ISEMOA

Improving seamless energy-efficient mobility chains for all

Supported by INTELLIGENT ENERGY EUROPE

Relationship of energy-efficiency in transport and accessibility of the whole mobility-chain

Deliverable no. D2.6 of the project ISEMOA

Date of finalisation of this document: December 2011

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Start date of the project: 18/05/2010 End date of the project: 17/05/2013	Project website: http://www.isemoa.eu

Grant agreement no. IEE/09/862/SI2.558304 – ISEMOA, Improving seamless energy-efficient mobility chains for all

ISEMOA is co-funded by the European Union under the IEE 2009 STEER programme.

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1 ABOUT THE PROJECT ISEMOA

ISEMOA - Improving seamless energy-efficient mobility chains for all – started in May 2010 and is a 3-year project supported by the European Commission within the IEE-programme.

ISEMOA aims to help local and regional authorities in Europe to increase energy-efficiency in transport by improving the accessibility of door-to-door mobility-chains and thus enabling all citizens and visitors (including people with reduced mobility (PRM)) to adopt a less car-dependent life-style. Furthermore, improving the accessibility of public spaces and public transport will increase the quality and attractiveness of public transport, and contribute to increasing safety for pedestrians and cyclists.

In order to achieve this goal, ISEMOA develops tailor-made quality-management-schemes for continuous improvement of the accessibility of the whole door-to-door mobility-chain in European municipalities, cities, and regions (in the following text these schemes are called ISEMOA-schemes). These ISEMOA-schemes are a standardised quality management process based on the successful BYPAD, MaxQ and MEDIATE-schemes. At the core of the ISEMOA-schemes is a moderated audit process that helps local and regional stakeholders to assess together with an external auditor, the state of accessibility of public space and public transport in their area and to develop strategies and measures to continuously improve the quality of accessibility.

The ISEMOA-schemes apply a holistic approach by taking into account;

- the needs of all categories of PRM (i.e. people with disabilities, people with heavy / bulky luggage, people with small children, people with temporal impairments, people with non-average stature, elderly people,…)
- the whole door-to-door mobility-chain with sustainable transport modes, including walking, cycling, public transport, multi-modal mobility
- all kinds of barriers (i.e. barriers related to physical conditions, organisational aspects, attitudes of people,…)

In order to elaborate these ISEMOA-schemes according to the needs of the stakeholders, the project sets a strong focus on continuous involvement of all relevant stakeholder-groups (PRM, city-consultants, local / regional authorities,…) from the very start of the project. The development of the ISEMOA-schemes is an iterative process, as they are first implemented in 15 test-sites all over Europe, and then improved according to the feedback of the test-sites'-stakeholders.

The implementation-process of the ISEMOA QM-schemes raises awareness among the local and regional decision-makers of the correlation of accessibility and energy-efficiency in transport, initiates communication among all relevant local and regional stakeholders, and helps to bring forward a local / regional strategy for improvement of accessibility.

Consultants, agencies, and organisations working with municipalities, cities, or regions all over Europe are invited to attend the ISEMOA training-workshops for external auditors. These training-workshops are implemented in 15 European countries in order to enable consultants, agencies, and city-advisors to use the ISEMOA QM-schemes in their daily work with local and regional authorities.

1.1 The ISEMOA consortium

Coordinator:	
FGM-AMOR (AT)	

Partners:	
AGEAS (IT)	NP (CZ)
BSRAEM (BG)	SECAD (IE)
Ecuba (IT)	Sinergija (SI)
Edinburgh Napier University (UK)	TAS (UK)
Energy Agency of Plovdiv (BG)	Technical University Dresden (DE)
ETT (ES)	Trivector (SE)
IEP (CZ)	UIRS (SI)
ITS (PL)	University of Zilina (SK)
Mobiel 21 (BE)	URTP (RO)

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2 SUMMARY

This paper examines the relationship of accessibility of the whole mobility-chain and energy-efficiency in transport in order to gain a better understanding of the transport-energy-related and environmental benefits resulting from improving accessibility of public transport and public space. It also forms the basis for a guidance paper for decision makers and politicians on the correlation of accessibility and energy-efficiency in transport.

In the past it was generally thought that accessibility is a function of transportation, meaning that more roads and transport offers means more accessibility. Today it is accepted that this is not the case. For everybody, but especially for PRM, a spatial environment with direct routes and short distances helps most to realise accessibility to services and satisfaction of needs. ISEMOA is strongly supporting those structures.

The mobility behaviour of PRM compared to those of non-PRM is of crucial importance in this paper to identify a potential gap that can be closed by creating the same accessibility conditions for everybody. Unfortunately there is a substantial lack of (comparable) data for mobility behaviour in general; and for mobility behaviour of PRM in particular.

The official data about PRM living in the different countries involved in ISEMOA and the proportion of PRM using public transport, varies a lot and depends on the definition and boundaries set. The data available shows a surprising proportion of PRM in the population. – According to the synopsis of the results in this report, approximately 35% of the whole population suffer from reduced mobility.

When comparing the number and length of trips of PRM to those of non-PRM there are significant differences. PRM, in general, are less active outside of their homes (so called “mobile” persons). Those PRM that are mobile undertake (in total) fewer trips than non-PRM. In particular the number of business trips is much fewer, whereas PRM undertake more private/leisure trips than non-PRM.

Distances travelled by PRM are significantly shorter than by non-impaired persons. This concerns both the length of one single trip and the total length travelled per day. The daily mobility radius of PRM is thus clearly limited.

People with reduced mobility generally travel with less speed than non-PRM, need more time even for relatively short distances and can find trips more physically exhausting. Therefore, although distances travelled are less, the total time spent travelling is not significantly shorter for PRM than for non-PRM.

Modal split data indicates that private motorised transport is the most popular transport mode for PRM. Nevertheless, for some PRM groups public transport share is higher than for non-PRM. This is not necessarily due to good accessibility of public transport but due to the absence of any alternatives for specific PRM groups (private car not affordable/not allowed to drive). Many PRM groups are still more or less completely excluded from specific (public) transport means and therefore from accessing public spaces ISEMOA aims to address this issue, establishing accessibility for the use of public space and public transport for everybody.

In summary, analysed mobility data indicate that different PRM groups still face disadvantages in transportation. There is still a big difference between the mobility behaviour of PRM and non-PRM. Creating accessibility for all in public space and public transport is a prerequisite to raise the mobility potential of PRM and offer the same services to everybody. That also means that PRM might travel more than they do today, but with less energy consumption. The calculation of the effect of adopting the ISEMOA QMS on energy consumption in the ISEMOA test sites shows that about 275 million car km per year will be shifted to other mobility modes. Considering additional public transport trips taken instead this still amounts to CO_2 savings of 39,000 tons per year. Rebound effects that lead to shorter trips for everybody and further shift from car use to public transport, walking and cycling as well as effects from further sites that will implement the ISEMOA QMS are not included in this calculation and would enhance the energy savings.

3 STRUCTURE AND AIM OF THE REPORT

3.1 Structure of the report

The following chapter briefly describes the methodology used to compile this report, whilst chapter 5 discusses the consequences of changing transport systems and infrastructure that increase personal motorised transport.

The mobility behaviour of PRM will be presented in detail in the main part of this report (chapter 6). Particular attention will be paid to the share of PRM, the number of trips, the distances travelled and the duration of travel. Furthermore there will be a closer look at the modal split, at the differences between rural and urban areas and the question of whether PRM prefer travelling by car or public transport.

Chapter 7 details a calculation of how many car trips can be avoided by removing barriers and making the whole mobility chain accessible, the amount of fuel (energy) that can be saved and the consequential reduction in quantity of CO_2-emissions over the coming years as a result of implementing the ISEMOA-QMS.

The final chapter gives conclusions to the overall analysis. .

3.2 Aim of the report

The aim of the report is to provide a better understanding of the transport-energy-related and environmental benefits resulting from improving accessibility of public transport and public space. By removing barriers it is possible to enable PRM to adopt a less car-dependant lifestyle. An increased use of public transport (and walking and cycling) instead of personal motorised transport will significantly reduce CO_2 emissions. In the course of this report a model calculation will illustrate the amount of savings achievable as a result of the ISEMOA process.

