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MASTER'S THESIS

Sustainable Urban Mobility Plans

A Comparison of the Implementation in Spain and Sweden

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Preface

This report is the result of a master thesis realised to complete a master's degree in traffic engineering in the MSc Programmes of Environmental Engineering and Design at Luleå University of Technology. The study was done in autumn 2005 in collaboration with the Transport Research Centre TRANSyT at the Madrid University of Technology. Supervisor and examiner has been Glenn Berggård at the Division of Architecture and Infrastructure, Department of Civil and Environmental Engineering at LTU.

The report is a literature study about sustainable urban mobility plans in Europe in general and in Spain and Sweden in particular. A comparison between the two countries has been made with the aim to find out if a common European mobility plan would be possible to implement. I hope that the present and future work being realised in Europe within sustainable urban transport plans will lead to a better traffic situation in the cities and a healthier environment for its citizens.

I would like to thank everybody at TRANSyT for giving me the opportunity to realise my master thesis there. Especial thanks to Prof. Andrés Monzón, Esther Madrigal and Ana María Pardeiro for their help and support during my stay.

Madrid in February 2006

Caroline Mattsson

Abstract

The European Union Commission is preparing to put forward a proposal for every city or municipality in the Union larger than 100.000 inhabitants to prepare and implement a sustainable urban transport plan, also called a mobility plan, in order to improve the traffic situation in the cities. A sustainable mobility plan is an integrated plan considering all modes of transport planned towards a sustainable urban development. The measures implemented are a mixture of physical changes and information with the aim to reach a better traffic environment with reduced traffic volumes and emissions, increased accessibility and safety; and an increased quality of life for all citizens. The physical changes can be compared to traditional traffic planning while the information part goes under the name Mobility Management and includes among other things change of travel habits.

In some European countries implementation of transport plans have already been done. This is the case in the United Kingdom where Local Transport Plans, LTP are done for all regions; France which has their Urban Mobility Master Plans, PDU, Holland and Italy. In Spain there is no tradition of creating integrated mobility plans though at present they are developing a guide for cities larger than 100.000 inhabitants according to the EU proposal. Sweden is known as a precursor country of how to reach a sustainable environment but in this case there is no all embracing plan for transports. Some cities have started working with mobility management lately.

A comparative study has been done between Spain and Sweden considering their present traffic situation and what would be necessary to change to reach demands of reduced emissions and increased accessibility. The thesis ends with a discussion of whether it would be possible to implement a common sustainable urban mobility plan in all European countries and if it would have any exit.

Sammanfattning

Europeiska Unionens Kommission håller på att förbereda en förslag om att alla städer och kommuner inom unionen med fler än 100.000 ivånare ska förbereda och genomföra en uthållig urban transportplan, även kallad mobilitetsplan, med syftet att förbättra trafiksituationen i städerna. En uthållig mobilitetsplan är en plan som tar hänsyn till alla slags transportslag i planeringen för en uthållig utveckling. Åtgärderna som tillämpas är en blandning av fysiska förändringar i stadsmiljön och information med syftet att nå en bättre trafikmiljö med minskade trafikvolymer och utsläpp, ökad tillgänglighet och säkerhet samt ökad livskvalitet för alla invånare. De fysiska förändringarna kan bli jämförda med traditionell trafikplanering medan imformationsdelen går under namnet Mobility Management och bland annat innehåller förändrade resvanor.

Vissa europeiska länder har redan implementerat transportplaner. Så är fallet i Storbritannien och Nordirland där Local Transport Plans, LTP görs för alla regioner; Frankrike som har sina Master Plans för urban mobilitet, PDU, Holland och Italien. I Spanien finns det ingen tradition att använda sig av integrerade mobilitetsplaner, men för närvarande håller en guide på att utvecklas för städer med fler än 100.000 invånare liknande EU:s förslag. Sverige är känt som föregångsland när det handlar om att planera för en uthållig framtid, men i det här fallet finns det ingen övergripande plan för transporter. Några städer har på senare tid börjat arbeta aktivt med mobility management.

En jämförande studie har gjorts mellan Spanien och Sverige med hänsyn till nuvarande trafiksituation och vad som skulle behöva ändras för att uppnå krav på minskade utsläpp och ökad framkomlighet. Examensarbetet avslutas med en diskussion som handlar om ifall det skulle vara möjligt att implementera en gemensam uthållig urban mobilitetsplan i alla europeiska städer på ett lyckosamt sätt.

Wordlist

4-step principle	When increased capacity for a road is needed the following 4 steps should be followed: 1. Measures affecting the demand of transport and way of travel 2. Measures using the road system more effective. 3. Limited improvements of the road. 4. New investments and larger constructions. (Mårtensson, 2004)
Bike&Ride	Bicycle parks in connection with a public transport stop or interchanger.
Boverket	National Board of Housing, Building and Planning
Carpooling	Two or more persons travelling in the same vehicle and where one of them is the owner of the vehicle.
Car sharing	A transport system based on a fleet of vehicles shared by members where no one is the owner of the vehicles and you only pay for the time using it.
CO_2	Carbon dioxide. Formed by combustion of fossil fuels. The principal responsible for the climate change.
CO_2-equivalents	All gases contributing to the greenhouse effect have different effect. To simplify graphs etc these gases are converted into the effect CO_2 would have. Principal gases are nitrous oxide, N_2O and methane, CH_4.
GDP	Gross Domestic Product
Green transports	vehicles driven by renewable fuels emitting less air contamination.
HOV	High Occupancy Vehicle, lanes often permitted only for public transport, taxis and/or private vehicles with 3 persons or more.
IDAE	Instituto para la Diversificación y Ahorro de la Energía
Intermodality	A mixture where all modes of transport are used at the same extent and have the same importance.
ITS-service	Intelligent Transport Systems
Kyoto-protocol	An amendment to the United Nations Framework Convention on Climate Change (UNFCCC) from 1998 where countries ratifying the document commit to reduce their emissions of greenhouse gases.
LAURE	Loi sur l'Air et l'Utilisation Rationnelle de l'Energie
LOTI	Loi d'Orientation des Transports Intérieurs
LTP	Local Transport Plans
MKB	Miljökonsekvensbeskrivning, Environmental Quality Standards
Modal distribution	The modes of transport calculated as percentage.
Mode of transport	Are often divided into motorized and non-motorized modes of transport. Motorized include the private vehicle, urban and interurban bus, tram, underground, trains, etc. non-motorized modes include walking by foot and bicycle.
Motorization index	Number of vehicles per 1000 inhabitants.
Naturvårdsverket	National Environment Protection Board
NMVOC	Non Methane Volatile Organic Compounds. A large number of hydrocarbon compounds in gas form. Some of these compounds can be dangerous for people's health. Formed by incomplete combustion. Methane usually isn't included in the group despite being a hydrocarbon.
Non-renewable fuels	Fuels from resources that can't be reproduced e.g. fossil fuels
NO_x	Nitrogen oxides. Formed by combustion of fossil fuels. Contribute to the formation of particles and can affect the public health negatively.
O_3	Ozone. O_3 on the ground is formed by NO_x and VOC and can affect the respiratory organs negatively
Park&Pool	Car park in connection with a public transport stop or interchanger exclusively for car pool vehicles.
Park&Ride	Car parks in connection with a public transport stop or interchanger.
PDU	Plains de Déplacements Urbains
PM_{10}	Particles smaller than 10 µm. Formed by combustion and wear to tyres. Small particles cause increased mortality and unhealthy.
PMUS	Plan de Movilidad Urbana Sostenible
Road pricing	A range of economical measures with the aim to restrain car traffic
SO_2	Sulphur dioxide. Formed by combustion of fossil fuels with rich content of sulphur. SO_2 is the main responsible for "acid rain".
SRU	Loi relative à la Solidarité et au Renouvellement Urbain
Vägverket	the Swedish National Road Administration
ÅP	Åtgärdsprogram, Measure programme

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1 Introduction

1.1 Background

The European Union Commission has stated in a communication 2004, “Towards a Thematic Strategy on the Urban Environment”, a strategy in which they hope to reinforce the contribution of environmental policy to the sustainable development of urban areas, particularly by four themes: sustainable urban management, sustainable urban transport, sustainable construction and sustainable urban design. With this communication the Commission initiate a consultation between parties interested, in order to identify the best measures to help European cities towards a more sustainable future and a healthier and more attractive place to live in. (EU Commission, 2004)
A definition of sustainability was established by the World Commission on Environment and Development in the Bruntland Report in 1987 and reads as follows:

> *“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”*

(UNESCO, 2003)

In April 2001 the EU council adopted the following definition for a sustainable transport system:

- allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations;

- is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy, as well as balanced regional development;

- limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and, uses non-renewable resources at or below the rates of development of renewable substitutes while minimising the impact on the use of land and the generation of noise.

Since all European cities face similar environmental problems, the strategy is a way of creating a framework on European level where local initiatives and decisions are encouraged. The focus is put on the urban environment but also taking into account economical and social issues.

Urban transport systems ensure that people have access to goods, services, employment and recreation opportunities, that freight circulate efficiently and they enable local economies to flourish. However, urban traffic has a significant impact on the environment, the health and the quality of life of the inhabitants. It's one of the main contributors to CO_2-emissions and other pollutants as ozone, NO_x and particles. The facility of using transports is contributing to a more sedentary life-style with a range of negative effects on health. Other important factors are noise and the rate of accidents related to urban traffic. Traffic is perceived as one of the key factors affecting the

quality of life negatively. The energy consumption increases with increased traffic as well as the costs for congestion. Many Europeans also suffer from social exclusion when they can't afford a private vehicle.

The 2001 White Paper on European Transport Policy launched by the EU Commission 2001 states that the European traffic has entered a phase where the transport systems have to be clean, well functioning and less fossil fuel based. This is considered indispensable for achieving the Community's overall objective of sustainable mobility. The need to reduce the consumption of energy in the transport sector is highlighted in the Commission's Green Paper on the Security of Energy Supply. One of the targets is to substitute 20 % of the diesel and gasoline fuels to alternatives by the year 2020. The European Union is also working for road user charges to be facilitated by a Directive on electronic charging systems. It is preparing a Directive on the promotion of energy efficient and clean vehicles and demonstration projects on alternative road transport fuels. A series of Directives are setting emission limits for different kinds of vehicles and standards for fuel quality, noise emission limits air quality standards and roadworthiness testing. (EU Commission, 2004)

Broadly speaking, the development of road transport in the EU15 can be summarised by a few figures:

- the global distance travelled by all road vehicles has tripled over the last three decades
- the number of private cars has increased from 232 per thousand persons in 1975 to 469 in the year 2000
- the volume of road freight haulage have grown by 34% between 1991 and 2000
- road freight haulage made up about 75% of the total freight traffic within the European Union in 2000 compared to 50% in 1970
- the road traffic causes some 40.000 fatalities a year (half the figure of 1970) and more than 1,7 million injured.

(EU Commission (1), 2005)

Despite recent improvements regarding transports in areas of management, planning and technology, the predicted increase of vehicles will take the edge of it. The Community therefore envision that all capitals and cities with more than 100.000 inhabitants each prepare, develop and implement a sustainable urban transport plan with short-, medium- and long-term targets. Such plans would help the 500 largest towns in the EU25 to meet the requirements of the EU Directives and the targets of the Kyoto-protocol. The plans would be particularly important for the Acceding Countries to maintain their existing levels of use of more efficient transports. (EU Commission, 2004)

1.2 Objectives

The objectives are to see if it is possible to compare two countries like Sweden and Spain considering present and future traffic. Would it be possible to use similar models when planning and would a similar implementation lead to the same results? Examples of transport plans from other countries are brought up and the impacts they have had, could any of these plans be used in Sweden or Spain? Which measures and ways of implementation have given best results? A last question is if it would be possible to agree on one plan in the EU as the Commission suggests and does the integrated urban plan have any future?

