhance flexibility and operational performance.

In July 2000 Royal Mail introduced two Wavedriver LDV Convoy electric vans at delivery offices in Grays and Winchmore Hill for evaluation over a six month period. The Wavedriver system incorporates an integrated on-board fast charger and drivetrain control system. The fast charger can replenish 50% of the power to the batteries in 30 minutes and 80% within an hour, extending the flexibility of the vehicle. The vehicles in Royal Mail specification have an operational range between recharges of approximately 30 miles. The vehicle has a peak power of 90 kW and is limited to a maximum speed of 50 mph (81 kph). Drivers have commented favourably on the vehicle's performance and refinement after their introduction into the fleet. The trials were scheduled for completion in early 2001.

9 PROJECT RESULTS

9.1 Monitoring Programme

CITELEC took charge within EVD-POST of the comparative evaluation of postal operations with electric vehicles in the different project sites.

Measurement campaigns were conducted in Finland, Sweden, Belgium, and Germany. These followed a common methodology verified during a first campaign in 1998 in Kajaani. In each campaign, one postal EV was fitted with a special monitoring system devised by CITELEC, and used for several days in normal postal duties with measurements being taken. Monitoring data for the campaign in Germany were recorded through a permanent on-board system also used in the routine observations of Deutsche Post. These data sets for mechanical and electrical parameters were used to categorise the postal routes travelled by the trial vehicles. In total, seven measurement campaigns were conducted throughout the EVD-POST project in Kajaani (1998), Turku (1999), Nacka, Brussels, Wavre, Oostende (2000), and Bremervörde (2001). For each campaign, a comprehensive monitoring and evaluation report is available through CITELEC.

In addition to the dedicated measurement campaigns, nominal fleet management data were recorded by the operators for all vehicles throughout the project. Driver perceptions were polled by means of direct feedback meetings or questionnaires.

CITELEC, the European Association of cities interested in the use of electric vehicles (EVs), was founded on 2 February, 1990 under the aegis of the European Community. The association now unites over 60 member cities in various countries.

CITELEC and its members are studying the contribution of EVs in order to solve their traffic and pollution problems. CITELEC's main tasks are:

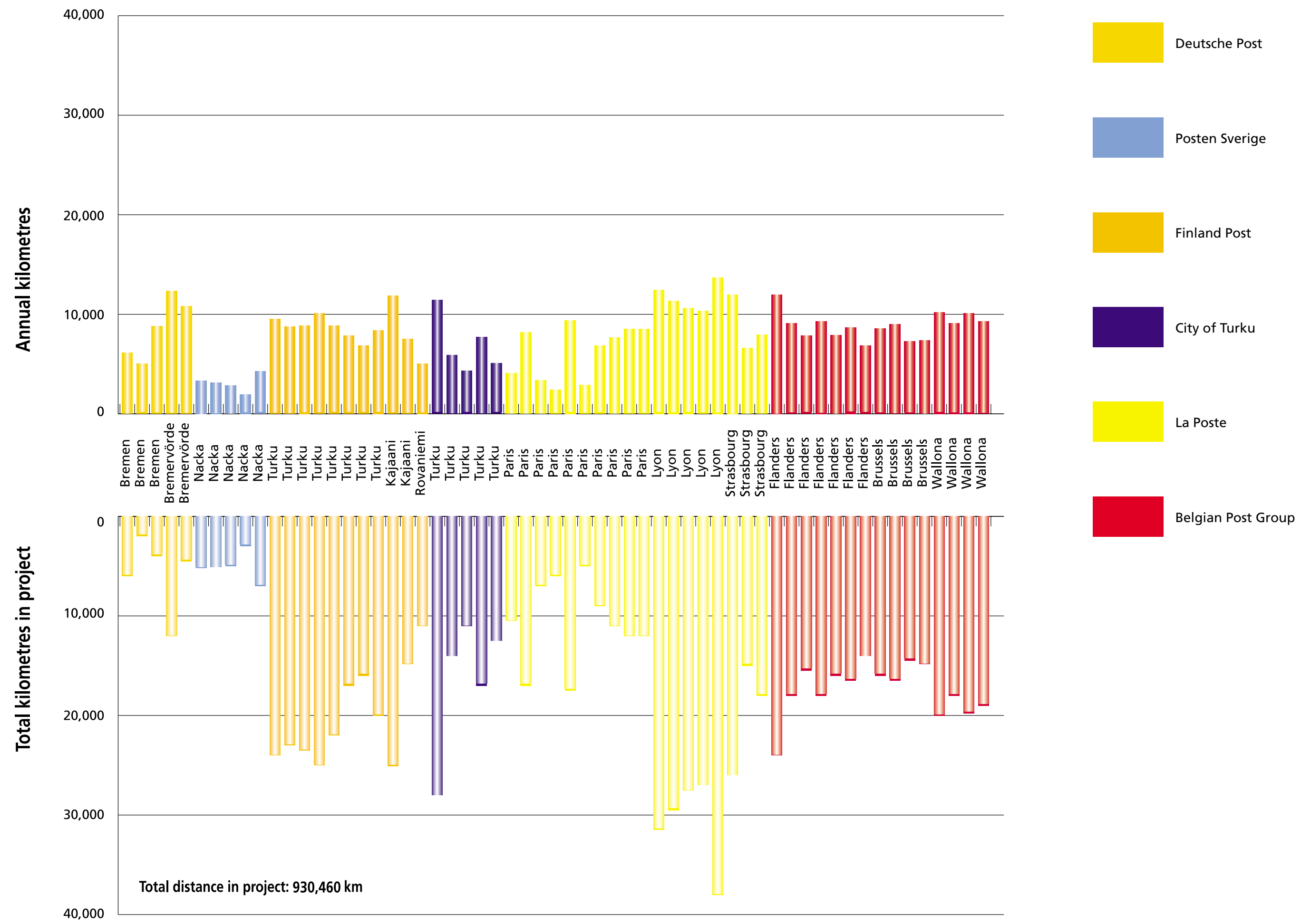
- to inform cities about performances and characteristics of EVs
- to help cities with the deployment of EVs and give user-training
- to accompany the build-up of infrastructures for EVs
- to organise test demonstrations with EVs in urban traffic, e.g. the '12 Electric Hours'
- to perform tests and assessments of EVs in the European market
- to partake in actions to study and demonstrate EVs and hybrid
- vehicles in European cities.

