AcceptH2

Deliverable 2:
Assessing Local Situations
– Berlin –

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Contents

Abbreviations and Acronyms

BVG	Berliner Verkehrsbetriebe (Berlin transport service operator)
CEP	Clean Energy Partnership
CHP	Combined Heat and Power
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
GHG	Greenhouse Gas Emissions
H_2	Hydrogen
ICE	Internal Combustion Engine
LH_2	Liquefied Hydrogen
LPG	Liquefied Petroleum Gas
R&D	Research and Development
RME	Rape oil Methyl Ester
VAT	Value Added Tax
VBB	Verkehrsverbund Berlin-Brandenburg (Berlin-Brandenburg transport association)

1 PAST, PRESENT AND FUTURE ALTERNATIVE PROPULSION INITIATIVES

1.1 Greenhouse Gas Reduction Commitments

According to the Kyoto protocol greenhouse gas (GHG) reduction targets and in the framework of EU-burden-sharing, Germany committed to reduce its emissions of the six major GHGs by 21% by the year 2008 – 2012 on the basis of 1990 (CO_2, CH_4, N_2O), respectively 1995 (H-FKW, FKW, SF_6).

The German government self-committed to a CO_2 reduction of 25% by the year 2005 regarding the base year 1990 – an equivalent of 1,000 million tons CO_2. Nearly ¾ of this committed CO_2 reduction has been realized so far mostly by de-industrialization effects in former Eastern Germany. The transportation sector shall contribute a CO_2 emission reduction of 1.5 – 2.0% in reference to the year 1990, or 15 – 20 million tons of CO_2. Nonetheless, there are no dedicated national reduction targets concerning the public transportation sector.

Low-sulfur diesel is promoted by means of a dedicated petroleum taxation rebate [BMU 2000]. Upon request, currently 0.0614 EUR/l of the 0.15 EUR/l environmental/petroleum tax may be refunded if the fuel is consumed for public transportation purposes.

Income tax may be rebated by commuters independent of the chosen transportation mode.

1.2 Initiatives, R&D and Demonstration Projects

In Berlin, one of the first hydrogen fleet demonstration took place in the 80'ies. Further hydrogen demonstration projects followed at the end of the 20th century which could represent the basis for a built-up of infrastructure, such as an initial network of public hydrogen refueling stations in metropolitan regions and in selected hydrogen corridors.

In the following subchapters an overview over hydrogen initiatives, R&D and demonstration projects in the field of alternative propulsion is given which took place in Berlin. Further projects with hydrogen/fuel cells for stationary applications – such as the combined heat and power (CHP) fuel cell demonstration project in the Berlin district Treptow [Senatsverwaltung

2004] which started 1998 – are likely to have an influence on the public perception and acceptance of hydrogen and fuel cell technology, too. However, the stationary application of hydrogen and fuel cells is beyond the scope of AcceptH2 and thus not part of this report.

Fig. 1-1: Proton exchange membrane fuel cell powered by reformed natural gas in a demonstration project to provide heat and power for the Berlin district Treptow [Senatsverwaltung 2004]

1.2.1 Berlin Hydrogen Fleet Trial

From 1984 to 1988 five Mercedes-Benz station wagons and five Mercedes-Benz vans were operated as medical vehicles in Berlin.

Fig. 1-2: Mercedes-Benz propelled by hydrogen powered internal combustion engines (1984-1988)

All ten vehicles were propelled by hydrogen powered internal combustion engines. The hydrogen was stored onboard in metal hydride storage systems. At the end of the four year trial period the covered distance totaled a remarkable 250,000 km.

1.2.2 BMW CleanEnergy WorldTour 2001

For demonstration and promotion reasons, BMW held its so-called "CleanEnergy WorldTour" in 2001. 15 hydrogen powered 7 series vehicles (branded 750hL by BMW) were presented in five major cities (Dubai, Brussels, Milan, Tokyo, Los Angeles, Berlin). The events were targeted to attract the attention of politics, science and media. Major topics were the production, distribution and application of hydrogen for transportation purposes. The tour ended in November 2001 with a closing event in Berlin.

Fig. 1-3: Closing event of BMW's CleanEnergy WorldTour 2001 in Berlin

BMW's 750hL are equipped with a twelve cylinder, hydrogen powered internal combustion engine. Hydrogen is stored onboard in a liquid state of matter. Thus, each vehicle comprises a liquid hydrogen storage tank. More than 150,000 km was in total covered by the fleet.

BP und Linde Gas AG were partner of the CleanEnergy Tour.

1.2.3 Berlin Hydrogen Bus Trial and Hydrogen Competence Center

In Mai 2004 Berlin's public transport operator BVG put one MAN (now: NEOMAN) hydrogen bus into daily service. The trial is accompanied by the survey project AcceptH2 [AcceptH2 2004].

The hydrogen bus is the first of its kind in Berlin. It is equipped with a modified internal combustion engine (140 kW) in order to run on hydrogen. A bank of hydrogen pressure vessels are situated on the roof top for space and safety reasons. 1,600 liter hydrogen may be stored onboard sufficing to cover a distance of some 200 km. Current "list price" (the bus is not yet a series

version) is 500,000 EUR per bus which is some 100,000 EUR more compared to similar Diesel propelled buses [Kurier 2004].

Fig. 1-4: MAN hydrogen bus during the official handing over to BVG (Source: BVG)

The termination of the bus trial is not yet fixed, but will presumably be in the course of 2005. From mid July to end of September 2004, the bus will be off-service for a scheduled retrofitting at the premises of MAN in Munich.

By the beginning of July 2004 the bus had already been on service on popular route #100 ("Zoologischer Garten" <> "Alexanderplatz") and #119 ("Grunewald" <> "Flughafen Tempelhof"). Bus rides are free of charge for BVG customers using the hydrogen bus. The appearance of the bus differs significantly from BVG's corporate design color yellow.

The refueling of the bus with compressed gas hydrogen takes place at a dedicated refueling station which is jointly operated since 2002 by BVG, TOTAL, Linde, MAN and Opel/General Motors under the TOTAL brand. It is situated in the Usedomer Straße (Berlin district "Wedding").

Fig. 1-5: Hydrogen refueling station of the BVG/MAN bus trial

The refueling station provides compressed gas as well as liquefied hydrogen. Compressed gas hydrogen is produced onsite via electrolysis. Liquefied hydrogen is supplied by Linde via truck.