1.3 Delimitations

The project is just dealing with mobility and transport plans for cities, towns and regions. Companies are not considered even if they are mentioned in some places. It is also important to remember that traffic planning is the key area and not urban planning. However the two areas are so close connected that they interfere in each other. No detailed studies have been made for freight transport, but since they are an important share of road traffic, they haven't been excluded completely either. Passenger transport is however most prominent.

1.4 Disposition

In the second chapter the sustainable mobility plans are described, how they have been developed and which aim they have. Further the connection with mobility management is explained and the difference between traditional and new traffic planning. Some examples of mobility plans in Europe and European projects close this chapter.
Chapter 3 and 4 are dedicated to Spain and Sweden respectively. A brief introduction of the country and present legislation is followed by the development and present traffic situation. The chapters end with an overview of some traffic plans in each country. In the Spanish chapter the Spanish sustainable urban mobility plan under development is explained.
Chapter 5 consists of a comparison between the countries starting with future visions and goals fulfilling and continuing with a comparison divided into some headlines.
In chapter 6 a cross table summarize the European plans followed by three cases of made up cities and what measures that would be effective in each of them.
The conclusions and discussion can be found in chapter 7 followed by a wordlist, the bibliography and the appendices.

2 Sustainable Mobility Plans

2.1 What is a Sustainable Mobility Plan

A mobility plan is a way to reach a more energetically efficient and less pollutant transport system by implementing integrated measures. The aim is to promote the use of different modes of transport trying to avoid the increase of traffic in urban areas. Principal characteristics of the plans are

- that they act on a local or metropolitan level
- they guarantee the accessibility and necessities of municipal mobility
- they cover all modes of transports, personal as well as freights
- they are connected to strategic national and regional plans
- they should reduce negative impacts from transports
- they try to resolve increasing volumes of traffic and congestion
- they intend to change the modal distribution in favour of the cleanest and most efficient ones

(IDAE, 2006)

The measures implemented are a mixture between physical changes and information campaigns. Physical changes include e.g. construction of new bikeways and roundabouts or changing a bus route to make it more efficient. The information campaigns go under the name Mobility Management, explained later on in this chapter.

The area of matter in a mobility plan is larger than in an ordinary traffic plan. It affects all the mobility within all its aspects and one of the main aims is to make the citizens conscious about the necessity of a more rational use of the transport system. The cooperation with the citizens is essential in order to make the plan work and obtain the effects wanted. Sustainability is the new important term adding an extra dimension to the plans.

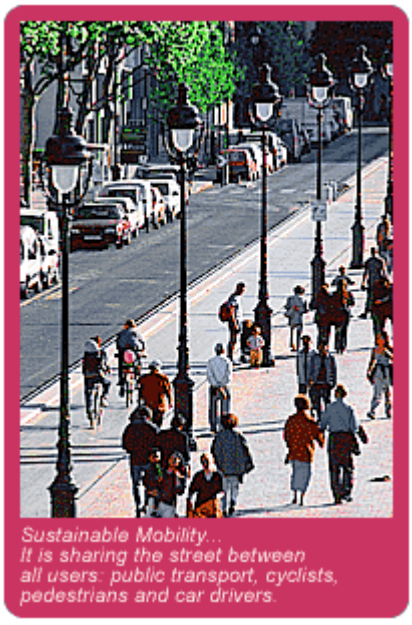

Figure 1: Interaction between different traffic modes. Source: SMILE, 2005

For all municipalities with a sustainable urban mobility plan implemented the following profits are likely to occur:

- Decrease of traffic jams and congestion followed by a diminution of noise, atmospheric contamination, contribution to the greenhouse effect and accidents.
- Lower energy consumption.
- Reduction of travel time.
- Improvement of the public transport services.
- More public spaces available.
- A general improvement of accessibility, included for disabled.
- Reduction of external costs.
- Increased health among the inhabitants because of less contamination and increased use of bicycle and walking.

- Increased quality of the urban environment and quality of life among the citizens.

(IDAE, 2006)

The negative effects of the transport system should be eliminated or at least reduced at the same time as the economical growth, the liberty to move and the quality of life are maintained. The plan should guarantee the accessibility and needs of the transports, all plans being different depending on the conditions of each community. The measures should all be implemented under survey and after extended studies in order to be able to follow-up and evaluate their efficiency.

2.2 Mobility Management

Mobility Management is a new demand-oriented concept to promote sustainable transport solutions. The purpose is not only to improve the environment, it is also a way to make sure that access to all destinations can be guaranteed in a sustainable way. Mobility Management is a way to support and encourage a change of attitude and behaviour towards sustainable modes of transport and to create attractive alternatives to individual car use and thus increase the number of travels with transport modes such as walking, cycling, public transport and carpooling. The aim is to improve the quality of life of citizens and to provide sustainable access to all destinations. (EPOMM (2), 2005-10-31)

Mobility Management can be derived from Transport Demand Management, TDM, which was developed in USA during the petroleum crisis 1973. Since most movements was/are made with vehicles driven by fossil fuels the country will be vulnerable during petroleum crisis. The Americans realised lot of measures and activities during these crisis', with car sharing as the most successful. During the following years congestion and environmental problems grew, making the TDMs' useful for these matters too. The TDM-plans were born. (Bäckmark et al, 2004)

The core of Mobility Management is "soft" measures (e.g. information or coordination of existing user services), which enhance the effectiveness of "hard" measures of traffic planning (e.g. new tram lines, new roads and new bike tracks). (EPOMM (1), 2005-10-31) The purpose is to influence the trip or transport before it has started. One of the main thoughts is cooperation between different entities in the community. For a Mobility Management project to be successful at least three parts have to be involved – traffic, environment and information.

Mobility Management can be used at many different levels, e.g. for special events, in residential areas, in companies, in municipalities or in regions. In all cases the objective is to change the demand on trips and make profits on the environment, safety and economy. Many of the measures used are not new, what's new is the way of thinking by combining them into a system that co-works and can benefit from each other. The measures in Mobility Management are not supposed to be used by their own, but combined with traditional traffic planning. Much of the work is done in collaboration with the business world and different organizations.

Examples of what kind of measures that can be carried out:

- Counselling and consultancy
- Information and education

- Marketing of the Mobility Management way of thinking
- Support measures
- Develop new or better services or products for Mobility Management
- Effective organization and cooperation of activities
- Better situation of activities
- Research and studies
- Create easy bus and train information
- Eco adapt transports
- "Bicycle-to-work"-campaign
- "Try-it"-periods with bicycle or public transports
- Replace reunions in person with telephone or video conferences
- Initiatives to car sharing and carpools
- Coordinated home delivery of goods
- Distance working from home or from special IT-centres nearby home
- Support of local trading and local producers
- Use bicycle or public transport instead of car
- Use train instead of aeroplane

(MM, 2005-10-31)

In general, mobility plans have been used more by companies as a combination between a transport plan and environmental management. In traditional environmental management transports are often excluded since it is considered a relatively intangible problem. With the new combination the transports can be developed and profits be made in this sector too. (Bäckmark et al, 2004)

For the coordination of the measures, mobility offices and centres are established.
A Mobility Centre is the operating unit at the urban/regional level, where mobility services are initiated, organised and provided. The two basics for a mobility centre are a multi-modal approach in the provision of services and individual access for the public via personal visits, phone and fax calls, e-mail, information terminals or online services.
A Mobility Centre concentrates all services serving as a place for communication and exchange. Its presence can give Mobility Management a public face and thus, promote its presence in the transport marketplace. The objective of the Mobility centre is to provide its clients with information as detailed as possible about anything related to transports.

A Mobility Office differs from a Mobility Centre in the way that the services are not offered to the general public, but specific for e.g. a company. It can vary from being a help desk only reached by phone, to a 'drop-in' centre with its own room. The services might be somewhat reduced or specially directed towards a certain area. To be able to offer broader information it is recommendable that the Mobility Office is connected to a Mobility Centre. The Office can also be responsible for the set up and implementation of a Mobility Plan. (EPOMM (1), 2005-10-31)

The first Mobility Centres' in Europe started in Germany, Austria, Italy and Belgium in the middle of the 90s', thus the phenomenon is relatively young. Generally the principal information in these centres concerns public transport. But they also organise activities such as bicycle renting, tourist information, parking information, foundation of carpools and initiation of campaigns. In order to get a mobility centre to work effectively a

landmark is that it should have at least 100.000 inhabitants. If the city is smaller it is advised to form a regional mobility centre together with nearby communities.
The Mobility Centres/Offices in Sweden have had quite a different direction of information. Instead of concentrating on information on public transport, the focus has been on project-based measures even if direct guidance also exists. Some examples are campaigns to walk or go by bicycle to school or to work, foundation of carpools, campaigns to change travel behaviour and habits and so on. (Wendle et al, 2003)

2.3 Examples of Mobility Plans in Europe

Many European countries, (Finland, Italy, UK, the Netherlands and France) have lately started the implementation of sustainable urban transport plans. The plans have the objective to cover the whole urban area and be closely connected to regional and national plans and strategies. They also cover all kinds of transports with the aim of changing the modal split towards more efficient transports such as public transport, cycling and walking. One of the basic objectives is to create a transport system that serves all of the town's citizens and make them understand that the key role to make the system work is their everyday choice of transport. The link to environmental management is essential.

2.3.1 France – Grenoble

In France Urban Mobility Master Plans, (Plains de Déplacements Urbains, PDU), were created in 1982, originating from the law of internal transport, LOTI, and the law of air quality and rational use of energy, LAURE. According to French legislation it is mandatory to implement PDUs in areas with more than 100.000 inhabitants. The responsibility is on municipal level. First an overall PDU is created for the entire area or city and then the PDU is decomposed into different levels. The local PDU has to agree with the local and regional plans and directives already introduced. (Lundgren, 2004) In 2000 the SRU, law of new urban areas, was created to oblige the PDUs to include road safety and to ensure that they are compatible with the planning and the use of soil. (IDAE, 2006)

Grenoble is one of the first urban areas that have developed a PDU, the present one origin from 2000. The region consists of 26 municipalities over 30.707 hectares and 396.792 inhabitants (1999).
The objectives are set to 2010, with base year 2000, and have the following goals to meet:

- A decrease of the car traffic from 54 % to 48 %.
- An increase of the public transport from 14 % to 17 %.
- An increase of the use of bicycle from 5 % to 8 %.
- A consolidation of trips by foot of 27 %.
- Reduce the emissions of particle in suspension, NO_x, CO and VOC 50 %
- Reduce the number of people exposed to levels higher than the average annual by 50 % of atmospheric contamination.

Figure 2: Tram in Grenoble. Source: (IDAE, 2006)

Although Grenoble has a relatively complete public transport system, there are projects planned to increase the offer and accessibility of the present network. Among other things a new route for trams will be constructed as well as new routes for a metropolitan bus network. Interchangers will be restored and the network for bus and trolleybus will be restructured.
Prioritised measures in the PDU are to:

- make the city more accessible with the projects mentioned above.
- increase the security on bikeways and pedestrian streets, create parking lots for bicycles and make the traffic situation more adequate in 30-zones.
- clear the inner city from congestions through surrounding roads and a new tunnel.
- create car parks on the outskirts of the urban area
- the information on bus and train stations will make it easier to change modes of transports and one tariff will be used for the whole area.