9.2 Vehicle Performance and Reliability

The 59 electric vehicles deployed in the course of the EVD-POST project together logged a combined distance of 930,460 km during 122 vehicle-years of operation. The annual distance for a given vehicle typically ranged between 5,000 and 10,000 km as compared to the usual 10,000 to 25,000 km logged by a conventional delivery vehicle running on petrol or diesel fuel. The lowest annual distance was recorded for an EV in Nacka (2,200 km) and another one in Paris (2,300 km); the highest annual distance in the project was achieved by a vehicle in Lyon with 13,500 km.

Route	Operational data					Primary energy consumption			
	Annual km	Mean speed [1] (kph)	Moving speed [2] (kph)	Effective range (km)	Direct energy use (kWh/100km)	Electric vehicle (kWh/100km)	Thermic vehicle [3] (kWh/100km)	Energy savings (%)	Anual savings [4] (kWh)
Bremen	5,745	13	23	50 – 85	57	143	136	-5	-522
Bremervörde	10,986	10	21	55 – 90	56	140	134	-4	-441
Nacka	3,393	7	13	20 – 30	40	100	134	26	2,578
Turku (post)	8,001	12	23	35 – 50	41	104	135	24	2,375
Kajaani	9,116	6	18	35 – 50	49	122	154	21	2,397
Rovaniemi	4,744	6	18	35 – 50	49	122	154	21	2,397
Turku (city)	6,404	25	45	60 – 70	48	120	152	21	2,386
Paris	5,850	7	11	40 – 50	48	119	136	12	1,277
Lyon	11,075	20	29	60 – 70	39	98	116	16	1,395
Strasbourg	8,412	9	13	40 – 50	50	125	141	12	1,232
Flanders	8,362	17	27	35 – 65	40	99	117	16	1,381
Brussels	7,434	14	21	35 – 45	47	118	134	12	1,258
Wallonia	9,090	25	45	40 – 50	46	115	132	13	1,275

1 average speed including stops
2 average speed when moving (v>0)
3 gasoline/diesel reference vehicle (Renault Kangoo)
4 normalised for annual distance of 7,500 km



The electric vehicles generally showed good performance to suit their designated duties and routes, not surprisingly as the applications had been designed carefully bearing in mind any limitations especially with respect to range, top speed, and payload capacity. A definite advantage of the electric vehicles was found in their superior acceleration from standstill, particularly useful in the stop-start patterns encountered in postal deliveries and in urban traffic. Apart from substituting petrol or diesel vehicles in selected operations, the availability of EVs also enabled the motorisation of some deliveries on foot or bicycle that previously relied on a lorry to ferry mail bundles to designated pickup points. The light electric vehicles employed by Posten Sverige proved particularly successful in this capacity, not least because of their unique clearance to move on otherwise restricted roadspace such as cyclepaths.

As noted previously, however, it is quite important not to mistake a successful performance in favorably tailored pilot applications for a general suitability of electric vehicles for the postal services and their broad range of transport applications and vehicle requirements. EVs remain at a serious operational disadvantage especially due to their lower range and payload capacity, and thus constrained versatility as compared to conventional gasoline or diesel vehicles.

The rated ranges of electric vehicles as specified by the respective manufacturers already show significantly lower figures than could be expected from a corresponding petrol or diesel vehicle. In postal deliveries with their heavy stop-start characteristics, the effective range turned out to be even lower, typically 60-80% of the rated distance. The maximum range of EVs in delivery operations was found to depend heavily on the route characteristics, and decrease with the number of stop-starts and in hilly terrain as encountered in Nacka and Wallonia. The effect of driving style is very important, too. Only in a few cases including Lyon and Oostende, and the municipal vehicles in Turku, distances near 100% of manufacturer specifications were achieved on level routes with few stops and relatively high moving speeds.

The range limitations of electric vehicles in general, reduced even further by the stop-start character of postal deliveries, restricts their possible use to rather short routes interrupted by periods of recharging when the electric vehicle – unlike its petrol or diesel counterpart – is unavailable for further duties. Such deficiencies tend to put EVs outside at least the immediate consideration of fleet management and procurement strategies aiming at mass standards rather than assortments of niche applications. The route planning process is likewise constrained in its options to achieve maximum efficiency and economy, and requires significantly higher lead times to identify suitable duties and routes for the electric vehicles. A possible solution, at least technically, is offered through innovative battery technologies with higher energy contents such as the ZEBRA system demonstrated in the vehicles of Deutsche Post. These offer the prospect of extended operations over several days with nighttime or opportunity recharging outside normal operating hours.

Improved battery technologies however are only but part of the electric vehicle. Despite the substantial increase in capacity and performance offered through the ZEBRA technology, the electric Vitos employed by Deutsche Post still exhibit other typical constraints associated with electric vehicles, especially those derived from conventional designs. In the case of the Vito-E, payload capacity is reduced by 25% in terms of volume and 40% in terms of weight as compared to the standard petrol or diesel version. The EV has thus been assigned to duties that are usually operated by a smaller petrol or diesel vehicle such as the Renault Kangoo. Although the electric Vito fully meets the performance requirements for these operations, it is thus still penalised economically as compared to standard practise. Moreover, the vehicle is only manufactured to specific order in a specialised workshop, at substantially higher costs than the serial industrial production applied for the Berlingo-Partner Electrique. Likewise, the risk of quality problems and overruns in delivery dates is much higher for the former than the latter design. At present, however, the Berlingo-Partner is only available with NiCd batteries and hence subject to the operational and economic drawbacks of restricted range. Future EV models should thus aim at combining industrial design and manufacturing with a high-performance power source, such as the ZEBRA or the emerging Li-type batteries as well as fuel cells and hybrid electric drivetrains.

The adoption of automotive industrial standards and best practises is a critical issue also for other sectors, most notably the provisions for maintenance and repair. The electric vehicles demonstrated in EVD-POST generally showed good reliability expressed in a small number of technical breakdowns, with exception of the prototypic Vitos with ZEBRA batteries. Many of these breakdowns as well as regular maintenance works, however, resulted in extended periods of non-availability as the skills to service and repair electric vehicles proved insufficient in most demonstration sites. Workshops were found to lack proper knowledge of EV technologies except where specialist training had been provided by vehicle manufacturers, and was sustained through routine servicing of small local fleets. In several cases, the delivery of spare parts or battery replacements was delayed for weeks or even months. Some failures also required extensive diagnostics and analysis before treatment could commence. In all such cases, a backup vehicle was required to continue operations. The lack of an adequate network of service points or garages capable of handling EVs, combined with insufficient spare part logistics and training of mechanics, thus further adds to the operating costs of this technology.