At the same time this report aims to form the basis for developing a guidance paper for decision makers and politicians on the correlation of accessibility and energy-efficiency in transport and may give support if they have to reach a decision concerning capacious (re) planning of public space. With the help of this report and the corresponding guidance paper, decision makers will be able to calculate the possible energy saving effects of improved accessibility, which should influence such a decision.

4 APPROACH

The starting point for this report was the proposition of Annex I which led to a discussion at the project kick-off meeting in Graz. The participants argued general issues like mobility behaviour of PRM and non-PRM, car ownership and diverse energy consumptions of transportation means. Those issues were also addressed at the 2nd consortium meeting in Bucharest (January 2011) and some ISEMOA-partners (EAP, ECUBA, IEP, SECAD, UIRS, URTP and University of Zilina) were asked to deliver mobility behaviour data for their country or test site. Elementary questions were the differences in the number of trips and car use regarding PRM and non-PRM. The data submitted was analysed and used to compile this report.

Simultaneously, existing literature (approximately 55 sources) was reviewed and analysed. For example; official statistics, reports from other projects dealing with mobility behaviour of PRM or dealing with energy consumption and savings in transport. The main result was that there were – if available at all - just figures for people with disabilities and elderly people. But in the majority of cases there was no data available for people with reduced mobility (as in the broad definition of the ISEMOA project).

Consequently, the question about the mobility behaviour of PRM was difficult to answer for all involved partners. In addition, comparison of data for partners with that found in the literature review was difficult due to different classifications of groups of people with reduced mobility (who is counted as PRM) or information being only available for non-PRM but not for PRM, etc. Where there is sufficient data, these figures are presented in this paper.

5 INTRODUCTION

In the past it was generally thought that accessibility is a function of transportation, meaning that more roads and transport offers means more accessibility. Today it is accepted that this is not the case because user reactions and spatial pattern were not considered in the past. The effect of building more roads is that destinations once close to home (e.g. grocery store) move further away, resulting in the phenomena of ‘induced traffic’ where increased trips are caused by improvements to infrastructure. This phenomenon is often not sufficiently considered in accessibility and transportation planning.

Promoting infrastructure that leads to induced traffic is not only counterproductive from the point of view of accessibility but also in terms of energy consumption. The crucial question is: what is the aim of transportation planning? Is it to “produce” again and again more kilometres driven, more hours spent in traffic, more CO_2 produced by transport, to foster urban sprawl? Or is it to deliver as many options (not constraints) as possible to the user?

The focus in transportation must be on true satisfaction of needs (go to grocery store, doctor, etc.) with less traffic. If this focus could be realised PRM as well as non-PRM would react and adapt their mobility behaviour (dynamic reaction). Then situations are changing: proximity and multifunctionality become important again. The level of accessibility rises, with less energy.

If a system is changing by concentrating on true satisfaction of needs this has an implication for PRM. If they have to travel long distances to satisfy their (even basic) needs they are dependent on trains and cars. But improving the macro accessibility level leads to more options; more options in the destinations they can reach and more options in the transport means they can use (appropriate micro accessibility is a prerequisite). And there is another positive effect. The whole change in transportation structure (infrastructure, etc.) makes the system slower, because if the distances are short it will be possible to walk and use the bicycle, and consequently safer and thus easier to use for PRM. In summary, this leads to less individual and societal costs for transportation, less traffic and less energy consumption. Therefore it is of utmost importance to remove barriers in public space and transport to enable PRM to change transport modes from their private car to public transport or walking and cycling. This will save a huge amount of energy and CO_2 emissions. The ISEMOA project leads towards this direction.

6 ANALYSIS OF TRAVEL BEHAVIOUR OF PRM

The following chapter deals with data on the mobility behaviour of PRM in comparison to non-PRM. The availability of data varies considerably within the European Union. Data on the mobility behaviour of PRM is not collected in a standard way in different countries, in some countries is not collected at and for others (e.g. Germany) is only available for recent years. Nevertheless it was possible to collect some meaningful data for this report.

In what follows the share of PRM in the test sites or at least in the countries in which they are located, the number of trips carried out by PRM in comparison to non-PRM, distances travelled and the duration of travel will be examined. Furthermore, the modal split, differences between urban and rural areas and some explanations for choosing the car over public transport are presented. Data from Germany, Austria (especially Lower Austria), Italy, Bulgaria, Slovenia, the United Kingdom and some more countries has been evaluated and summarised. Where appropriate and necessary for the calculations in chapter 7, average numbers have been used.

It should be noted that direct comparison of the figures from different countries is not possible due to differences in definition of PRM groups as well as different methods of collecting data within the different regions.

6.1 Share of PRM

According to EDF (2011) more than 40% of the population counts as PRM.

The ISEMOA partners were asked to provide facts and figures regarding PRM for their test sites (or countries) if available.

Almost 134,000 PRM live in *Plovdiv*, the Bulgarian test site, which equals 36% of the whole city population (data provided by ISEMOA partner EAP). The proportion of people with disabilities in *Ireland* ranges between 10% (which are some 360,000 people) and 19.4% (e.g. BOOZ ALLEN HAMILTON 2003, P.57). In addition there are many other PRM, by the ISEMOA definition of PRM that are not counted in this figure.

According to BOOZ ALLEN HAMILTON (2003, P. 103) the estimated number of people with a severe disability living in the *European Union* amounted to 26 million in the year 2000 which equals 6.8% of the population. Besides people with minor and severe disabilities there are also many people who are reduced in their mobility due to other reasons. Elderly people and small children, who have reduced mobility reduced due to their age, make up about 20% of the EU population as a whole. Taking into account all categories of PRM the proportion of PRM in the population can be as high as 35%, for example in *France* (e.g. BOOZ ALLEN HAMILTON 2003, P.104).

The proportion of different categories of PRM varies between countries but on an average 36% of PRM are walking impaired, 15% are hearing impaired, followed by 11% of PRM with visual impairment and the rest having from other impairments (e.g. BOOZ ALLEN HAMILTON 2003, P.104).

According to official German statistics there were 6.6 million people with severe disabilities (owning a disability pass) living in *Germany* which equals about 8% of the population. But the number of people with reduced mobility is much higher: approximately one third of the German population can be considered mobility impaired (e.g. ARNDT 2004, P. 74). Extrapolations based on these statistics demonstrate that 20-30% of Germans would need a barrier-free environment. The proportion of public transport users in Germany who are PRM is as much as 20% in some areas (e.g. ARNDT 2004, P. 74).

In the *Netherlands,* it is believed that the number of people with limited mobility, due to walking difficulties, will increase considerably in the coming years. In 2010, about 1.05 million people (which equal 6.3% of the whole population) have limited mobility. Because of the ageing society it is predicted that this figure will increase up to 1.62 million walking impaired people (9.4% of population) in 2030 in the Netherlands (e.g. AVV 2005, P.12).

30% of the population in *Austria* has at least one physical impairment (e.g. cardiovascular disease), 7% have at least one movement restriction, 6.5% are hearing impaired and 43% have visual impairments (of which 90% could be corrected by glasses, contact lenses or by surgery) (e.g. HERRY 2008, P. 24).

Based on the above figures, the proportion of PRM (as identified in ISEMOA) equates to, on average, 35% of the whole population.

6.2 PRM and non-PRM trips

<u>Out-of-home share</u>

A household survey 2003 in *Lower Austria*, the biggest state of Austria, showed a significant difference in out-of-home activities of PRM and non-PRM. 63% of people with reduced mobility undertake at least one trip outside the house on a working day. Therefore they are seen as “mobile PRM”. By contrast the out-of-home share was 90% for non-PRM (e.g. HERRY 2008, P.27).

The enquiry „Mobilität in Städten“ (mobility in cities) analysed the mobility behaviour in *Germany*. The mobile share (see above) of visually impaired people is 79.1% and the share of mobile walking impaired people amounts to 61.4%. For people with impairments other than visual impairments, 71.4% can be considered mobile, compared to 90% of non-PRM (e.g. SRV 2008).

Trips per day per person

According to a survey in the German *city of Nuremberg*, people with reduced mobility undertake on average 2.15 trips per day, the German average is 3.2 trips per day per person. 47-70% of respondents (depending on PRM-group) face problems (= barriers) while moving in public space (e.g. ARNDT 2004, P. 75).