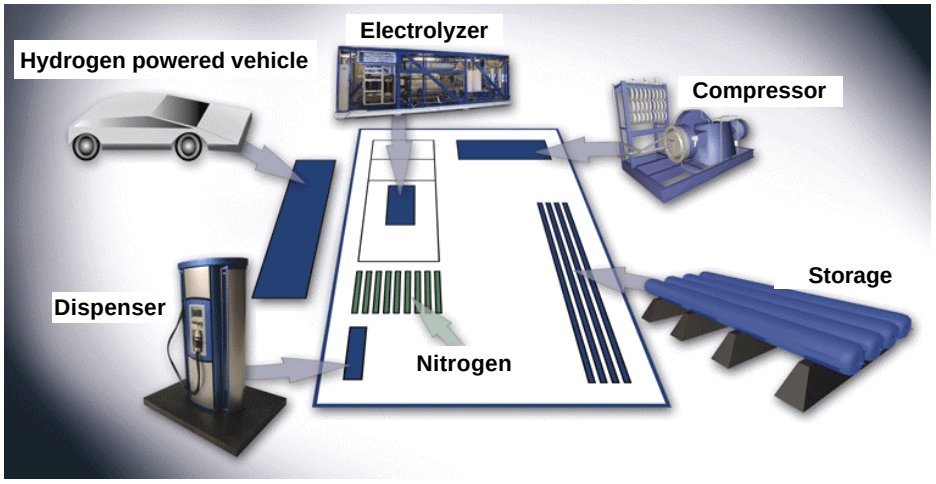
According to newspaper publications BVG plans to buy commercial versions by 2010 in undisclosed numbers [Kurier 2004].

1.2.4 Clean Energy Partnership (CEP)

"The Clean Energy Partnership (CEP) is a consortium comprising the corporate partners Aral, the BMW Group, Berliner Verkehrsbetriebe (BVG), DaimlerChrysler, Ford, GM/Opel, Hydro/GHW, Linde, Vattenfall Europe. In late 2004 CEP will start a project to demonstrate the reliability of hydrogen in everyday motor vehicle operation. The CEP will test various methods of hydrogen production as well as develop the hydrogen technologies for vehicles to mass production capability.

A public hydrogen filling station is currently under construction at the Messedamm in Berlin. On site, hydrogen will be derived from water by electrolysis and stored as pressurized gas. Additionally, cryogenic liquid hydrogen will be delivered and stored. The hydrogen will be used in vehicles which are either powered by a modified internal combustion engine or by a fuel cell propulsion systems.

Fig. 1-6: Technical scheme of the CEP refueling station (Source: CEP)

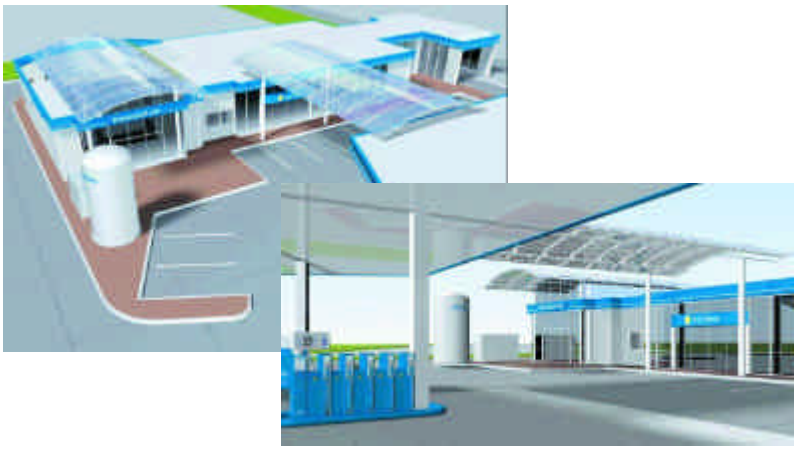


The CEP, constituted for a period of five years, is supported by the German Federal Government as part of the National Strategy on Sustainability. The federal initiative is setting out to demonstrate future-oriented technologies and to determine which technological and economic requirements must be fulfilled for the use of alternative fuels in road transport. Establishing beneficial environmental effects is a crucial consideration in this regard. The hydrogen must therefore be derived wherever possible from regenerative energy forms, e.g. from electricity generated by hydro or wind power. This will ensure that from the production process right up to the use on board the vehicle virtually no pollutants nor greenhouse gas emissions occur." [CEP 2004]

Fig. 1-7: Ground-breaking ceremony for the CEP refueling station on 25 November 2003 (Source: CEP)

The CEP refueling station will be the first public refueling station world-wide which provides conventional fuels alongside with compressed and liquefied hydrogen as well as a garage specialized in servicing hydrogen powered vehicles.

Fig. 1-8: Artists view of the CEP public refueling station (Source: Aral)



The CEP refueling station will provide enough hydrogen to power 16 hydrogen vehicles (fuel cell as well hydrogen internal combustion engine) in the beginning. The fleet will consists of one Opel HydroGen3, two 7 series BMW modified to comply burning hydrogen in an conventional internal combustion engine and store liquid hydrogen, three Ford Focus FCEV Hybrid and ten DaimlerChrysler fuel cell vehicles based on the A-class comprising compressed gas hydrogen storage vessels (35 MPa) [VDI 2003].

Fig. 1-9: Initial CEP fleet [IserUndSchmidt 2004]