Other drawbacks include the extensive lead times required for duty planning, which, unlike for petrol and diesel vehicles, must take into account the range and payload restrictions of electric vehicles, and insufficient cabin heating by means of small gasoline or diesel burners that, despite heavy fuel consumption, were found wanting in power and adjustment control on all vehicles. The established lifetimes for lead and nickel type batteries of no more than two and three years, respectively remain unsatisfactory, whereas the projected longer durability of more advanced battery systems are still to be verified. Electric vehicles also require the provision of special parking places with power plugs for recharging that further add to the necessary up front investments.

9.3 Vehicle Perception

The electric vehicles demonstrated in EVD-POST on the whole were received extremely well by drivers, customers, and the general public. These positive views were generally expressed irrespective of the technologies and operating conditions in a given site, and did much to support the corporate image of the participating operators. The demonstrations also received strong attention of both local and national news media.

Drivers were found to embrace the idea of electric vehicles after an initial period of hesitation. Initial training to familiarise drivers with the new technology, the building of confidence in its reliability, and follow-ups to maintain the motivation of drivers and support the exchange of experiences and expertise were established as key success criteria for the introduction of EVs into the postal fleets. Drivers recruited from among volunteers usually performed best as a result of superior motivation and interest. Once familiar with the special characteristics of the electric vehicles, the drivers were quick to appreciate certain benefits such as ease of use and reduced background noises and vibrations. These attributed to a significant reduction of stress levels perceived by the drivers during delivery duties, not only only as compared to petrol and diesel vehicles but also with biking or walking. Despite some concerns especially with regard to the limited range and insufficient cabin heating, most drivers expressed satisfaction with the overall performance of electric vehicles. Many drivers even proved unwilling to return to a conventional petrol or diesel vehicle, and some even stated a principal interest in adopting electric vehicles also for private use given a substantial reduction in prices.

The absence of exhaust emissions and low noise levels generated by the electric vehicles were rated as main benefits in the view of customers and citizens, though some concerns exist with regard to a possible increase of accident risks due to the virtual noiselessness of EVs. A user survey commissioned by Finland Post even suggested a significant willingness of customers to pay a modest surcharge for 'green' delivery services, however it is uncertain at this point if or how such intentions might translate into viable business cases. An interesting such service has recently been established for home deliveries in London (http://www.electricdelivery.com).

9.4 Energy Consumption and Emission of Air Pollutants

The direct energy consumption of the electric vehicles was recorded from charging data. The vehicles used on average 45 kWh per 100 km from the grid, with a variation between 35 and 60 kWh per 100 km depending on the respective duty pattern and EV model. Consumption figures at Finland Post were found to increase by on average 17% during winter due to higher rolling resistance with winter tyres and on wet snow, and due to the additional use of energy for battery heating. Use of the vehicles on shorter trips also resulted in an increase of energy consumption from the grid, as the less depleted batteries were exposed to a higher share of the less efficient final recharging phase. Driving styles also showed a significant impact on the energy consumption of the electric vehicles.

Statement of a Postal Driver

My name is Tarja. I have used an electric vehicle in my work for over a year. The reason why I have had the privilege of driving it is that I suffer from an injury to my back which is susceptible to strain.

Every day I deliver mail to just over 500 houses. The area is rather hilly and a long way from the post office, but there is no problem getting there and delivering the mail in the electric vehicle. It's easy to steer, which means that I can reach nearly every postbox from inside the vehicle. My seat is very comfortable and high up, which make things easier for my shoulders and my back. I have with me all my mail and advertising material, which can sometimes weigh up to 250 kilos. The load area is high up and convenient. It's easy to load and unload mail without hitting my head, which is sometimes a problem with other vehicles. In the winter, when it's icy and there's a lot of snow, it's very easy to get about. The electric vehicle ploughs through the snowdrifts with ease.

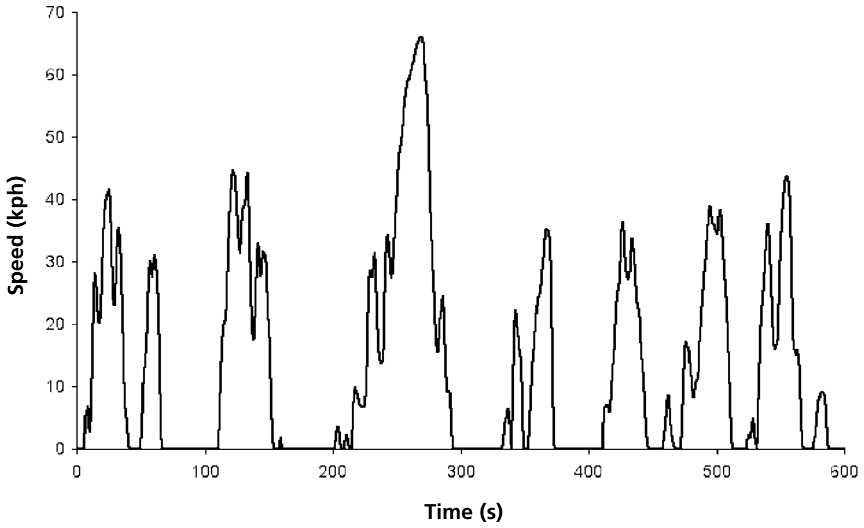
The customers think that the electric vehicle is practical, pleasant and environmentally friendly. They're curious and ask me questions about it. I've nothing bad to say about it. It may be a little too silent, and the customers have mentioned that they don't hear me coming. It might be an idea to have a little bell which rings or goes ting-a-ling.

