EMTA
EUROPEAN METROPOLITAN TRANSPORT AUTHORITIES

CONSORCIO TRANSPORTES MADRID

EMTA BAROMETER OF PUBLIC TRANSPORT IN EUROPEAN METROPOLITAN AREAS (2004)

July 2007

Presentation

EMTA is the association of European Metropolitan Transport Authorities that brings together the public authorities responsible for planning, co-ordinating and financing the public transport systems in 27 of the European largest metropolitan areas promoting the exchange of information and good practices in the field of public transport.

Where they exist, public transport authorities are the only organisations with a broad view of mobility issues in large urban contexts. **Metropolitan areas have in fact multimodal and multioperators public transport networks but have to be understood as an integrated system**. Data collection should therefore be a key responsibility of public transport authorities.

As a first step to achieve this objective, a *Barometer of Public Transport* was published in 2002 with the aim to present the most important figures of the socio-economic and transport context in the associated metropolitan areas. Afterwards, every two years a new edition of the barometer has been published, this present edition being the third one. The report shows absolute data obtained from a questionnaire and also makes comparisons and sets ratios, **therefore it becomes a useful source of information to understand the different realities of each transport authority**.

The methodological difficulties we have found on gathering the data to produce the report are:

- the definition of the indicators are not the same in many cities and countries, though a manual was delivered with the questionnaire trying to set the meaning of each figure requested;
- the availability of data is very heterogeneous depending on cities, and sometimes even between modes within the same city;
- even when the data exist, it is rare that a single organisation has them all. Their collection therefore requires a big amount of work;
- lastly, the comparison of data is a difficult exercise since it requires comparable contexts. This means that the analysis of raw figures needs to look carefully at the geographical, institutional and social reality behind names of territories, to be able to draw few conclusions. As in the previous editions, the data in the *Barometer* are based on the territories of public transport authorities that submitted them.

These difficulties and biases are well known from experts. EMTA thinks it is time for a process of harmonisation of definitions at European level, in co-operation with the representatives of the public transport sector. **It is desirable the indicators used in the *Barometer* become more harmonised in the coming years for the metropolitan areas concerned**.

24 metropolitan areas have collaborated to this third edition of the *EMTA Barometer of Public Transport* by providing data based on year 2004: Amsterdam, Barcelona, Berlin-Brandenburg, Bilbao, West-Midlands (Birmingham), Brussels, Cadiz Bay, Frankfurt Rhein-Main, Helsinki, Greater London, Greater Lyon, Madrid Community, Greater Manchester, Oslo Region, Paris Ile-de-France, Prague, Seville, South Yorkshire (Sheffield), Stockholm, Greater Stuttgart, Turin Metropolitan Area, Valencia, VOR Region (Vienna) and Vilnius.

We would like to thank the responsible persons in transport authorities that have contributed to the updating of this Barometer because we know collecting all the information required for the questionnaire is so thorough.

Lastly, Consorcio Regional de Transportes de Madrid (Madrid Transport Regional Consortium) deserve our special thanks, namely Carlos Cristobal Pinto Head of Studies and Planning Department who supervised the document and Laura Delgado Hernandez responsible for aggregating the data and giving consistency to the *Barometer of Public Transport* .

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1. Basic Socio-Economic Data of Metropolitan Areas

These background data have two main purposes:

- on one hand, they show a picture of the metropolitan areas through basic figures;
- on the other hand, they can be used as reference indicators that enable to compare the transport items described along the present report in relative terms, which means that the data among the different metropolitan areas will be more homogeneous. As an example of this, the bus network length divided by population or by surface covered is a more accurate approach to the supply level than the absolute value of the network length.

The metropolitan areas mentioned are very heterogeneous in every socio-economic aspect considered (Table 1). For example, in terms of population, Paris Ile-de-France is the most populated region (11,097,400 inhabitants) and Vilnius the least (553,076 inhabitants), giving a ratio of 20. Greater London also has a great number of inhabitants (7,388,000 inhabitants) as well as Madrid Community (5,964,143 inhabitants) or Berlin-Brandenburg (5,955,532 inhabitants). Concerning the surface, Berlin-Brandenburg has the biggest metropolitan area (30,730 km^2), then Frankfurt Rhein-Main (14,000 km^2), Paris Ile-de-France (12,012 km^2) and Madrid Community (8,030 km^2), while Vilnius does not reach 400 km^2.

Table 1. Basic socio-economic data of metropolitan areas [1]

Name of the region or metropolitan area	Population 2004 (inhabitants)	Surface (km^2)	Urbanised surface (km^2)	Family size	Annual GDP per capita (€)
Amsterdam	1,353,820	1,003		2.2	33,000
Barcelona	4,770,180	3,236	588	2.7	21,373
Berlin-Brandenburg	5,955,532	30,730	1,669		20,636
Bilbao	1,135,243	2,217	344	2.8	23,887
West-Midlands (Birmingham)	2,578,400	901	433	2.5	23,793
Brussels	2,980,106	5,162	1,150	1.9	
Cadiz Bay	629,054	2,087	80		6,800
Frankfurt Rhein-Main	4,793,000	14,000		1.9	35,000
Helsinki	990,448	743	235	2.2	39,200
Greater London	7,388,000	1,579		2.4	33,887
Greater Lyon	1,167,086	500	211	2.3	25,153
Madrid Community	5,964,143	8,030	1,040	2.9	23,777
Greater Manchester	2,539,000	1,272	959	(1) 2.4	16,470
Oslo Region	1,024,064	5,014	384	2.4	46,494
Paris Ile-de-France	11,097,400	12,012	2,521	2.3	38,740
Prague	1,700,000	3,860		2.4	17,155
Seville	1,213,747	1,759	409	3.0	14,550
South Yorkshire (Sheffield)	1,272,609	1,552		2.4	20,402
Stockholm	1,900,000	6,500			
Greater Stuttgart	2,405,168	3,012	674	2.0	34,858
Turin Metropolitan Area	1,529,157	837		2.1	(2) 23,769
Valencia	1,664,560	1,415	313	2.6	18,077
VOR Region (Vienna)	2,349,000	6,457		2.3	31,000
Vilnius	553,076	392	80	3.0	7,588

(1) 1991 data
(2) In Turin, data is referred to the province territory

[1] *In order to compare easily between the different tables and graphs contained in this report, all the metropolitan areas that have contributed to this updating of the EMTA Barometer appear in all tables and graphs. When a particular data is not available, there is an empty space beside the name of the metropolitan area.*

The figures of surfaces reflect not only the different sizes and densities of metropolitan areas, but also the different administrative and institutional organisation of local authorities. They highlight the differences between countries where public transport systems are co-ordinated on a regional basis and where large parts of rural areas are integrated in the provision of services, like Germany, and those where public transport is organised in a more urban and local scale.

The 24 areas surveyed have a total population of 67 million people, that is to say 14.5% of EU25 total population.

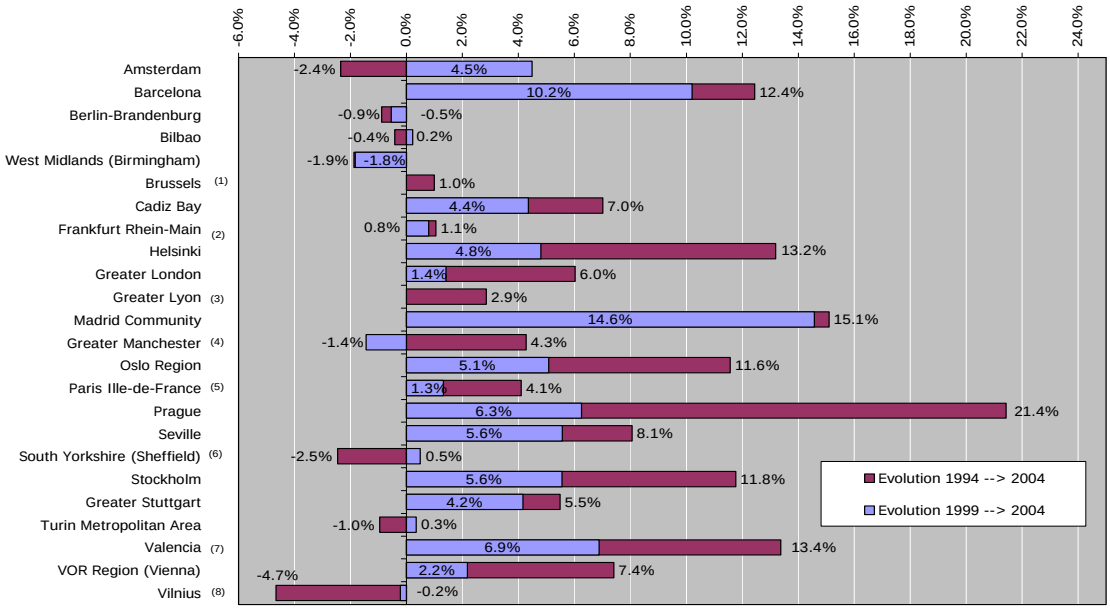
The size of the families in the Spanish metropolitan areas and Vilnius is larger (2.6-3.0 persons/family) than in the rest of European cities, where it is less than 2.5. It is remarkable that in Frankfurt Rhein-Main and Brussels (1.9) there are plenty of single-parent families or people living alone. In the rest of the analysed European metropolitan areas, the situation is quite similar. These figures mean that a couple has roughly one single child or any at all, revealing the serious ageing problem of the population.

If we look at the economic figure, annual GDP per capita, we can see Oslo (46,494 €) has an annual GDP per capita seven times higher than Cadiz Bay (6,800 €). In addition, Helsinki and Paris Ile-de-France have a GDP close to 40,000 € while the average of the metropolitan areas surveyed is 25,255 €.

1.1. Evolution of population

During the period 1994-2004, most of the metropolitan areas have seen their population increase, with an average ratio of 4% every 5-year period (Graph 1).

Graph 1. Population evolution 1994-2004 and 1999-2004 in metropolitan area



(1) Brussels, period 1993-2004
(2) Frankfurt, period 1996-2004
(3) Lyon, period 1990-2004
(4) Manchester, periods 1991-2004 and 1998-2004
(5) Paris, period 1991-2004
(6) Sheffield, periods 1996-2005 and 2001-2005
(7) Valencia, periods 1996-2004 and 2001-2004
(8) Vilnius, periods 1993-2004 and 2001-2004

Several of these metropolitan areas have seen an increase over 10% in the last 10 years. This is the case of Prague, Madrid, Valencia, Helsinki, Barcelona, Stockholm and Oslo. In Madrid and Barcelona the growth over the last 5 years has been very significant, due to the massive immigration that Spain has experienced.

Among the cities having provided data, three experienced a steady decrease in population as Berlin-Brandenburg (-0.9%), West Midlands (Birmingham) (-1.9%) and Vilnius (-4.7%). Some like Amsterdam, Bilbao, South Yorkshire (Sheffield) and Turin showed an overall decrease for the past ten years although the last five years have seen an increase in population. On the contrary, Greater Manchester shows an overall increase in the past decade while the last five years reveal a decline of the population.

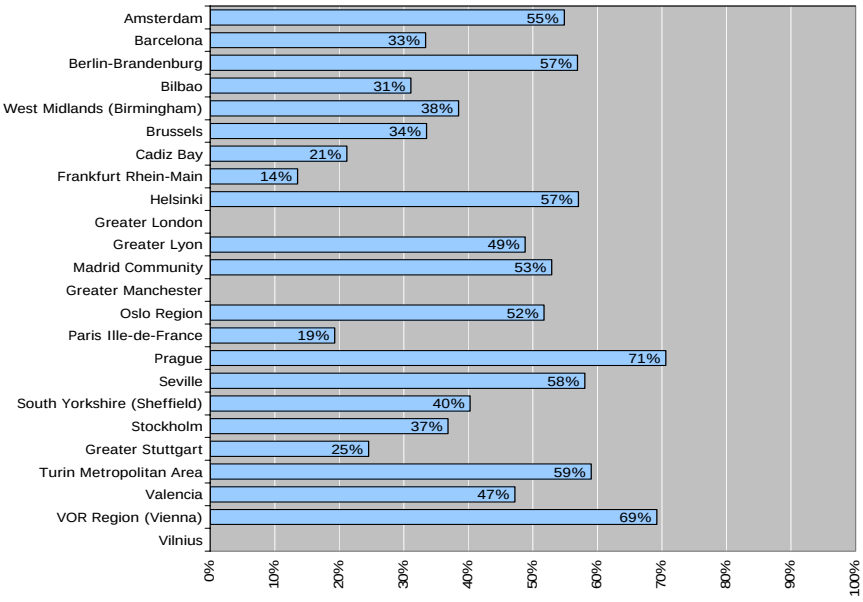
1.2. The weight of main city in the metropolitan area

The main city gathers almost 44% of the population of the metropolitan area, with great differences showing the diverse administrative frameworks and structures of the metropolitan areas (Graph 2).

Cities like Prague and Vienna host more than two thirds of the population of the metropolitan area. Cities like Turin, Seville, Helsinki and Amsterdam concentrate more than 55% of the population due to the great surface of the city compare to the whole metropolitan area. Other cities like Berlin, Madrid and Oslo also host more than 50% of the population due to the extension of the main city surface (over 400 km^2) in spite of an expanded metropolitan area. Greater London does not appear in the graph because the metropolitan area falls under the administrative limits of the greater city surface.

Contrary to these cities, Paris and Cadiz have low ratios (19 and 21%) due to a limited and completely developed city area without surface to expand, and also Frankfurt and Stuttgart (14 and 25%) because of the typical structure of German cities, based on conurbations.

Graph 2. Population main city / population whole metropolitan area

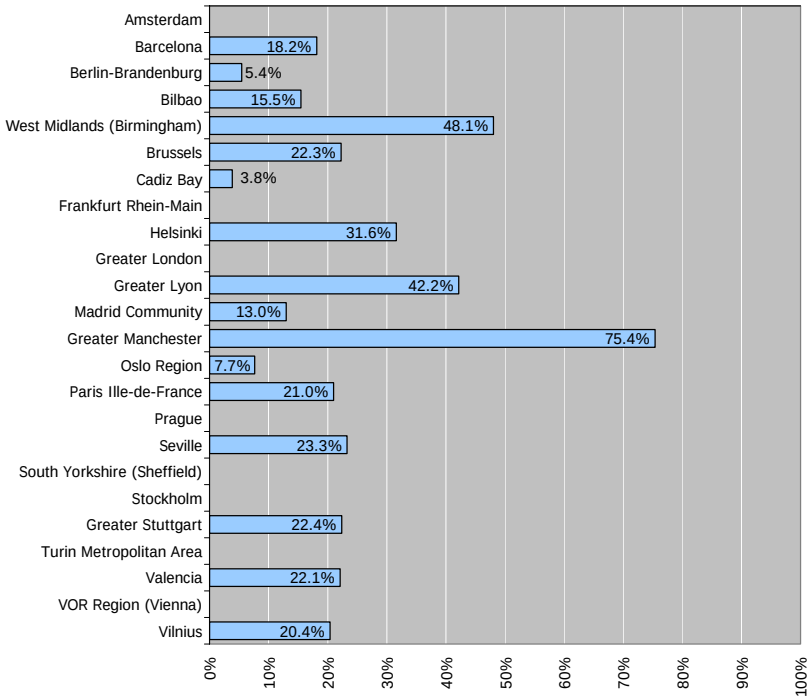


These different urban layouts have strong consequences for the coordination of the provision of public transport among the various local authorities concerned.