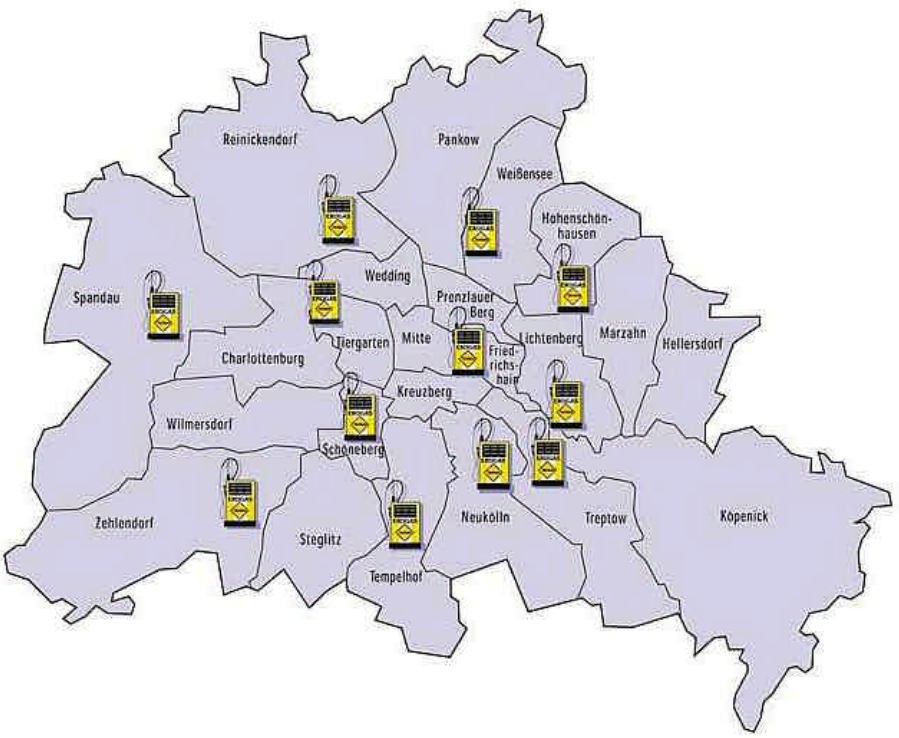
Furthermore, the refueling station will comprise a hydrogen information center [Aral 2003a].

1.2.5 Alternative Fuels Refueling Stations other than Hydrogen

Currently, 462 natural gas refueling stations exist in Germany [Erdgasfahrzeuge 2004]. Thereof, twelve refueling stations are located in the Berlin area (sorted by district):

- Friedrichshain: Holzmarktstraße 37 (Total)
- Hohenschönhausen: Rhinstraße 175 (Total)
- Karlshorst: Blockdammweg 6 (Total)
- Neukölln: Karl-Marx-Straße 267 (Shell)
- Pankow: Prenzlauer Promenade 70 (Orlen)
- Reinickendorf: Ollenhauerstraße 101 (Shell)
- Schöneberg: Sachsendamm 90 (Shell)
- Spandau: Nonnendammallee 42 (Sprint)
- Tempelhof: Mariendorfer Damm 195 (Aral)
- Mitte: planned
- Treptow: Schnellerstraße 20 (Aral)
- Zehlendorf: Berliner Straße 22 (Esso)

Fig. 1-10: Natural gas refueling stations in the greater Munich area [TUT 2004]



Esso Deutschland GmbH – a subsidiary of Exxon – plans to open some 200 additional CNG refueling stations within the next five years in Germany [Esso 2003]. TotalFinaElf (now Total Deutschland) shortly afterwards announced to add another 200 refueling stations [TotalFinaElf 2003]. Furthermore, Aral decided to erected 250 natural gas refueling stations by the end of 2004 [Aral 2003]. In 2002, nineteen major German gas companies together established erdgas mobil GmbH, a company aimed at getting 1,000 natural gas refueling stations operational within the next couple of years [DVGW 2002].

LPG is sold nationwide at more than 400 refueling stations [Autogas-Forum 2003]. There are some five LPG refueling stations in the Berlin area: Freie Tankstelle Andreas Henning, Tyczka Totalgaz GmbH, FGK - Flüssiggas Komplettservice GmbH, Peter Lindner GmbH, Autogas Fernholz [Gas-Tankstellen 2004].

Biodiesel (RME) may be bought at approximately 800 fuelling stations in Germany. Currently, there are some 24 locations exist in the Berlin area [Biodiesel 2004].

1.2.6 Deutscher Wasserstoff- und Brennstoffzellen-Verband e.V. (DWV)

The German Hydrogen and Fuel Cell Association (www.dwv-info.de/e/index.html) was founded in 1996. It took up residence in the city of Berlin. The lobby association promotes the research and development of hydrogen infrastructure and applications mainly in the field of energy and transportation. The vision of DWV is a transition to a hydrogen economy. It thus brings together stakeholders – mainly from industry and research organisations – and provides a platform for the required up-front informational exchange.

1.2.7 Photo-biological Hydrogen Production (Technical University of Berlin)

With publications dating back to the early 90'ies, photo-biological production of hydrogen from bacteria and algae is one of the research issues being undertaken by the Institute of Bionic & Evolution Technology of the Technical University of Berlin.

2 POLICY AND REGULATORY FRAMEWORK

2.1 Financing the Berlin Public Transportation Sector

The Berlin administrative districts and non-district communities are responsible for providing buses, tram and subways for public transport purposes. It is a political objective to foster a shift from the use of cars to the use of public transportation – above all in the inner city area – by means of shortening the journey time, control of car traffic, influence on the transport mode decision and the preference of public transport in urban infrastructure development schemes.

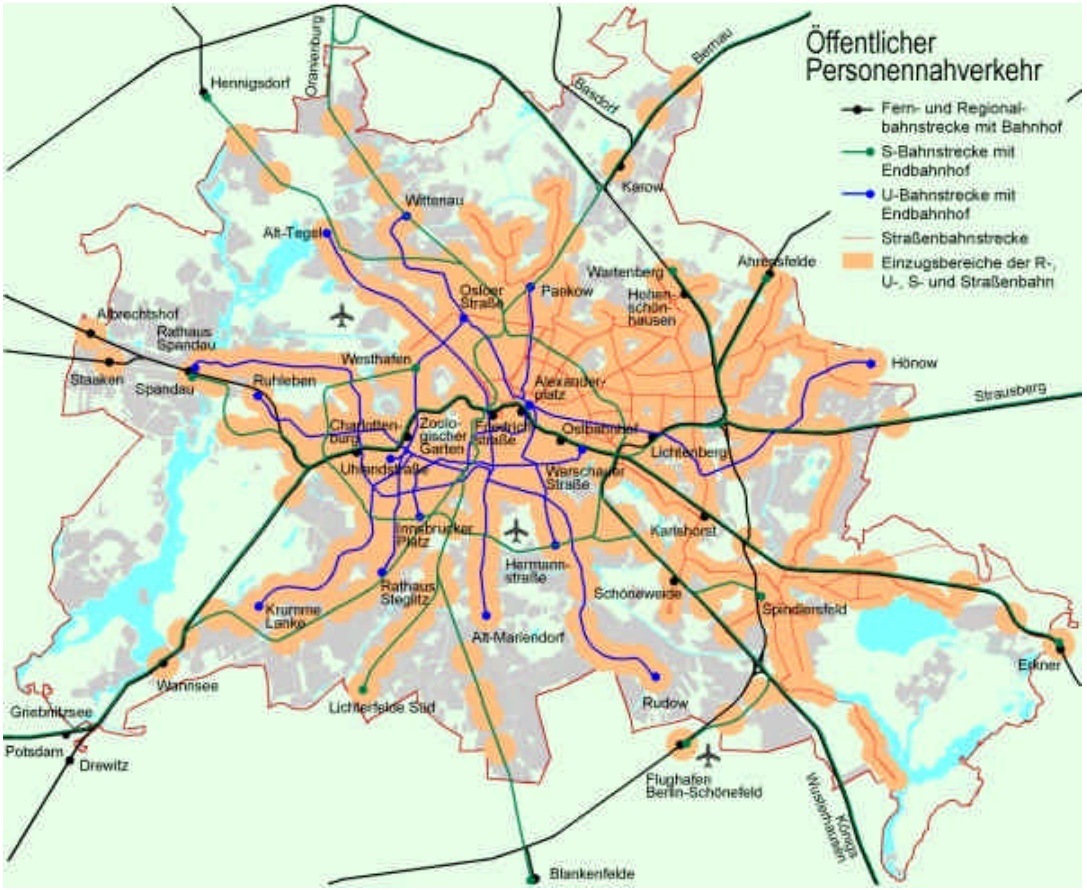
In addition to its operational incomes, BVG receives some EUR 411 million annually during the fiscal period of 2000-2004 based on the affiliation agreement, some EUR 427 million/a from the so-called 'regionalization funds', between EUR 82 and 90 million/a in compensation payment by law as well as EUR 110 to 170 million/a for investments in infrastructure. [SfS 2004]