The financing of the plan is set to 7.708 millions franc (€ 1.175 millions), the majority invested in public transport and measures for vehicles and parking lots. A small part will be used for "soft" measures and the creation of a mobility observatory.
A committee consisting of the city councils in the area and authorities concerned has been created in order to evaluate the PDU and the different projects and to analyse the results of the observatory and its impacts of the environment. The evaluation consists of three stages; a mobility survey 2000, an evaluation plan of the objectives, actions and measures and an analysis of the mobility policies. (IDAE, 2006)

2.3.2 United Kingdom – Leeds/West Yorkshire

Since 1994 Great Britain has had common guidelines for planning of traffic facilities and settlements through the Planning Policy Guideline 13. In 2001 the guidelines were tightened up even more in the English part, now with demands that all larger establishments, such as workplaces, offices, commerce and leisure complexes, shall be available to public transports, bicycles and pedestrians. In Great Britain there are rules, not legislation, regulating how to construct buildings considering the availability and range of different modes of transports. (Lundgren, 2004)

West Yorkshire is situated in the northwest of England. It has a population of 2,1 million inhabitants in a total area of 2.000 km^2. A large part of the population resides in rural areas. The region consists of the districts Leeds, Kirklees, Calderdale, Wakefield and Bradford. Around 42 % of the jobs are to be found in Leeds, the economical centre of the region. Congestion in the transport system in cities like Leeds is a threat to the economy and environment that has to be solved. The fast growth of the population makes the problem even more urgent. During the last years the average commuting

distance has increased as well as the average household car ownership, in 2001 reaching 0,98 vehicles per household.
Trips within the districts form the major flows with over 70 % living and working in the same district. The main mode for trips to work is by private vehicle (70 %) with bus users being next most important. Rail use for local trips is relatively low.
Local Travel Plans, LTP, have been used to develop transport strategies since 2001. The Local Transport Authorities, LTA, are in charge of preparing and evaluating this five-year plan, producing an annual evaluation report each year. The first plan, LTP1, was in effect 2001-2005, the second one, LTP2, last from 2006-2011.

Some objectives from the LTP1 are, divided in sectors:

- Economical – providing a competitive sustainable economical growth and improve operational efficiency between transport systems
- Social – improving safety, security and health
- Environmental – reducing impacts of transports on air quality and noise and the contribution of greenhouse gas emissions
- Subsidiary objectives – reducing absolute traffic levels, encouraging a greater proportion of journeys to be made by alternative modes to the private car, improving integration between transport modes

The objectives have been transformed into indicators, which in turn have been assigned measures in order to reach the objectives.

Figure 3: Guided bus in Leeds. Source: IDAE, 2006

Some of the measures realised during the first plan are lanes for High Occupancy Vehicles, HOV, improvement of bus and train stations, establishment of Park&Ride's, bicycle lanes, bus priority signals, residential 30-zones and pedestrian zones. In two corridors guided bus lane systems have been introduced, also allowing the use of bicycle. A lot of investment has been made in change of behaviour initiatives such as commuter travel plans and school travel plans, together with the Yellow Bus Initiative (a school bus similar to the one in USA).
The plan is financed by local taxes and from the central government. Every year has a different budget, e.g. in 2002-2003 it was 94,6 million pounds.

The overall objective of the new plan, LTP2 is:

> *"To develop and maintain an integrated transport system that supports economic growth in a safe and sustainable way and enhances the overall quality of life for the people of West Yorkshire."*

Some new objectives are added, but in general the plans are similar. One problem in the first plan has been that very few indicators have had a standardised measurement methodology, making it difficult to clearly differentiate good performance from

selective measurement. Also the financial rewards for authorities reaching their goals have been increased.
The LTP process can be viewed as a success. It has certainly provided stability in planning, staffing and skills development absent under the previous annual system of bid submissions. (Marsden, 2005)

2.3.3 Holland – Apeldoorn

Apeldoorn is a city in the eastern part of the Netherlands in the province of Gelderland. The population counts to 156.000 inhabitants and in general every inhabitant owns 0,5 cars (2004). Traffic problems in the area are created in the city centre on market days and Saturdays during the shopping hours. New residential areas that are built on the edges of the city are also creating a quick growth of traffic. (de Bruin, 2005)

Nota Ruimte (spatial development) and Nota Mobiliteit (mobility) are the legal frames that set the lines at national scale. According to these two frames all cities are obligated to make a transport plan with targets for 2010. The plans are approved by the town council. However the character and effects tend to vary depending on the political situation in each municipality. (de Bruin, 2005) Another national environmental law (Wet Milieubeheer) can force companies and activities to introduce and evaluate transport plans. The national environmental legislation is actually being retouched to be easier incorporated to the European Union demands. (Lundgren, 2004)

Apeldoorn has been trying to regulate traffic in a sustainable way for more than 10 years. Its overall strategy is to create a place where individuals, households and companies can develop themselves without negative consequences for other regions or future generations.
A total of 120 millions of Euros will be spent on the plan until the year of finish, 2010.
The overall goals for the traffic and transport plan are to optimise the living quality, mobility and safety in the city. Some goals more in detail are:

- A traffic structure that contributes to the spatial quality
- Stimulation of bicycle-use
- Raising the quality of the public transport system, including cost-effectiveness
- Concentration of car traffic to ring-structure and principal streets
- A logical and recognizable road structure
- No car traffic in the inner city
- Integrated mobility plans for industrial and office areas, schools and hospitals

Many aspects are to be combined in the implementation of the traffic and transport plan. To increase the quality for bicycles a number of radial axes will be increased, where bicycles have priority in intersections. The pathways have been improved with better asphalt and illumination. Some areas in the city centre have been prohibited for traffic, with the only exception of goods transports that are allowed to enter at special assigned hours.
A successful experiment that has been carried out is reduced prices on public transport for car drivers who park their cars on the outskirts of the town and then transfer into the city. Available parking lots are shown on signs on the entrance roads to the city. A popular concept in the Netherlands is the Sustainable Safety, which includes the categorization of all streets into three speed levels. Within residential areas maximum speed is 30 km/h, roads going out from the area to the ring structure are regulated to 50

km/h and outside the population centres the speed limits rise from 70 km/h to 120 km/h. (de Bruin, 2005)

2.3.4 Austria – Graz

Graz is situated in the south of Austria in the province of Styria. The population is 240.000 inhabitants, making it the second largest city in Austria. The main problem of the city is the rise of cars due to a tendency of the people moving from the city centre to the outskirts. This leads to increased traffic and increased environmental problems. Graz is a member of the project CIVITAS Trendsetter together with 4 other European cities.

The city centre has many pedestrian areas and separated bicycle traffic. It was the first city in Europe to implement a speed limit of 30 km/h for the entire city area and the first city in Austria to open a mobility centre. The mobility centre offers information on public transports both locally and regionally and for buses as well as trains. Mobility services in general are also offered.

Targets have been put up in the areas of environment, safety, mobility and awareness. Some of the goals are to reduce the fuel consumption and transport emissions, reduce the number of accidents with body injuries, increase the share of handicapped people in public transport, increase the level of satisfaction in public transport and increase the use of bicycle.
(Trendsetter (1), 2003)

Some of the most important measures include traffic behaviour and how to influence people to change their habits. A new model for strolling zones have been introduced called the “onion skin model”. The inner city, the “core of the onion”, is a pedestrian zone with the “first skin” allowing bicycles and the “second skin” still being strolling zone but allowing limited car traffic.
Another measure implemented has been to give 30 % discount of parking fees to low emission vehicles. Parking fees are used to support and develop other modes of transport.

Figure 4: Tram in Graz. Source: Trendsetter (2), 2003

Regarding public transport, 60 bus and tram stops have been restored and equipped with maps, timetables and real time information. The information has been adapted for visually handicapped as well. Real time information, guidance system and traffic light priority for buses increase the accessibility and punctuality. It is estimated that around 5000 cars (2003) park on Park&Ride’s and continue with public transport with the number increasing due to the parking restrictions in the city centre. New tangential bus routes have been implemented which are travelling between the outskirts without passing the centre, new interchangers are under construction and night buses have been introduced with success.
In order to reduce the solitaire travelling in private vehicle a HOV-lane was established at one of the access roads to the city. A Park&Pool has also been established for commuters carpooling.
The cycling in Graz is characterised by a dense network in the city centre, Bike&Ride facilities and a bicycle policy. A special bicycle map and parking lots at bus and tram stops are also offered. The modal share has increased from 6 % in 1980 to 15 % in

2003. 10-year old children have the opportunity to take cycling exam to be allowed to go by bike without adult escort. Without it they have to wait until 12.
100 % of the bus fleet and 60 taxis use bio diesel as fuel. The fuel is recycled from cooking oil and collected from restaurants and households.
(Trendsetter (2), 2003)

Figure 5: Bus driven by bio diesel. Source: Trendsetter (2), 2003

2.4 European projects

Further on some European projects are presented in the area of sustainable mobility. Many of the projects have been successful with their objectives giving them fame in the region and making the implementation continue after closing the project.

2.4.1 CIVITAS

CIVITAS stands for city vitality sustainability. The first part started in 2002 within the 5th framework research programme and the second part, CIVITAS II in 2005 within the 6th framework research programme. CIVITAS I included 19 cities in 4 demonstration projects and the second one 17 cities in 4 projects. The objectives are to promote and implement sustainable, clean and energy efficient urban transport measures, to implement packages of technology and policies in the field of energy and transport and to build up critical mass and markets for innovation.
Meetings and forums where the members present and discuss the activities and measures implemented make the evaluation. One of the key elements is that CIVITAS is coordinated by the cities and that the cities are a living laboratory for investigation, learning and evaluation. (CIVITAS (3), 2005)

2.4.2 SMILE

SMILE stands for sustainable mobility initiatives for local environment and presents itself as the gateway to sustainable mobility. It aims to help local authorities to present good practices and introduce innovative approaches in order to resolve the citizen's mobility needs, increasing the quality of life and environment. The local authorities can also benefit from the experiences of 14 cities marketed as the most advanced cities in this field. (Terrassa and Lund are two of the cities that are presented later on)
SMILE compiles the results and experiences of European cities in projects and measures according to the needs of specific target groups; it gathers experience on how to best promote public transport in sustainable mobility initiatives; and it identifies innovative activities in reducing noise from urban traffic. The data collected is put in a

database where it is possible to search for European projects and their results. The database contains good practices in the following areas: integrated approach/urban transport plans, mobility advice and campaigns, urban planning, responsible car use/mobility plans, public transport, cycling, walking, intermodality, traffic calming/living streets, parking and goods delivery. (SMILE, 2005)

2.4.3 Eurocities

Eurocities was founded in 1986 and consists of 120 member cities in 30 European countries. It provides a platform to share ideas, exchange experience, analyse problems and develop innovative solutions in forums, projects and activities. Eurocities is the principal network to represent the European cities in the EU institutions on all aspects of the EU legislation, programmes and policies. The network is active in various areas such as economic development, provision of public services, environment, transport and mobility, employment, culture, education, information, government and international cooperation. A range of strategic objectives have been determined in order to fulfil the general goal:

> *"to work towards a common vision of a sustainable future in which all citizens can enjoy a good quality of life"*

An important aspect is that all citizens have the possibility to participate in all areas.
In Sweden Malmö, Gothenburg and Stockholm are full members and in Spain Barcelona, Bilbao, Gijón, Madrid, Málaga, Murcia, Seville, Valencia, Valladolid and Zaragoza. (Eurocities, 2005)

2.4.4 Polis

Polis is a network of European cities and regions working together for the development of innovative technologies and policies in local transport. It was founded in 1989 and has over 65 members in 18 countries. Most of the members are regional authorities, public transport organisations transport and mobility agencies and research centres. The network works as a platform where the members can exchange experiences. The primary objective is to improve quality of life in European cities through measures reducing congestion, enhancing safety, lowering polluting emissions and offering better access to public transport. Mobility issues have to be planned together with other areas why Polis aims to integrate economical, social and environmental aspects when planning for public transport. Priority areas in which Polis have been active over the years are: Use of ITS services, environment-friendly transport and clean vehicles, integrated strategies, mobility services, public passenger transport, road pricing, safety on urban roads, traffic management and information, urban freight distribution, urban transport noise. (Polis, 2003)

3 Spain

Spain has 44.108.530 inhabitants (2004) in an area of 505.182 km^2. 51 % of the population live in municipalities larger than 50.000 inhabitants, representing only 1,6 % of all municipalities, while the ones smaller than 10.000 inhabitants represent 91 %. (INE (2), 2005) The average density is 87 inhabitants/km^2, varying a lot depending on the regions. The provinces with lowest density, around 25 inhabitants/km^2 are those situated on the Spanish step land, Aragon, Castilla and Extremadura. Not counting Ceuta and Melilla, the two provinces in the north of Morocco, Madrid Community is the one with highest density, 743 inhabitants/km^2. (INE (3), 2005) See appendix 1 for a map over Spain.