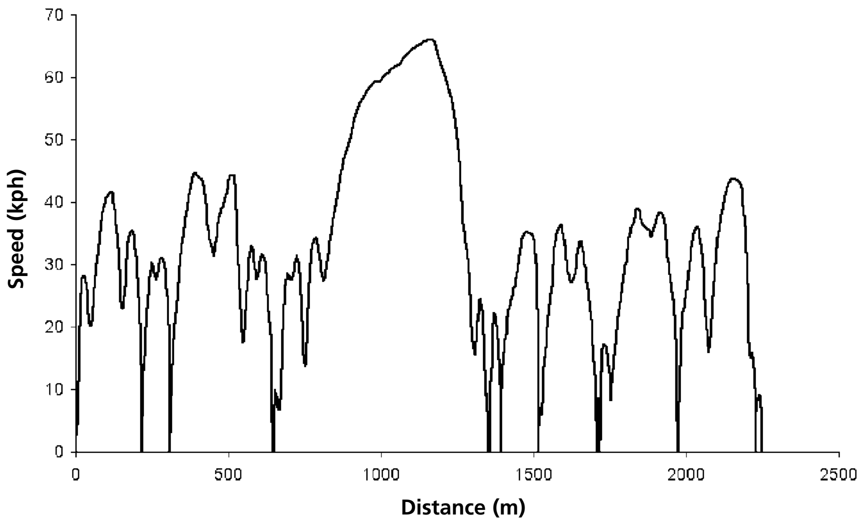
In other words, I'm really happy with the electric vehicle. It has had the effect that I'm not as tired and physically worn out at the end of a day's shift. More people should have a chance to drive an electric vehicle in their work. For me personally, the vehicle has been a godsend in allowing me to work.

Route	Vehicle	Postal EV (Wh/km)	Postal EV (Wh/Tonkm)	Reference EV (Wh/Tonkm)
Nacka	Carryall 2	398	613	n/a
Turku	Cityvan 200	420	311	204
Kajaani	Cityvan 200	523	387	204
France	Partner	535	330	191
France	Berlingo	523	322	191
Oostende	Partner	357	210	191
Brussels	Partner	474	279	191
Wavre	Partner	456	268	191

The comparison of some figures for the direct energy consumption per ton km with reference values of CITELEC for similar vehicles in ordinary traffic shows a substantially increased use of energy by the postal vehicles. This higher energy consumption in postal traffic of course has some repercussions on the attainable range of the vehicle, which for heavy postal delivery duty may be as low as half the range attainable at constant speed. This is a mere result of the laws of physics: stop-start operations use a lot of energy. It should not be considered a drawback of electric vehicles; similar rises in consumption can be witnessed with petrol and diesel vehicles. When planning the deployment of electric vehicles in postal duties, the prospective operator should aware however when assessing the performance of a vehicle: the range and consumption values given by manufacturers always refer to operation at constant speed or on standardised "urban" cycles (e.g. the ECE-15 cycle). The real range to be expected in heavy postal delivery duty will invariably be lower, and the vehicles will have to be deployed according to this. A failure to meet the expected "standard" range should be not be grounds for disappointment or disapproval of the electric vehicle: the postal delivery service just isn't comparable to normal traffic, putting a much heavier burden on the vehicle.

For a direct comparison between energy consumptions of the electric and a petrol or diesel reference vehicle, the measured direct energy consumption of the EVs was translated into the associated use of primary energy generated by a power plant. The same calculation was made for the fuel consumptions recorded on the same or similar routes for a petrol or diesel version of the Renault Kangoo, a typical delivery vehicle widely used in postal operations throughout Europe.