Legal framework for the financial burden sharing are the "Gemeindeverkehrs-finanzierungsgesetz" (GVFG) and the "Regionalisierungsgesetz". Both laws stipulate how financial contributions from the German state are distributed among the transportation modes.

In Germany, ticket sales generally cover 65 - 70% of the overall expenses.

2.2 Structure of Public Transport in Berlin

Fig. 2-1: Scheme of current public transport lines in Berlin (without bus routes) [SfS 2004]



2.2.1 Berliner Verkehrsbetriebe (BVG)

The Berlin hydrogen bus trial (for details see chapter 1.2.3) is conducted under the auspices of the Berliner Verkehrsbetriebe GmbH (BVG) in co-operation with MAN (now NEOMAN), Total and Linde AG. BVG is the public transport provider of Berlin. It operates bus lines, tramway lines, underground system as well as ferries. Detailed data as per 31.12.2003 are compiled in the following table Tab. 2-1.

Tab. 2-1: Key data about BVG operation and performance

Personnel	12,878
Number of customer journeys (irrespective of the number of transport modes required)	890.3* million
Number of customer trips (taking into account the number of transport modes required)	1,013.3* million
Thereof • Subway	457.9*

• Tramway	157*
• Bus (incl. ferries)	398.4*
SUBWAY	
Number of lines day / night	9 / 7
Track length day / night	144.2 / 120.3 km
Line length day / night	151.7 / 120.3 km
Stations day / night	170 / 145
Average station distance	0.79 km
Average travel speed	30.9 km/h
Subway vehicles	1,361
TRAMWAY	
Number of lines day / night	27 / 5
Track length day / night	187.7 / 57.2 km
... thereof on dedicated railway construction	108 km
Line length day / night	362.6 / 59.7 km
Stations day / night	377 / 110
Average station distance	0.461 km
Average travel speed	19.4 km/h
Tramway vehicles	602
BUS	
Number of lines day / night	161 / 54
Track length day / night	1,271 / 568 km
Line length day / night	1,905 / 754 km
Stations day / night	2,730 / 1,522
Average station distance	0.520 km
Average travel speed	19.56 km/h
... ExpressBuses only	22.71 km/h
Bus vehicles	1,426
Thereof	
• Double-deck	394
• Single-deck	512
• Kneel bus	409
• Others	111

* preliminary data

Further information on e.g. tariffs are given in chapter 3.

In 1998, 27% of individual traffic was provided by public transport (individual motorized mode 37% and individual non-motorized traffic 34%). Three fourth of the Berlin population lives in the vicinity of any of the track-bound public transportation modes. In 1999, some 1 million passengers were served by public transportation. [SfS 2004]

2.2.2 Verkehrsverbund Berlin-Brandenburg GmbH (VBB)

Public transport in Berlin and its surrounding district Brandenburg is unified in the Transport Association Berlin-Brandenburg (Verkehrsverbund Berlin-Brandenburg GmbH – VBB). VBB comprises states, administrative districts and administratively independent cities. VBB represents the interface between the political administration (ordering party) and the transport companies (service providing party).

Political partners as per August 2004 are the State of Berlin and the State of Brandenburg, furthermore fourteen administrative districts as well as four administratively independent cities of the Brandenburg district.

Transport operators as per August 2004 are some 43 public and private transport service providers which are located in the Berlin and Brandenburg district.

2.3 Cost of Demonstration and Large-Scale Introduction

In order to get an idea about the cost sensitivity of a hydrogen bus trial and a full-scale introduction of a hydrogen bus fleet, the cost implications are calculated in two models and presented in the following subchapters. However, it has to be noted that the Berlin bus trial comprises an hydrogen internal combustion engine. Investment costs of this type of hydrogen propulsion system today and in the near future is significantly lower than those of hydrogen fuel cell powertrains which are mostly applied in hydrogen bus trials throughout Europe. Thus, the following calculations represent the lower end of cost implications for the replacement of conventional buses by hydrogen propelled ones. Furthermore, in a first estimation the cost of change in infrastructure – such as hydrogen refueling and service station – are not taken into account.

2.3.1 Demonstration Fleet

Assuming the replacement of some 10 out of the 1,462 BVG buses operated in Berlin by hydrogen ICE[1] buses for a demonstration project at 500,000 EUR per H2-ICE bus (a conventional bus approximately costs 400,000 EUR each[2]) and further assuming the fuel would cost four times as much as

[1] internal combustion engine

[2] The hydrogen fuel cell buses made by DaimlerChrysler are applied throughout the CUTE project (all

conventional fuel, then the overall bus depreciation would increase by 0.17% whereas the fuel costs would increase by 2%.

Personnel and administration costs account for some 83.5% of the overall costs of bus operators in Germany. Thus, overall bus operation costs would increase by about 0.12%.