Today there are 58 Spanish cities and municipalities with more than 100.000 inhabitants, see appendix 2, that would have to make a mobility plan according to the EU commission communication. (IDAE, 2006)

Legislation

Unlike other European countries in Spain there is no tradition in writing integrated transport plans where all modes of transport are considered. However plans and incentives are lately being implemented. In the Basque Country an environmental and sustainable development strategy (IHOBE) was implemented in 2002, lasting until 2020. Based on that document, some municipalities are starting to implement mobility plans. In Catalonia a new mobility law was approved in 2003, (Movilidad de Cataluña) saying that within three years after coming into effect, the government in cooperation with the municipalities should establish a special mobility plan for industrial and commercial areas.

With the objective to increase the savings and efficiency of the use of energy the Spanish strategy of Energy Efficiency 2004-2012 (Estrategia Española de Eficiencia Energética 2004-2012) establish the implementation of mobility plans in cities larger than 100.000 inhabitants, transport plans to workplaces and public transport plans as efficient measures towards a sustainable transportation. Another strategy considering sustainable mobility plans important is the Infrastructures and Transport Strategic Plan (Plan Estratégico de Infraestructuras y Transporte). The National Plan and Law of Emission 2002-2007 (Plan Nacional de Asignación de Derechos de Emisión) encourage actions to use alternative modes of transport to reduce emissions. (IDAE, 2006)

3.1 Traffic and Social Planning Situation

3.1.1 Development

During the last decades there have been important social changes in the Spanish society. The changes are marked with low birth rate, resulting in a progressive aging of the population. The incorporation of the woman in the labour market and the increasing prices of residents are other important factors, as well as the increasing immigration from North Africa and South America. According to information from the Spanish National Statistic Institute the number of households has grown 20 % between 1991 and 2001 and the population only 5 %. Since the 60s' the number of municipalities with more than 100.000 inhabitants has been doubled, now counting 58. (IDAE, 2006)

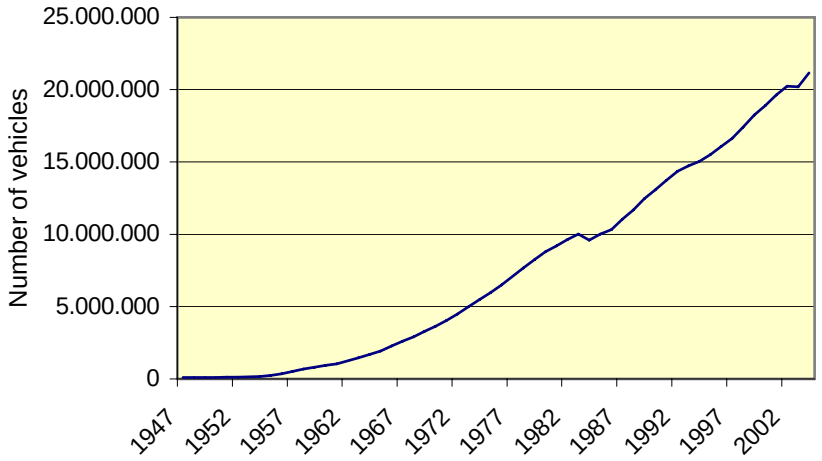

Figure 6: Development of the number of registered private vehicles (cars and motorbikes) in Spain, 1947-2004. Source: INE (4), 2005; DGT, 2004

From the beginning of the 1970 the increase of private vehicle has been 500.000 per year. The dip 1984 seen on the graph in figure 6 is caused by the change of method of calculation. Before the number was estimated, from 1984 the number is exact. 2004 was a new record year counting 21.450.000 vehicles. (DGT, 2004) The motorisation index has augmented from 280 vehicles/1000 inhabitant in 1980 to 596 in 2003. The increase of the index is closely connected to the increase of the GDP (Gross Domestic Product). During the same period public transport users increased 21 % compared to the growth of population of 11%. (IDAE, 2006)

From the last years of the last century there has been a change of which type of fuel private vehicle use. In 2004 65 % of all new private vehicles registered were driven by diesel compared to 1995 when the percentage was 33 %. (DGT, 2004)

3.1.2 Present situation

According to the mobility inquiry Movilia in 2000 the average time for a round trip to work was 47 minutes. The number of movements per day was 1,9 with the total duration augmenting with the size of the city. 53 % of all trips were obliged, i.e. had the destiny work or studies. (Ministerio de Fomento, 2000)

The autonomous communities can be divided into groups depending on their characteristics in the use of transport, see figure 7. Regions with large cities like Aragon (Zaragoza), Catalonia (Barcelona) and Madrid show a higher percentage of bus or metro, so do also Navarre and the Basque Country, the wealthy regions in the north. Rioja and the two communities surrounding Madrid, Castilla La Mancha and Castilla and León, show a high share of trips by foot and bicycle. This might be because these regions have low density forming isolated villages and that most trips within these villages are done by foot. One of the main reasons for the Canary Islands to show such a high share of cars and motorbikes is cultural.

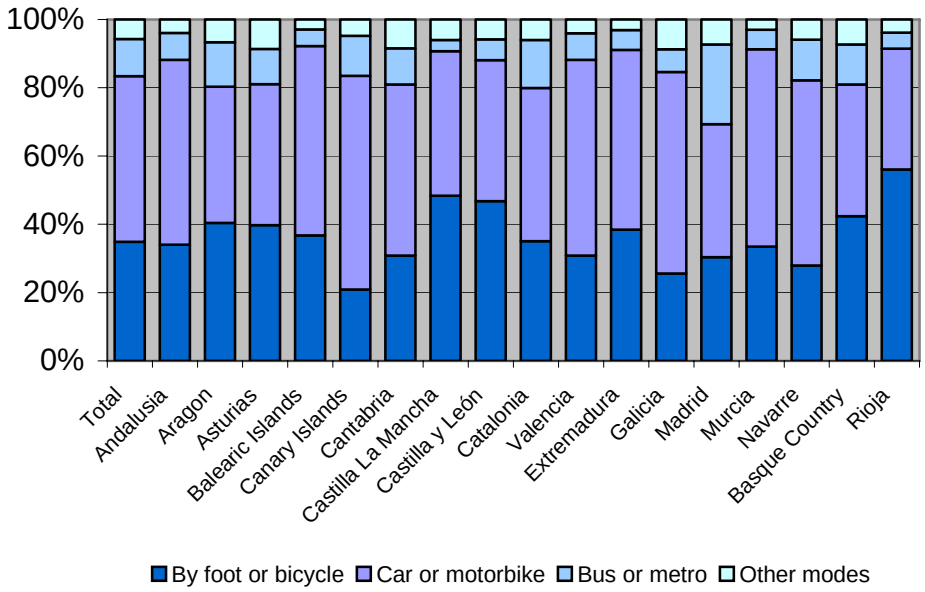

Figure 7: Modal distribution divided into the autonomous communities. Source: Ministerio de Fomento, 2000.

The use of public transport is low in cities smaller than 50.000 inhabitants, while in large cities where there is a higher supply it competes with the private vehicle almost reaching equal parts of the distribution. In cities larger than 500.000 inhabitants with a developed transport system, approximately 27 % use public transport. Madrid and Barcelona reach shares of 36 % and 30 % respectively. Trips realised by foot show a quite interesting picture. For trips to work, 14-26 % go by foot while when there is another motive, up to 60 % use this mode of transport. The use of private vehicle shows a similar distribution, but the other way around. It is used more to go to work than for other trips. (Monzón et al, 2005) Almost 70 % of the households have access to one car or more. (IDAE, 2006) The motorization index is highest in the big city regions of Madrid, Catalonia and Valencia and the Balearic Islands. (DGT, 2004) As well as for passenger trips goods transports have increased too in the last years. The last 15 years the vehicle park in Madrid Community has grown to four times as many, now reaching 16 % of all vehicles registered. In Barcelona 10 % of all vehicles are commercial transports. Even if technology has lowered the consumption of fuel, goods transports stand for 43 % of the energy designated to transports. Regarding external effects goods transports are supposed to cost 4,5 % of the GDP. (IDAE, 2006)

The total number of victims in traffic accidents in the whole country was 2004, 143.124 whereof 4.741 were mortal. About 47 % of the accidents occurred in urban areas. (INE (1), 2005) Within urban areas 9472 pedestrians were run over by cars in 2004, 33 of them died. The situation regarding accidents resemble for bicycles. Due to the scarce infrastructure the cyclists take a big risk sharing lane with cars and buses. In 2004 occurred 2485 accidents with 89 dead, 72 % were due to collisions with another vehicle. (IDAE, 2006) The general tendency the last years is a slow reduction of accidents, though in urban areas this reduction is lower than the total. (Monzón et al, 2005)

Within the urban areas in Spain, the current distribution of transports generates more than 80 % of all pollutants emitted. 83 % of them can be deduced from car traffic.

(IDAE, 2006) Spanish legislation follows the European directives established for maximum value of concentration of NO_2, PM_{10}, SO_2 and O_3 as can be seen in table 1.

Table 1: European directives 1999/30/CE and 2002/3/CE of maximum admitted concentration of NO_2, PM_{10}, SO_2 and O_3. Source: Monzón et al, 2005

	Year of target	*Maximum concentration ($\mu g/m^3$)*	*Time of surmounting (hours)*	*Maximum number of times exceed in one year*
NO_2	2010	200	1	18
PM_{10}	2005	50	24	35
SO_2	2005	125	24	3
O_3	2010	120	24	25

SO_2 and O_3 don't exceed the limits and neither NO_2 for population centres smaller than 500.000 inhabitants. For larger cities the situation is descending but still without reaching the target. The situation for PM_{10} is the worst; all cities above 100.000 inhabitants exceed the maximum concentration more than 35 times per year and between 1990 and 2003 the concentration augmented with 4,7 %. Madrid shows the highest number of exceeding days for both NO_2 and PM_{10}. Spain is also increasing their emissions of CO_2 continuously, now being far away from fulfilling the Kyoto protocol.
The transport sector contributes to 20,1 % of the emissions of acidifying substances, 28,2 % of ozone precursors and 32,2 % of emissions of PM_{10}. As can be seen in figure 8 precursors of ozone have decreased the last years while acidifying substances and particles show stagnation. (Monzón et al, 2005)

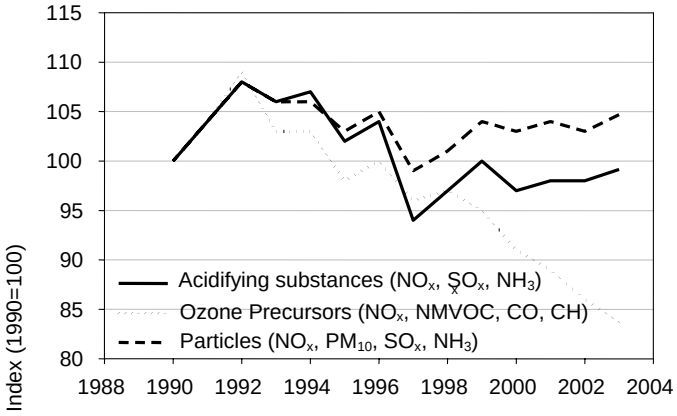

Figure 8: Total emissions of atmospheric contaminants proceeding from transports 1990-2003. Source: Monzón et al, 2005

Furthermore it is estimated that 74 % of the population is affected by noise and 23 % is subjected to levels higher than 65 dB(A). (IDAE, 2006)

3.2 Summary of the Spanish Sustainable Mobility Plan

3.2.1 Guía para la implementación de Planes de Movilidad Urbana Sostenible

In order to stop the development of growing urban areas and the dependency of the private vehicle IDAE, the Spanish Institute for Diversification and Energy Saving, is establishing mobility plans as one measure to achieve a major use of more efficient

modes of transport. Urban expansion and a higher use of private vehicles produce a high consumption of space and energy, and cause severe environmental impacts. Another objective of the mobility plan is to make ordinary inhabitants conscious of a more rational use of transports. By promoting more efficient transport modes with a more rational use of the private vehicle, considering criteria for town planning, parking and infrastructure this should lead to avoid an increase of traffic in sensible areas.