According to the mobility enquiry in *Lower Austria* 2003 the whole group of PRM undertake on average 1.93 trips per day per person whereas non-PRM undertake about 3.14 trips per day per person. Comparing only those persons who were mobile on the day of the survey, (therefore only those who undertake at least one trip outside their homes) showed less significant difference: mobile PRM made 2.90 trips and mobile non-PRM made 3.43 trips. This difference is primarily due to the significantly lower proportion of working and training trips of those with mobility limitations. For private activities there is a completely different image: PRM, who have undertaken trips outside the home, make 2.64 trips per day for "private errands", "shopping" and "leisure". For non-PRM trips for this purpose constitute 1.69 routes (e.g. HERRY 2008, P.28).

The project “ÉGALITÉplus” published the following results regarding the number of trips per day for different PRM groups in *Austria* (Table 6.1):

Impairment	Trips per day
Wheelchair user	2.5
Walking impairment	3
Visual impairment	2.9
Blindness	3.3
Hearing impairment	2.8

Impairment	Trips per day
Deafness	2.7
Learning difficulties	2.4
Elderly people	2.7
Children	2.9
Migration background	2.9

Table 6.1 Trips per day per PRM in Austria

(summary from the ÉGALITÉplus conference held on 9 May 2011 in Vienna, sent by FGM AMOR for this report)

The average number of trips, calculated out of this table, is 2.81 trips per PRM per day in Austria.

Italians make on average 3 trips per day (no PRM data available). Though it can be noted that the number of trips tend to be higher the smaller the city is, e.g. in towns with less than 20,000 inhabitants there are 3.1 trips per day made (data provided by ISEMOA partner ECUBA).

The inhabitants of Ljubljana, the capital of Slovenia, make 3.1 trips per day whereas people living in the Ljubljana urban region (excluding Ljubljana) make only 2.5 trips per day. The average for all people in the region is 2.7 trips per day per person (no PRM data available) (data provided by ISEMOA partner UIRS).

The VICTORIA TRANSPORT POLICY INSTITUTE (2010, TABLE 6) published the following average number of trips for different European countries (Table 6.2):

Country	Number of trips
Austria	3
Belgium	3
Germany	3.3
France	2.9

Country	Number of trips
Spain	1.8
Sweden	2.7
United Kingdom	2.9

Table 6.2 Trips per day in different countries (general population)

If we consider the figures available, PRM undertake about 2.76 trips per day per person compared to 2.87 trips per day per person for non-PRM.

6.3 Distances travelled

As it can be expected, the total distances covered by PRM are significantly shorter than by non-impaired persons. This concerns the lengths of one single trip and the distance length covered per day. The daily mobility radius of PRM is thus clearly limited (e.g. HERRY 2008, P. 31F.).

Distances of single trips

HERRY (2008, P.31) listed the following distances for the population of *Lower Austria* (Table 6.3):

path length (in km)	PRM	non-PRM
<0,5	17%	12%
>0,5-1	14%	11%
>1-2,5	15%	14%
>2,5-5	18%	16%
>5-10	14%	14%
>10-20	9%	13%
>20-50	10%	13%
>50	3%	7%

Table 6.3 Trip distance per PRM and non-PRM in Lower Austria

For Lower Austria this leads to an average trip distance of 8.5 km (PRM) and 12 km (non-PRM).

The project "ÉGALITÉplus" published the following results regarding the averaged trip distance for PRM in *Austria (Table 6.4)*:

Impairment	Distance (km)
Wheelchair user	5.5
Walking impairment	6.4
Visual impairment	7.7
Blindness	8.2
Hearing impairment	10.1

Impairment	Distance (km)
Deafness	9.5
Learning difficulties	9.9
Elderly people	8.5
Children	10.1
Migration background	7.7

Table 6.4 Trip distance for PRM in Austria

(summary from the conference held on 9 May 2011 in Vienna, sent by FGM AMOR for this report)

Based on these figures, the average trip distance for PRM in Austria is 9.0 km. The average trip distance for the whole population in Austria is 9.5 km (e.g. HERRY 2007, P.86).

The average trip distance for Germany's whole population is 11.8 km per person (e.g. MID 2010, P. 21).

For *Plovdiv* (Bulgaria) the average distance for a single trip per person is 3.4 km. The trip distance for PRM is significantly shorter. Walking impaired people only cover an average distance of 200m and wheelchair users about 1km per day. Visually impaired people as well as older people travel half the average distance covering approximately 1.7 km per single trip (data provided by ISEMOA partner EAP).

According to a survey in the Czech city of *Pilsen* in 2005 (findings sent by ISEMOA partner IEP) the average length of a trip by public transport is about 5.81 km, by car 6.36 km, by bike 4.55 km and for walking the average trip distance is 2.04 km.

The average of the figures available shows PRM have a trip distance of 6.65 kilometres whereas non-PRM have a trip distance of 9.2 kilometres.

Daily trip length

The sum of all trips per day for all categories of PRM in *Lower Austria* is on average 19 km. Considering just the mobile PRM this figure becomes larger: approximately 29 km per day. In comparison, non-PRM cover 46 km per day and mobile non-PRM cover a distance of 50 km per day (e.g. HERRY 2008, P. 31).

Germans cover 3,214 million km every day. Germany has approximately 82 million inhabitants, which means that every *German* travels on average 39 km per day. 79% of these trips are made by car (55% as car driver and 24% as car passenger), on foot 3% and by bike 3%. Germans use public transport for 15% of their trips (e.g. INFAS 2009, P.5).

The average daily travel distance for *Plovidv*, the Bulgarian test site, is 20.4 km (3.4 km trip length * 2 (round-trip) * 3 trips) (data provided by ISEMOA partner EAP).

In *Italy* the distance covered daily is on average 34 km; in larger cities, such as the test site Modena, the distance is as high as 37.1 km. Short trips are the most frequent with 33% of trips being 2km or less (data provided by ISEMOA partner ECUBA).

The VICTORIA TRANSPORT POLICY INSTITUTE (2010, TABLE 6) published the following average travel distance per person per day for different European countries (Table 6.5):

Country	**Distance (km)**	**Country**	**Distance (km)**
Austria	28.1	*France*	35.3
Czech Republic	21.9	*Sweden*	44.1
Germany	36.9	*United Kingdom*	31.8

Table 6.5 Daily travel distance in different countries (general population)

6.4 Duration of travel

People with reduced mobility travel with less speed than non-PRM, need more time even for relatively short distances and can become physically exhausted more easily. That is why PRM prefer shorter trips and undertake fewer trips than non-PRM (see above). However, the time spent travelling is not significantly less than for non-PRM.

<u>Duration of a single trip</u>

HERRY (2008, P.32) listed the following durations for a single trip in *Lower Austria* (Table 6.6):

duration (in min)	PRM	non-PRM
<10	38%	42%
>10-15	19%	16%
>15-20	11%	8%
>20-30	14%	13%
>30-45	4%	7%
>45-60	6%	6%
>60-90	4%	5%
>90-120	2%	2%
>120	1%	1%

Table 6.6 Duration of travel for PRM and non-PRM in Lower Austria

For Lower Austria this gives average trip duration of about 19.45 minutes for PRM and 21.59 minutes for non-PRM.

The project “ÉGALITÉplus” published the following results regarding the average duration of travel for PRM in *Austria* (Table 6.7):

Impairment	**Duration (min)**
Wheelchair user	24.4
Walking impairment	23.8
Visual impairment	29.4
Blindness	31.2
Hearing impairment	26.5

Impairment	**Duration (min)**
Deafness	31.4
Learning difficulties	34.8
Elderly people	25.6
Children	23.5
Migration background	23.8

Table 6.7 Duration of travel for PRM in Austria

(summary from the conference held on 9 May 2011 in Vienna, sent by FGM AMOR for this report)

The average duration of travel for PRM in Austria amounts to 27.44 minutes per trip.

In the city of *Ljubljana* the average duration of trips is 23.6 minutes and in the Ljubljana urban region the trips lasts about 28.5 minutes (data provided by ISEMOA partner UIRS).

Almost 50% of all *Italians* (not divided into PRM or non-PRM) have an average journey length of less than 15 minutes. 37% travel between 15 and 31 minutes; the rest spend more than 31 minutes on an average trip (e.g. TRANSPORT RESEARCH CENTRE 2003, P. 35). The high proportion of short distances clearly demonstrates the potential to encourage people to switch from car to public transport and walking and cycling. And, if there are mainly short trips it is more appealing to change means of transport.