1.3. Urbanised area

Another remarkable figure is the urbanised surface in the areas of our study (Graph 3). Where data are available it is an indicator of the nature of the region, whether it has wide rural areas or covers built-up zones. Though the definition of "urbanised area" might vary in different cities we can notice that Greater Manchester has the greatest ratio comparing the urbanised surface with the total metropolitan surface (75%), followed by West Midlands (Birmingham) (48%), Greater Lyon (42%) and Helsinki (31%). The rest of the regions range from 15 to 30%, with the exception of Madrid, Berlin-Brandenburg, Oslo and Cadiz Bay where there are extended non-built areas.

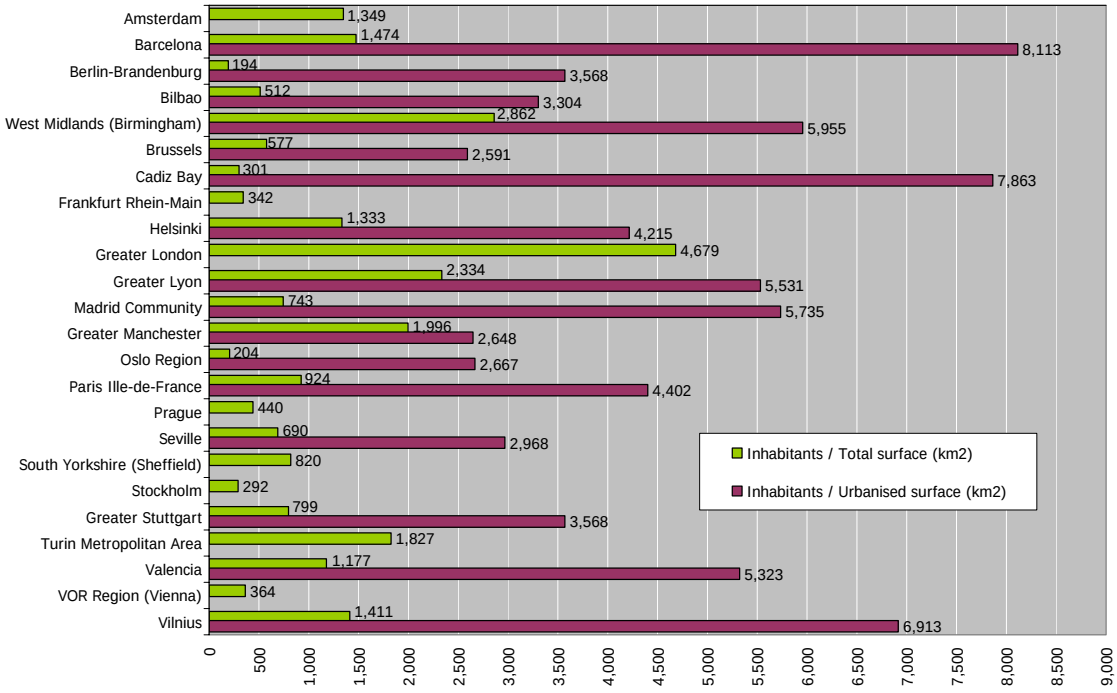
Graph 3. Urbanised surface on metropolitan area / metropolitan area surface



1.4. Density of population

Metropolitan areas whose administrative boundaries cover mostly urbanised areas like Greater London (4,679 inh/km^2), West Midlands (Birmingham) (2,862 inhabitants/km^2) or Greater Lyon (2,334 inh/km^2) reach much higher gross densities than those including large rural parts as Berlin-Brandenburg (194 inh/km^2), Oslo (204 inh/km^2), Stockholm (292 inh/km^2) or Cadiz Bay (301 inh/km^2) (Graph 4).

Graph 4. Population density in metropolitan area (inhabitants/km^2)



Therefore, it is more pertinent to look at the density in urbanised areas, which reach very high rates in cities having a tradition of collective housing such as Spanish cities Barcelona, Cadiz, Madrid and Valencia and also Vilnius, Birmingham and Lyon where the net density is over 5,000 inh/km^2 (or 50 inh/ha).

2. Mobility

This section gathers data related to mobility such as the main features of the trips in the metropolitan areas and modal split, car ownership and traffic safety (Table 2).

Table 2. Mobility parameters in metropolitan areas

	Trips per person per day	Motorised trips		Home to work & school trips/ total trips	Car ownership rate	Number of taxis	People killed in road accidents / million inh	People injured in road accidents / million inh
		Average duration (min)	Average distance (km)	(%)	(Vh/1,000 inh)			
Amsterdam	3.60	25	16	30.0%	585	3,097	24	274
Barcelona	1.68	32	9	54.6%	411	11,325	44	4,173
Berlin-Brandenburg	2.90			43.0%	322		59	4,045
Bilbao	2.60	34	6	59.0%	406	774	38	2,769
West-Midlands (Birmingham)	2.73	22	11	59.0%	557	12,047	29	3,987
Brussels	3.00	54		45.0%	439	1,247	74	375
Cadiz Bay				60.9%	397		188	7,681
Frankfurt Rhein-Main	3.30	74	13	38.0%	580	4,000		
Helsinki	3.62			34.0%	381		25	1,313
Greater London	2.35		12	40.0%	328	21,000	7	2,240
Greater Lyon	3.36	24	7	32.0%	460			
Madrid Community	2.60	34	8	56.4%	504	15,672	50	3,155
Greater Manchester	3.13	26		29.0%	405	10,357	138	3,486
Oslo Region	3.58	18	9	43.0%	542	2,951	25	2,446
Paris Ile-de-France	3.50	29	7	34.0%	455	17,023	40	2,191
Prague	3.10			65.0%	635	4,500	51	2,497
Seville	2.37	26	7	96.0%	227	2,311	33	3,317
South Yorkshire (Sheffield)	1.85	16	9	21.0%	402	3,656	44	4,934
Stockholm	3.00				380			
Greater Stuttgart	4.05		16	42.8%	586	1,410	33	3,459
Turin Metropolitan Area	2.49	28		36.0%	670	1,570	72	5,059
Valencia	2.42	24	10		451	2,731	32	4,621
VOR Region (Vienna)	2.70	40	13	30.0%	403		26	
Vilnius	3.00	30	4	84.0%	450	1,600	98	2,537

Just in the city
1995 data
1996 data
1998 data
1999 data
2001 data
2002 data
2006 data

2.1. Main characteristics of the trips in metropolitan areas

The number of daily trips varies significantly across the metropolitan areas; this is due partially to the method followed to calculate the figure. In some metropolitan areas walking trips of less than five minutes are not considered into the calculation, in other cases trips under a certain length are not considered either. Despite this, the number of trips per person per day is in between 2.0 and 3.6 with an average of 2.9 trips. Barcelona shows a low figure (1.68 trips/person-day) because it is calculated as an average of the week including weekend days (with less mobility) instead of considering the number of trips in a labour day. At the other end, Greater Stuttgart has a mobility ratio of 4.05 trips per person per day.

The average duration of motorised trips is comprised between 20 and 40 minutes with extreme cases such as Frankfurt Rhein-Main (74 min) and Brussels (54 min) and the average length is between 7 and 16 km,

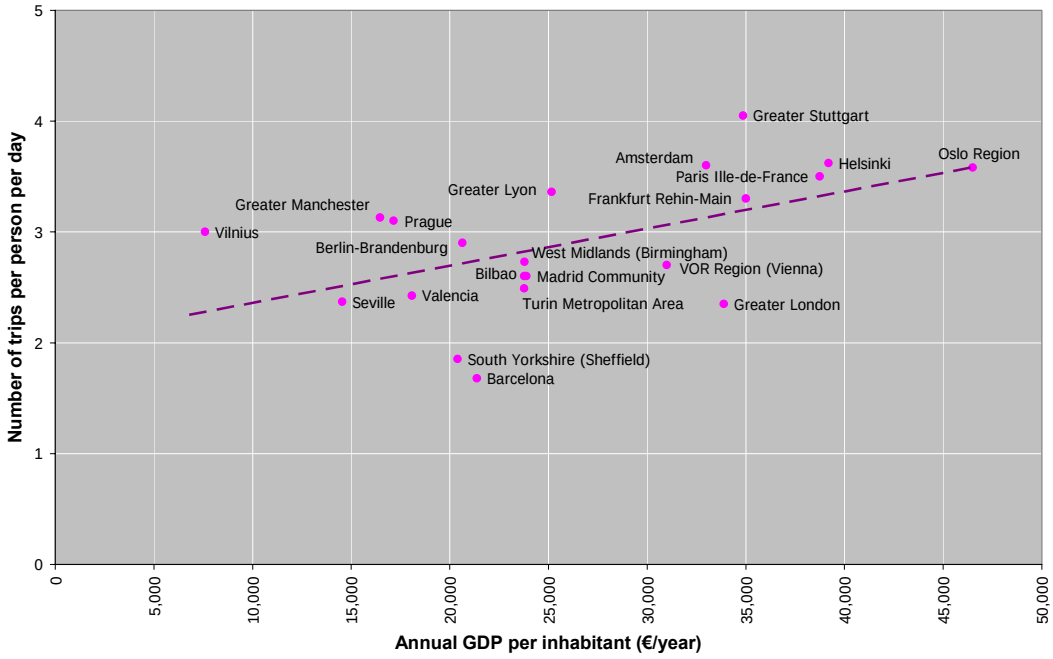
inducing an average speed of 20.5 km/h. On the basis of 3 trips per day, this means that the majority of the population spends between one and two hours travelling everyday in metropolitan areas. Therefore it is important to promote safe and comfortable transport systems to make this long period of time as pleasant as possible.

Interestingly there is no clear relationship between the size of the metropolitan area and the length of the trips. As an example, in the largest areas (with the exception of Berlin-Brandenburg whose figure is not available) Paris Ile-de-France, Frankfurt Rhein-Main and Madrid Community, the average trip is quite shorter (7, 13 and 8 km) than in some medium sized metropolises as Amsterdam or Stuttgart (16 km).

Regarding commuting mobility (trips to work or to school), it still appears as the main purpose adding to more than 45% of the total trips. It is a figure to take into account since this mobility has a very high concentration on peak hours. Few European metropolitan areas have a commuting trips ratio under a third of the total trips , these are South Yorkshire (Sheffield) (21.0%), Greater Manchester (29.0%), Amsterdam and VOR Region (Vienna) (30.0%).

In Graph 5 we see there seems to be a link between the annual GDP per inhabitant (€/year) and the number of trips per person per day. It seems that the higher the GDP the higher the number of trips. We can infer from this trend that wealthy regions have higher needs of mobility. The statement is not new and is confirmed by socio-economic researches. One explanation would be, among others, that the travel cost weights less when the income is higher, therefore travelling becomes more usual. Another would be that lower GDPs lead to less leisure time, thus less mobility needs. Also wealthy areas have more and better infrastructures, therefore the transport system is more accessible.

Graph 5. Link between annual GDP / inhab and number of trips per person and day



2.2. Car Ownership and safety

In these metropolitan areas car ownership rate is on average 457 cars/1,000 inhabitants ranging from the lowest levels of 227 cars in Seville and 322 in Berlin-Brandenburg to the highest levels of 635 cars/1,000 inhabitants in Prague and 670 in Turin (Table 2).

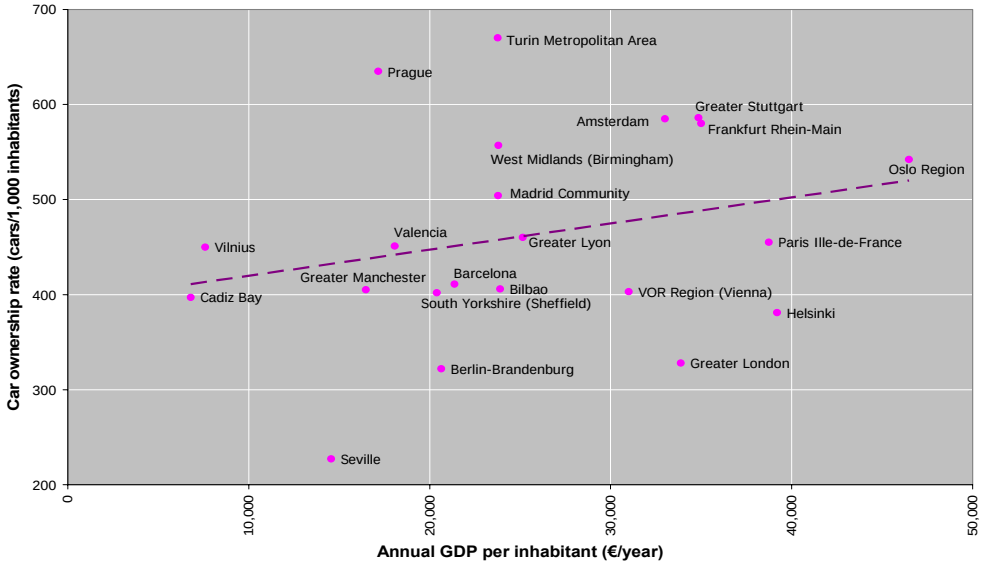
Concerning the injuries and fatalities in road accidents, there are great differences among the areas surveyed. There might be a bias here for the meaning of "one injured" (seriousness of the injury) or "one fatality" (period of time considered after the accident) differs significantly from a country to another. In addition, we have to take into account the size and the inclusion of rural areas to give sense to these figures. As an example, Cadiz, which has very high figures on injuries (7,681 injuries per million inhabitants) and people killed in road accidents (188 people killed per million inhabitants), includes a very large country area. Also we have to look carefully those figures referred just to the main city, where there might be less people killed than the average (Prague, Seville, Valencia and Vienna) since the car accidents in urban areas are less serious but more numerous.

On fatalities, where the average is 54 killed /million inhabitant, London (which figure refers only to the city centre), Amsterdam, Helsinki and Oslo have 25 or fewer fatalities per million inhabitants, while Cadiz, Greater Manchester and Vilnius have close to or over 100 people killed in road accidents per million inhabitants. Regarding injuries, Amsterdam and Brussels have very low ratios (274 and 375 people injured per million inhabitants) while the highest are Cadiz, Turin and South Yorkshire (Sheffield).

No other correlation between injuries or fatalities and car ownership or modal share of private vehicle can be confirmed. Very different geographic contexts and dispersion of data might be the reason.

However, on Graph 6 seems that car ownership rate tends to relate to annual GDP per inhabitant thus acting as a socio-economic indicator.

Graph 6. Link between annual GDP/inhab and car ownership rate (cars/1,000 inhab)



2.3. Modal split

We can say generally that the modal split in the areas surveyed is 31% of non motorised trips (mainly walking), 19% are trips made on public transport and 50% are trips using private vehicles. This fact highlights the wide participation of the private vehicle in our mobility, and the need for a change in these patterns. However, besides these general figures, clear differences in mobility behaviours of each of the metropolitan areas appear in Table 3 below.