The sustainable urban mobility plan will be implemented in all provincial capitals and all municipalities or metropolitan areas with more than 100.000 inhabitants. In a second stage this might be extended to cities with more than 50.000 inhabitants, which at present are obligated to offer public transport to the citizens. The geographical area of implementation is set to urban areas – the plan shouldn't be limited to a residential district nor extended to include a region. Objectives should be considered on three terms, short (up to two years), medium (four years) and long (more than eight years). After four years a new plan should be started to be produced. Follow-ups for every measure should be made every year.

The implementation methodology will be conducted in six phases:

- Organization and process start
- General objectives
- Analysis and global diagnosis
- Project preparation
- Starting up of the project
- Follow-up, evaluation and corrective measures

Responsible part is the municipal authorities, both for the plan process and as a coordinator between other partners in traffic and urban planning, environment and social matters. The sustainable urban transport plan will be of an agreement type and not forced on as legislation. However municipalities signing the agreement will be subsidised.
(IDAE, 2006)

3.3 Examples of Plans in Spain

3.3.1 Terrassa

The city of Terrassa is situated on the northern limit of the Barcelona Metropolitan area, see appendix 1. The population was in 2005 200.000 inhabitants, almost half of them living in the northern districts of the city. Jobs are concentrated to the centre parts and so are shops. The motorization index is 0,596 per inhabitant. (Ajuntament de Terrassa, 2003) Terrassa is connected to Barcelona through a network of roads to the south. Five new railway stations are being built whereof two will be the basis of a metro-system with nine stations. During the last years the central urban streets show a high level of congestion due to their combination of serving as central streets and serving traffic crossing the city. This has led to a high rate of accidents as well. (Alegre, 2003)

In figure 9 the modal distribution can be seen, where the trips by foot and car have almost the same shares, 46 % and 43 % respectively and public transport reach 11 %. Terrassa is a member of the European project SMILE. During the last two years Terrassa has been involved in a process of parallel planning of five areas: the environment, urban development, accessibility, business and mobility. A Mobility Plan

including 18 principles and objectives has the aim to make mobility a fundamental element of the planning in the city. A sustainable and reasonable model for the suburbs and the city as a whole is promoted as well as areas for pedestrians and the least pollutant modes of transport.

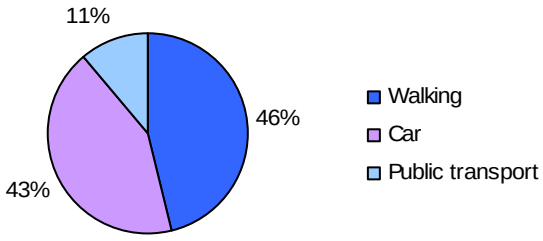

Figure 9. Modal distribution, Terrassa. (1996) Source: Alegre, 2003.

The areas that were highlighted after the first discussions as fundamental to change in order to achieve improvements were: urban and regional development, necessary and unnecessary mobility, traffic, public transport, parkings, goods deliveries and businesses, pedestrians, bicycles and the environment. Information to the citizens is an essential part in order to reach good results. (Alegre, 2003)

The transport model suggests ring roads and radial entry roads to distribute the traffic, with the rest of the network considered as 30-zones. To make the public transport more attractive the service frequency should be denser and 7 km of bus lanes will be built. In order to increase accessibility the whole fleet of buses should have low platform within 2 years. The construction of the new railways should be speeded up. As for goods delivery a reloading centre will be created to lower the amount of vehicles circulating and two lorry parks will also be built. To improve for the pedestrians a continuous 150 km accessible and safe network is proposed. Urban barriers should be reduced and specific signals to improve safety will be put up, particularly around schools and in areas used by elderly people. A 145 km bicycle network has been proposed, which should connect various suburban centres and outlying areas. The network is mixed between coexistence with cars or pedestrians and separate lines or roads.

Figure 10: Bikeway in Terrassa. Source: Alegre, 2005

A sonic map has been recommended in order to reduce the noise levels in the centre. Two measures could be to moderate the traffic and apply absorbent (anti-noise) asphalt. As an aim to fulfil the goals in the Kyoto protocol the emissions of CO_2 should be reduced with 8 % until 2010. This means a reduction of the car traffic with 8,5 %

divided on an increment of 1 % of bicycles, 2 % of pedestrians and 5,5 % of public transport. (Ajuntament de Terrassa, 2003) The calculated cost for the measures above is 50.854.550 € during 15 years.

Indicators are used to evaluate the measures being carried out, allowing the assessment of seeing whether the plan is heading in the right direction or not. A balanced mobility model is proposed respecting the need to use the private vehicle, but tending towards a city for pedestrians and more sustainable modes of transports. A discussion forum on mobility has also been created, where new ideas can be launched and reflected. (Alegre, 2003)

3.3.2 Burgos

Burgos, a city in the North-central part of Spain, has 170.000 inhabitants in an area of 108,26 km^2 and is known for its historical and monumental heritage, see appendix 1 for the situation. The city is well connected with the rest of Spain due to its situation between Madrid and the French border. During the last decades the city has grown because of an important increase of population from rural areas. However over the last years people tend to settle down in villages nearby commuting to their work in the centre. (CIVITAS (2), 2005)

Burgos is one of four members of the European Union project CIVITAS CARAVEL. The other cities are Genoa, Stuttgart and Krakow. The project is a 48 months long demonstration project about sustainable mobility that started in February 2005.
The principal objective with the project is to:

> *"agree to establish a new culture for clean mobility in European cities in support of sustainable development, citizen's well being and safe access for all."(CIVITAS (1), 2005)*

Concretely this means to:

- reduce the emissions caused by transports
- minimize the traffic influence on sensible areas
- make the citizens aware of their responsibility
- give priority to public and collective transport over the individual
- improve the security and accessibility to transports to children, elderly and disabled persons
- recover open spaces to the citizens, clear the traffic and increase road safety.

The special lines of investigation that will be made in Burgos within the project are:

- Healthy city centres – reached by control and reinforcement of pedestrian areas, the realisation of a pedestrian plan, improved logistics when loading and unloading of goods deliveries and limited access to the city centre for private vehicles are other measures.
- Less polluting vehicles – Promotion of public transport and alternative fuels like natural gas and bio-diesel.
- Information – Promotion campaigns; improved information about traffic conditions, public transport, parkings, and participation for citizens in forums making the inhabitants feel responsibility and that they are a part of the changes.
- Alternatives to the use of the private vehicle – Improved accessibility and routes to make public transport more attractive, making the road-users aware about

each other leading to higher traffic safety in general and pedestrian security in particular, promotion of an increment of use of bicycle and the establishment of plans to improve their being in the centre, implementation of carpools and so on. (Escudero et al, 2005)

Eight CNG (compressed natural gas) buses and three clean delivery vehicles will be bought and demonstrated in Burgos during the project and bio-combustibles will be used in 5% of the diesel fleet. Investments will be done in 20 electronic information panels at bus stops together with ten touch screens for booking cars in a car pool and five screens with transport information. The existing 15 km of bicycle path will be extended to 38 km. (CIVITAS (1), 2005)

Figure 11: A street in the city centre of Burgos exclusively for pedestrians. Source: Escudero et al, 2005

Amongst others a transport, environmental, economic and social policy have been implemented. The city council of Burgos, the technological institute of Castilla and León and the association of strategic plans of Burgos are all supporting the project. The cost of the project is supposed to be 6,9 million €, whereof 41% is supported by the European Commission. (Escudero et al, 2005)

4 Sweden

Sweden has a population of 9.011.392 inhabitants (2004) and a total area of 450.295 km^2. The population is very uneven distributed; almost 8 million inhabitants live in the area RO1-RO5 that represents 42 % of Sweden. Stockholm is the far densest region with almost 290 inhabitants/km^2. RO2-RO5 (the south of Sweden with the Stockholm metropolitan area excluded) has a density of 55 inhabitants/km^2 while the three northern regions barely reach 9 inhabitants/km^2. (SCB (4, 5), 2005) See appendix 3 for the division of regions. In Sweden the thirteen municipalities would be affected by the EU suggestion, see appendix 4.

Legislation

In Sweden today the Environmental Code (MB) can regulate transport activities for special cases. When preparing Measure Programmes (ÅP) because Environmental Quality Standards (MKB) are exceeded there are possibilities to make demands of the company's activities, transports included. Through the Plan and Construction Law (PBL) there is no possibility unlike most countries in Europe. However there is a connection to the County Administration and their supervising responsibility to make sure health and environment aren't damaged. (Lundgren, 2004)

In 1999 the Swedish government determined an environmental policy with 16 environmental goals to be met 2020. The goals describe the quality and the condition of the Swedish environmental, natural and cultural resources, so to be ecologically sustainable on a long-term view. A few areas cause a major part of the present environmental problems, why the work will be concentrated to three strategies; more efficient energy use and transport, non-toxic and resource-efficient cyclical systems and management of land, water and built environment. See appendix 5 for the environmental policy. (Miljömålsportalen (1), 2005)

The Swedish government has also through the National Road Administration stated a transport political policy, which is to "assure social, economical, effective and long-term sustainable transport support for citizens and trade and industry in the entire country". The policy is divided into six sections, see appendix 6. (Vägverket (1), 2004)

In a bill of infrastructure (2001:02/20) the Swedish government has stated a goal of a long-term sustainable transport system as part of the work towards an ecological, social, cultural and economical sustainable development. Among other things the National Road Administration should work with measures influencing on the demand of transports towards sustainable travelling. Measures that are important are a development of social and building planning and to use the 4-step principle in new infrastructure planning.