Daily duration of travel

People in the OECD region spend on average 60-80 minutes a day travelling (e.g. OECD 2001, P.27).

In *Lower Austria*, the whole group of PRM has average daily trip duration of 48 minutes and for mobile PRM this figure is 73 minutes. Non-PRM spend 81 minutes travelling and mobile non-PRM 89 minutes (e.g. HERRY 2008, P.33).

The interviewees (general population) for an *Italian* report declare that they spend on average 62.9 minutes travelling; in cities with more than 250,000 inhabitants as Modena, the Italian test site for ISEMOA, people spend 72.5 minutes travelling a day (data provided by ISEMOA partner ECUBA).

The VICTORIA TRANSPORT POLICY INSTITUTE (2010, TABLE 6) published the following average travel time per person per day for different European countries (Table 6.8):

Country	Travel time (min)	Country	Travel time (min)
Austria	68.8	*Spain*	44.4
Germany	80	*Sweden*	62.6
France	58.2	*United Kingdom*	63.3

Table 6.8 Duration of travel in different countries (general population)

6.5 Purpose of travel

As mentioned above, in *Lower Austria* the share of private trips (private errands, shopping, leisure) for PRM is significantly higher than for non-PRM (84% versus 55%) (e.g. HERRY 2008, P.30).

In *Germany* the share of private trips for PRM is much higher than the share of business trips. The main purposes of trips for PRM are shopping and leisure. The proportion of business trips (journey to work or other official trips) ranges from 4.5% for people with walking impairments, to 6.4% for people with other impairments, to 8.3% for visually impaired people (e.g. SRV 2008).

6.6 Modal Split

In Lower Austria, modal split for PRM differs considerably to that for non-PRM (Figure 6.1). Motorised private transport is the most popular transport mode for both groups. However, for individuals with physical disabilities walking have much higher priority than for non-impaired persons (e.g. HERRY 2008, P.29).

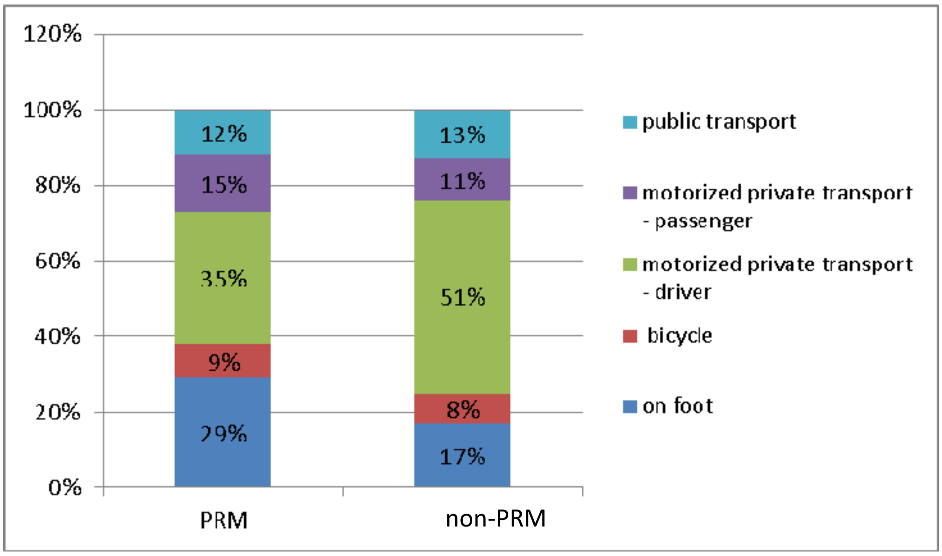

Figure 6.1 Modal Split for PRM and non-PRM in Lower Austria

(in style of HERRY 2008, P. 29)

According to the ISEMOA partner EAP, in *Plovdiv (Bulgaria)* 35% of all trips made by PRM are by car.

In *Germany* there are 281 million trips made every day. Of these 58% are made by car (43% as a driver and 15% as a passenger), 24% on foot, 10% by bike and the rest, only 8%, are made using public transport (e.g. INFAS 2009, P.4). INFAS (2009, P. 20) stated that there is a potential to shift the means of transport used by about 30% of the whole population of Germany.

Transport use depends on the activity pursued. The modal split of all activities for elderly people in Germany on average is as follows: 10% public transport, 7% car - passenger, 22% car - driver, 5% bike, 55% on foot (e.g. BMVBS 2010, P. 39). This shows that walking and public transport are of higher importance for the elderly than for the general population as a whole.

A similar result was found in a study in two rural districts in Mecklenburg-West Pomerania in the North-East of Germany where people were asked about their main means of transport (Table 6.9). The results show that, in particular, cycling plays an important role for the elderly in rural areas (e.g. BURMEISTER 2008, P. 5):

Interviewee (in…)	Public transport	On foot	Car	Bicycle
Municipality ≥ 3.000 inhabitants	3	25	28	44
Municipality ≤ 3.000 inhabitants	2	13	58	27
50- under 65 years	2	17	56	25
More than 65 years	5	23	30	42

Table 6.9 Main means of transport in Mecklenburg-West Pomerania

The modal split for PRM in *Sibiu (Romania)* is completely different compared to the overall modal split of Germany. For travelling inside the city, almost 63% of PRM use public transport, 30% walk and 24% use their wheelchair. Only 15% use their own regular car and 3% have a private car adapted to their needs (multiple answers permitted; the sum is more than 100% - survey conducted by ISEMOA partner URTP, link: http://www.tursib.ro/sondaj).

There is quite a lot of data for PRM mobility behaviour available for *England and Wales*. PRM travel a third less often than the overall population. They drive a car far less (47% less often), but taxis and minicabs are used, 67%, and buses, 20%, more frequently. Nevertheless PRM consider private cars as the only convenient and accessible form of transport because vehicles can be adapted to their needs and cars are seen to be more reliable, comfortable and secure. Two thirds of PRM never use local trains, compared to just over half of the overall population. 39% of PRM never use local buses as opposed to 31% of the overall population. 80% of PRM never use trams, light rail or underground (e.g. DPTAC 2001, P. 28F.).

The following figures and tables show the results of the study in more detail. Figure 6.2 shows the usage of forms of transports in England and Wales.

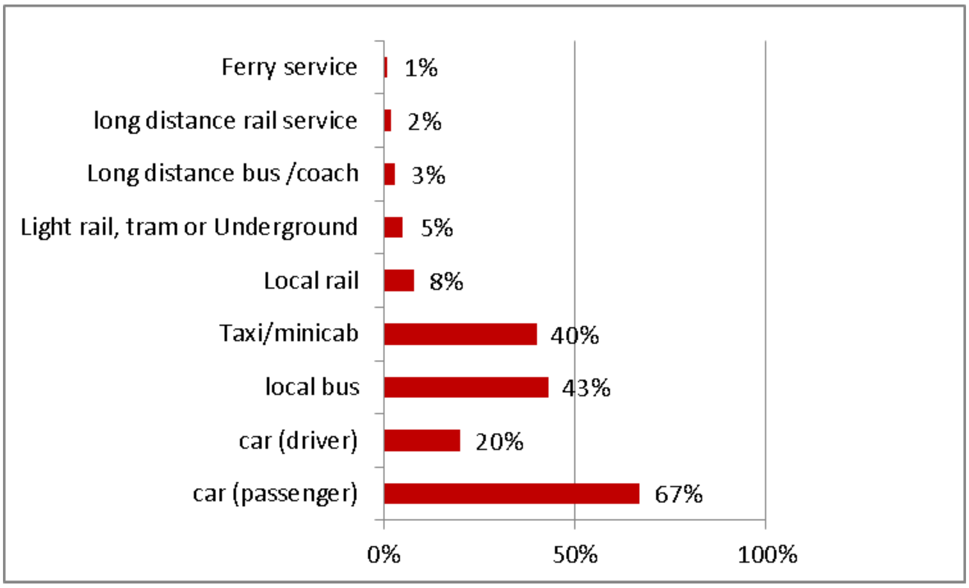

Figure 6.2 Did you use these forms of transport at least once a month?

(e.g. DPTAC 2001, p. 29)

Another question was about the car usage of different PRM groups (Figure 6.3).