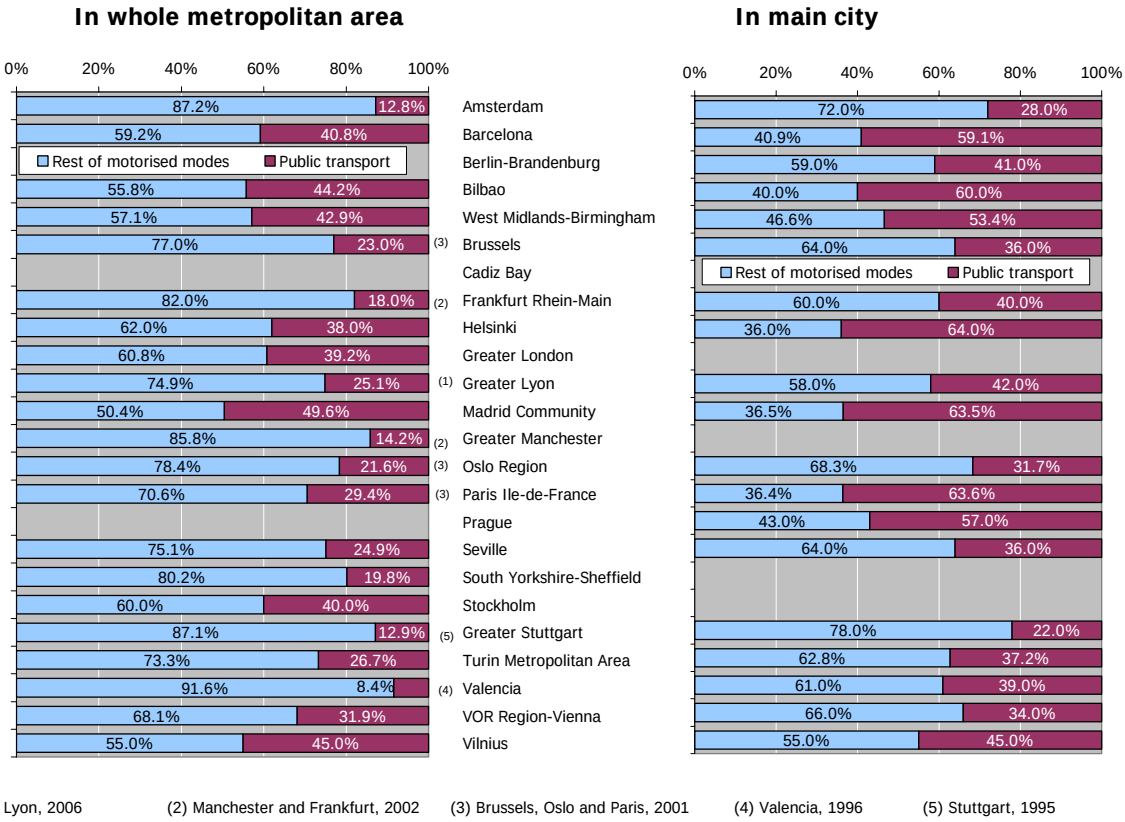
The metropolitan areas with higher share of non motorised trips are Bilbao, Valencia, Amsterdam and South Yorkshire (Sheffield). In three of them walking represents more than 40% of trips, and Amsterdam has an outstanding participation of cycling in non motorised modes (26% of total trips). At least in all metropolitan areas 25% are non-motorised trips except in Prague, Brussels and West Midlands (Birmingham) where the modal share is between 18 and 20%.

Table 3. Modal split in whole metropolitan areas

	TABLE I: GENERAL MOBILITY				TABLE II: PUBLIC TRANSPORT MOBILITY			
	Modal share NON MOTORISED TRIPS (%)	Modal share of walking (%)	Modal share of cycling (%)	Modal share MOTORISED TRIPS (%)	Modal share of PT in motorised trips in whole region (%)	Modal share of PT main city ↔ main city trips (%)	Modal share of PT suburbs ↔ main city trips (%)	Modal share of PT suburbs ↔ suburbs trips (%)
Amsterdam	44.4%	22.0%	26.0%	55.6%	12.8%	28.0%	24.0%	8.5%
Barcelona	38.7%	35.4%	0.8%	61.3%	40.8%	59.1%	53.2%	22.1%
Berlin-Brandenburg	37.0%	29.0%	8.0%	63.0%		41.0%		
Bilbao	46.2%	45.0%		53.8%	44.2%	60.0%		
West-Midlands (Birmingham)	19.4%	18.8%	0.8%	80.6%	42.9%	53.4%	53.4%	22.6%
Brussels	18.4%	16.1%	2.3%	81.6%	23.0%	36.0%	16.0%	10.0%
Cadiz Bay								
Frankfurt Rhein-Main	28.5%	19.7%	8.8%	71.5%	18.0%	40.0%	15.5%	13.0%
Helsinki	29.0%	22.0%	7.0%	71.0%	38.0%	64.0%	57.0%	21.0%
Greater London	28.9%	27.2%	1.7%	71.1%		39.2%		
Greater Lyon	35.4%	33.6%	1.8%	64.6%	25.1%	42.0%	27.9%	9.5%
Madrid Community	31.2%	31.1%	0.1%	68.8%	49.6%	63.5%	49.5%	25.7%
Greater Manchester	25.6%	24.6%	0.8%	74.8%	14.2%			
Oslo Region	25.0%	20.0%	5.0%	76.0%	21.6%	31.7%		13.8%
Paris Ile-de-France	35.3%	34.0%	1.3%	64.7%	29.4%	63.6%	59.7%	16.1%
Prague	18.0%	17.5%	0.5%	82.0%		57.0%	32.4%	
Seville		37.8%		62.2%	24.9%	36.0%	16.3%	6.5%
South Yorkshire (Sheffield)	41.0%	40.5%	0.5%	59.0%	19.8%			
Stockholm					40.0%		55.0%	
Greater Stuttgart	28.9%	22.0%	6.9%	71.1%	12.9%	22.0%		
Turin Metropolitan Area	30.4%	28.8%	1.6%	69.6%	26.7%	37.2%	23.0%	7.0%
Valencia	44.5%	45.1%		55.5%	8.4%	39.0%	25.0%	
VOR Region (Vienna)		36.2%	5.3%		31.9%	34.0%		
Vilnius	28.0%	30.0%	2.0%	72.0%	45.0%	45.0%		

Just in the main city
1995 data
1996 data (Brussels, 1999)
2001 data
2002 data
2006 data

Graph 7. Modal split in metropolitan areas in motorised trips



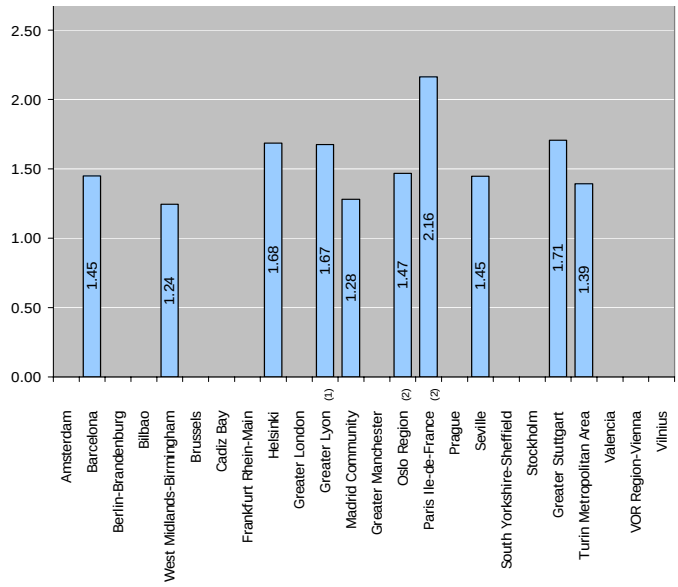
(1) Lyon, 2006 (2) Manchester and Frankfurt, 2002 (3) Brussels, Oslo and Paris, 2001 (4) Valencia, 1996 (5) Stuttgart, 1995

Madrid is the metropolitan area where the public transport accounts for the highest percentage within motorised trips (49.6%), followed by Vilnius (45.0%), Bilbao (44.2%), West Midlands (Birmingham) (42.9%), Barcelona (40.8%), Stockholm (40.0%), Greater London (39.2%) and Helsinki (38%) (Graph 7). In the case of Madrid, the figure is even more interesting considering the high rate of car ownership 504 cars/1,000 inhabitants meaning that half the population owns a car. In the rest of metropolitan areas, the public transport is used in less than one third of the motorised trips, coming down to Valencia (8.4%), Amsterdam (12.8%), Greater Stuttgart (12.9%) and Greater Manchester (14.1%).

The higher ratio “in main city” (Graph 7 right part), reflects the denser transport networks in city centres compared to suburbs. In general, the figure is over 30% in the main cities surveyed, meaning that at least one out of three motorised trips are made on public transport. Helsinki (64%), Paris (63.6%), Madrid (63.5%), Bilbao (60.0%), Barcelona (59.1%) and Prague (57%) are the cities with the highest modal share for public transport.

Graph 8 highlights the strong gap between modal share in main city and in the whole metropolitan area. The ratio varies between 2.16 in Paris Ile-de-France (the use of public transport in the main city is twice as high as in the metropolitan area) and 1.24 in West Midlands (Birmingham). When figures are close to 1, we can say that the use of the public transport is more homogeneous in a broad view in the whole metropolitan area.

Graph 8. Modal share of Public Transport in motorised trips: Ratio PT in main city / PT in whole region

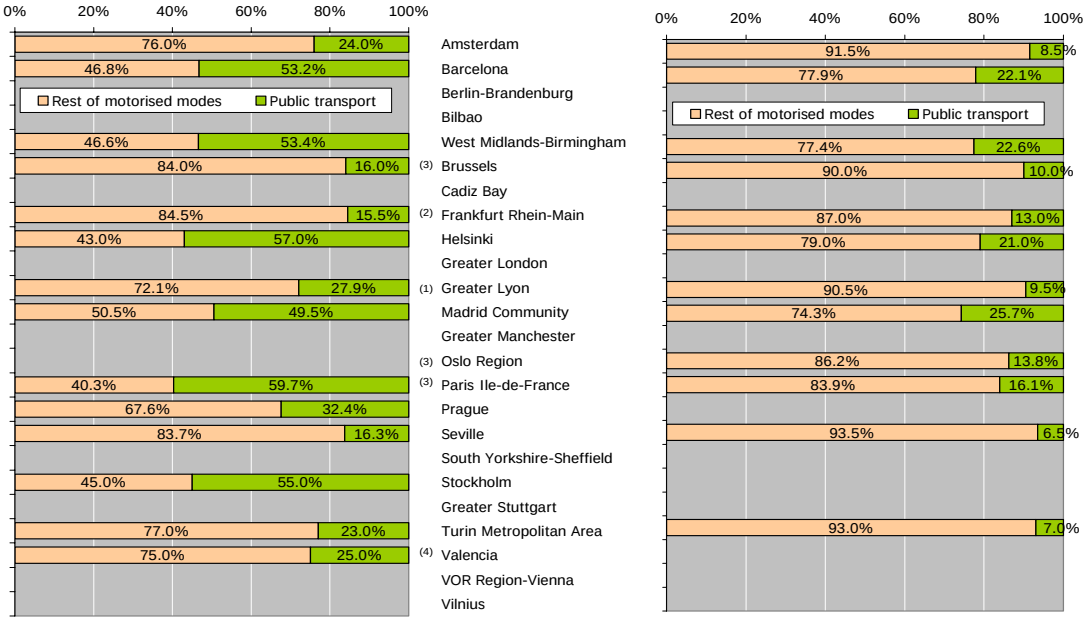


(1) Lyon, 2006 (2) Oslo and Paris, 2001

Looking more into details of trips (Graph 9) helps understanding the leading role of the private vehicle. The radial trips between metropolitan ring and the main city, are done in majority by other modes (mainly private car) reaching up to 84.5% in Frankfurt Rhein-Main, 84.0% in Brussels and 83.7% in Seville. However, there are noticeable exceptions where the public transport is dominant in Paris Ile-de-France (59.7%), Helsinki (57.0%), Stockholm (55.0%), West Midlands (Birmingham) (53.4%) and Barcelona (53.2%).

Graph 9. Modal split in metropolitan areas in motorised trips

Share on suburbs ↔ main city trips **Share on suburbs ↔ suburbs trips**

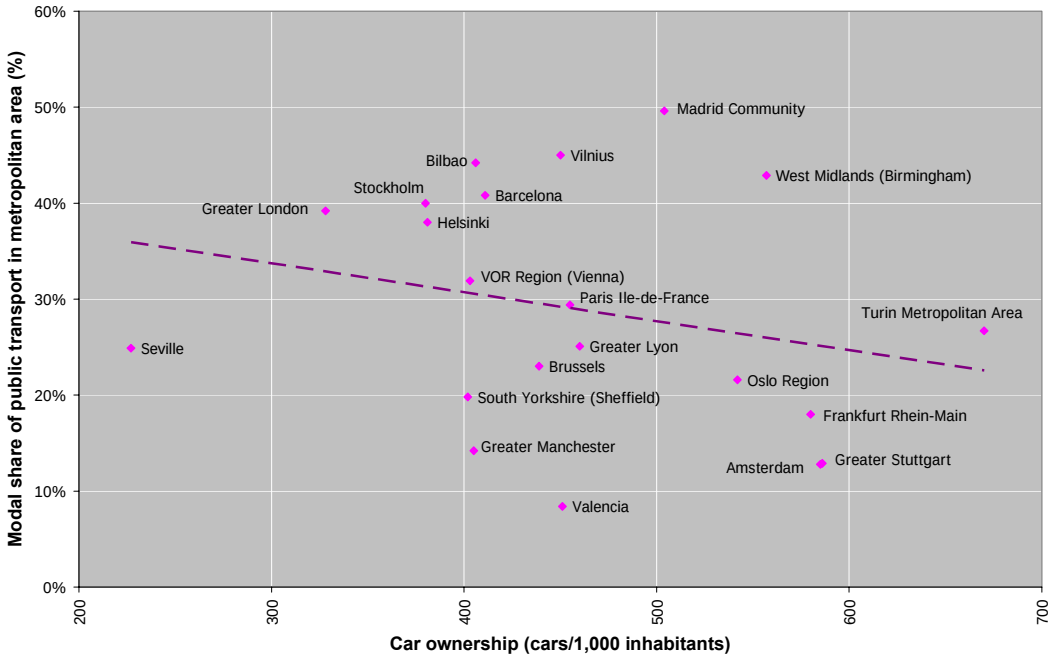


(1) Lyon, 1995 (2) Frankfurt, 2002 (3) Brussels, Oslo and Paris, 2001 (4) Valencia, 1996

On the reverse, figures for trips from suburb to suburb show an absolute predominance of the private vehicle. The lowest ratios here of public transport use are in Seville (6.5%), Turin (7.0%), Amsterdam (8.5%) and Greater Lyon (9.5%), while in some cases the share is over 20% as in Madrid (25.7%), West Midlands (Birmingham) (22.6%), Barcelona (22.1%) and Helsinki (21.0%). These figures become even more important when we realise that the tendency in our metropolitan areas is to grow within these suburbs, though we have to bear in mind the complexity of the territories when comparing the figures.

Finally, trying to verify the hypothesis that high car ownership rates lead us to low modal shares of public transport in the metropolitan areas (Graph 10), it seems to be a trend, the more we own cars, the less we use public transport.

Graph 10. Link between car ownership rate (cars/1,000 inhabitants) and modal share of public transport in metropolitan area



3. Description of the Public Transport System

3.1. Public transport networks

3.1.1. Bus

The metropolitan areas surveyed have very dense bus networks. Paris Ile-de-France, Frankfurt Rhein-Main and Berlin-Brandenburg are the metropolises with the greatest number of bus lines (both urban and suburban lines) with 1,311, 999 and 908 lines respectively (Table 4). Also each of the British metropolitan areas (Greater Manchester, West Midlands and South Yorkshire) have more than 600 lines. This is a consequence of the deregulation process. Greater London also has more than 600 lines however this is due to the size of the area.