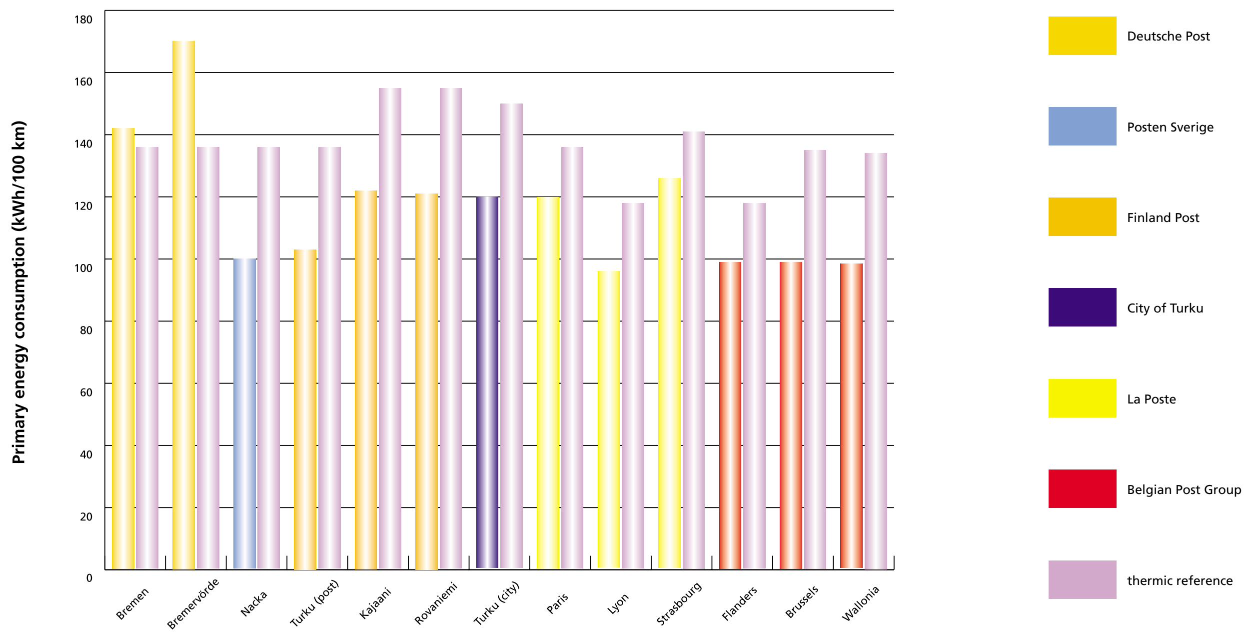


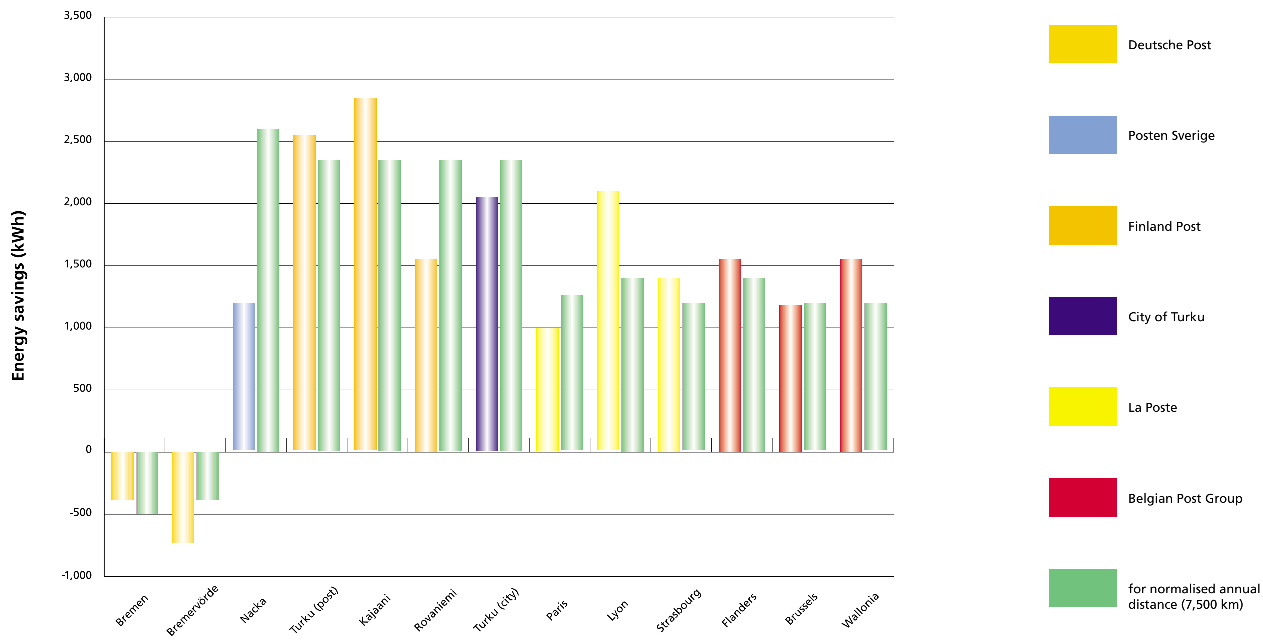
The electric vehicles of the same size class as the Renault Kangoo, i.e. the Carryall 2, Cityvan 200, and Berlingo-Partner showed significantly lower levels of primary energy consumption. The reduction varied between 20-25% for the Nordic vehicles and 12-16% for the vehicles in France and Belgium. Assuming a typical annual distance of 7,500 km, the absolute savings of primary energy for each of these vehicles are about 2,400 kWh respectively 1,300 kWh.

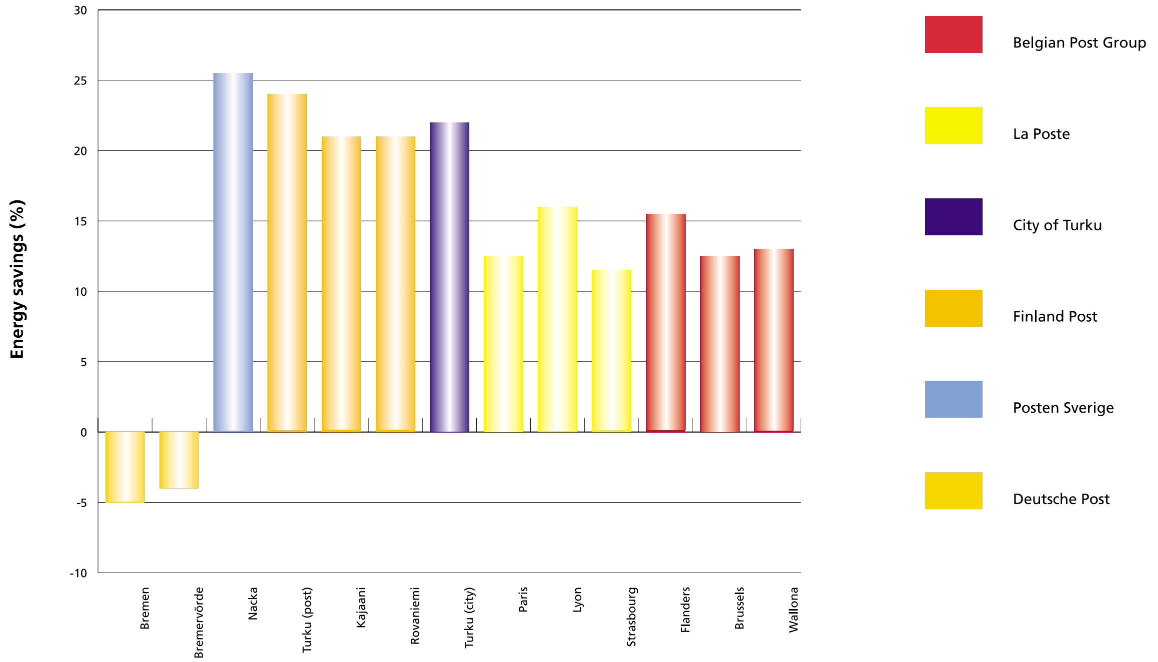
In the case of Deutsche Post, as set out previously, medium vans were selected for the trials in order to offset the operational limitiations of current EV technologies in terms of range and payload capacity. In direct comparison with the Renault Kangoo, which would normally operate on those routes now served by the electric Vitos, these larger vehicles are necessarily penalised in terms of energy consumption. Consequently, the German sites registered an increase in primary energy consumption of 4 – 5%, that would translate into an additional use of about 500 kWh in primary energy per year for an annual distance of 7,500 km. It should be noted, however, that this vehicle would also produce comparable energy savings as the other EVs when compared with a conventional van of similar size such as the VW T4.