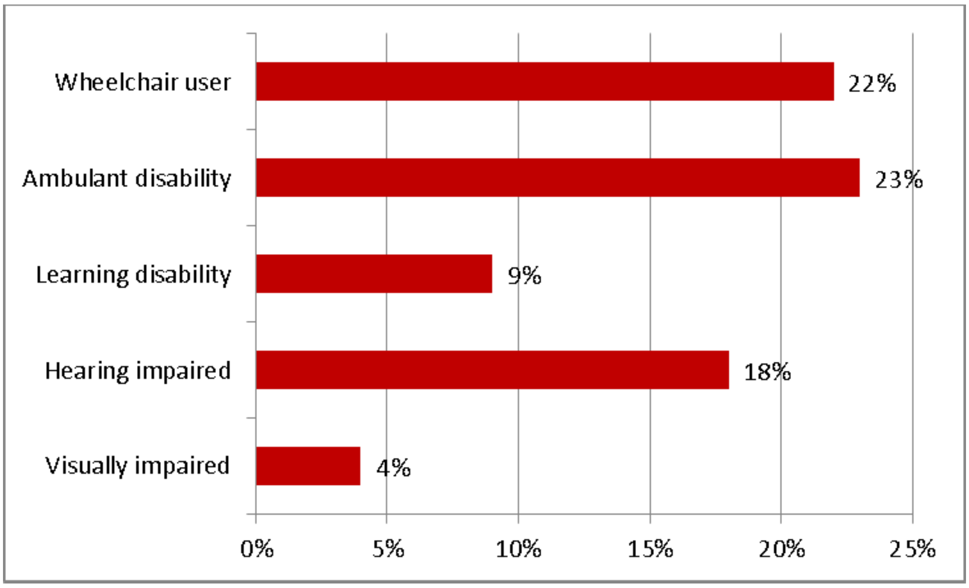

Figure 6.3 Did you drive a car by yourself? (at least once a month)

(e.g. DPTAC 2001, p. 30)

Another question was about the usage of a car driven by someone else. The results were as follows (Figure 6.4):

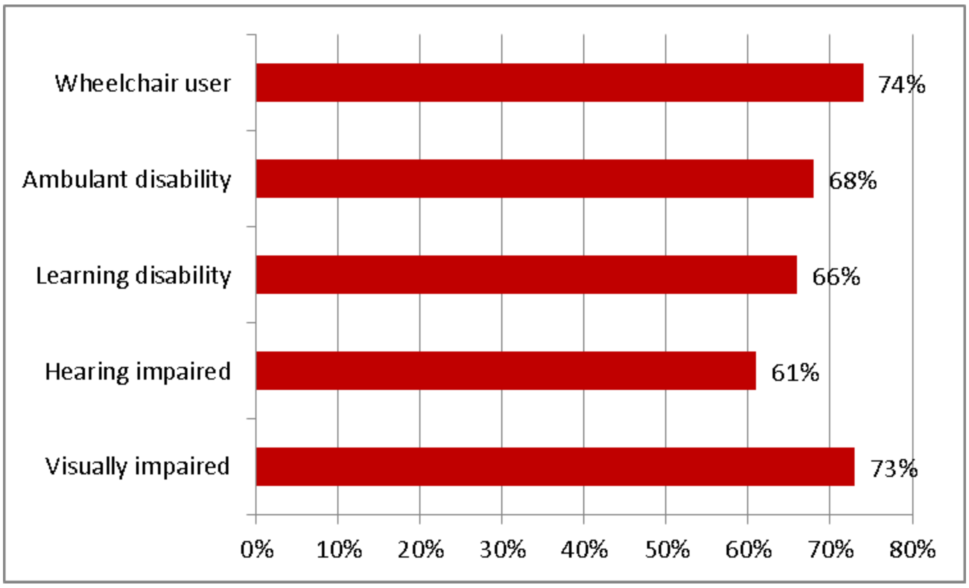

Figure 6.4 Did you go by car driven by someone else? (at least once a month)

(e.g. DPTAC 2001, p. 31)

The third means of transport asked for in the study was the use of taxi and minicab by PRM in England and Wales (Figure 6.5).

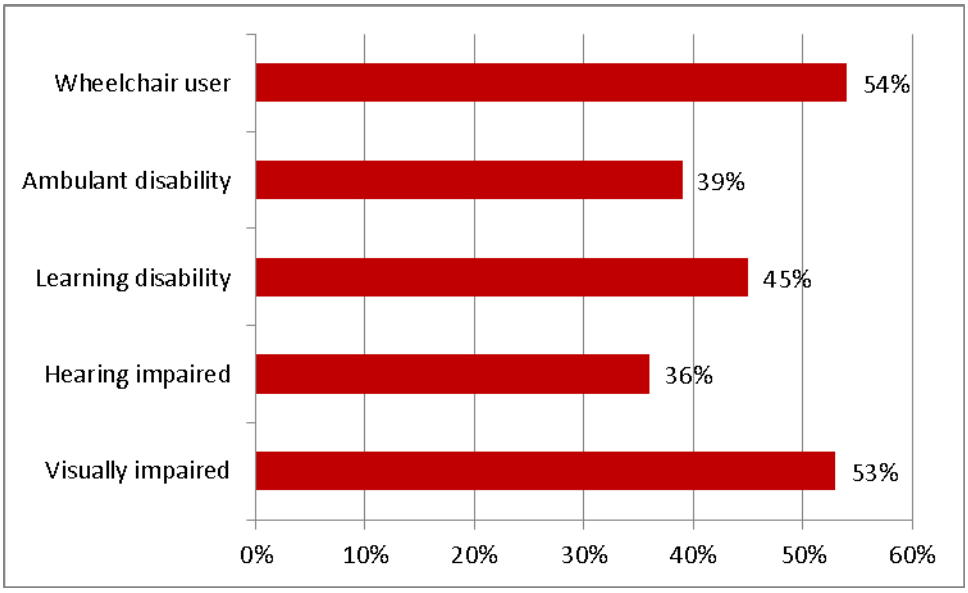

Figure 6.5 Did you use a taxi or minicab? (at least once a month)

(e.g. DPTAC 2001, p. 32)

The next chart shows the use of local buses by PRM in England and Wales. The answers were distributed as follows (Figure 6.6):

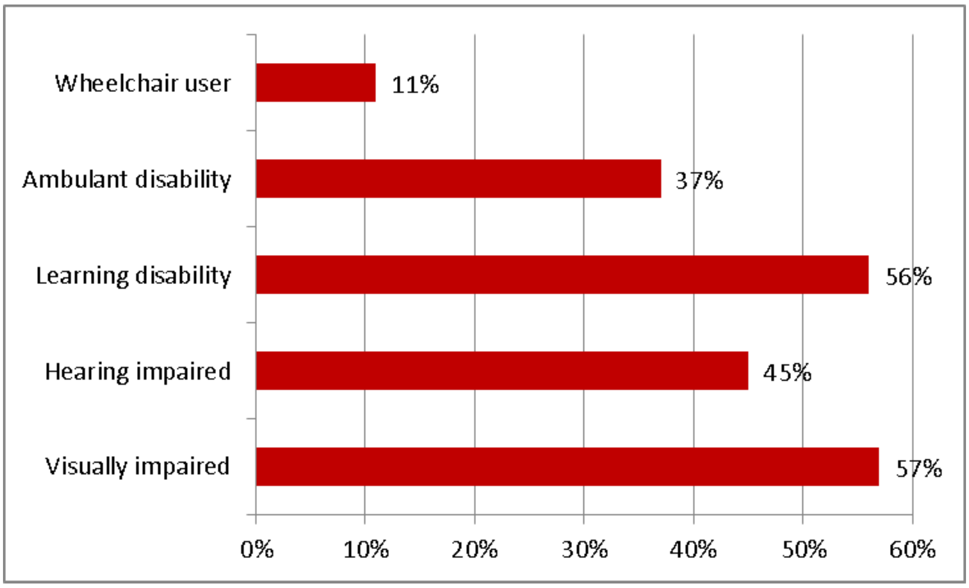

Figure 6.6 Did you use local buses? (at least once a month)

(e.g. DPTAC 2001, p. 33)

There are some differences in mode use among different categories of PRM in England and Wales. Visually impaired people use rail and underground more often (42% compared with 31% overall). Moreover, wheelchair users are less likely to be bus users. 72% never use the bus compared with 39% of PRM as a whole (e.g. DPTAC 2001, P.34).