(Lundgren, 2004)

4.1 Traffic Situation

4.1.1 Development

After the end of the II World War the Swedish industry grew fast leading to an immense recruitment of workers from various European countries principally from Italy, Austria, Greece, Yugoslavia and Finland. From 1950-1970 the number of immigrants increased three times, in some municipalities reaching 20 % of the population. After the top in 1970, the immigration was stabilised to the mid 80's when it changed character to refugees, due to civil wars and oppression in Asia and South America. Without this

migration, the Swedish population would be around 1,8 million less inhabitants today. (SCB (3), 2005)

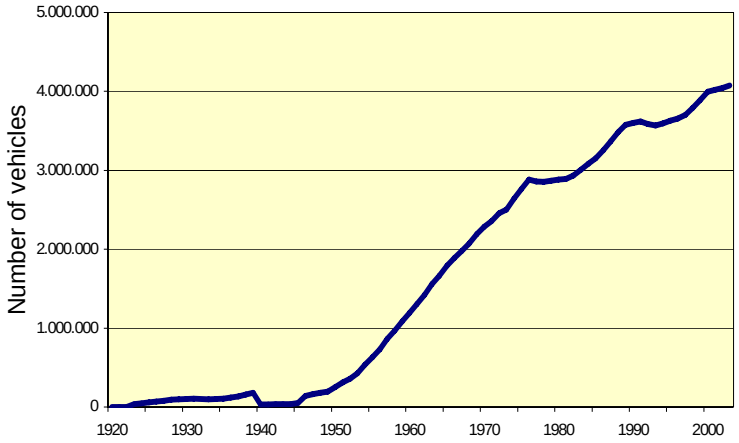

Figure 12: Development of the number of registered private vehicles in traffic in Sweden, 1923-2003. Source: SCB (2), 2003

During the II World War, 1940-1944, most cars in Sweden were deregistered. Since then the growth has been significantly increasing with approximately 100.000 cars per year from 1950 to 1976. The stagnation in the 70s and 90s are due to lower economic growth. The top number was noted the year 2003/2004 reaching 4.077.973 cars (4.473.574 motorbikes and snowmobiles included), see figure 12.
Goods transports have increased since 1994 with approximately 15 %. Transports with lorries have grown the most. (SCB (2), 2003)

4.1.2 Present situation

Most work places are situated in population centres, why in average 86 % of the population work in cities. Since 1995 cities over 20.000 inhabitants have grown, especially the largest ones, while smaller ones show a decrease. (SCB (5), 2005) 30 % of the population live in municipalities larger than 100.000 inhabitants, representing 4 % of all municipalities, while 20 % of the population live in municipalities with less inhabitants than 20.000. These represent 58 % of all municipalities. (SCB (4), 2005)
A mobility inquiry was made 2001 for the whole of Sweden. The total modal distribution was car 55 %, bicycle and by foot 30 %, public transport 10 % and others 5 %. The most common destiny was going to work or school with 49 % followed by trips to free time activities 30 %, shopping 13 % and other destinies 8 %. In average 1,7 trips per day and person were made. (SCB (1), 2002) Figure 13 show the modal distribution of trips to work based on the length of the trips.

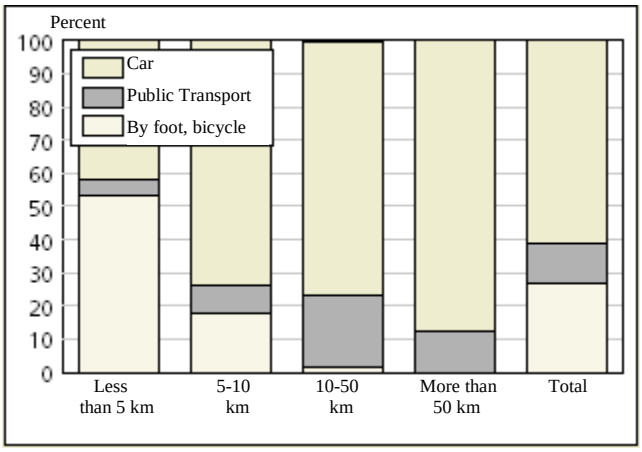

Figure 13: Trips to work based on length of the trip and mode of transport. Source: SCB (1), 2002

The car is the dominant mode of transport calculated as the number of trips (55 %) as well as the number of travelled kilometres (66 %). Around 74 % of the households have access to one car or more. 55 % of all travelled kilometres are done with only one person in the car. (SCB (1), 2002) The total number of trips by public transport has augmented slightly since 1994, but with bus, the most common mode of transport, the number of trips has decreased outside of Stockholm. (SIKA, 2005) The average length travelled during one day was 44 km, bringing out that trips on free time were longer than trips to work or school. The average time spent to and from work was 49 minutes.

Figure 14 show the total modal distribution divided into different regions. The regions are shown to be very alike, except for RO1, the region of Stockholm that show a much higher use of public transport and a lower use of car.(SCB (1), 2002)

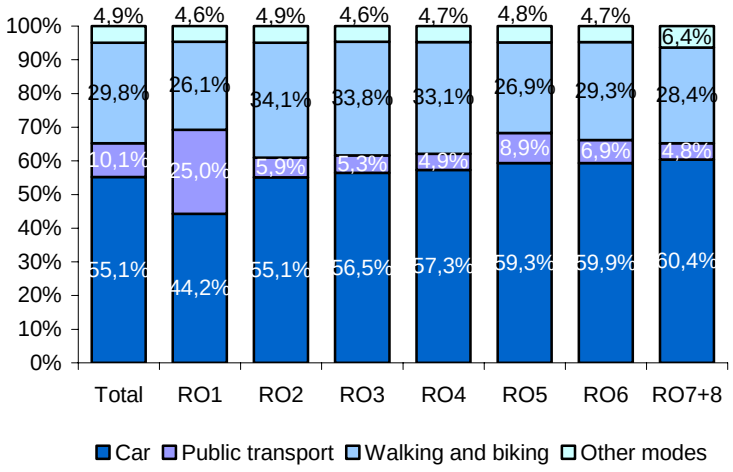

Figure 14: Modal distribution divided into regions in Sweden. Source: SCB (1), 2002

The motorization index is 498 vehicles per 1000 inhabitants (motorbikes and snowmobiles included) (2003/2004). The highest indexes can be found in the provinces with low population density and the lowest in Stockholm. (SIKA, 2005)

Around 20 % of the population is estimated to be affected by noise from road traffic exceeding 55 dB(A) outside and less than 3 % are exposed to levels over 65 dB(A).

Sweden has since 1197 been working nationally with a traffic safety programme called the "0-vision". The goal is to finally reach 0 killed or severely injured in traffic accidents. During 2003, 529 persons were killed and 4664 persons were severely injured in accidents related to traffic, one of the lowest rates in the world
According to the National Environment Protection Board the transport sector stand for 37 % of all emissions of CO_2 (the highest share of all sectors), 49 % of NO_x, 32 % of VOC and only 2 % of SO_2. (Naturvårdsverket (2), 2004)
The environmental policy goals for emissions of CO_2 and other greenhouse gases should during the period of 2008-2012, be reduced to 4 % under the levels of 1990. Goals for emissions of other contaminants follow in table 2.

Table 2: Swedish environmental goals for maximum admitted concentration of NO_2, SO_2, O_3, PM_{10} and $PM_{2,5}$. Source: Miljömålsportalen (2), 2005

	Year of target	*Maximum concentration ($\mu g/m^3$)*	*Time of surmounting*	*Maximum number of times exceed in one year*
NO_2	2010	30	1 h	175 h
SO_2	2005	5	1 year	
O_3	2010	120	8 h	
PM_{10}	2010	35	24 h	37 days
$PM_{2,5}$	2010	20	24 h	37 days

The emissions of CO_2 have diminished since 1990 but the last four years it has started increasing again due to the fact that the transport sector is increasing their emissions constantly. SO_2 emissions have been reduced to less than the half since 1990. This means that the goal for 2010 already has been reached. Due to better technology and sharpened demands within the car industry, the emissions from NO_x have diminished. However an increase of the road traffic and a higher share of heavy traffic obstruct the trend. PM_{10} seems to be a troublesome contaminant hard to control. There is no clear tendency of reaching the goals. PM_{10} is a problem springtime with studded tyres wearing the roads raising dust. In average the content of O_3 is under the limit, but it is not uncommon with shorter episodes exceeding it. Emissions of VOC are difficult to calculate and incompletely surveyed, but compilations indicate a reduction. The largest decrease is thanks to the catalytic converter. Despite a long way to reach the goal for 2010 it can be possible through new directives within the sectors affected. (Naturvårdsverket (2), 2004)

4.2 Examples of Plans in Sweden

Among Swedish municipalities three types of projects are more common than others. These are *Collaboration for Sustainable Travelling*, the *MöTs-strategy* (Environment and Safety on Road) and *MaTs* (Environmentally Friendly Transport System). MaTs will be explained further on in this chapter. There is also a new way of planning called TRAST (Traffic for an attractive City) developed as an integrated traffic and social planning strategy, which will be explained later on as well.

The project Collaboration for Sustainable Travelling aims to develop alternatives to reduce unnecessary and solitaire travelling with private vehicles and to go alone in a car. The focus is put on implementing alternative transport modes in new residential areas, the implementation of carpools, smart traveller and secure walkways to school including walking school bus.

MöTs is a project in cooperation with the National Environment Protection Board, the municipalities union and the National Police Board. The activities are mostly focused on influence on behaviour even if some physical changes also are included. Examples of activities are: walk and bike to school, bicycle helmet campaigns, traffic safety campaigns, eco-driving, carpools and in the city without my car.

A compilation of a study made of the National Road Administration show that most of the cities don't have an all-embracing plan for sustainable transports. LundaMaTs presented in chapter 4.2.1.1, the traffic strategy in Malmö, recently finished, and the present work in Helsingborg and Umeå are examples that can be compared to sustainable transport plans. However sustainable transports are mentioned in other plans like environmental programmes and deepened comprehensive plans. The majority of the municipalities have plans for different areas like bicycle plans and public transport plans. (Neergaard et al, 2004)

4.2.1 MaTs

A MaTs is a transport system based on what the nature and the people can handle, considering production, application and final treatment of vehicles and infrastructure. The system originates from the four so-called conditions of circulation:

1. Minimisation of the use of non-renewable resources.
2. The discharge of substances hard to dissolve shall cease.
3. The maintenance of the physical prerequisites for the natural cycle.
4. The use of non-renewable resources has to be below the rate of their development.

The term "environmentally friendly transport systems" has been used since the mid 90's. It was founded by the National Environment Protection Board when they started a collaboration with the traffic authorities, car industry and government agencies. The definition of an environmentally friendly transport system is:

> *"a way of organising and realising transports of people and goods within the limits of what people and nature can endure". (Region Skåne, 2001)*

Mobility Management mixed with infrastructure changes has an important role in MaTs.

4.2.1.1 LundaMaTs

Lund is a city in the south of Sweden situated close to Malmö, see appendix 3. It's one of the oldest cities in Sweden constructed 990 A.D. The municipality counts just over 100.000 inhabitants (2003) in an area of 430 km^2. The great majority lives in the city of Lund. Other communities are Södra Sandby, Dalby, Veberöd and Genarp. (Wikipedia, 2005) Lund is famous for its university with about 40.000 students.

Lund has been working with MaTs since 1997. During 2005 a work has been done to widen the matter of LundaMaTs to include "sustainable" transport system and not just "environmentally friendly". The updates are presented in LundaMaTs II, the continued process with new targets, reforms and goals for 2030.
According to a study of the traffic situation from 1997, 60 % of the transportation in the city of Lund were made by cars and light lorries and 30 % by cycle or walking, while in the municipality as a whole 70 % were made by cars and light lorries and 20 % by

cycling or walking. The city is an important commuting centre for the region. Around 65 % of the transports originate from or have as destiny some place outside the municipality. (Trivector AB, 1998)

Targets were made for air pollution, air quality, land use, noise and recycling and they have been discussed in forums at both municipal, regional as national level. Stage objectives were made for 2005 and 2020 with the final year 2050. In order to reach the targets, five overall strategies have been stated.