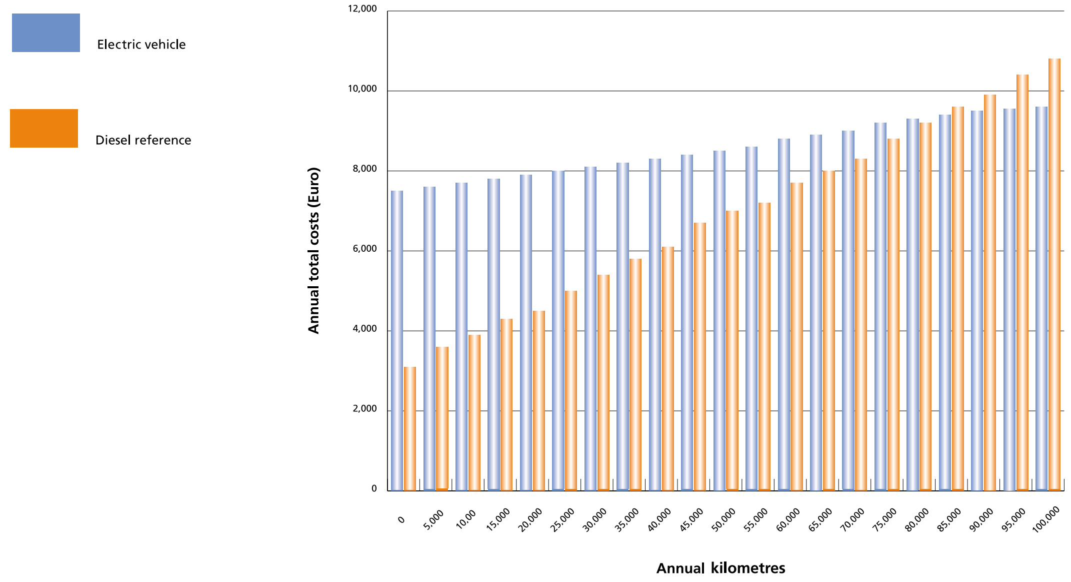
The absence of tailpipe or local exhaust emissions are usually referred to as a key benefit of electric vehicles, especially in urban areas with a high density of both traffic and population. Electric vehicles nevertheless are connected with air pollution by power plants generating the necessary electricity for their operation. The aforementioned reduction of energy consumption of EVs against petrol or diesel reference vehicles however suggest a positive effect for air pollution also beyond local levels, at least in those countries where energy production relies to a higher degree on renewable sources such as wind or water, or on nuclear power plants.

The exhaust emissions generated by primary energy production for the electric vehicles were calculated using both national and European power mix data. Unlike the calculation of energy consumptions, however, no emission data could be obtained for a petrol or diesel reference vehicle under comparable operating conditions, i.e. stop-start delivery trips. Standard measurement data were found to be based on standardised cycles such as ECE-15 that are not representative or could be extrapolated for this type of operations. It is expected for such data to become available in early 2002 under a project presently conducted by CITELEC and TNO, at which time the data from EVD-POST will be taken into account for a comparative analysis also of exhaust emissions.









Annual distance	Total annual costs in Euro €		
	EV	Diesel	Difference
10,000 km	7,700	3,900	3,800
20,000 km	7,900	4,650	3,250
30,000 km	8,100	5,400	2,700
40,000 km	8,350	6,150	2,200
50,000 km	8,550	6,900	1,650
60,000 km	8,750	7,650	1,100
70,000 km	8,950	8,400	550
80,000 km	9,150	9,150	0

Cost calculation all figures in Euro €	Project case 3 year writeoff		Typified case 6 years writeoff	
	EV	Diesel	EV	Diesel
Vehicle purchase price	14,800	7,300	14,800	7,300
Spare battery set	n/a	n/a	3,500	n/a
Residual value	n/a	-2,920	n/a	-730
Interest (7%)	n/a	1,530	6,950	3,070
Annual financing costs	**4,930**	**1,970**	**4,210**	**1,610**
Registration tax	n/a	120	n/a	120
Road tax	280	n/a	280	n/a
Annual tax costs	**280**	**120**	**280**	**120**
Liabilities	370	350	370	350
Claims management	included	80	included	80
Legal costs	20	included	20	included
Passenger insurance	30	20	30	20
Material damages	800	580	800	580
Annual insurance costs	**1,220**	**1,030**	**1,220**	**1,030**
Tyres	100	100	100	100
Maintenance	1,700	300	1,700	300
Annual maintenance costs	**1,800**	**400**	**1,800**	**400**
Total (fixed) costs per year	**8,230**	**3,520**	**7,510**	**3,160**
Fuel consumption per 100 km	40.8 kWh	9.1 litres	40.8 kWh	9.1 litres
Fuel/electricity price per kWh/litre	0.05	0.82	0.05	0.82
Variable costs per 100 km	**2.04**	**7.46**	**2.04**	**7.46**

9.5 Economy

Economic viability is the other decisive factor next to operational performance to determine the success or failure of any vehicle technology in commercial operations. This is true not only for electric vehicles, but equally for other clean fuel technologies including CNG or LPG as well as the emerging fuel cell type systems for automotive applications. Some fundamental conclusions presented for the vehicles demonstrated in the EVD-POST project might thus be found of interest also for these technologies.

The calculation of vehicle life cycle costs somewhat differs between the partners on account of individual corporate accounting standards and financial regulations in the respective home country. The economic evaluation of the postal EVs is thus based on an average case deemed representative for the range of applications demonstrated in EVD-POST. The original project case of three years duration has been translated in this context into a typical six-year writeoff period that forms the basis of all further assessments.

It becomes apparent from either calculation that the fixed costs of the electric vehicle are much higher than those of the petrol or diesel reference vehicle. This is essentially due to three factors, i.e. the procurement price, the resale value, and the expenses on maintenance. The electric vehicle in turn has a strong economic advantage in terms of variable or running costs, i.e. is cheaper to run than its petrol or diesel counterpart. In other words, the electric vehicle starts out expensive but only adds slowly to its total costs during operations. The petrol or diesel vehicle is rather cheap at the start, but incurs substantial additional costs when actually moving.

An electric vehicle in theory is thus quite capable of outperforming costwise a petrol or diesel vehicle of similar size and function, given good utilisation that allows the annual mileage to pass the economic break-even point where the higher initial or fixed costs of the electric vehicle are offset by the higher variable costs of the petrol or diesel vehicle.

The initial costs for an electric vehicle however are so high it would be required to log distances that far exceed the typical annual mileage of a delivery vehicle, in order for its total costs to draw level with those of a petrol or diesel equivalent. The situation is often worsened by the limitations of most existing EV designs in terms of range and payload that prevent repeated use during a day to increase utilisation levels and thus the annual kilometres. Those vehicles operated on two tours per day with an intermediate recharging actually showed improved economies as compared to other EV units with only a single daily tour.