The *Italians* in general have the following modal split (no separate data available for PRM/non-PRM): 12.7% of trips are done by foot, 3% by bike and 4.3% by motorbike. Public transport amounts to 9% (tram/bus 5%, underground 1.7%, train 2.3 %). The majority, almost three-fourths of trips are done by car (65% driver, 6% passenger) (e.g. TRANSPORT RESEARCH CENTRE 2003, P.32).

In *Slovenia* older people with physical disabilities almost never use public transport whereas young PRM use public transport more often (e.g. PNZ 2003).

Due to age-related restrictions and health reasons and also in order to keep fit and agile, elderly people often go on foot or ride a bicycle. Older people cover about two thirds of their trips in their residential areas on foot and thus attach importance to the immediate availability and accessibility of necessary destinations (e.g. BURMEISTER 2007, P.26).

For the calculation given in the following chapter we need to know the proportion of car trips made by PRM. Out of the data available, described above, the average share of car trips for PRM is 41% of all trips. By comparison the modal split for PRM using public transport is 27%.

6.7 Differences between urban and rural areas

In *England and Wales* 63% of people living in rural areas rely on and prefer using the car to public transport compared to 55% living in more urban areas. This may be as a result of the provision of public transport in rural areas (e.g. DPTAC 2001, P.35).

The modal split for *Germany* shows only slight differences for rural areas with lower density to the national average, especially comparing public transport and private transport.

Average value…	…for whole Germany	…for rural areas
Non-motorised transport	31%	32%
Motorised individual transport	61%	64%
Public transport	8%	4%
Bicycle	9%	10%

Table 6.10 Modal Split for Germany

(e.g. Burmeister 2007, p.27)

In Germany the greatest difference between urban and rural areas is seen in the role of car. Its use is higher in rural areas than in urban areas. The percentage of households without a car is 20% in Germany, but in areas of lower density it is just 4% (e.g. BURMEISTER 2007, P.27).

Older people are considerably less likely to own a season ticket for public transport than owning a car. However, there are notably differences between rural and urban areas: for example, in the Bonn region in Germany 19% of people asked (aged over 60) have public transport season tickets. In suburban and rural areas these figures are only 4% and 1% respectively (e.g. BMVBS 2010, P.37).

6.8 Car or public transport?

In *England and Wales* 60% of PRM have no car in the household; compared with the overall population where there are just 27% without a car (e.g. DPTAC 2001, P.35).

Nevertheless the majority (59%) of PRM prefer using the car to public transport; compared to 17% who disagree with the statement *'I prefer using the car to public transport'.* This is especially true for elderly people (65% prefer using the car), wheelchair users (66%), and people with ambulant disabilities (65%) (e.g. DPTAC 2001, P.35). The following figure 6.7 illustrates these answers:

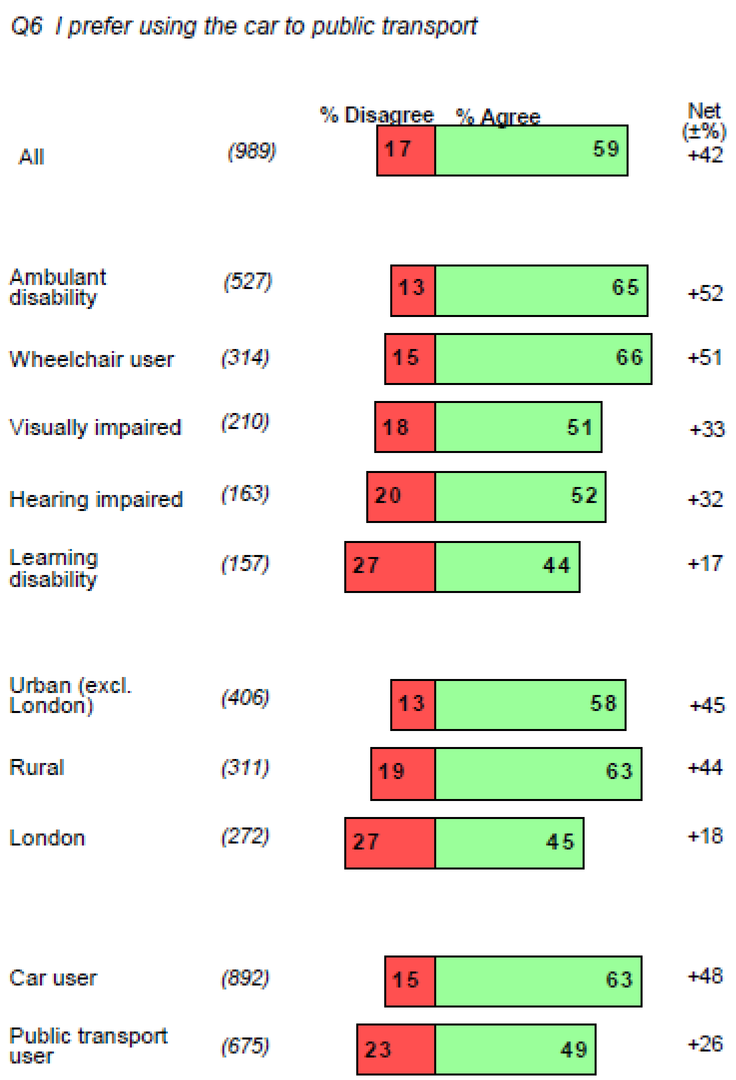

Figure 6.7 Agreement to the statement of preferring car to public transport (DPTAC 2001, p. 37)

People's (both PRM and non-PRM) preference for the car can be explained by the ease and convenience of the car (mentioned unprompted by 38%) as well as the advantage of door-to-door / direct travel (31%). The difficulty of getting on/off public transport is mentioned by 13%. No waiting at stops and stations by using the car and avoiding the need of having someone to help are both mentioned by 11% of the respondents (e.g. DPTAC 2001, P.35). The answers are illustrated in the following figure 6.8:

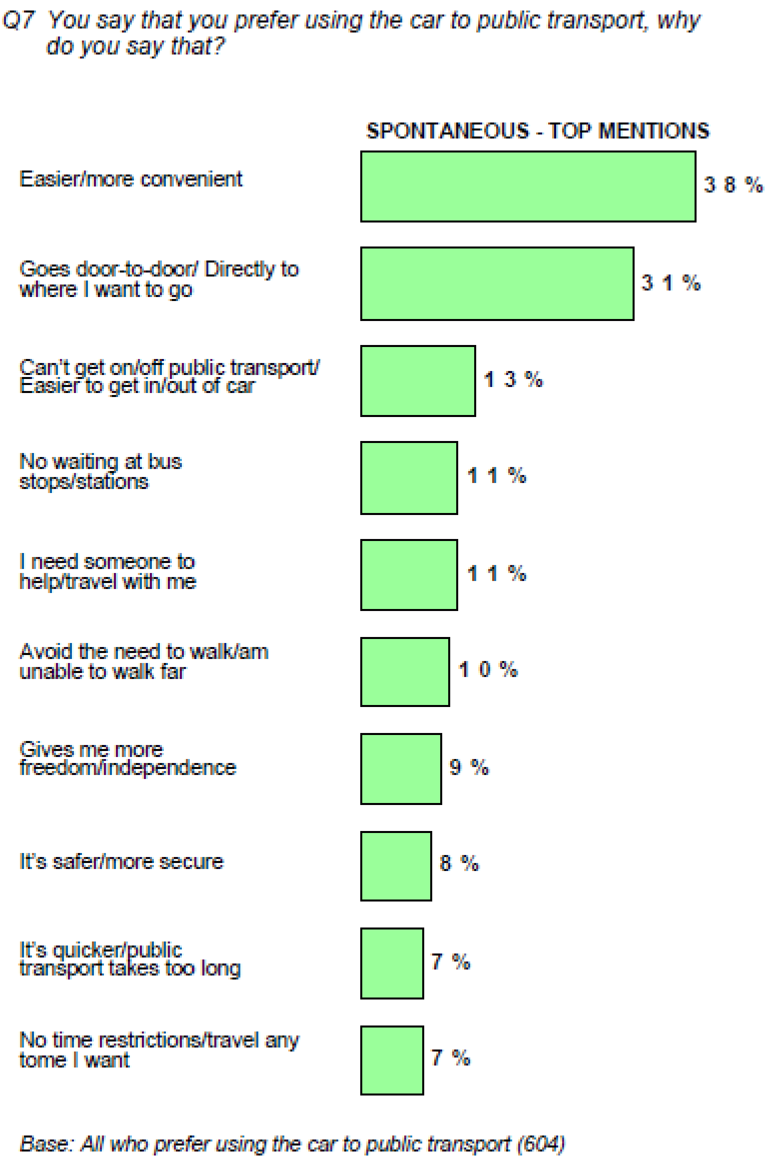

Figure 6.8 Reasons for preferring car to public transport (DPTAC 2001, p.38)