Table 4. Characteristics of bus supply

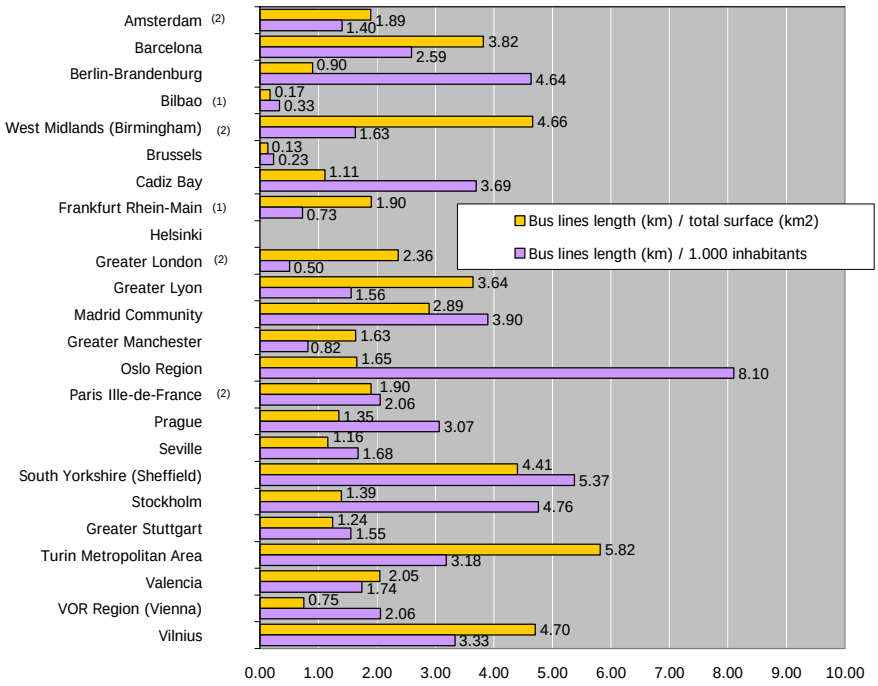
	Number of lines	Lines length (km)	Number of Stops - Line	Number of vehicles	Veh - km (million / year)	Number of operators
Amsterdam	160	1,901.0	5,825	643	56.0	5
Barcelona	453	12,362.6	21,000	1,744	101.3	37
Berlin-Brandenburg	908	27,623.7	13,061	2,778	172.0	41
Bilbao	136	379.9	971	460	6.0	7
West-Midlands (Birmingham)	650	4,200.0	5,061	2,132	136.0	55
Brussels	99	692.2	2,124	691	19.3	3
Cadiz Bay	67	2,324.0	882			7
Frankfurt Rhein-Main	999	472.0	11,856			153
Helsinki	255		5,300	1,400	89.0	11
Greater London	700	3,730.0	17,500	7,969	470.0	29
Greater Lyon	115	1,822.0	3,800	981	36.0	10
Madrid Community	583	23,237.0	26,109	3,707	247.0	36
Greater Manchester	840	2,077.0	61,023	3,518	114.6	60
Oslo Region	312	8,298.0	2,758	1,015	41.0	10
Paris Ile-de-France	1,311	22,819.0	28,920	8,044	278.0	96
Prague	303	5,215.0		1,286	79.4	15
Seville	92	2,037.0	2,722	544	39.0	12
South Yorkshire (Sheffield)	665	6,837.0	3,307	1,109		41
Stockholm	466	9,040.0	6,820	1,800		5
Greater Stuttgart	358	3,735.0	3,281	1,263	52.0	41
Turin Metropolitan Area	126	4,870.0	3,200	1,228	52.0	10
Valencia	109	2,904.0	3,933	610	30.2	9
VOR Region (Vienna)	253	4,845.0	3,156	483	30.0	14
Vilnius	86	1,844.0	3,418	629	32.7	2

Km-network or stops-network (in Brussels and Berlin includes stations of tramway)
Just urban bus (in Vienna is stops-network of urban bus)
Amsterdam gives network length and stops-line including tramway and metro on both
In Turin is stops-network of urban bus including tramway

The average length of a bus route including interurban lines is close to 20 km. One single company operates an average of 21 routes and this figure is even higher if we take into account that in the city centre (where there is a high density of routes) usually there is no more than one company operating the urban lines. This is the case for example of Madrid (EMT has 194 lines), Barcelona (TMB Bus has 103 lines), Vienna (81 lines), Turin (80 lines) and Paris (RATP has 59 lines).

Regarding the density of lines per km^2 of surface (Graph 11), Turin (5.82 km of bus lines/km^2 surface), Vilnius (4.70 km/km^2), West Midlands (Birmingham) (4.66) and South Yorkshire (Sheffield) (4.41) appear with more than 4 km of bus lines per km^2 of surface, probably as a consequence of a small area (less than 1,000 km^2) and the provision of small rail network.

Graph 11. Bus lines density



(1) Bilbao and Frankfurt, just urban bus

(2) Amsterdam, Birmingham, London and Paris give km of network instead of km of lines

If we compare the figures mentioned above with the density in terms of bus lines length per 1,000 inhabitants, we note in some cases a significant difference between these two figures. This is related to population density. Metropolitan areas with strong gap in the two bus density figures have either a very high (West Midlands, Lyon) or very low (Oslo, Berlin, Stockholm) density of population.

3.1.2. Tramway/Light rail

Compared with previous editions of Barometer, tram systems have appeared in several cities, highlighting the tendency of the public transport systems to include trams (or light rail) as a modern, safe and clean transport standing between buses and metro systems. Of the surveyed cities, only three could not provide data. In two of them (Seville, Madrid) tram is under construction; in the third one (Vilnius) it is planned.

As we see in Table 5 Prague has the longest tram network (559 km and 34 lines), then Berlin-Brandenburg (503 km), Brussels (203 km), Vienna (182 km) and Frankfurt (144 km). Cities where the number of lines is the highest in fact never removed the trams from their streets. These cities mentioned above together with Helsinki, Oslo and Turin have the most dense tram networks (Graph 12) with more

than 60 km of tram lines/million inhabitants. Especially high is the tram density in Prague (329 km/million inhabitants) due to a less populated area.

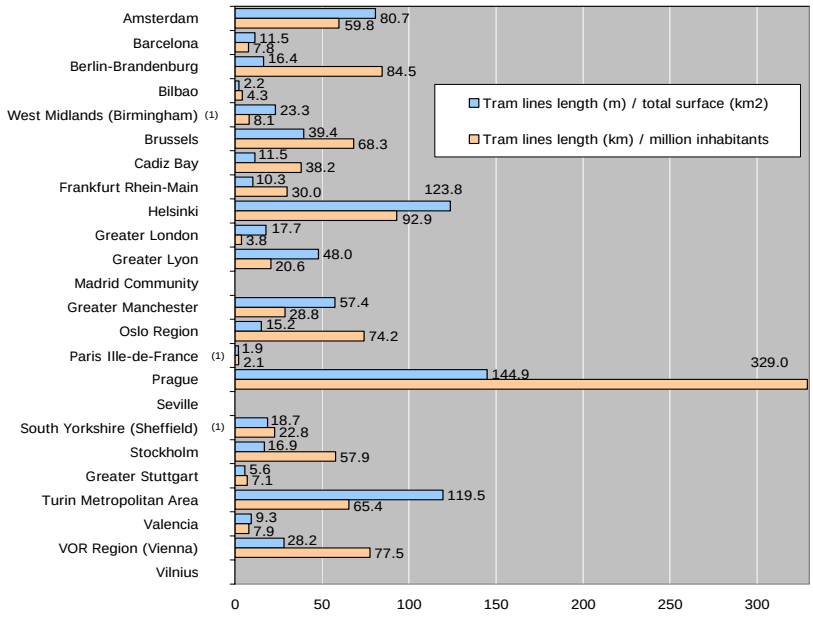
The average distance between stations is 800 m.

Table 5. Characteristics of tram supply

	Number of lines	Lines length (km)	Number of Stations - Line	Number of vehicles	Veh - km (million / year)	Number of operators
Amsterdam	16	81.0		232		1
Barcelona	4	37.3	75	37	1.1	1
Berlin-Brandenburg	41	503.5		764	34.0	8
Bilbao	1	4.9	12	21	0.2	1
West-Midlands (Birmingham)	1	21.0	23	16	2.0	1
Brussels	16	203.4		290	11.4	1
Cadiz Bay	1	24.0	15			1
Frankfurt Rhein-Main	20	144.0	205			3
Helsinki	10	92.0	242	127	5.3	1
Greater London	1	28.0	39	24	2.4	1
Greater Lyon	2	24.0	49	47	2.0	1
Madrid Community						
Greater Manchester	3	73.0	71	32		1
Oslo Region	7	76.0	99	72	3.0	1
Paris Ile-de-France	2	23.0	34	235	5.0	1
Prague	34	559.3	268	716	49.2	1
Seville						
South Yorkshire (Sheffield)	3	29.0	82	25		1
Stockholm	8	110.0	98	187		2
Greater Stuttgart	2	17.0	20	38	2.4	1
Turin Metropolitan Area	7	100.0		232	7.0	1
Valencia	1	13.1	28	24	1.0	1
VOR Region (Vienna)	32	182.0	1,135	873	39.0	1
Vilnius						

Km - network or stations - network

Graph 12. Tramway lines density



(1) Birmingham, Paris and Sheffield give tram network length instead of lines length

3.1.3. Metro

17 out of 24 cities surveyed have a metro system (Table 6) that is to say 70%. The most developed networks in relation with number of lines are in Paris (16 lines), Stuttgart (14 lines), Madrid and London (12 lines), but regarding the network length the most populated cities come first London (461.5 km), then Madrid (227.0 km) and Paris (211.0 km), and to a lesser extent Stuttgart (190.0 km).

Table 6. Characteristics of metro supply

	Number of lines	Lines length (km)	Number of Stations - Line	Number of vehicles	Train - km (million / year)	Number of operators
Amsterdam	4	63.0	43	106		1
Barcelona	7	112.3	136	109	78.5	2
Berlin-Brandenburg	9	144.9	170	1,391	20.0	1
Bilbao	2	42.8	43	148	3.7	1
West-Midlands (Birmingham)						
Brussels	3	43.1	64	217	17.8	1
Cadiz Bay						
Frankfurt Rhein-Main	7	85.0	84			1
Helsinki	2	21.0	16	54	12.9	1
Greater London	12	461.5	275	3,954	65.0	1
Greater Lyon	6	30.5	47	77	6.0	1
Madrid Community	12	227.0	236	1,550	155.0	2
Greater Manchester						
Oslo Region	5	104.0	96	207	4.0	1
Paris Ile-de-France	16	211.0	381	3,553	44.0	1
Prague	3	53.7	53	396	8.9	1
Seville						
South Yorkshire (Sheffield)						
Stockholm	7	108.0	100	548		1
Greater Stuttgart	14	190.0	174	157	14.2	1
Turin Metropolitan Area						
Valencia	3	132.0	94	68	5.3	1
VOR Region (Vienna)	5	61.0	85	636	60.0	1
Vilnius						

Km - network or stations - network
Lyon has 4 metro lines plus 2 underground funicular railway lines

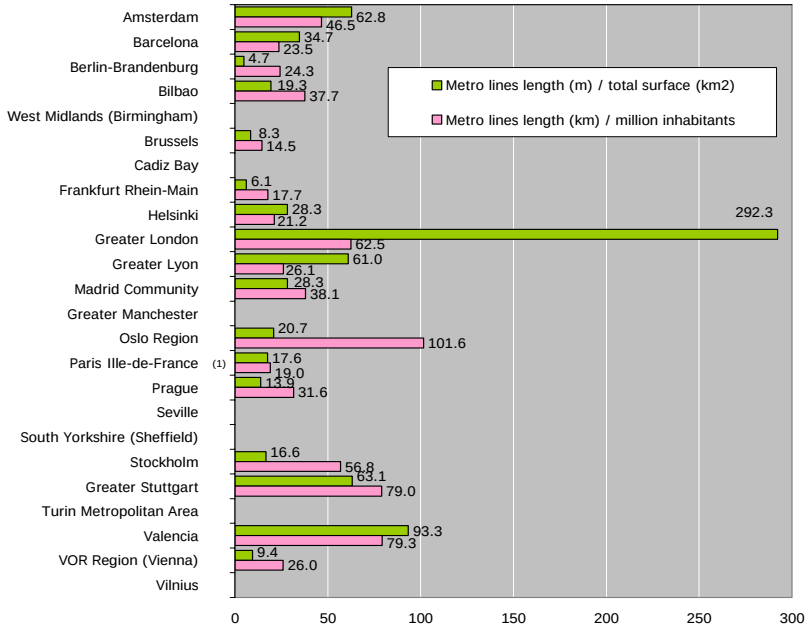
The average length of a line is 18 km, but it varies from 44 in Valencia (38 in London) thus serving a metropolitan area larger than the sole core urban centre, to 5 km in Lyon. The average distance between stations is 1 km. However, stations are more distant in London (1.7 km), Amsterdam (1.5 km) and Valencia (1.4 km), while they are closer in Paris (0.6 km).

Usually one single company operates the whole network. Madrid and Barcelona have two operating companies. In Madrid, the second company operates a short section of the network as a concession, while in Barcelona the second company operates the suburban part of the system, actually an old train route upgraded to a metro system.

In terms of density (Graph 13), it is more indicative the density expressed in km of metro lines per million inhabitants (in metropolitan area) because the metro systems are usually inside the boundaries of the main city, where there is a high density of population. The lowest densities are in Brussels (14.5 km of

metro lines/million inhabitants) and Frankfurt (17.7 km/million inhabitants), while the highest is in Oslo (101.6 km/million inhabitants), followed by Valencia (79.3) and Stuttgart (79).

Graph 13. Metro lines density



(1) Paris gives metro network length instead of lines length

3.1.4. Suburban railway

Table 7. Characteristics of suburban railway supply

	Number of lines	Lines length (km)	Number of Stations - Line	Number of vehicles	Train - km (million / year)	Number of operators
Amsterdam	26	130.0	98			1
Barcelona	6	815.0	285	231	63.6	2
Berlin-Brandenburg (1)	43	3,281.6	357	420	71.0	5
Bilbao	7	221.0	121	135	5.2	3
West-Midlands (Birmingham)	8	187.0	64	112	3.5	5
Brussels	5	210.0	100	100		1
Cadiz Bay	1	49.0	11			1
Frankfurt Rhein-Main (1)	42	1,750.0	389		38.0	6
Helsinki	5	72.0	34	110	5.3	1
Greater London	1	788	321			
Greater Lyon						
Madrid Community	9	587.0	166	780	105.0	1
Greater Manchester	9	319.0	98	80		2
Oslo Region	9	755.0	88		9.0	1
Paris Ile-de-France	12	1,411.0	452	4,870	69.0	2
Prague	26		211		8.2	1
Seville	4	190.0	32	37	2.0	1
South Yorkshire (Sheffield)	1	114.0	30			1
Stockholm	3	200.0	50	331		1
Greater Stuttgart	23	248.0	71	148	8.5	1
Turin Metropolitan Area	6	315.0	82	39	3.5	2
Valencia	6	162.0	42	49	8.4	1
VOR Region (Vienna)	36	1,477.0				2
Vilnius						

Km - network or stations – network

(1) Regional and suburban railway included

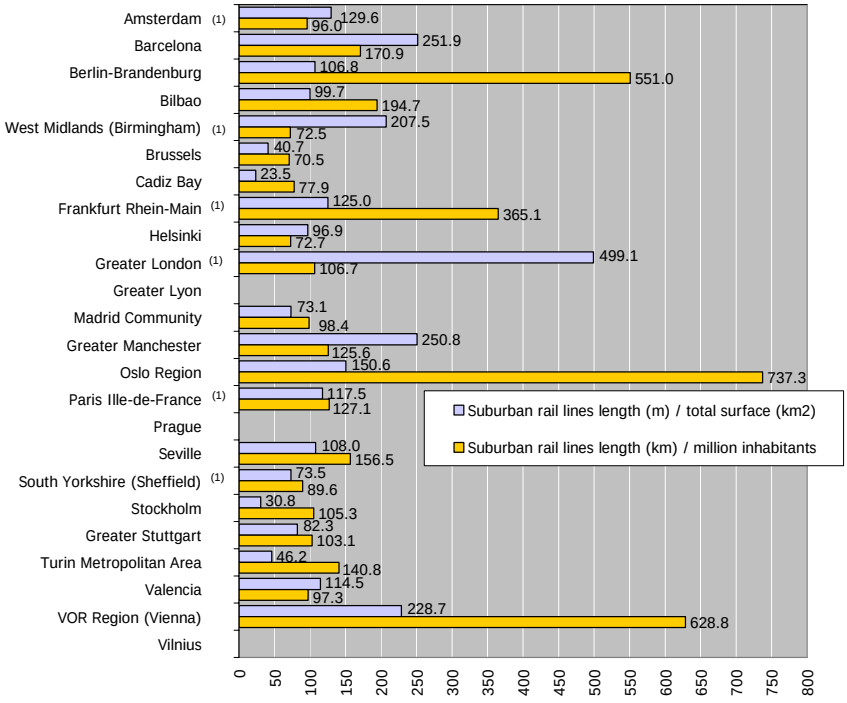
Nearly all the cities surveyed have a suburban rail system serving metropolitan and regional purposes. The number of lines varies from just one single line (Cadiz or South Yorkshire (Sheffield)) to 43 in Berlin-Brandenburg or 42 in Frankfurt Rhein-Main (Table 7). The case of Greater London is particular; they consider just a single line of railway, but with ramifications and junctions, coming up to 788 km of line.