1. **Reduce the total traffic.** The most effective way to decrease the environmental impact. A very important instrument to lower the need to travel is social planning.
2. **Increase the collaboration between different modes of transport.** To optimise the traffic system so that every mode of transport can be used in the right context. Concerning goods transports is also important.
3. **Make every mode of transport more efficient.** Develop measures to make the modes of transport more adapted to the environment.
4. **Realize technical measures at vehicles and combustions.** Be open to new ideas for reducing the consumption of fuel, developing combustion cells, etc.
5. **Better environmental adaptation when constructing and operating infrastructure.** Sharper Environmental Impact Assessments for all new construction.

The strategies lead to a plan of action with five principal reforms, two complementary and one informing. The emphasis of the measures has been put on those measures facilitating a voluntary transition to an environmentally friendly transport system.

Reform 1: Town and Country Planning

This reform has concerned land use and structural planning. First and foremost the reform means to improve the possibilities to use other transport modes than the private car. It has included public transport and bikeway planning, reduction and redistribution of parking lots and the possibility to by local produced products. The cost was calculated to 23 millions SEK (€ 2,5 millions).

Reform 2: Bicycle Municipality

The objective with this project has been to transfer short car trips to bicycle and to make the bicycle trips safer. The work has included both physical measures and influence on behaviours such as extending the bicycle network, introduction of bicycle renting and encouraging the use of bicycle. Cost: 121 millions SEK.

Reform 3: Extended Public Transport

This reform has had the objective to decrease the car dependency by improving the public transport. Some measures were: new and improved bus and train routes, better accessibility and frequency, separate bus lanes and Park&Rides and Bike&Rides close to interchangers. The cost was calculated to 680 million SEK, the larger part invested in infrastructure projects.

Reform 4: Environmentally friendly car traffic

Impacts from the car traffic that will continue exist can be reduced by technical alignment as well as a change of attitudes and behaviour. Among

the measures was formation in eco driving, introduction of carpools, installation of engine pre-heaters, synchronize traffic signals and reserved HOV-lanes. The cost was 130 millions SEK.

Reform 5: Commercial and Industrial Transportation

This reform had the aim to describe measures both from the view of the companies and the personnel to reduce freight transports. Measures suggested were coordinated distribution among companies, home delivery of goods and extended bidding of “green transports”. The costs were calculated to 3 millions SEK.

IT

The reform has included the possibility to telecommute by constructing IT-centres in small communities, marketing and information about the projects going on in LundaMaTs. One solution to the environmental problems could be route guidance information systems, which will make the travelling more efficient.

The cost was 15 millions SEK.

Trips outside Lund

The reform had the aim to inform the citizens of Lund of alternative transport modes when travelling outside the municipality. Cost: 1 million SEK.

Outreach programmes

An extensive information campaign was planned to increase the positive effects of the other reforms containing consultations, distribution of information, marketing and education and training. Cost: 35 million SEK.

(Trivector AB, 1998)

Two evaluations have been made, the first one in 2001 and the second in 2004. The aim with the evaluations has been to find out how much knowledge the citizens have of the different projects realized and how they have been affected by them. An estimation about the effects reached has been calculated and a comparison between the two evaluations has been made to see the development over the years. The evaluation is shown for the five biggest population centres in the municipality.

The projects studied for 2001 were, LundaMaTs as a whole, the mobility office, the bicycle municipality, walking and biking to school and Lundalänken. Within each project different kinds of activities have been realized. The most famous ones are “Lund – bicycle town of the year 2001”, a guarded bicycle garage at the central station in Lund, improved bikeways, and the campaign "cycle to work". (Lyborg et al, 2001)

2004 three projects were going on in LundaMaTs; the mobility office, Lundalänken, and the bicycle municipality. The most known projects are the bicycle municipality and Lundalänken. (Hyllenius et al, 2004)

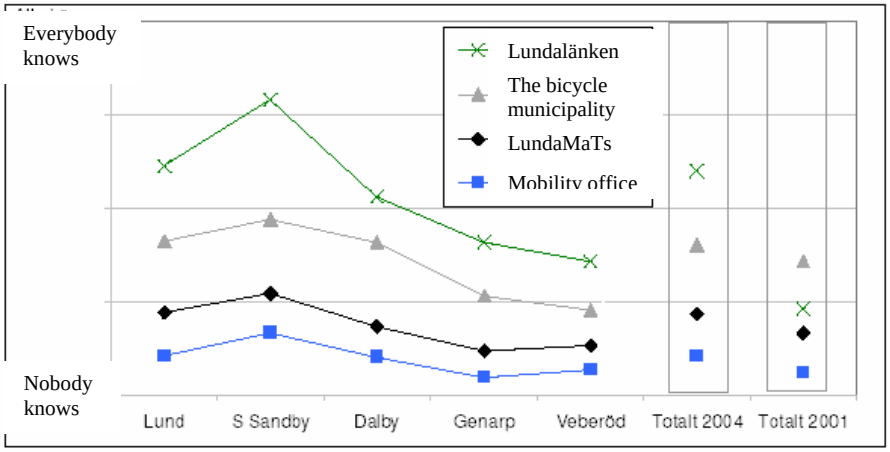

Figure 15: Index of knowledge for LundaMaTs in the five communities respectively. Source: Hyllenius et al, 2004

As shown in figure 15 around 40 % knew of the overall MaTs-project in 2004, which is an increase of 10 % from 2001, the same growth as the mobility office, which reaches knowledge of 20 %. Half of the population know about the bicycle community, the same as 2001, and 80 % about Lundalänken, an increase of more than the double. (Hyllenius et al, 2004)

The mobility office work with information, formation and guidance through the principle – right transport at every moment. According to the enquiry more people know about the activities in particular the mobility office is conducting than the office itself. The most known activities are the European mobility week, carpools and test travellers. Test travellers are an attempt to make car users leave their car at home by offering them free public transport during a couple of months.
One project is called "Smart Road User" and tries to reach people at home and work with personalized information in order to make them choose the smartest and most sustainable mode of transport or communication at all situations. Citizens visited by Smart Road User tend to change their way of travelling more than the others.

Figure 16: Bicycle parking at the central station in Lund. Source: Lyborg et al, 2001

About 60 % know about **the bicycle community**, but as in the mobility office the activities within the project are more known than the project itself. The most known projects are guarded bicycle garage, improved bikeways, and the campaign cycle to

work. There are no clear differences in knowledge about the activities compared to 2001. (Hyllenius et al, 2004)

The purpose of the project **Walking and biking to school** has been to make fewer parents drive their children to school in private cars. Dangerous intersections and sections of streets have been rebuilt to increase the safety. Another measure is the walking school bus, a number of pupils from the same area that walk to school with an adult. (Lyborg et al, 2001) The project finished in 2002. (Hyllenius et al, 2004)

Lundalänken is a public transport section from the central station in Lund passing the university hospital, the university, a company village and further onto a residential area. It was opened for traffic in February 2003. This is the most known project of them all, probably because of great infrastructure changes and a lot of attention. The percentage saying they have changed from car to bus is higher than normally in this kind of public transport changes. (Hyllenius et al, 2004)

90 % of the inhabitants think the LundaMaTs project is good or very good. It's about the same result as 2001, see figure 17. (Hyllenius et al, 2004)

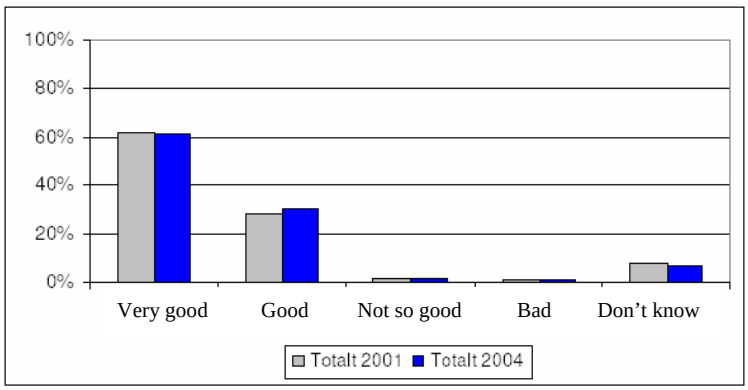

Figure 17: Citizens' opinion of MaTs. Source: Hyllenius et al, 2004

A rather large part also thinks some activities have changed their way of travel, see figure 18. (Lyborg et al, 2001)

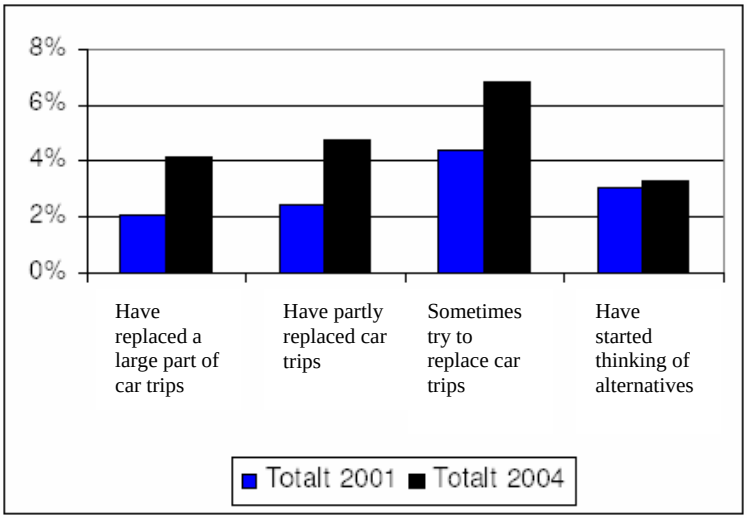

Figure 18: Percentage that has changed their trips because of activities in LundaMaTs. Source: Hyllenius et al, 2004

Of the ones that have replaced their car trips about 80 % say they have changed to bicycle/walking, 65 % go by public transport and 10 % use car sharing (the same person has been able to give various alternatives). Compared to 2001, the share of travellers with public transport have increased, the other modes of transport are about the same.

The study has roughly estimated the effects the activities have reached based on with how much the inhabitants have answered they have reduced their car trips, calculated for the whole population and adding estimated effects on car sharing, eco driving and carpooling, see table 3.

Table 3: Roughly estimated effects on the traffic work and the emissions of CO_2 by different activity groups the year 2004. (Hyllenius et al, 2004)

	Million travelled kilometres	%	Ton Carbon dioxide	%
Transfer from private car to bicycle	4,4-5,4	45	1200-1400	50
Transfer from private car to public transport	4,4-5,4	45	900-1100	40
Car sharing and carpool	0,7	10	250	10
Totally 2004	9-11	100	2300-2800	100

Compared with the private traffic work from 1996 enumerated to 2004 the effects show a reduction of 2,5-3 %. A similar estimation for CO_2 gives a reduction of 2,5-3 %. The public transport has increased during the same period; the number of trips 18 % and the number of trips per inhabitant 2 % and year. The bicycle traffic shows an increase of 12 %, which means around 1 % per inhabitant and year. As can be seen in table 3 there have been a diminution of 10 million travelled kilometres and a save of around 2500 tons of CO_2. (Hyllenius et al, 2004)

It seems like the citizens are satisfied with the measures realized. This is noted not just from the enquiry but also through the response at various projects. Even though just 1 % has changed their travel habits, 90 % think the commitment is good.
If a good result is to be reached, physical as well as informing measures have to be mixed. In a short future the effects will show result, assuming that the measures continue. It is also likely that synergic effects will be reached when many measures are carried out at the same time.