The practical ability of electric vehicles to offset their higher fixed costs against petrol or diesel vehicles during regular operations thus appears doubtful. In France, however, electric vehicles in general have enjoyed above average success due to a unique combination of supporting measures that tackle a number of the inherent disadvantages of EVs including the high fixed costs:

- governmental subsidies of 2,300 € for procurement of the vehicles;
- subsidies Electricité De France (EDF) for leasing of batteries;
- strong involvement of the manufacturer through a maintenance contract backed by a large network of service stations.

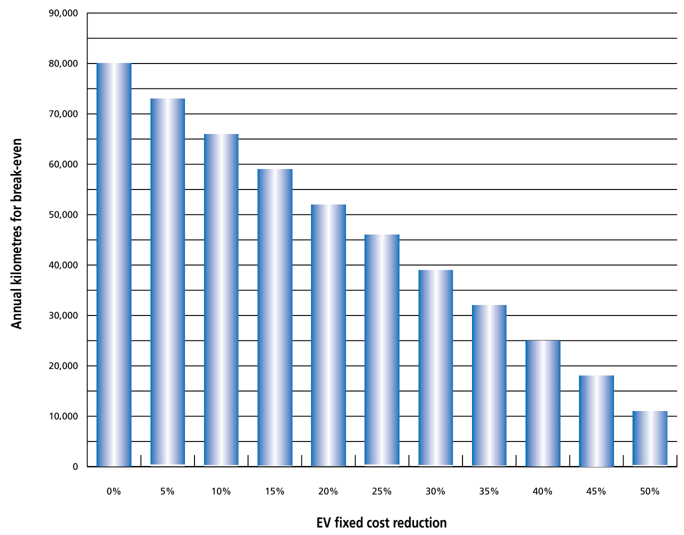
French vehicle manufacturers also offer EVs as industrial line products rather than conversion designs to specific orders. On the other hand, national legislation requires a defined share of clean fuel vehicles to be included with fleet procurements of public companies, thus providing a steady base demand for this kind of vehicles.

The support mechanism thus touches on all critical points related to the economy of electric vehicles. In consequence, La Poste deduced that, taking into account all available benefits, its EVs become profitable already at an annual distance between 9,000 and 14,000 km.

A reduction of the fixed costs for electric vehicles appears a prerequisite to lower the annual mileage required for attaining a breakeven point closer to practical levels. Next to the decrease of current vehicle prices, other decisive elements in the cost calculation such as resale values and maintenance should equally be taken into account. The principal importance also of these other elements is highlighted by the Finnish experience where the restructuring of servicing and repair agreements for the sixteen EVs alone generated cost savings of € 4,400 per month.

Key Findings and Future Plans

The monitoring and evaluation of the electric vehicles demonstrated in EVD-POST produced a two-sided result. EVs of modern making appear much improved in comparison with previous designs but still are not up and level with their petrol and diesel counterparts in terms of performance and maturity. Industrial design and production and serious product marketing of EVs appear a rarity within automotive industries. Electric vehicles are extremely well perceived by drivers as well as customers and the general public, however their poor economy driven by the high fixed costs makes them unattractive in the view of corporate procurement and management.



Reduction of fixed costs	Critical annual distance
0%	80,000 km
10%	66,000 km
20%	52,500 km
30%	39,000 km
40%	25,000 km
50%	11,000 km

Main benefits ⊕

1. No local pollution and low noise emissions
2. Extremely well perceived by customers and general public
3. Very popular with vehicle drivers
4. Sound performance on dedicated routes
5. Lower energy consumption than petrol or diesel vehicles of same size
6. Lower variable costs than petrol or diesel vehicle of same size
7. Decent reliability regarding number of breakdowns for most models

Main drawbacks ⊖

1. Very high acquisition costs, typically twice those of petrol or diesel version
2. Long delays, high costs of maintenance and repairs for lack of servicing infrastructure
3. Range and payload constraints constrict applicability or necessitate larger than usual vehicle
4. Significantly higher lead times and constraints for trip planning
5. Battery liftetimes too short or yet unverified in practical applications
6. Overruns in delivery dates and quality problems with some components
7. Most manufacturers lack serious product strategy and management for EVs
8. Very limited product diversity, usually conversion designs built to specific orders
9. Arrangements for full service and leasing contracts usually not up to market standards

At the conclusion of the EVD-POST project in late 2000, only two of the postal partners had contracted larger numbers electric vehicles for their fleet operations. The Swedish approach using light electric vehicles provides an interesting solution for local deliveries in urban and suburban areas with minor traffic volumes, and has already been picked up in a further trial by Royal Mail. Despite the past successes with these vehicles and some 500 units in operation, however, Posten Sverige has yet to consider its position regarding future deploy-ments of EVs, and at present anti-cipates these to be slowed down in the face of the associated high costs.

In France, the domestic support measures allowed La Poste to launch into the deployment of a larger fleet of electric vehicles, even without waiting for the final results of the EVD-POST project. By the end of 2000, La Poste operated about 560 electric in over 50 cities. Nevertheless, the future of EVs has become somewhat uncertain also in France as public subsidies for electric vehicles to offset the inherent higher costs have come under scrutiny. Technical concerns over the use of heavy metals in the prominent NiCd batteries and restrictions to the inhouse parking of EVs further add to these uncertainties, obliging La Poste to be very careful in the matter of electric vehicles and, for the time being, not to engage in placing further such vehicles into service.

Among the other operators, Finland Post is facing a special dilemma as the single domestic provider of electric vehicles ceased production in early 2000. Despite a continued interest of the post in this technology, the use of EVs much depends on their availability in the Finnish market. The possibilities of purchasing another delivery EV have been scanned, but in early 2001 the situation still remains unclear. Importers appear extremely reluctant to start dealing with a rarity such as EVs, because the responsibility for maintenance and spare parts can be assumed to cause extra work and costs but not very much, if any, financial benefit.

The views of Deutsche Post and Belgian Post Group are likewise focused on the question of vehicle costs. Evidence from the project clearly suggests that while the technical shortfalls of previous EV generations appear substantially lessened, the immense costs of this technology still prevail to a level unacceptable to commercial operators. Without financial support from public bodies or a significant reduction of fixed costs, future efforts regarding electric vehicles are bound to be redirected from a further extension of existing pilot fleets to a more passive market observation.

10 CONCLUSIONS

The EVD-POST project aimed to demonstrate the technical and economic viability of electric delivery vehicles in regular postal operations across Europe, in expectation for a successful performance to provide an impetus for the wider use of EVs by other operators.