Considering that bus transport is only one out of a number of different transport modes operated by BVG, the overall increase of operational costs of all transport modes is lower.

In Germany, ticket sales generally cover 65 - 70% of the expenses of public transport operators. Further funding is provided by public bodies such as the German state, administrative states and communities. Thus, the overall impact on the ticket price is even lower when considering third party funding.

2.3.2 Large-Scale Introduction

As future scenario, assuming the replacement of all of the 1,462 BVG by hydrogen ICE buses at bus prices 50,000 EUR above those of a conventional diesel bus, and hydrogen fuel to cost as much as conventional fuel per kilometer, then bus depreciation would increase by 12.6%. Fuel costs would remain constant.

Considering the overall cost of bus operation analogue to the previous chapter, then the overall cost of bus operation would increase by some 1.45%.

A further discussion on the impact on BVG ticket prices proceeds analogue to the previous chapter 2.3.1.

3 MANAGEMENT AND ADMINISTRATIVE STRUCTURES AFFECTING HYDROGEN BUSES

3.1 Timetables

The timetables of all regional train („S-Bahn“), underground („U-Bahn“), tramway, bus and ferry lines are harmonized under the auspices of the

in all 30 units). Investment costs are reported to be 1,250,000 EUR each [Spiegel 2003].

Verkehrsverbund Berlin Brandenburg (VBB). All timetables are compiled in a single electronic database which can be accessed via www.vbbonline.de.

3.2 Tickets and Fares

VBB follows the concept of intermodal traffic. There is no differentiation between bus, tram, subway or regional train.

The overall VBB tariff area comprises 43 private and public transport companies in more than 20 regional network districts. A unified ticket and tariff system is applied throughout the area. Minor differences may consist regarding dedicated tickets.

Figure 3-1: Unified tariff structure of the VBB region [VBB 2003]

The Berlin region is further subdivided into three rings – A, B and C – as shown in Figure 3-2.

Figure 3-2: Tariff structure of the Berlin region only [BVG 2003]

"A" represents Berlin's inner city area, "B" Berlin's city border and "C" the border of the administrative district of Berlin. The ticket price is determined by three major parameters: traveling range – such as the number of areas traveled –, validity period, and membership to dedicated focus groups – such as children, student, couples, elderly etc. Basically, the following ticket types are offered:

- single tickets
- season passes.

The ticket types are described in further detail in the subsequent chapters.

3.2.1 Single Tickets

The Berlin single ticket is valid for two consecutive hours. The ticket's validity is bound to its dedicated traveling zones (A, B and C respectively).

Tab. 3-1: Berlin single ticket fare 2003 [BVG 2003]

Zone	Regular price (incl. VAT)	Deducted price (incl. VAT)
AB	2.20 EUR	1.50 EUR
BC	2.25 EUR	1.55 EUR

Zone	Regular price (incl. VAT)	Deducted price (incl. VAT)
ABC	2.60 EUR	1.90 EUR
ABC (short distance)	1.20 EUR	1.00 EUR

A short distance fare ("Kurzstrecke") may apply if the traveling distance does not exceed three stations (subway or regional train) or six stations (bus or tram) respectively.

A reduced single fare is valid if the ticket holder is between six and fourteen years old or is owner of the "Berlin-Ticket" (38 EUR/year). Children up to the age of six years are free of charge.

3.2.2 Season Passes

For information about the applicability of regular and deducted fares, see previous chapter.

Tab. 3-2: Berlin (multiple) day ticket prices 2003 [BVG 2003]

Zone	Regular (incl. VAT) 1 day	Deducted (incl. VAT) 1 day	Welcome Card (incl. VAT) 3 days	Weekly Card (incl. VAT) 7 days
AB	5.60 EUR	4.20 EUR	-	23.40 EUR
BC	5.70 EUR	4.30 EUR	-	24.00 EUR
ABC	6.00 EUR	4.50 EUR	19.00 EUR	29.00 EUR
ABC + 1	-	-	-	31.50 EUR
ABC + 2	-	-	-	38.80 EUR

Tab. 3-3: Berlin month and year ticket prices on a monthly basis 2003 [BVG]

Zone	Standard (incl. VAT) Month	Premium (incl. VAT) Month	Standard (incl. VAT) Annual	Premium (incl. VAT) Annual
AB	58.80 EUR	67.30 EUR	48.75 EUR	56.08 EUR
BC	60.00 EUR	69.00 EUR	50.00 EUR	57.50 EUR
ABC	72.50 EUR	83.40 EUR	60.42 EUR	69.50 EUR
ABC + 1	95.50 EUR	109.80 EUR	79.58 EUR	91.50 EUR
ABC + 2	117.50 EUR	135.10 EUR	97.92 EUR	112.58 EUR
all of VBB	142.80 EUR	164.20 EUR	119.00 EUR	136.83 EUR

Furthermore, there are dedicated tickets, such as the student/sibling card ("Schüler-/Geschwisterkarte"), the apprentice card ("Azubitickett"), the senior ticket ("Seniorentickett"), the unemployed ticket ("Berlin A"), the social welfare ticket ("Berlin S") or the leisure time card ("Freizeitkarte").

The leisure time card is valid the whole day on weekends and public holidays and from Monday to Friday between 18.30 in the evening to 03.00 in the morning of the consecutive day. Furthermore, it is valid for the Berlin tariff sectors A, B and C and may be transferred to other users of public transportation. The leisure time card costs 24 EUR/month.

3.3 Fuel Costs

3.3.1 Diesel

As shown in Fig. 3-1, the bulk customer cost of diesel ranged between 0.625 EUR/l and 0.785 EUR/l between mid 2000 and mid 2004. Delivery and petroleum tax (currently 0.15 EUR/l) is included, VAT is excluded. In the course of the Ökosteuergesetz (environmental tax bill) – adopted March 3rd 1999 by the German Parliament – 0.0614 EUR/l of the environmental tax rate on diesel may be rebated upon request if the diesel is spent for public transport purposes. The refunding is granted if the bus is operated in line service, traveling time does not exceed one hour and traveling distance is below 50 km for one trip (§25.4 [MinöStG 2003]).