The average length of a line is 50 km, but again there are differences, from Barcelona (136 km/line) or Paris Ile-de-France (118 km) to Amsterdam (5 km) or Greater Stuttgart (11 km).

The distance between stations is 4.0 km on average, varying from 9.2 km in Berlin and 8.6 km in Oslo to Amsterdam 1.3 km. The size of the territory explains these differences.

Greater London has the highest density of network (499.1 m of suburban rail lines/km^2), followed by Barcelona (251.9 m/km^2), Greater Manchester (250.8 m/km^2) and VOR Region (Vienna) (228.7 m/km^2) (Graph 14). In relation with the population in the metropolitan area, the greatest densities are those in Oslo Region (737.3 km/million inhabitants), Vienna (628.8), Berlin-Brandenburg (551.0) and Frankfurt Rhein-Main (365.1 km/million inhabitants).

Graph 14. Suburban railway densities



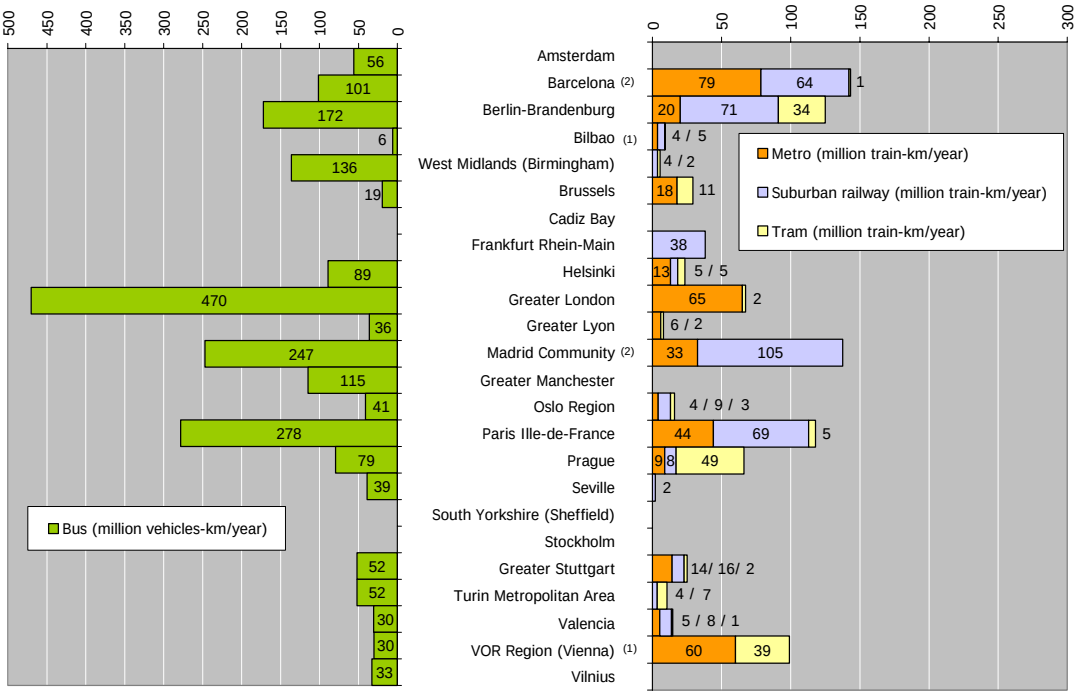
(1) Amsterdam, Birmingham, Frankfurt, London, Paris and Sheffield give suburban rail network length instead of lines length

Please, note that the units used in bus systems densities (Graph 11) are “km of lines/km2” and “km of lines/1,000 inhabitants” while on rail modes (tram, metro, and heavy rail) are “m of lines/km2” and “km of lines/million inhabitants” (Graphs 12, 13 and 14). This difference is made to avoid the representation of decimal and centesimal figures, which are more difficult to understand and compare.

3.2. Public transport supply

The greatest supply (in vehicles-km/year) on bus systems is offered in Greater London, Paris Ile-de-France, Madrid and Berlin-Brandenburg, which is not surprising since these are the biggest and most populated areas (Graph 15).

Graph 15. Public transport supply in million vehicle-km (or train-km) / year

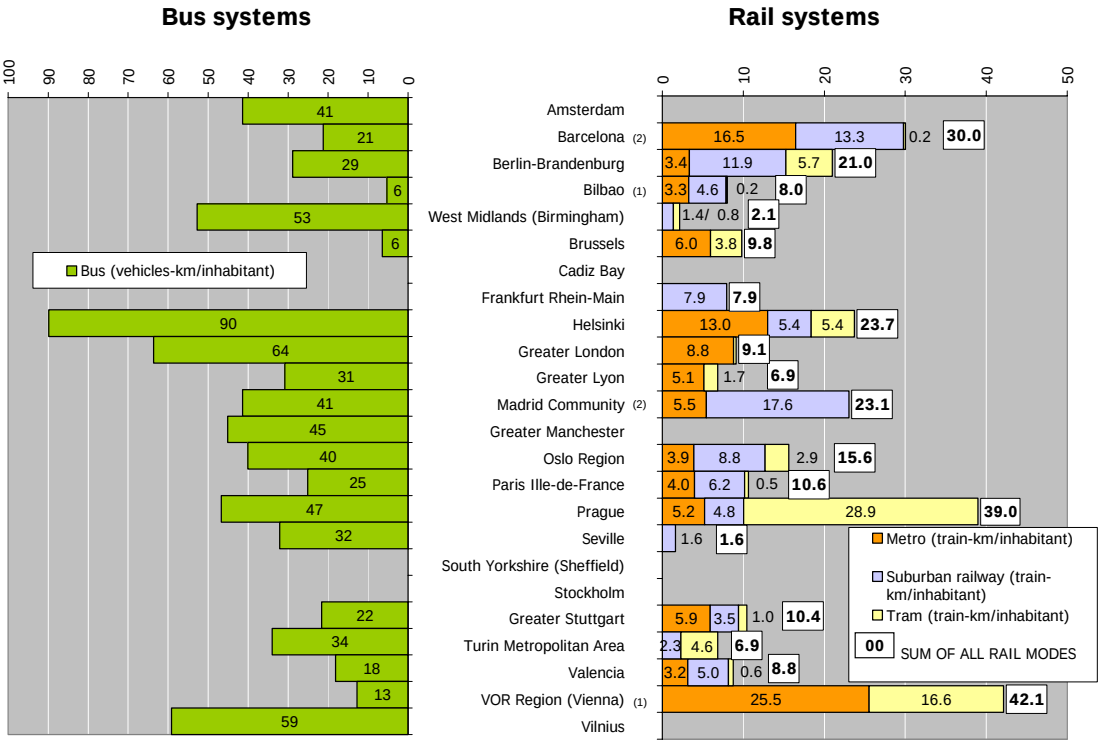


(1) Veh-km of Bilbao and Vienna are just urban bus, do not include suburban bus

(2) Barcelona figure for metro and suburban rail is veh-km; in Madrid, suburban railway in veh-km

The bus is the mode that provides the largest figures to such an extent that the number of vehicles-km provided by bus more than double the sum of all rail modes, though we have to bear in mind that we are comparing vehicle-km with train-km. This statement also has to be looked at carefully because there is lack of figures or little rail supply in some cities (integration is not fully achieved). Still it gives a picture of public transport supply in European metropolitan areas.

Graph 16. Public transport supply in vehicle-km (or train-km) / inhabitant / year



(1) Veh-km of Bilbao and Vienna are just urban bus, do not include suburban bus

(2) Barcelona figure for metro and suburban rail is veh-km; in Madrid, suburban railway in veh-km

To be able to compare between the cities surveyed in terms of density and by modes we can look at Graph 16, where we see the largest bus supply are in Helsinki (90 veh-km/inhabitant), Greater London (64), Vilnius (59) and West Midlands (Birmingham) (53). On metro supply the highest are Vienna (25.5 train-km/inhabitant) and Helsinki (13) (Barcelona figure refers to vehicles-km); on suburban railway is Berlin-Brandenburg (11.9 train-km/inhabitant) (note that Madrid and Barcelona figures are given in vehicles-km as well) but there are many cities with lack of information; and on tram supply, the head is Prague (28.9 train-km/inhabitant).

3.3. Public transport demand

If we analyse the demand looking at the number of passengers by mode, we will note that buses transport almost as many people as all the rail modes together (7,046 million journeys/year on bus, 8,119 million journeys/year on rail modes). However, if we compare the demand by the number of passengers-km, the result is in favour of the rail modes, highlighting the different use of the modes depending on their functionality and the length of the trip. Around three quarters of the total demand (on passengers-km/year) on the European metropolitan areas surveyed are on rail modes (metro, suburban rail, tram) where suburban railway covers almost half the demand (43% of 115,514 million passengers-km/year), bus covers 29%, metro 25% and tram 3% of the demand (see Table 8 and Graph 17). In adding up all modes, Vienna has not been included in the figures since they refer to places-km instead of passenger-km, which would lead to a misinterpretation of the results.

Table 8. Public transport demand

	Bus		Metro		Suburban Railway		Tram	
	Journeys / year (million)	Passenger - km (million)	Journeys / year (million)	Passenger - km (million)	Journeys / year (million)	Passenger - km (million)	Journeys / year (million)	Passenger - km (million)
Amsterdam	248	1,258						
Barcelona	327	1,461	386	2,704	147	2,938	8	23
Berlin-Brandenburg		2,354		2,193		1,061		529
Bilbao	62	424	73	450	31	408	2	6
West Midlands (Birmingham)	315	1,617			29	395	5	52
Brussels	77	370	106	317	66		66	299
Cadiz Bay	31		1		2			
Frankfurt Rhein-Main	306	558	96	976	165	2,371	70	697
Helsinki	162	1,078	55	404	38	348	56	119
Greater London	1,803	6,781	976	7,605	700	21,000	19	112
Greater Lyon	134		150				34	
Madrid Community	750	6,036	618	3,861	196	3,497		
Greater Manchester	218	1,009			18	302	20	178
Oslo Region	89	733	59	356	20	465	30	75
Paris Ile-de-France	1,222	4,065	1,335	6,678	1,051	14,740	44	155
Prague	106	1,486	138	1,956	26	322	98	1,411
Seville	102	444			7	165		
South Yorkshire (Sheffield)	120	300			6		13	44
Stockholm	253	1,516	278	1,556	62	1,103	29	214
Greater Stuttgart								
Turin Metropolitan Area	165				14			
Valencia	116	505	52	253	10	151	5	21
VOR Region (Vienna)	162	4,098	420	8,534	84	16,636	205	4,155
Vilnius	277	1,010						
TOTAL	**7,046**	**33,005**	**4,743**	**29,309**	**2,671**	**49,266**	**704**	**3,935**

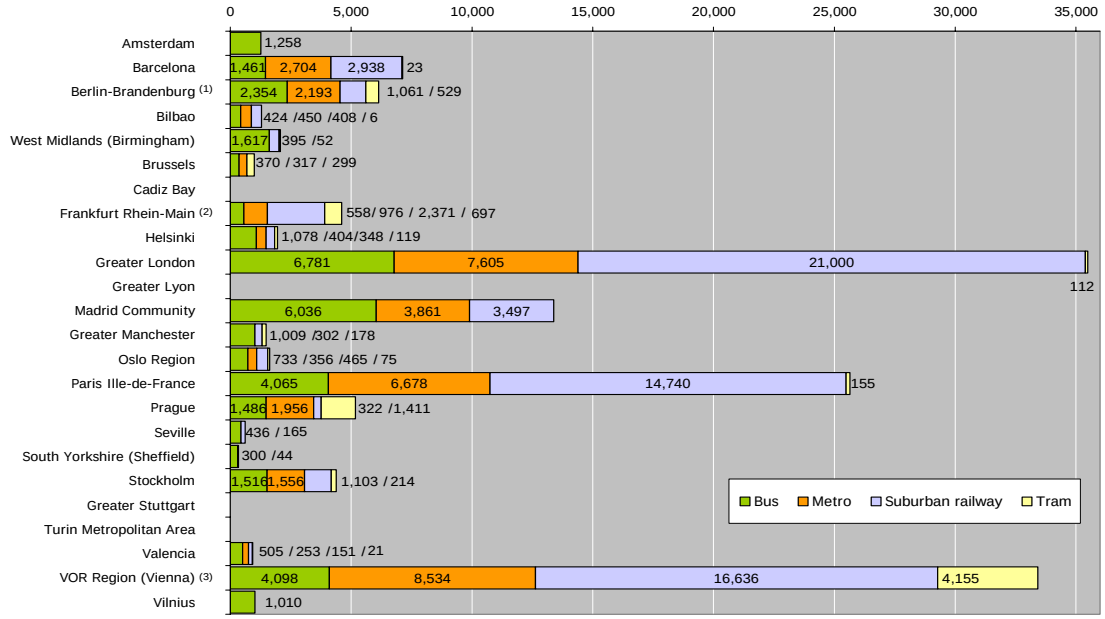
Trips instead of journeys
Vilnius is Bus + trolleybus; Turin is bus+tramway
Vienna gives data on places-km instead of passenger-km

Just urban bus

Just suburban bus

Looking at Graph 17 we observe that the highest demand on passenger-km come from the most populated metropolitan areas like Greater London, Paris Ile-de-France, Madrid, Barcelona, Berlin-Brandenburg and Vienna. Thus it is more interesting to analyse the figures by ratios related with population, for example journeys/inhabitant (Graph 18).