"A wide range of other advantages of the car are identified, including avoiding the need to walk (10%), more independence/freedom (9%), safer/more secure (8%). As with the overall population, many PRM have a starting point that public transport is difficult to use and is not adequate for their needs. Those who can avoid using public transport do so either through using their own car or relying on friends and neighbours." (DPTAC 2001, P.36)

The most important criteria for public transport users in *Germany* is punctuality. Other crucial criteria are comfort, safety and security, celerity, proximity and accessibility (of stops and stations), reliability, connection (direct connection, no changeover problems) and price. Criteria very often mentioned by old and very old users are proximity, accessibility for PRM and safe (de-)boarding. Elderly car drivers frequently mention reliability, temporary disposability of means of transport, easy transportation of luggage and the accessibility and mobility at the destination as important in deciding their means of transport (e.g. BMVBS 2010, P. 41F.).

Accessibility of stops and stations

According to the mobility study in *Lower Austria* in 2003 "barrier-free access to mobility for people with reduced mobility" was the most important point people mentioned as a future focus for transport policy (e.g. HERRY 2008, P.24).

According to ARNDT (2004, p.75) in a survey in the German *city of Nuremberg*, 50 to 70% of respondents would use public transport more often if there were fewer difficulties.

On the other hand it is interesting that – at least for *Lower Austria* - there are just small differences between the groups of PRM and non-PRM on the subjective assessment of accessibility of bus and train stations within walking distance. In both groups about 9 out of 10 people (90% PRM, 93% non-PRM) perceive reaching a bus stop to be achievable and about two thirds of respondents (64% PRM, 63% non-PRM) believe that a tram stop is easily accessible to them. This evaluation is based less on the actual distance between stops and places of residence and more on the "knowledge" of the people interviewed. Since PRM depend more on public transport (for example blind people and cognitive impaired people are not able to drive a car) they have quite often better knowledge of public transport networks than non-PRM (e.g. HERRY 2008, P. 35F.).

Again, this demonstrates a great potential for a shift from car use to eco-friendly modes of transport (resulting in energy savings), as – once the accessibility conditions are satisfactory – PRM will use the offer of accessible means of transport.

7 ENERGY EFFICIENCY AND ACCESSIBILITY

A starting point for this chapter were the calculations made and documented in Annex I. Discussions about these calculations began in a working group during the ISEMOA kick-off meeting in Graz. How realistic are the assumptions made, which data are missing and where therefore do we have to work with assumptions? Although it was very difficult to find meaningful data, compiling this report took into account all appropriate figures supplied by the ISEMOA-partners as well as figures obtained from research by TUD research in order to obtain a realistic estimation of energy savings achievable by using the ISEMOA QMS.

By the end of the ISEMOA project lifetime its QM-schemes will have been implemented in 18 test-sites across the European Union. According to the test-site descriptions, completed by the ISEMOA partners, more than 5.7 million people will be reached within this project. Taking into account that the share of PRM amounts to approximately 35%, the target group of ISEMOA stands at slightly more than 2 million people. PRM are often limited in their mobility and – in many cases – still have to rely on a car to carry out their daily trips. As a result of implementing the ISEMOA QM-schemes, the participating cities, regions and municipalities will initiate measures to improve the accessibility of the whole mobility-chain in order to enable PRM to walk, cycle and use public transport instead of using a private car. When the barriers in public space and in public transport are removed, we can presume that PRM can substitute at least about 5%[1] of their car trips with ecologically beneficial modes of transport. Based on this scenario the following calculation can be made:

2,000,000 PRM in target area x 6.65km average trip distance x 2.76 trips per day per person x 41% car trips x 5% modal shift from car users to other modes of transport x 365 days = **275 million car km per year shifted to other mobility modes**

We presume that about 50% of these car trips are shifted to public transport and 50% are shifted to walking and cycling. The fuel consumption in public transport is 0.02[2] litres per

[1] According to studies conducted by SOCIALDATA in German cities, about 5% of the trips done by car are not „captive“. This means these trips could have been made by other modes of transport.

[2] With an average capacity utilisation of 20% a public-transit bus needs 2 litres of diesel per 100 passenger-km („Bei einer durchschnittlichen Auslastung von 20 Prozent liegt der Flottenverbrauch eines Linienbusses bei nur rund 2 Liter Diesel pro 100 Kilometer“)
Source: http://www.vda.de/de/arbeitsgebiete/omnibusse/index.html

passenger km and average fuel consumption for private cars is about 0.075[3] litres per km. The calculated amount of fuel saved is as follows:

50% x 275 million km x 0.075l/km + 50% x 275 million km x (0.075-0.02)l/km = **18 million litres of fuel saved per year.**

Taking into account the fuel mix, there are 2.45 kg CO_2 emitted per one litre of fuel, this equals **44,000 tons of CO_2 saved per year**.

However for the calculation we also have to consider the phenomenon of induced traffic. If, as a result of implementing the ISEMOA QMS, barriers will be removed and public space and public transport will be accessible for PRM, it has to be assumed that the mobility behaviour of today's PRM will also impact positively on the mobility behaviour of non-PRM. Therefore it is assumed that the distance of trips will extend from 6.65 km to 9.2 km and the number of trips will escalate from 2.76 trips to 2.87 trips per person. This has to be taken into account in the calculation of energy savings. At first sight this calculation of additional public transport km by PRM might look underestimated as probably the longer trips (of average 9.2 km) will be undertaken by public transport, whereas on foot and by bicycle shorter trips will be done. On the other hand it is probably also more than on average 6.65 car km that will be replaced. Unfortunately there is no data available about driven km by different transport modes by PRM (but only average numbers for all modes).

2 million PRM x (2.87-2.76) trips x (9.2-6.65) km per trip x 0.5 (shift to public transport) x 365 days per year = 102 million km travelled more by PRM per year due to full accessibility.

102 million km x 0.02 l fuel consumption per km = 2 million litres of fuel

2 million litres of fuel x 2.45 kg CO_2 emissions per litre = 5,000 tons of CO_2 emissions per year

The achieved CO_2 savings of 44,000 tons per year have to be downsized by 5,000 tons which leads to real savings of 39,000 tons of CO_2 every year.

It is assumed that the total impacts of ISEMOA will not be fully achieved by the end of the project. The improvement of accessibility will take some time and thus the energy saving impacts will continuously increase from 10% of the potential annual savings in the first year after the end of the project (2014) and achieve 100% of potential savings 10 years after the end of the project.

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[3] According to TRANSPORT LEARNING 2011

The accumulated real savings of CO_2 by 2020 will amount to 106,000 tons and 10 years after implementing the ISEMOA QMS 835,000 tons of CO_2 will be saved in total.

These figures show impressively that – apart from all the social (and economic) advantages the ISEMOA project brings to PRM and cities/regions/municipalities – additionally significant energy savings in transport will be reached. This way we achieve a very positive win-win-situation.

8 CONCLUDING REMARKS

The aim of the report was to contribute to a better understanding of the transport-energy-related and environmental benefits resulting from improved accessibility of the whole mobility-chain in public transport and public space. An intensified use of public transport in place of using private cars will reduce CO_2 emissions significantly. This report is also intended to form the basis for developing a guidance paper for decision makers and politicians on the correlation of accessibility and energy-efficiency in transport. Based on this paper there a concise brochure about transport-energy-related benefits of improving the accessibility of public transport and public space will be produced.