Fig. 3-1: Diesel price for bulk consumers (@10,000 l) including transport and excluding VAT in Germany June – August 2004 [euraOIL 2004]

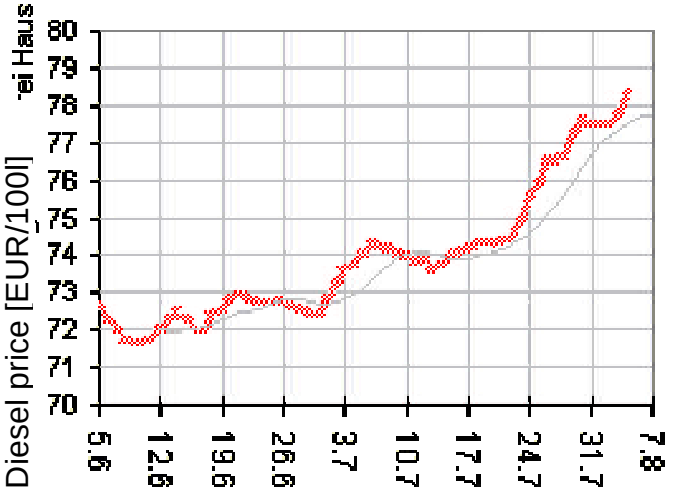
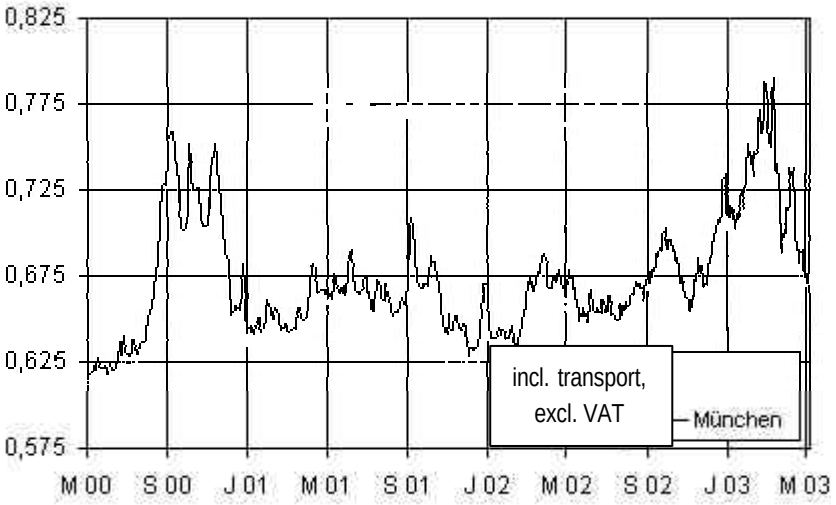


Fig. 3-2: Diesel price for bulk consumers between 2000 – 2003 [Dieselindex 2003]

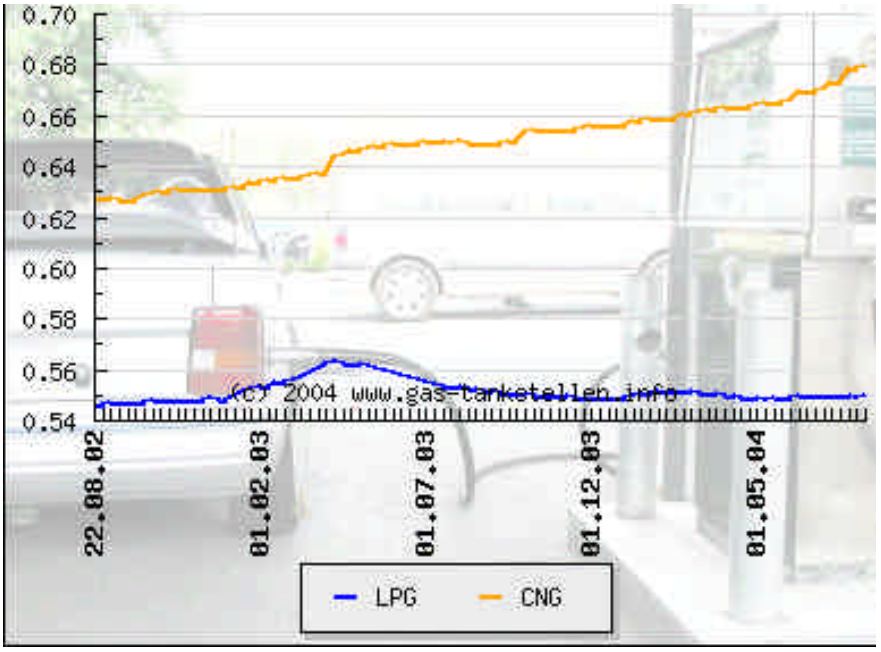


The triple hunch at the end of 2000 was caused by a sudden increase in US heating energy demand. As natural gas alone couldn't satisfy this demand, oil was bought by the USA on the EU market. This effect occurs again at present (including other geo-political implications) and is seen as an important signal for fossil resource constraints becoming increasingly visible on international energy markets [Energyshortage 2004].

3.3.2 Natural Gas and LPG

Average compressed natural gas (CNG) and liquefied petroleum gas (LPG) consumer prices in Germany developed according to Fig. 3-3 between 2002 and 2004.

Fig. 3-3: Average CNG and LPG consumer retail price in Germany 2002-2004 in EUR/kg (CNG) and EUR/l (LPG) [Gas-Tankstellen 2004]

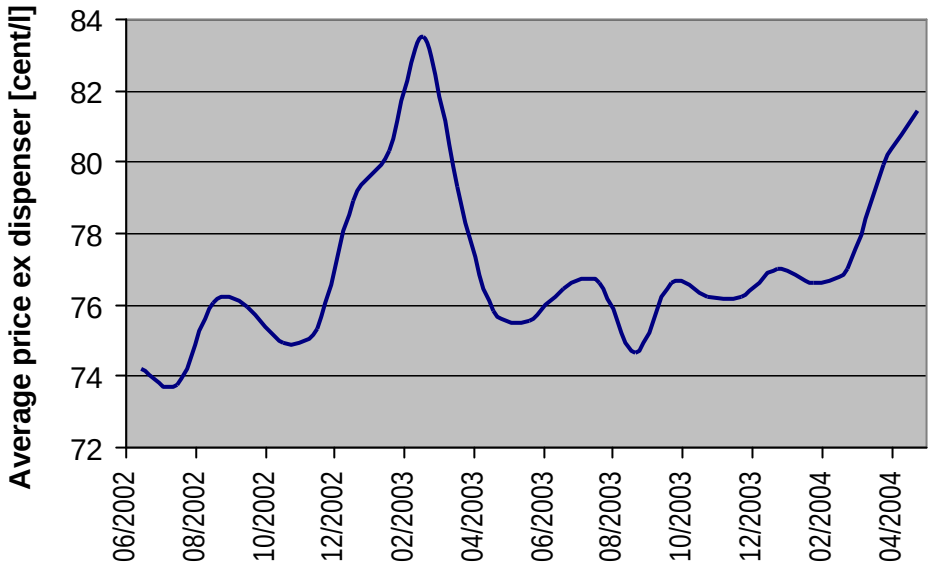


As part of the governmental environment initiative, reduced mineral oil tax for natural gas consumed by the transportation sector is valid until December 31, 2020.