Graph 17. Public transport demand in million passenger-km/year

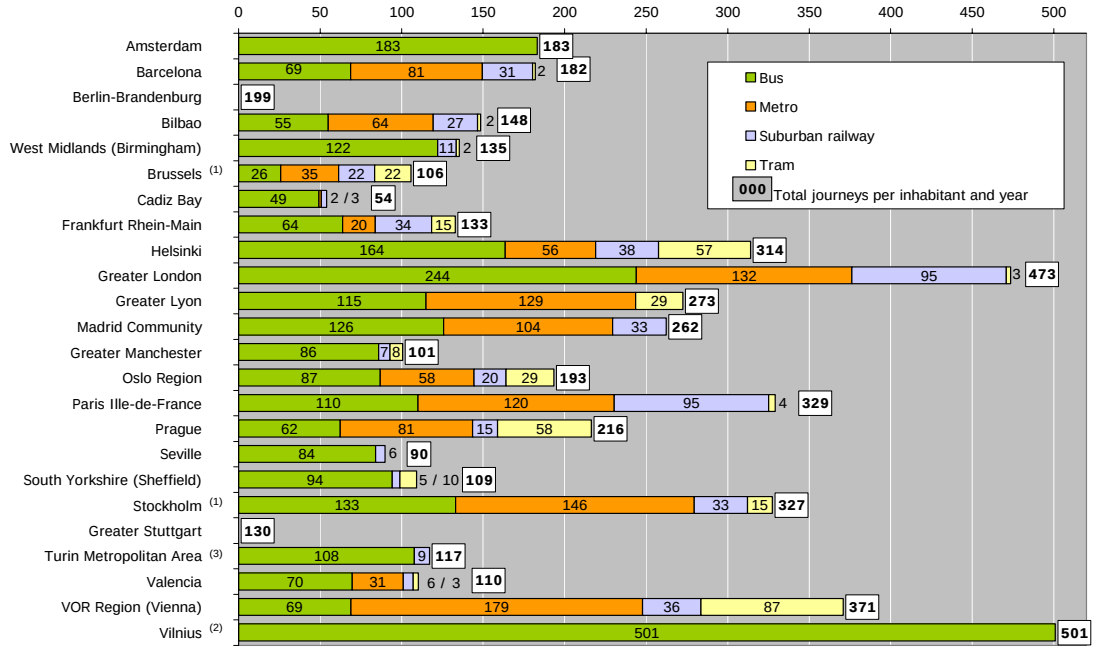


(1) Bus in Berlin refers to urban bus, does not include suburban bus (2) Bus in Frankfurt refers to suburban bus

(3) Vienna gives data on places-km instead of passenger-km; bus figure is just suburban bus and metro figure includes metro+tramway+urban bus

Graph 18 allows us to compare the metropolitan areas notwithstanding their size. On average, the population travels 211 journeys/inhabitant-year on public transport. This means that every person does at least one journey on public transport every labour day. Half of the journeys are made on bus, highlighting the importance of this network in metropolitan areas, as a complement to the rail modes. Several cities have more than 300 journeys on PT/inhabitant-year such as Vilnius (501 journeys, on bus and trolleybus), Greater London (473), Vienna (371), Paris Ile-de-France (329), Stockholm (327) and Helsinki (314).

Graph 18. Public transport demand in journeys per inhabitant per year



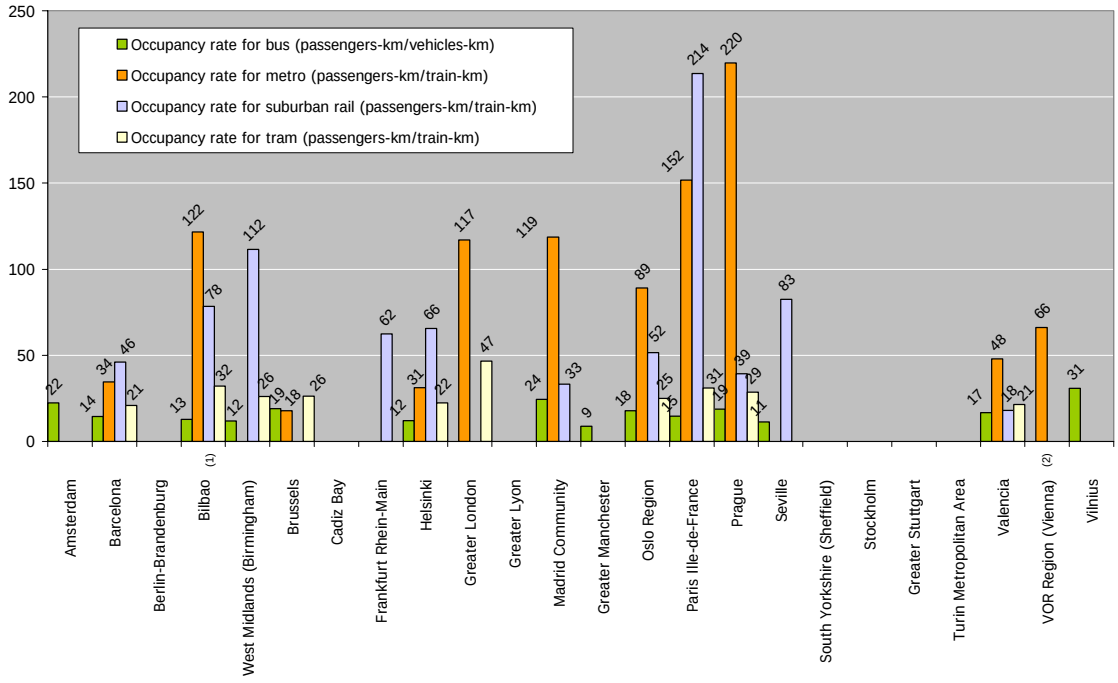
(1) Brussels and Stockholm give trips instead of journeys in all modes (2) Vilnius figure is bus+trolleybus (3) Turin bus figure is bus+tramway

3.3.1. Occupancy and intensity of use of public transport

On Graph 19 is shown the occupancy rate by vehicle for the different public transport modes expressed as passengers-km/vehicles-km or train-km on rail modes. As we could expect, metro systems have the highest occupancy ratio (92 passengers/train on average), followed by suburban railways (73) because of the bigger capacity of the rail rolling stock.

Regarding the heavy rail occupancy, the highest ratio is in Paris, followed by West Midlands (Birmingham) and Seville. On metro, the highest occupancy is in Prague, then Paris Ile-de-France, Bilbao, Madrid and Greater London. On buses, the highest ratio is in Vilnius, then Madrid and Amsterdam.

Graph 19. Occupancy rate by modes



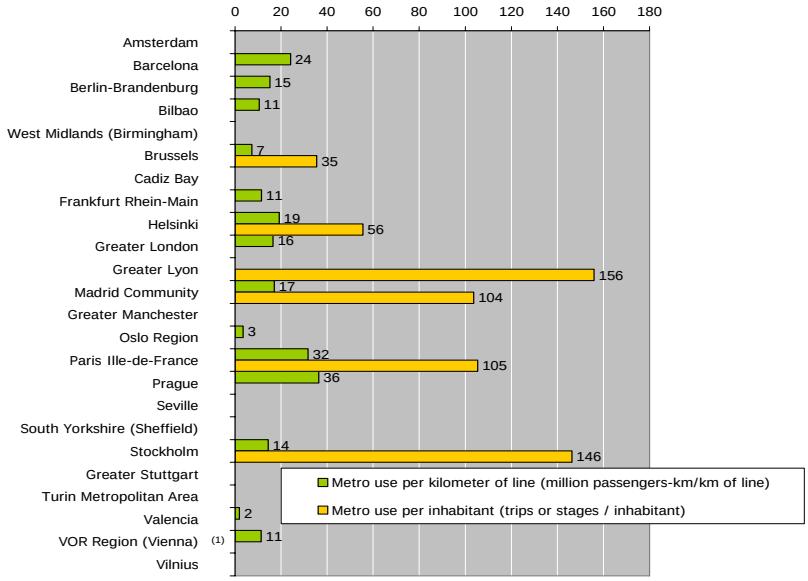
(1) Bus figure in Bilbao refers just to urban bus

(2) Vienna metro figure is metro+tramway+urban bus and places-km instead of passenger-km

Looking at Graph 20, Prague has the highest ratio in metro use (passenger relative density) with 36 million passengers-km/km of line followed by Paris (32) and Barcelona (24). It is surprising such low figures on Brussels, Oslo and Valencia networks (7, 3 and 2 million passengers-km/km of line respectively).

However, if we observe the other figures of metro use expressed on trips per inhabitant and year, Lyon, Stockholm, Paris and Madrid have a metro use of more than 100 metro trips per inhabitant and year, which is a very intense use of this system. On the other part, Helsinki and Brussels have around 50 trips per inhabitant and year or less.

Graph 20. Metro use per km of line and per inhabitant



(1) Vienna figure is metro+tramway+urban bus and places-km instead of passenger-km

3.4. Quality of public transport supply

Public transport authorities and operators have regarded an improvement of the quality of services provided as one decisive way to improve the attractiveness of public transport systems over the past years. Quality of service includes very different features, and Tables 9 and 10 refer to some basic ones.

Table 9. Supply quality indicators for bus and tram or light rail

	Bus (urban)				Tram			
	Commercial speed (urban/suburb) (km / h)	Amplitude of service (hours)	Low floor buses (%)	Average age of vehicles (years)	Comercial speed (km / h)	Amplitude of service (hours)	Station accesible for PRM (%)	Average age of vehicles (years)
Amsterdam	22 / 30	19.0	82%	7.0	15.5	19.0	20%	8.0
Barcelona	12.5 / 25	16.5	85%	7.0	15.0	19.0	100%	0.4
Berlin-Brandenburg	19.6	20.0	80%		19.3	20.0	100%	
Bilbao	10.14 / 24.2	19.5	90%	8.2	14.7	17.0	100%	1.0
West-Midlands (Birmingham)	20.0	18.0	75%	8.0	35.0	17.0	100%	5.0
Brussels	17.0	19.0	8%	8.0	16.7	19.0	10%	31.0
Cadiz Bay	13.0	17.0	0%	5.0				
Frankfurt Rhein-Main		20.0	60%			22.0		
Helsinki	20 / 32	20.0	85%	4.8	17.0	20.0	85%	19.5
Greater London	18.0	24.0	100%	8.0	22.0		100%	5.0
Greater Lyon	17.0	19.5	56%	9.0	16.4	19.5	100%	3.0
Madrid Community	14.0	19.3	86%	5.0				
Greater Manchester	19.0	20.0	48%	8.8	35.0	17.5	100%	7.5
Oslo Region	26.0	18.0	79%	5.0	17.0	18.0	100%	14.0
Paris Ile-de-France		19.0	42%	9.5		19.0	100%	
Prague	25.9	20.0	31%	6.3	19.9	24.0	100%	15.9
Seville	12 / 26	18.0	56%	9.0				
South Yorkshire (Sheffield)		19.5		8.0	35.3	18.5	100%	11.0
Stockholm	15.0	19.0	25%		30.0	19.0	100%	
Greater Stuttgart	22.5		60%	7.0	19.1	20.0		
Turin Metropolitan Area	16.7 / 19.1	20.5	33%	8.0	14.9	20.5		
Valencia	12.6 / 27	19.0	50%	7.0	17.5	18.5	100%	7.2
VOR Region (Vienna)	19.7	20.5	63%		16.1	20.0	16%	
Vilnius	22.0	20.0	12%	12.1	18.5	20.0	12%	14.2

For Vilnius is trolleybus instead of tram; for Stuttgart is just S-Bahn

3.4.1. Bus quality indicators

Generally speaking, the commercial speed for urban bus lines is less than 20 km/h (17 km/h on average), while on suburban lines commercial speed is clearly much higher (26 km/h).

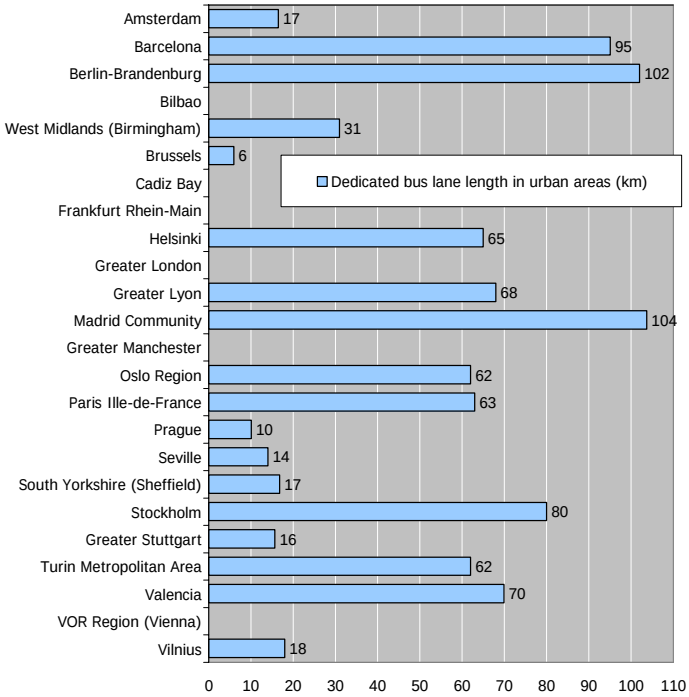
The average age of the fleet is quite high; several cities are over 7 years, Vilnius (12 years old), Lyon and Seville reach 9 years, while Helsinki, Madrid, Cadiz and Oslo do not exceed 5 years old.

In the cities that provided information there are on average 50 km of dedicated bus lanes in urban areas, varying from 6 km in Brussels to over 100 km in Madrid and Berlin (Graph 21).

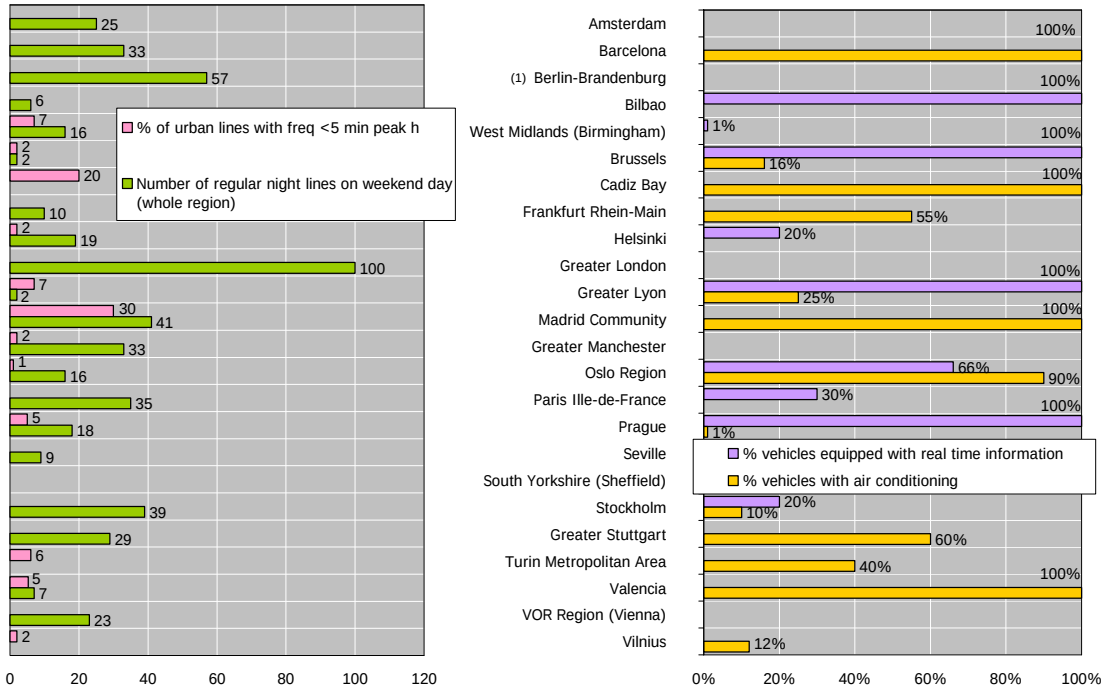
Madrid and Cadiz have the highest frequency on peak hour, with respectively 30% and 20% of urban lines with less than 5 minutes of frequency on that period. All cities but four have night bus services on a weekend day from 2 lines in Brussels and Lyon to 100 lines in Greater London (Graph 22).