Many figures about the mobility behaviour of PRM and non-PRM were sourced, edited and analysed. Where ever possible, figures for PRM were compared with those of non-PRM. The main problem was finding information about the mobility behaviour of people with reduced mobility; finding data for a direct comparison between PRM and non-PRM was almost impossible. Consequently one matter for future research is to query and record mobility data especially for (consistently defined) PRM (groups). It should be stressed once again: the data provided is generally not comparable due to different sources and therefore different definitions of PRM groups.

To summarise it can be stated that in the test sites of ISEMOA or in the countries in which they are located, 35% of the whole population are people with reduced mobility. PRM undertake approximately 2.76 trips per day with an average distance of 6.65 kilometres. Most of these trips were made by private car (41%) and just 27% of all trips were made by public transport. Car use is even higher in more rural areas where the public transport network is often sparse.

For PRM car use seems to be advantageous. Car use is easy, flexible and convenient and has the advantage of door-to-door-transport. While using the car there is no need to wait at stops and no need to walk long distances. To persuade PRM to use public transport, the following expectations have to be met: accessibility, celerity, comfort, proximity, connection and safe (de-)boarding. From knowing this, it can also be derived what has to be done to convince more PRM of using public transport instead of their own car. ISEMOA seeks to improve accessibility of public space and public transport as a prerequisite for shifting car journeys to more sustainable modes (especially of PRM).

A fully accessible travel chain means freedom and more independence for PRM. They will use it and travel more than they did before or even start travelling at all which means a greater volume of traffic and perhaps longer distances travelled. But the rebound effects that occur will lower this effect, e.g. new proximity/nearness of basic destinations. On the other hand walking and cycling does not emit any CO_2 and is thus environmentally friendly and even beneficial to PRM's health. Travelling by public transport can result in some CO_2-emissions but far less than using motorised individual transport. At the end there is, even from the environmental point of view, still a positive effect.

In the course of this report a model calculation has illustrated the amount of savings achievable as a result of the ISEMOA process. As stated above, after removing barriers and therefore increased use of public space (walking and cycling) and public transport, there will be almost 275 million km car trips less than today. This way (including rebound effects and induced travel) about 16 million litres of fuel can be saved which equals approximately 39,000 tons of CO_2 saved per year. It is assumed that the full energy saving effects will not be achieved immediately. However, the accumulated savings will amount up to 106,000 tons of CO_2 by 2020. And there is still more potential for energy savings resulting from ISEMOA as this calculation only takes into account ISEMOA test sites and it is expected that in the future the ISEMOA QMS will be implemented in many additional European cities, regions and municipalities. Furthermore, there are positive rebound effects for the population as a whole that will lead to shorter trips with more environmentally friendly transport modes that are not included in the calculation.

9 LIST OF FIGURES

10 LIST OF TABLES

11 REFERENCES

ARNDT 2004

Arndt, W.-H. (2004): Barrierefreie Mobilität, in: Technische Universität Berlin (2004): Barrierefreies Planen und Bauen als interdisziplinäres Handlungsfeld. Symposium. ISSN 1613-5059, Heft 1. Berlin

AVV 2005

Methorst, R., AVV Transport Research Centre (2005): The future of everyday walking. Paper for Walk21 Conference (21.-24.09.2005, Zurich, Switzerland), in: http://www.walkeurope.org/uploads/File/background/The_future_of_everyday_walking.pdf (21.10.2011)

BESTRANS 2004

Bestrans (2004): Bestrans – Benchmarking of Energy and Emission Performance in Urban Public Transport Operations. Final Report. Project funded by the European Commission under the SAVE programme. In: http://www.tis.pt/proj/bestrans/LatestNews/BESTRANS%20Final%20Report.pdf (20.09.2011)

BMVBS 2010

Bundesministerium für Verkehr, Bau und Stadtentwicklung (BMVBS) (ed.) (2010): ÖPNV: Planung für ältere Menschen. Ein Leitfaden für die Praxis. BMVBS-Online-Publikation 09/2010. ISSN 1869-9324. In: http://www.bbsr.bund.de/cln_032/nn_629248/BBSR/DE/Veroeffentlichungen/BMVBS/Online/2010/ON092010.html (20.09.2011)

BOOZ ALLEN HAMILTON 2003

Booz Allen Hamilton supported by Taylor Lightfoot Transport Consultants and The TAS Partnership Ltd (2003): Study on accessible public transport. Final report.

BURMEISTER 2007

Hochschule Neubrandenburg, ISAB - Institut, Köln: Burmeister, J. (2007): Radverkehrsmobilität von Senioren/innen in ländlichen Räumen. In: http://www.nationaler-radverkehrsplan.de/eu-bund-laender/bund/index.phtml#senioren (13.10.2011)

CIVITAS 2010

CIVITAS ELAN Ljubljana (2010): Assessment of user, stakeholder and provider needs. Ljubljana. (provided by ISEMOA partner UIRS)

DPTAC 2001

Disabled Persons Transport Advisory Committee (DPTAC) (2001): Attitudes of Disabled People to Public Tranport. Research Study Conducted for Disabled Persons Transport Advisory Committee. In: http://dptac.independent.gov.uk/pubs/research/apt/pdf/apt.pdf (25.10.2011)

EDF (2011)

European Disability Forum (2011): Facts and figures about disability, in: http://www.edf-feph.org/Page_Generale.asp?DocID=12534 (28.10.2011)

HERRY 2007

Herry Consult GmbH (2007): Verkehr in Zahlen. Ausgabe 2007. On behalf of the German Federal Ministry of Transport, Innovation and Technology. In: http://www.bmvit.gv.at/verkehr/gesamtverkehr/statistik/downloads/viz07gesamt.pdf (11.11.2011)

HERRY 2008

Herry Consult GmbH (2008): ways2go – Zukünftige Mobilitätsbedürfnisse – Grundlagenaufbereitung. Endbericht. On behalf of the German Federal Ministry of Transport, Innovation and Technology

INFAS 2009

Institut für angewandte Sozialwissenschaft GmbH (infas), Follmer, R. (2009): Potenziale für eine ökologischere Mobilität – Verhalten und Ansprüche der wichtigsten Zielgruppen. Dena-Jahreskongress 23. und 24. Juni. In: http://www.mobilitaet-in-deutschland.de/pdf/Follmer_dena%20Jahreskongress_2009.pdf (20.09.2011)

MiD 2010

Institut für angewandte Sozialwissenschaft GmbH (Infas), Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) (2010): Mobilität in Deutschland 2008. Ergebnisbericht. Struktur – Aufkommen – Emissionen – Trends. Bonn und Berlin, PN 3849. In: http://www.mobilitaet-in-deutschland.de/pdf/MiD2008_Abschlussbericht_I.pdf (13.10.2011)

OECD 2001

OECD (2001): Ageing and transport. Mobility needs and safety issues. In: http://www.ocs.polito.it/biblioteca/mobilita/OECDAgeing.pdf (21.10.2011)

PNZ 2003

PNZ (2003): Household survey: Travel habit survey of Ljubljana Urban Region. [Anketa po gospodinjstvih: Raziskava potovalnih navad prebivalcev Ljubljanske regije]. Financed by City of Ljubljana, Department for Spatial Planning. PNZ, Ninamedia, Urbi. Ljubljana.

SOCIALDATA 2011

Socialdata (2011): Mobility in urban areas. In:

http://www.socialdata.de/daten/staedtepegel.php?lang=en (04.11.2011)

SRV 2008

Mobilität in Städten (2008): http://tu-dresden.de/die_tu_dresden/fakultaeten/vkw/ivs/srv/index_html/document_view?set_language=en, data provided by Dr.-Ing. Frank Ließke (05.11.2011)

TRANSPORT LEARNING 2011

Transport Learning (2011): Set of updated IEE Common Performance indicators including their baseline and assumptions for extrapolations. Deliverable D9.1. http://www.transportlearning.net (to be available on website very soon)

TRANSPORT RESEARCH CENTRE 2003

Transport Research Centre (2003): Life quality of senior citizens in relation to mobility conditions. State-of-the-art report. SIZE Deliverable D3. Public paper from WP2, in: http://www.size-project.at/results/Deliverable3-StateofArt.pdf (27.10.2011)

VICTORIA TRANSPORT POLICY INSTITUTE 2010

Victoria Transport Policy Institute (2010): TDM Encyclopedia. Transportation Statistics. In: http://www.vtpi.org/tdm/tdm80.htm (15.09.2011)