3.3.3 RME

RME stands for 'rape oil methyl ester' and is commonly called 'biodiesel'. Between 2002 and 2004 the consumer end price for RME developed according to Fig. 3-4.

Fig. 3-4: Average German consumer end price for RME ex dispenser [IWR 2004]



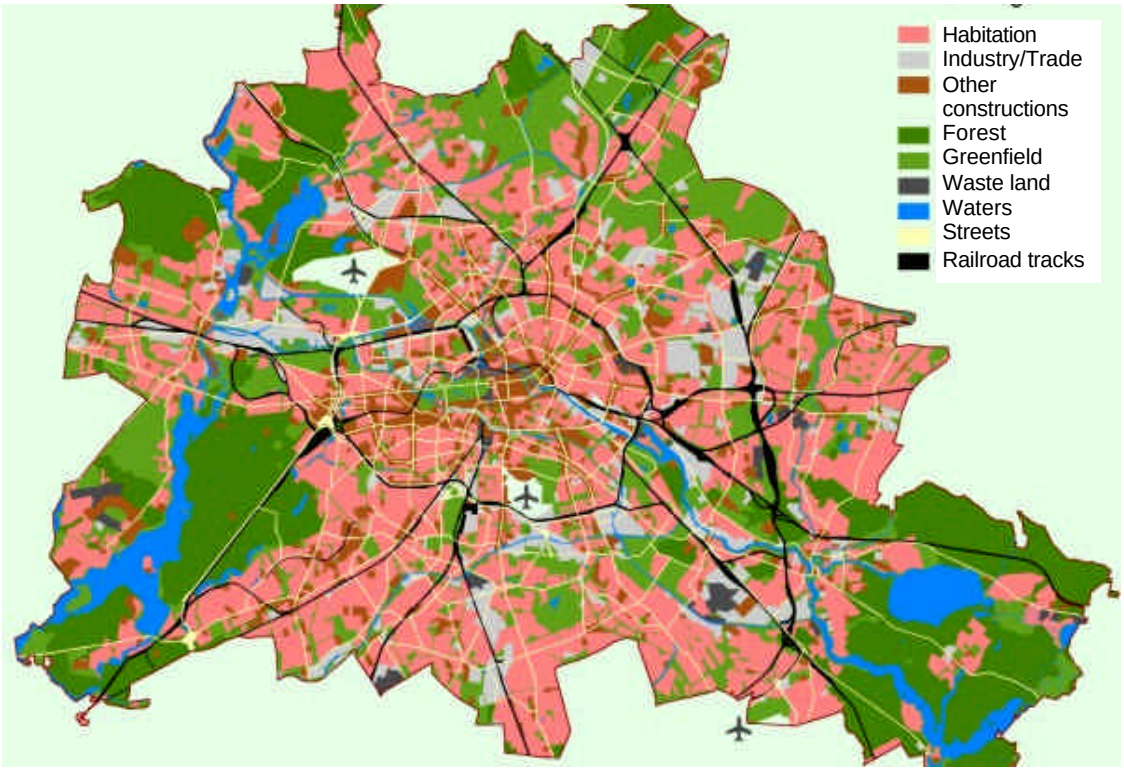
Neither mineral oil nor eco tax are due for sales of RME in Germany.

4 GENERAL SOCIAL BACKGROUND

4.1 Population, Employment and Income Levels

Berlin stretches over an area of 891 km². Thereof, 59% are covered by constructions, such as houses, streets etc. The remaining 41% comprises both green and open space. Of the area covered by constructions, more than 50% is reserved for housing.

Fig. 4-1: Land use in Berlin in 2000 [LfS 2004]



An average of 3,391,515 inhabitants lived 2003 in Berlin. In the following charts some general social data is stated about the Berlin population.

Fig. 4-2: Population and gender in Berlin (1950 – 2003) [LfS 2004]