Regarding the bus vehicles with real time information (Graph 22), in Bilbao, Brussels, Lyon and Prague the entire fleets have these equipments on board. In the same graph, we can observe that most of the Spanish cities have 100% of bus vehicles equipped with air conditioning due to their high temperatures. It is worth noticing the case of Oslo, with 90% of vehicles equipped with air conditioning.

Graph 21. Length of dedicated bus lanes in urban areas



Graph 22. Bus lines services and devices



(1) Berlin figure of night bus lines refers to a working day, instead of a weekend day

3.4.2. Light rail quality indicators

The commercial speed for tram systems does not exceed 20 km/h in all cases but London (22 km/h), Stockholm (30 km/h) and cities of the United Kingdom as Birmingham, Manchester and Sheffield (35 km/h) which are suburban networks (Table 9). It is worth noticing that the speed of the tram system is not higher than the speed of the bus system (including interurban buses) especially when they do no benefit from dedicated lanes. On the other hand, trams have other positive aspects such as higher capacity, regularity, image, urban regeneration, etc. The amplitude of the service is in general between 17 and 20 hours per day except for Frankfurt (22 h) and Prague (24 h). The great majority of the systems are 100% accessible for People with Reduced Mobility (PRM), but few cities with old systems keep a big quantity of non-accessible vehicles like Amsterdam (20% of accessible vehicles), Brussels (10%), Vienna (16%) and Vilnius (12%, referred to trolleybus). In the cities with newly inaugurated tram systems, the average age is very low compared to other older systems, Brussels being the oldest with 31 years.

3.4.3. Metro quality indicators

On Table 10, we observe the commercial speed of the metro system is over 30 km/h in many cities, reaching 45 km/h in Helsinki. Contrary to this, Madrid has the lowest speed (25.7 km/h) due mostly to the short distance between the stations on several lines. The amplitude of the services is very high; the majority of the cities are between 19 and 20 hours, reaching 22 h in Frankfurt and 24 h in Prague.

Table 10. Supply quality indicators for metro and suburban railway

	Metro				Suburban railway			
	Commercial speed (km / h)	Amplitude of service (hours)	Station accesible for PMR (%)	Average age of vehicles (years)	Commercial speed (km / h)	Amplitude of service (hours)	Station accesible for PMR (%)	Average age of vehicles (years)
Amsterdam	35.0	19.0	100%	17.0	69.6	20.5	100%	
Barcelona	28.3	19.0	27%	19.0	46.0	19.0	36%	12.0
Berlin-Brandenburg	31.1	20.0	31%		38.3	21.0	70%	
Bilbao	34.1	17.0	100%	6.8	41.2	17.0		16.0
West-Midlands (Birmingham)					38.0	18.0	77%	15.0
Brussels	29.4	19.5	15%	17.0	60.0			25.0
Cadiz Bay							55%	
Frankfurt Rhein-Main		22.0				21.0		
Helsinki	45.0	18.0	100%	16.5	44.0	20.0	100%	20.5
Greater London	33.0	20.0	13%	27.0	56.0	24.0	14%	14.0
Greater Lyon	27.1	19.5	86%	20.0				
Madrid Community	25.7	19.5	41%	12.0		19.0	58%	11.0
Greater Manchester					40.0	17.5	49%	21.0
Oslo Region	31.0	18.0	100%	36.0	58.0	19.0	100%	
Paris Ile-de-France		19.0	5%	25-30		19.0	28%	22
Prague	34.6	24.0	56%	9.1	52	20	100%	27
Seville					62.0			
South Yorkshire (Sheffield)						19.5		
Stockholm	30.0	20.0	100%		60.0	19.0	100%	
Greater Stuttgart	27.3	20.0	97%	12.0	50.0	20.0	60%	8.0
Turin Metropolitan Area					57.0	19.0	11%	
Valencia	37.0	19.0	95%	12.0	58.2	17.3	0%	10.7
VOR Region (Vienna)	31.5	20.0				20.0		
Vilnius								

For Stuttgart is just S-Bahn railway

The newest metro networks are 100% accessible for PRM, these are the cases of Amsterdam, Bilbao, Helsinki, Oslo and Stockholm, while in Paris is just accessible 5% of the stations, 13% in London and 15% in Brussels. Regarding the average age of the rolling stock there are big differences in the figures with the oldest in Oslo (36.0 years) and the newest in Bilbao (6.8 years) which is the period into operation of the metro system in that city.

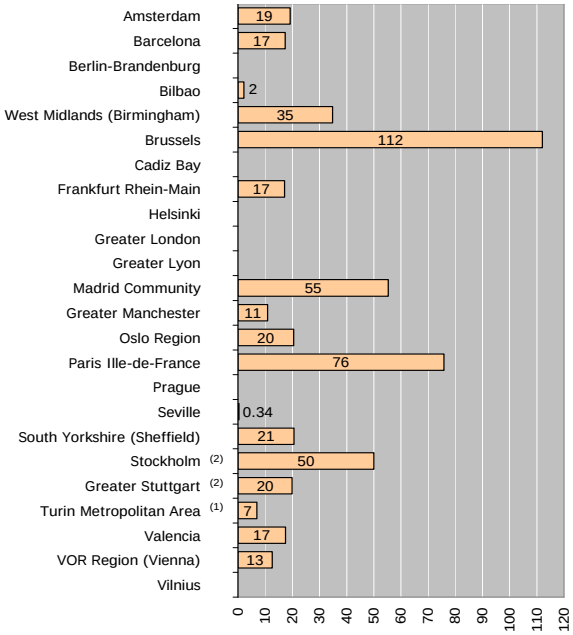
3.4.4. Suburban railway quality indicators

The majority of the suburban railway networks have commercial speed above 40 km/h, getting up to 70 km/h in Amsterdam, becoming the fastest public transport mode (Table 10). The amplitude of the service is similar to the rest of the modes, between 17 h and 20 h, highlighting the case of Greater London with 24 h of services. The accessibility to the stations for PRM is low, though the north European cities seem to have the most accessible suburban rail systems (Amsterdam, Helsinki, Oslo, Prague, Stockholm) with 100% of accessible stations. The average age of the vehicles is comprised between 8 years (Greater Stuttgart) and 27 years (Prague).

An important element of a suburban train system is the Park and Ride facility. In Brussels (Graph 23), there are more than 100 parking lots per km of suburban rail network, 76 in Paris Ile-de-France and 55 in Madrid. This policy leads the people to use public transport for radial trips from suburbs to city centre.

To have an idea about the policies developed by different metropolitan areas we can look at Graph 24, where we see that VOR Region (Vienna) has made a bigger investment on suburban rail network than on highways (47 times more length on train network than on highways), same in Greater London, Greater Stuttgart and Turin. On the other hand, many cities have a longer network of high capacity roads than of railway network; the extreme cases are West Midlands (Birmingham) (0.3), Valencia (0.3) and Madrid (0.5).

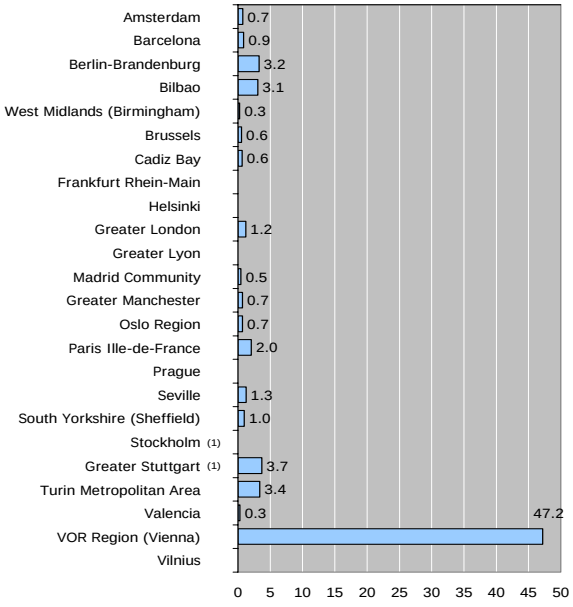
Graph 23. Number of Park and Ride places per km of suburban train network



(1) Turin figure is just urban Park and Ride places

(2) Stockholm and Stuttgart give suburban train lines length instead of network length

Graph 24. Suburban train network length (km) / highways length (km)



(1) Stockholm and Stuttgart give suburban train lines length instead of network length

4. Fares and Financial Aspects

Most of the cities have besides the single ticket, a daily pass, some of them have a multiple trip ticket and season integrated passes, as well as discounts for students and elderly people (Tables 11 and 12).

Table 11. Fares in main city for all modes

	Single ticket (€)	Daily pass (€)	Multiple trips coupon (€)	Trip with multiple trip coupon (€)	Monthly pass (€)	Yearly pass (€)	Student pass (€)	Elderly people pass (€)
Amsterdam	0.82	6.40	6.40	0.91	32.60	326.00	21.55	21.55
Barcelona	1.10	4.60	6.00	0.60	38.80	106.70	90.65	2.80 (10 trips)
Berlin	2.10	5.80			67.00	650.00	26.00	
Bilbao	1.10	3.00		0.60	24.50		162.00	2.30
Birmingham	(1) 1.50	7.75			73.38	775.37	36.69	0.00
Brussels	1.40		9.00	0.90	39.00	390.00	200.00	0.00
Cadiz								
Frankfurt	1.05	3.10			31.60	309.70	224.00	
Helsinki	2.00	5.40			39.70	440.50	331.00	220.00
London (3)	(1) 2.99	7.92			97.53	1,015.58	68.25	0.00
Lyon	1.40	4.20	11.50	1.15	45.10	477.40	32.40	32.40
Madrid	1.15	3.50	5.35	0.54	34.55	380.05	23.60	9.25
Manchester								(2)
Oslo	2.40	6.49	17.70	0.59	77.88		47.20	38.94
Paris	1.40	5.30	10.50	1.05	50.40	509.30	263.70	
Prague	0.48	2.82	0.69		16.20	143.20	8.10	
Seville	1.00	3.00	4.20	0.42	24.00		12.00	0.00
Sheffield								(2)
Stockholm	3.16	10.00		1.52	63.20	245.00	37.92	37.92
Stuttgart	1.65	5.00		1.58	45.50	455.00	33.80	35.20
Turin	0.90	3.00	12.50	0.83	29.00	265.00	16.50	16.50
Valencia	1.00	3.00	5.10	0.51	31.00		23.25	25.00
Vienna	1.50	5.00	6.00	0.60	45.00	417.00	27.00	209.00
Vilnius	0.23	1.16			14.48		2.90	7.24

(1) Single ticket just for buses in Birmingham, just for Metro in London
(2) Free in the off peak hours for buses, tram and suburban railway
(3) Figures for London are valid for the whole region “Greater London”

Monthly
Yearly
3 months,4 months in Stockholm

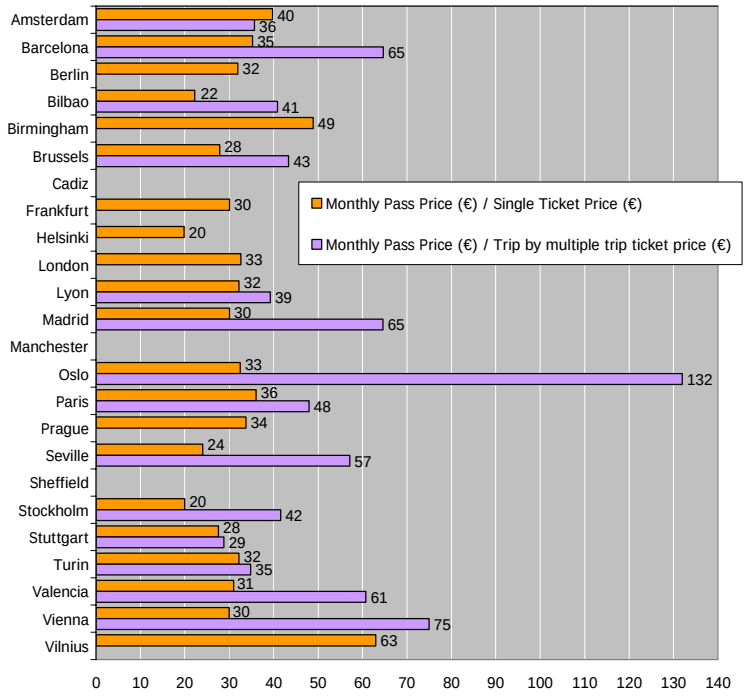
The price for a single ticket in the main city varies from 0.23 € in Vilnius to more than 3.00 € in Stockholm. Compared with a multiple trip coupon (which in most of the cities is valid for 10 trips), the trip using this kind of ticket makes you save around 40% of the price of a single one.

The price of a monthly pass goes from 14.48 € in Vilnius to 97.53 € in Greater London, but this value does not consider the differences in economy and size between the cities, so we better see later few ratios in order to compare them. For example, in the case of London, “main city” figures refer in fact to the whole area of Greater London, this has already been stressed at the beginning of this report.

What is worth noticing is the ratio of the monthly pass in relation to the single ticket (Graph 25). In a lot fair number of cities it stands around 30, which means that the user who buys an integrated monthly ticket is paying the same as one single ticket per day (30 days per month). In one extreme, we find Vilnius with a high ratio (63), meaning that the single ticket is very cheap compared to the monthly pass. In the

other extreme we find Stockholm and Helsinki with ratio 20 and Bilbao with ratio 22, cities where the saving on the integrated ticket is very important compared with the single ticket.

Graph 25. Ratios in main city



The price of a yearly pass is 10 times the price of a monthly pass, which is a ratio very homogeneous in all the cities surveyed, varying between 8.8 in Prague and 11.6 in Stockholm.

The student pass is on average around 50% cheaper than the adult pass of the same category (monthly, yearly) and almost every city has this kind of pass.

In case of ticket for elderly people, there is a wide range of discounts. In few cities it is completely free at least during off peak hours (Birmingham, Brussels, London, Seville, Sheffield, Manchester) or has a symbolic low price (Barcelona, Bilbao, Madrid). Others have the same discount as students (Amsterdam, Lyon, Stockholm, Turin) and in other cases there is no discount available (or not data given) for elderly people (Berlin, Frankfurt, Paris and Prague).

The share of use of the season passes is on average 60%, 19% for the multiple trips ticket and 21% for the single ticket, but we must look at these figures very carefully since there are very few data and very heterogeneous.