All in all, the project succeeded in verifying some principal merits of EV operations in postal and other delivery services, i.e. the provision of reliable transport services without adding to local air pollution and noise emissions. The vehicles were well received by both drivers and the general public, despite the impression of performance reductions against conventional petrol or diesel vehicles for some of the EVs, especially those powered by lead-acid batteries.

As for the newer battery technologies such as ZEBRA or the emerging Lithium-type batteries, these offer the promise of substantially higher performance but to date are still in the process of gaining sufficient maturity to have a true market impact. The fate of the Nickel-Cadmium battery, the other widely used battery type next to lead-acid, has recently become uncertain in light of an emerging EU directive on Cadmium use in automotive applications. This may imply a setback in the use of EVs depending on NiCd battery technology.

The average energy consumption of the vehicles was found around 45 kWh per 100 km but may vary between 35 and 60 kWh per 100 km depending on the actual duty pattern and EV model. Maintenance records show no particular disadvantages in reliability against petrol or diesel models, though for some EVs the maintenance process had to be adapted or amended. Range limitations were usually not a problem as the vehicles had been carefully matched with adequate delivery duties well within the performance levels of the respective EV model.

The project produced energy savings of more than 200,000 kWh during 1,466 vehicle months of operations in which the project fleet logged a total mileage of 930,460 km. Primary energy consumption of the EVs was usually found 10-25% less than for a conventional vehicle of the same size, depending on the respective vehicle and battery models and duty patterns.

On the downside, EVs still show a remarkable lack of economic maturity expressed as high procurement costs, limited product diversity, and little or no aftersales support. Overruns in delivery dates and costs are a frequent experience rather than exceptions. This leaves EVs highly unattractive to potential users, especially those exposed to commercial competition.

Acquisition costs remain a key problem for a more widespread use of EVs in commercial services. On average, vehicle prices were around twice the costs of a corresponding petrol or diesel model, even without considering the costs of the Deutsche Post vehicles which were prototypes.

Financial aid for the procurement of EVs and traction batteries, other than the support from the European Commission received under the EVD-POST project, was made available only in France. In the recent past, however, the French government revealed plans suggesting major cutbacks of these subsidies, effectively stalling the national EV market and postponing the release of promising new EV models into the market.

Life cycle costs turned out rather high; even though the variable costs per km of the electric vehicles were found to usually be less than those of a conventional vehicle of similar size, the difference was never near enough to offset the initial disadvantage in fixed costs within the normal utilisation rate of a postal delivery vehicle. The overall cost effectiveness especially of those EVs powered by lead-acid batteries was further compromised due to the necessity of intermittent recharging between trips when these vehicles, unlike their petrol or diesel counterparts, could not be used for further transport duties.

Reductions in payload capacity and range that are associated with conversion design EVs may be offset by either limiting their use to specially designed or selected duties, or as in the case of Deutsche Post by assigning the EV to a standard duty normally operated by a smaller vehicle. As a consequence, however, such EVs may not yield energy savings but instead show a small increase in energy consumption as compared to standard operational practise, even though the electric vehicle would still save energy as compared to a petrol or diesel vehicle of the same size. The situation also applies to operating costs, where such EVs are at a similar disadvantage against their smaller conventional counterparts.

The market for new electric vehicles is not taking off, leaving the second hand market equally stalled. With professional financing institutions refusing to guarantee residual values, existing rental offers for this type of vehicles are economically unattractive.

Finally, there is a notable absence of a universal framework governing the deployment of EVs or other clean fuel vehicles in commercial fleets. This omission results in a great unwillingness by operators to accept the associated extra costs, especially if without tangible economic returns, for fear of losing their competitive edge against other operators remaining free to choose not to adopt such vehicles (and costs) for their transport.

In conclusion, despite the generally good performances of electric vehicles in demonstration projects, there are still substantial barriers for wider deployment that leave EVs – and indeed clean fuel technologies in general - ill-prepared to compete with the acting market champions petrol and diesel. Of the broad diversity of alternative drivetrain options under research, there are very few examples where technology advances are translated by vehicle manufacturers into commercial propositions including serious product management, sales and aftersales support. Infrastructure deployments likewise remain scattered and further contribute to an undermining of user confidence in clean fuel technologies.

Despite the good experiences from pilot projects, interest to proceed beyond this stage with large-scale deployments of EVs is negligible as neither users nor industry, i.e. manufacturers and energy suppliers, can be expected to sustain prolonged investments in technical options without hope of commercial return.

The apparent reluctance of most vehicle manufacturers, utility companies and fleet operators to extend the use of EVs or other clean fuel technologies beyond the stage of demonstration projects much reflects the dominating role of petrol and diesel cars in the present market situation. The challenge is for the public authorities to effect changes towards sustainable mobility by backing policy objectives with durable incentives that offer lasting and tangible economic benefits to clean fuel vehicles without obstructing existing transport operations. Such incentives may include subsidies or tax exemptions but should equally take into account the possibility of privileged access rights and times e.g. to reserved lanes and loading zones for clean fuel vehicles as part of a comprehensive urban mobility management devised in consultation with the stakeholders.

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Learn more about electric vehicles!

Since 1993, the European Commission has placed an emphasis on supporting demonstration projects targeted at specific energy-saving themes. This approach allows current research results to be tested in a real-world environment, act as a catalyst for the development of markets for energy-saving products, and foster a widespread adoption of low energy and low emission vehicles.

JOULE-THERMIE was an integrated energy-saving programme (1993-1998) of the European Commission's former Directorates for Energy and for Science, Research and Development. Within the transport sector, the main role of the JOULE-THERMIE programme was to promote the implementation of policies and technologies to achieve a more rational use of energy in urban transport.

ENERGIE has succeeded JOULE-THERMIE since 1998. It is a European Commission programme highlighting the potential for innovative, more efficient, and more sustainable energy solutions. Two key actions are currently focused on clean energy systems, including renewables, and on economic and efficient energy for a competitive Europe.

Targeted Transport Projects such as EVD-POST combine an approach to specific problems of the transport sector and the needs of urban residents within the wider remit of the European Commission's energy programmes to promote greater use of innovative European energy technologies. Information about the Targeted Transport Projects is available on the Internet at http://www.thermie-transport.org/

<u>Notice to the interested reader:</u>

Extensive information on the European Union is available through the EUROPA server under the Internet address http://europa.eu.int/

For general information about transport and energy find out more by contacting the

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