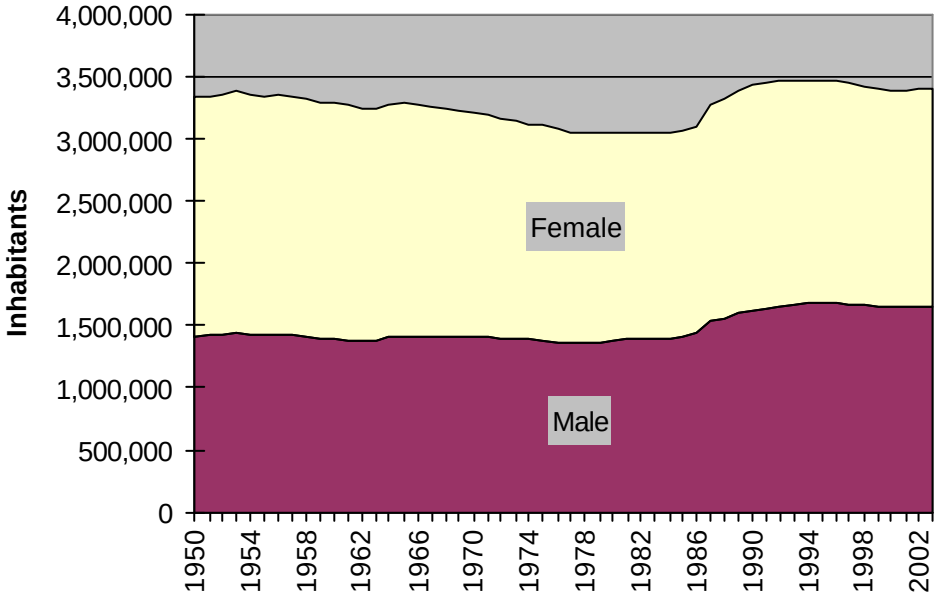
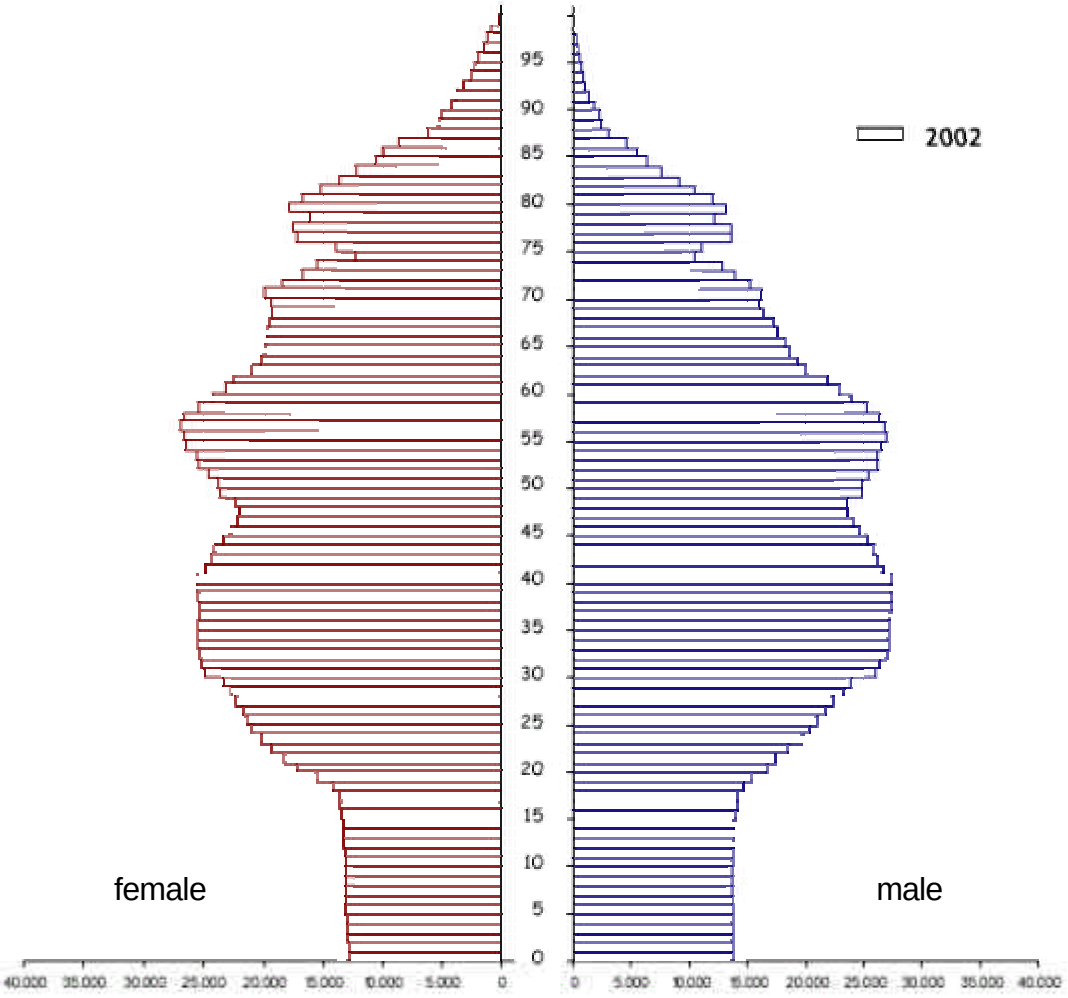


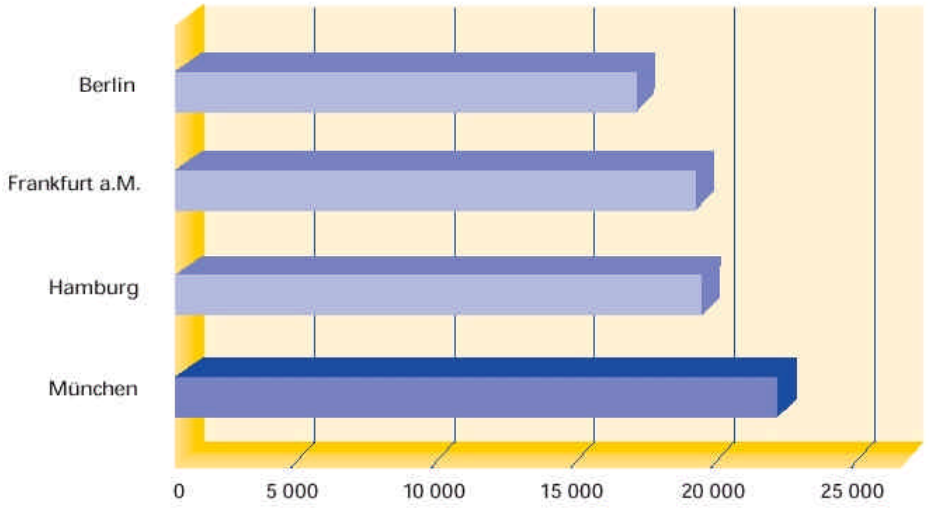
Fig. 4-3: Age distribution of the Berlin population as per 31.12.2002 [SfS 2004]



In 2002, some 444,800 (respectively 13.1%) of Berlin's population are foreigners [LfS 2004]. It is decided to conduct the Berlin survey in German only, though, there is a significant share of the Berlin population which is of Turkish origin. Yet, these are immigrants mostly already residing for one generation and longer in Germany.

As shown in Fig. 4-4 Berlin per capita purchasing power is some 17,000 EUR/a.

Fig. 4-4: Annual purchasing power of selected German cities in EUR/capita in 2001 [RfAW 2003]



In 2001, an average of 272,307 people were registered in Berlin as being unemployed [LfS 2004]. This represents an annual average unemployment rate of 17.9%, respectively 8% of total population.

In 2003, approximately 1.235.242 cars were registered in Berlin. This represents a car density of 0.36 cars per capita.

4.2 Social Structure of Public Transport Users

The Berliner Verkehrsbetriebe provided some statistical key figures regarding the socio-economic characteristics of its regular[3] customer base [BVG 2003a]. In the Berlin survey analysis, this data is applied in order to determine a possible bias between the interviewees' social structure and the public transport users' social structure.

Socio-economic characteristics were provided by BVG on a non-disclosure basis for the purpose of this study only. They are thus not part of this report.

[3] use of public transport at least once a month

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