Table 12. Fares in metropolitan area for all modes

	Single ticket (€)	Daily pass (€)	Multiple trips coupon (€)	Trip with multiple trip coupon (€)	Monthly pass (€)	Yearly pass (€)	Student pass (€)	Elderly people pass (€)
Amsterdam	3.25	12.80	6.40	1.60	58.00	459.50	215.50	215.50
Barcelona	4.50	12.90	26.10	2.61	109.90	292.55	248.75	2.80/10 trips
Berlin-Brandenburg	2.60	6.00			162.00	1,571.50	121.50	
Bilbao	1.25	3.00		0.71	29.50		190.00	2.30
West-Midlands (Birmingham)	1.50	7.75			100.38	1,052.29	50.19	0.00
Brussels	1.80		12.40	1.24	58.70	532.30	401.00	0.00
Cadiz Bay								
Frankfurt Rhein-Main	11.90	23.80			202.90	1,988.40	126.00	
Helsinki	3.00	8.50			70.30	771.70	579.00	336.00
Greater London								
Greater Lyon	1.40	4.20	11.50	1.15	45.10	477.40	32.40	32.40
Madrid Community	3.10	7.00	23.00	2.30	62.90	691.90	41.65	9.25
Greater Manchester								(1)
Oslo Region	3.78		22.78	0.76	138.07		110.93	69.03
Paris Ile-de-France	9.60	18.40	76.80	7.68	136.90	1,382.70	808.20	
Prague	(2) 0.39				(2) 11.50		8.50	0.00
Seville	1.00		8.70	0.87				
South Yorkshire (Sheffield)		7.39			102.30	1,015.58	0.00	0.00
Stockholm	7.90	10.00		3.82	63.20	245.00	37.92	37.92
Greater Stuttgart	5.65	10.30		5.30	154.50	1,545.00	115.20	52.60
Turin Metropolitan Area	1.40		19.50	1.30	38.00	342.00	29.00	
Valencia	2.00		10.00	1.00	46.00		34.50	32.20
VOR Region (Vienna)	1.50				31.00	320.00	22.00	
Vilnius								

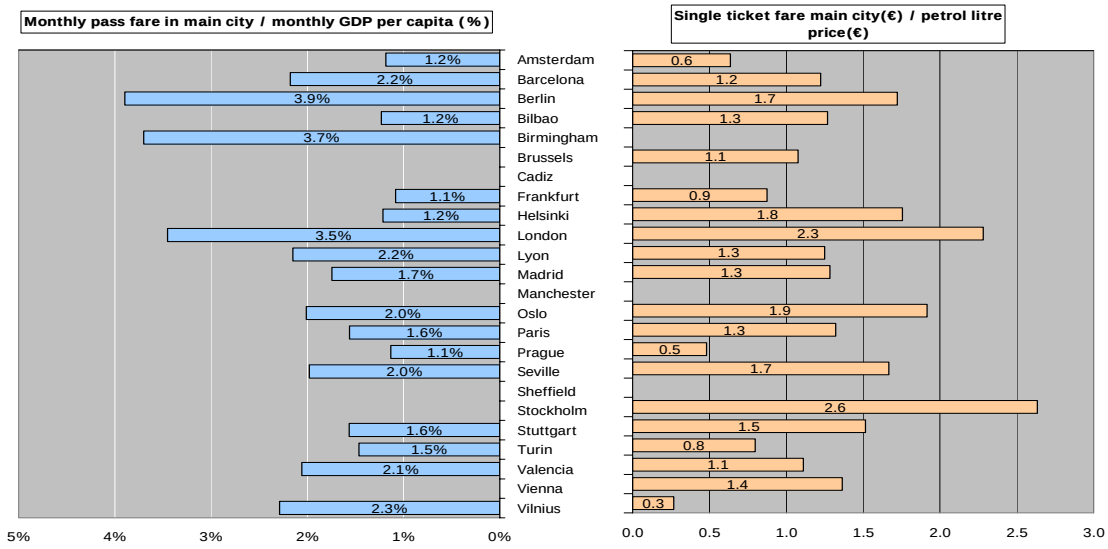
(1) Free in the off peak hours for buses, tram and suburban railway (2) 2 zones

3 months (4 months in Stockholm) Yearly Monthly Per zone

4.1. Comparison between main city fares ratios

The monthly pass price in main city compared with GDP per capita (annual GDP divided by 12) gives a ratio of 2.0% on average (Graph 26). However, especially cheap are the monthly passes in Frankfurt, Prague (1.1%), and Amsterdam, Bilbao and Helsinki (1.2%). The highest ratios are in Berlin (3.9%), Birmingham (3.7%) and London (3.5%).

Graph 26. Main city fares ratios



When we compare as in Graph 26 also the single ticket fare in main city with the price of a litre of petrol (unleaded 95) we observe a wide range of values. The most attractive price is in Vilnius and Prague, where a single ticket costs less than half of the petrol litre (0.3 and 0.5). This fact is opposite to the use of the private vehicle since the fuel of the car is much more expensive than the public transport ticket. On the other side, Stockholm has the most expensive public transport, the price being 2.6 times more than a litre of petrol, then comes London (2.3), Oslo (1.9 times), Helsinki (1.8), Berlin and Seville (1.7 times).

4.2. Financial aspects

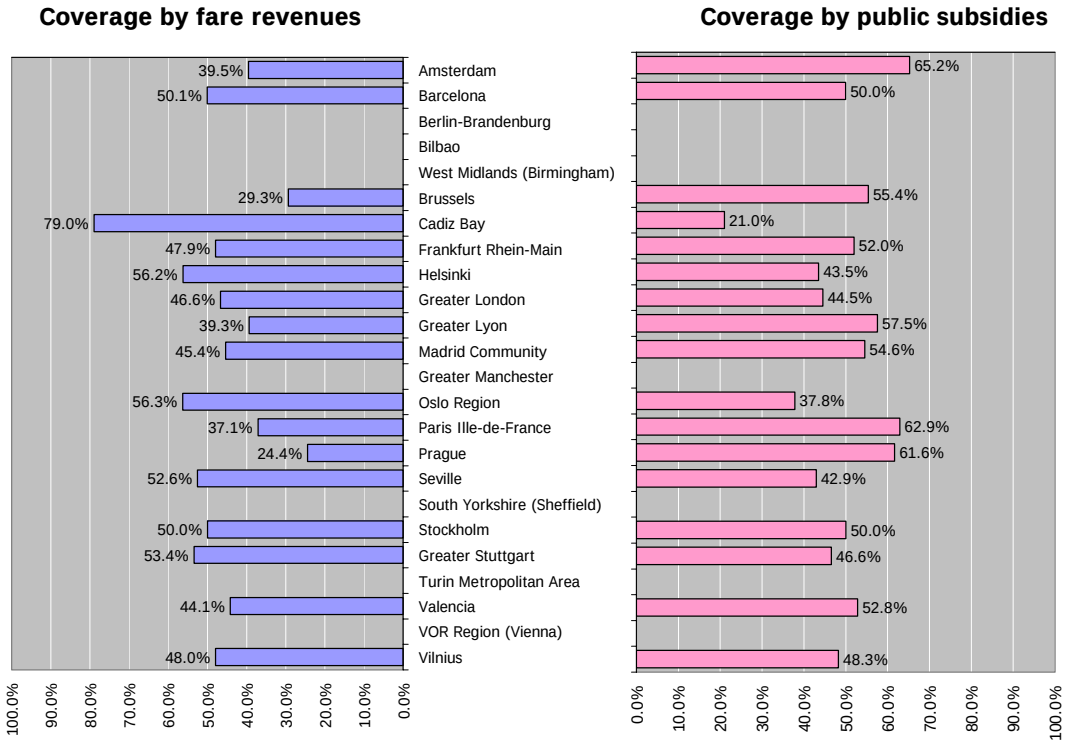
Table 13. Financial aspects

	Yearly operation cost (million € / year)	Revenues from ticket sales (million € / year)	Public subsidies (million € / year)	Other revenues (million € / year)	Modes included
Amsterdam	427.0	168.6	278.5		Bus Tram
Barcelona	930.0	465.6	464.6		All
Berlin-Brandenburg		872.0	958.4		All
Bilbao	74.0	47.7	1.0		Urban bus Metro
West-Midlands (Birmingham)	219.6	33.2	207.5		
Brussels	495.0	145.0	274.0	76.0	Urban bus Metro Tram
Cadiz Bay	2.1	1.7	0.3		Bus
Frankfurt Rhein-Main	1,200.0	575.0	624.0		All
Helsinki	338.0	190.0	147.0	1.0	All
Greater London	6,622.2	3,088.6	2,949.7	584.0	Bus Metro Tram
Greater Lyon	285.0	112.0	164.0	9.0	Bus Metro Tram
Madrid Community	1,480.0	672.0	808.0		All (Bus Metro HR)
Greater Manchester			228.0		All (Bus Tram HR)
Oslo Region	611.0	344.0	231.0	38.0	All
Paris Ile-de-France	6,580.0	2,440.0	4,140.0		All
Prague	521.0	127.0	321.0	73.0	All
Seville	93.2	49.0	40.0	4.2	All (Bus HR)
South Yorkshire (Sheffield)	161.3	3.3	134.9	13.3	All (Bus Tram HR)
Stockholm	712.0	356.0	356.0		All
Greater Stuttgart	552.0	294.8	257.2		Bus Metro Tram
Turin Metropolitan Area		64.0	207.0		Bus HR
Valencia	191.7	84.6	101.2	5.8	Bus Metro Tram
VOR Region (Vienna)		455.0			All
Vilnius	34.4	16.5	16.6	1.3	All (Bus Trolleybus)

Heavy rail (RENFE) subsidies are not included because they are unknown.
The difference (6.1%) is due to a deficit of 10 million € within their programme for 2004
Just Bus
Just Metro

Table 13 is very heterogeneous on its content depending on the metropolitan area. A very important indicator on public transport financing is the percentage of the operational expenses that is covered by the revenues collected by fares and the percentage covered by public subsidies. However, the attribution of costs and revenues varies very much in the different metropolitan areas. On Graph 27 we observe that the coverage of operational costs by fare revenues is on average 47%, but Brussels (30.3%) and Prague (24.4%) are cases remote from this average. In general terms, the percentage in cities where data are available is between 37% in Paris Ile-de-France up to 79% in Cadiz Bay.

Graph 27. Coverage of operational costs



The other indicator, the coverage by public subsidies is on average 50% what means that in average half of the public transport operational costs are covered by fares and half by public subsidies from national, regional or local authorities depending on the local context. The balance share between fare revenues and public subsidies is a consequence of the public service obligations entitled to public transports services and the existence of reduced social fares as we have seen in the previous section.

The rest of the percentages up to 100% are other revenues corresponding to publicity, congestion charging, taxi licensing incomes, bus enforcement fines, etc.

We should note that in few cases the figures are not consistent or do not include all modes, due to a lack of financial and rigorous information from different modes and operators and the difficulty to obtain them, even more when each case considers different items for each group of costs and different calculation. For example, British authorities in West-Midlands (Birmingham), South Yorkshire (Sheffield) or Greater Manchester do not directly operate public transport services neither collect fares, thus they do not have available meaningful figures to allow comparison. The figures on Table 13 for West-Midlands and South Yorkshire include only the operational cost of some authority's activities (promotion, planning, co-ordination, etc.) and only the revenues from tickets supplied by these authorities, namely CENTRO and SYPTE. Therefore, the figures are very different from the rest and not comparable. However, it must be said that the local public transport in those areas is privately operated and largely profitable.

5. Conclusions

The key facts we draw in this report are the following:

- **The metropolitan areas surveyed show differences in terms of surface in terms of population and in terms of urban density**. The different urban layouts have significant consequences for the coordination of the provision of public transport among the various local authorities concerned.

  Main cities gather 45% of the population of the metropolitan area on 10% of its surface. Mobility patterns in the city centre show specific characteristics that are not to be found in the rest of the area.

- **3 trips per person per day are done in average in the metropolitan areas surveyed.** Each motorised trip represents 30 min time. 45% are commuting trips as home-to-work and home to school.

- **There is one car every two inhabitants** which explains why private car remains the favoured mode of transport (50% of total trips), followed by non-motorised modes (30% walking and cycling) and public transport (just 20%). Still there are twice as many cars in Prague (635 cars/1,000 inhabitants) than in Berlin-Brandenburg (322). There is a trend to a link between car ownership and public transport use, though is not very strong, pointing out that the more we own cars, the less we use public transport.

- **Public transport accounts for 45% of all motorised trips in the densest part of most of the metropolitan areas surveyed**. This underlines the leading role of an efficient safe and fair public transport system in large urban territories. However when considering the whole metropolitan area, the share falls to 29% of motorised trips done by public transport against 71% of other motorised modes, mainly the private car. The lower level of public transport provision, but also the characteristics of urban development combined with road infrastructure provision have a determinant impact.

- **Metro systems are extending** or appearing in almost all the cities surveyed, being successful in dense areas.

- The number of tramway routes and systems is increasing very fast in several European metropolitan areas, based on the **new concept of tramways on dedicated platform called light rail system**. They represent an alternative for medium capacity modes.

- Considering public transport demand, **the bus attracts about the same number of passengers (a little less) than all rail modes combined** (journeys/year). However, looking at the figures on passenger-km/year the suburban railway has the highest figures, followed by metro, both gathering 70% of the total demand on public transport expressed on passenger-km. Functionality and length of trips impact on the choice of mode.

- On average, the population does more than **210 journeys per inhabitant and year on public transport, this means almost one journey every labour day**.

- The fastest modes are the rail modes, with averages **commercial speed of 52 km/h for heavy rail, 32 km/h for metro and 22 km/h for bus and 21 km/h for tram**. It is remarkable that tram and bus (interurban bus included) have the same speed though the tram usually runs on reserved platform.

- **The amplitude of public transport services is quite high, close to 20 hours** in all modes. The most accessible to people with reduced mobility is the tram; nevertheless, the bus is carrying out a big effort on low floor buses and to a lesser degree on on-board audio and visual information.

- **The single ticket price varies between 0.23 € to 3.00 €**. With the multiple trip coupon (usually 10 trips) one can save around 40%. The price of monthly pass is on average 30 times the single ticket, but for young and elderly people the pass is 50% cheaper than the normal monthly fare.

- Regarding the financing of the public transport systems, **operational costs are covered 47% by fares, 50% by public subsidies and 3% by other revenues** such as publicity, congestion charging, etc.

Annex I: List of Metropolitan Areas Surveyed

This is a chart with the metropolitan areas participants from the first edition of the Barometer until the present edition with the Transport Authority responsible.

	Country	Transport Authority	Barometer data 2004	Barometer data 2002	Barometer data 2000
Amsterdam	Netherlands	ROA	x		
Athens	Greece	OASA		x	x
Barcelona	Spain	ATM	x	x	x
Berlin-Brandenburg	Germany	VBB	x	x	
Bilbao	Spain	CTB	x	x	x
West Midlands (Birmingham)	England	Centro	x	x	
Brussels	Belgium	AED-BUV	x	x	x
Cadiz Bay	Spain	CMTBC	x		
Dublin	Ireland	DTO		x	
Frankfurt Rhein-Main	Germany	RMV	x	x	
Helsinki	Finland	YTV	x	x	x
Lisbon	Portugal	AML			
South East England (London)	England	GLA	x	x	x
Greater Lyon	France	SYTRAL	x		
Madrid Community	Spain	CRTM	x	x	x
Greater Manchester	England	GMPTE	x	x	x
Oslo Region	Norway	AS Oslo Sporveier	x		
Paris Ile-de-France	France	STIF	x	x	x
Prague	Czech Republic	ROPID	x	x	x
Seville	Spain	CTS	x	x	x
South Yorkshire (Sheffield)	England	SYPTE	x		
Stockholm	Sweden	ABSL	x	x	x
Greater Stuttgart	Germany	VRS	x		
Turin Metropolitan Area	Italy	AMMT	x		
Valencia	Spain	ETM	x	x	
VOR Region (Vienna)	Austria	VOR	x	x	x
Vilnius	Lithuania	MESP	x	x	x
Warsaw	Poland	ZTM		x	
Zurich	Switzerland	ZVV		x	x

On this third edition, 24 metropolitan areas have collaborated, which is a great achievement since the first one surveyed 15 cities.

The questionnaire used to gather the information contains 383 questions. It has represented a strong involvement from the Authorities to collect data and a considerable work for CRTM to consolidate these data.

Annex II: List of Tables and Graphs

List of Tables

List of Graphs