4.2.1.2 SkåneMaTs

Skåne is the region situated in the southwest of Sweden. It has a population of 1.160.919 inhabitants in an area of 11.027 km^2. The largest cities are Malmö, Lund, Helsingborg and Kristianstad. (Position Skåne, 2006) Together with Zealand, Mön, Lolland, Falster and Bornholm, belonging to Denmark, they form the area of Öresund with 3,6 million inhabitants with Copenhagen and Malmö as centre core, see figure 19 for its extension. The trade and interchange between the countries have increased substantially since the opening of the bridge between Denmark and Sweden in 2000. (Region Skåne, 2004)

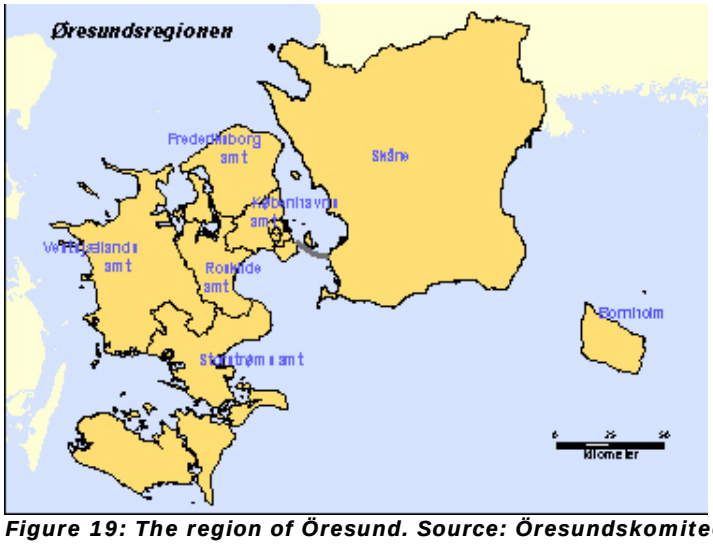

Figure 19: The region of Öresund. Source: Öresundskomiteen, 2006

Skåne (Scania) is a growing region, especially in the western parts, where many larger towns are situated. The traffic is constantly increasing, during the 90's the flow of traffic increased 10-50 % with E6 showing the biggest growth. The heavy traffic stands for a total increase of 10-20 %, on some roads this is a doubling. The county administration has estimated that half of all transports with dangerous goods in Sweden drive through Skåne because of its geographical situation. In the region 63 % of the trips are made by car, 30 % by bicycle or walking and the rest by other modes. Around one third of the trips, a growing part, are done on free time. One third of all workers commute between municipalities. The largest commuting sections are around Malmö and between Malmö and Lund and Malmö and Helsingborg. 95 % of all public transport trips are taken place to, from and within the 10 biggest cities. The share on the countryside is very low.
The traffic together with the agriculture creates the majority of all environmental problems. Many indication values for different contaminators are exceeded in some places. About 200.000 people are being exposed to noise from traffic. (Andersson et al, 2002)

SkåneMaTs started in 2001 and ended in 2003. The purpose of the project was to make the transport system in the region of Skåne environmentally friendly. Focus was put on the regional traffic and environment with the aim to complement other work done in the region. Since the commuting between various cities is intense, and there are a lot of goods transports and other transit traffic on the roads, an important aim has been to work on a regional level. A starting point has been to unite good environment and good accessibility.
The basis for the project consists of:

ESPD, European Spatial Perspective Development, “Scanian Viability” (Skånsk Livskraft), a development Programme for Skåne and the 15 national environmental goals and their regional specifications.
(Region Skåne, 2001)

The vision for SkåneMaTs is:

> *"The Scanian transport system is sustainable. The transports are environmentally friendly and the regional environmental goals fulfilled for the transport sector." (Mårtensson, 2004)*

The four developing goals in the programme Scanian Viability growth, attraction forces, strength and balance has been combined with the four national environmental goals connected to the traffic; limited influence on climate, fresh air, only natural acidification and a good built-up environment. Together they have formed the basis to make the Scanian transport system sustainable. The ambition has been to make Skåne work as one common living and labour market that could benefit all parts of the region. At the same time this could lead to increased transportation with the risk of increasing the environmental problems. (Mårtensson et al, 2002)
The challenges have to be to develop the enlargement of the transports based on an environmentally friendly transport system in Skåne and environmentally adapt the goods transports in and through Skåne. The following three objectives conclude the ambition:

- Fast, effective train and bus traffic connected to other modes of transport: "The perspective of the whole trip"
- Collaboration between social, infrastructure, public transport planning and environmental strategies
- Best technique and best behaviour patterns

(Mårtensson, 2004)

Some areas, with corresponding measures, to attend to that will contribute to adapting the Scanian transport system to the environment are:

- Increase the share of public transport of the total transports by extended railroads with person transport, Park&Ride, increased standard; accessibility, frequency, information.
- Social planning for reducing the environmental impact from traffic by planning from a public transport-point of view, development of comprehensive plans, a combined social, traffic and environmental planning.
- Influence on behaviour and attitudes with the purpose of making the transports more environmental by Mobility Management, regional mobility centres, collaboration with regional employments, eco driving.
- Increase the use of bicycle by safer environment for cyclists in the cities and on the countryside, improved and increased network locally and regionally.
- Increase the use of alternative fuel by strategies for a covering network of tank stations, joint contractation to increase the demand.
- Adapt the goods- and transit traffic environmentally by streamlining and coordination of goods transports, facilitation of intermodal systems, cooperation between harbours and the region to reduce the need of land transports.

- Influence the direction board of the regional, national and international means of control by discussion about what means of control that need to be changed, actively try to influence the government and EU.

(Mårtensson et al, 2002)

As a continuation of the project suggestions have been formulated in some key areas:

- A regional centre for environmentally friendly transports
- Environmental adaptation of all the transports in the public sector
- Social planning benefiting environmental transports
- Continued development in the public transport sector
- Environmental adaptation of goods and transport traffic and maritime traffic

One partial project is called Stråk-MaTs (thoroughfare) and studies the commuting sections in the region and how they can be more sustainable. The sections deal with great quantities of travellers concentrated in the western area and around Kristianstad. One forth of the trips is 15 km or longer crossing more than one municipality.
Another partial project deals with the countryside, and is therefore called Landsbygs-MaTs. The study suggests various measures to reach a good solution of how to promote sustainable transports in sparsely populated areas and how the inhabitants can reach the thoroughfares easily. (Mårtensson, 2004)

Due to the fast development in the area of Öresund there might be possibilities to extend the project to include Copenhagen and Zealand in the future. Close cooperation has been held with the municipalities, transport authorities and the county administration in order to keep the regional perspective. Responsible part is the Region Skåne. (Region Skåne, 2001)

4.2.2 Västerås traffic plan

Västerås is an average city just west of Stockholm beside the lake Mälaren, see appendix 3. The population is 126.328 people and the motorization index of 424 per 1000 inhabitants (2004), which is relatively high for a city of that size. Around 100.000 inhabitants live within a radius of 5 km from the city centre. An important part of the traffic is the motorway E18, which is used by a large part of the local traffic at the same time as the thoroughfare traffic effectively cross the city.
The present traffic situation doesn't bring any actual problems; the bicycle and pedestrian network is extensive and secure, the road system distances are short without any severe capacity problems and the public transport network covers a large part of the community. Despite these conditions extensive measures have to be done in order to create a long-term transport system for both trade and industry and private persons.
(Västerås stad, 2004)

According to the study of travel habits made 2001, 36 % of the travels to school or work are shorter than 3 km and 28 % are between 3 and 5 km. 54 % admit that they could go by bicycle more often and 15 % answer the same referring to public transport. 9 % are willing to join a carpool.
The modal distribution is presented in figure 20.

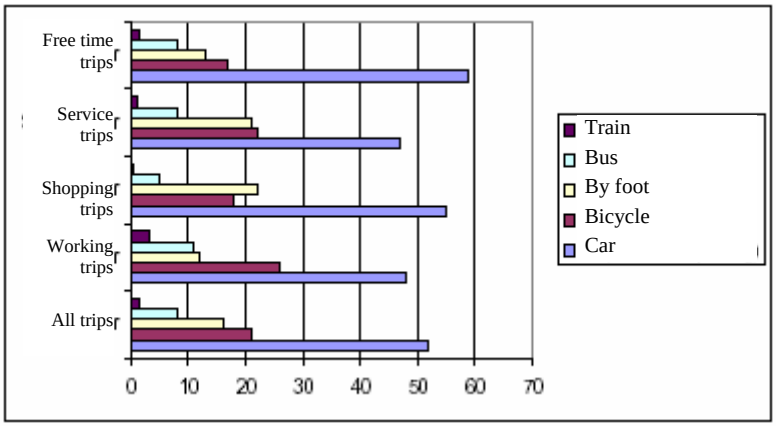

Figure 20: Modal distribution in Västerås 2001. Source: Västerås stad, 2004

The Västerås Traffic Plan is a part of the comprehensive plan developed primarily for the population centre of Västerås. The purpose of the plan is to designate how the transport system should develop in order to reach a sustainable city on a long-term view; as well ecological, cultural, economical as social. The following overall goals have been formulated for the period 2004-2013:

- Accessibility, security and closeness for everybody
- Attractive traffic for pedestrians, cyclists and public transport
- Sufficient transport quality for trade and industry
- Decreased percentage private car traffic of total transports
- Beautiful and functional formation of the streets

(Västerås stad, 2005)

The basis in the traffic plan is the transport political and environmental goals developed by the government. Other documents are the objectives taken by the municipal council for the comprehensive plan. The objectives that concern transports are:

- The air in Västerås shall not cause health or environmental problems locally, regionally nor globally.
- Non-renewable resources shall be maintained for future need and consume.
- Västerås shall offer a good environment for all inhabitants today and for all future generations.

Figure 21: The river Svartån in Västerås. Source: Foto Västerås stad, 2006

In order to reach a sustainable usage of the road traffic systems a mixture between influences on behaviour and new technology is suggested. The four-step principle by the National Road Administration will be applied at new planning and a new transport information centre will be created, among other things responsible for projects around

traffic matters in the residential areas. To increase accessibility and security for cyclists and pedestrians the passages will be attended to and signposts placed at the main roads. There will also be some expansion of missing links and recreation roads along Mälaren. The measures planned for the motorized road network are mainly the rebuilding of some junctions to roundabouts and new connections to the motorway E18 to increase the throughout of vehicles.
New buss stops and new bus routes will enhance the accessibility and traffic safety for public transport. Biogas buses will be bought. A more attractive city will be realised through making a tree plan for the main roads and rebuild and form the roads and the entrances to the centre. The traffic with charter and pleasure boats is popular due to the localization of the city. In the future the charter boats will be included in the public transport network and the possibility to make land will be improved. This is a way of marketing Lake Mälaren.

The physical measures suggested will reduce the transport need for the citizens even if it for some places might augment the time travelled. An analysis of a "maximum scenario" if all measures are implemented show that the increase of time travelled with car from the outskirts will be at most 1-2 minutes. The goal of a sufficiently high transport quality will be maintained.
The measures are supposed to lead to an increment of walking and bicycle traffic and public transport with improved safety and accessibility. The goal is that the bicycle traffic will increase with 40 % by 2005 and public transport with 50 % during the plan period. The measures will also lead to a more beautiful and pleasant street atmosphere. A positive and nice surrounding creates a calmer traffic rhythm and increases the teamwork between the traffic users.
The car traffic will most likely increase even though all these measures are done. Anyway this is a step on the way and together with more information, influence on behaviour and priority given to public transport, biking and walking it will be possible to reach the goals. (Västerås stad, 2004)

4.2.3 TRAST

A fact has been established that the planning tools that have been used since the beginning of the 80s', give advices that today are out-of-date. Therefore the municipalities, the National Road Administration, the National Railway Administration and the National Board of Housing, Building and Planning have developed a new tool; TRAST – traffic for an attractive city (trafik för en attraktiv stad). It is a planning tool supporting municipalities to develop a balanced traffic system. The overall concept is based on the architectural, environmental and transport political goals with the condition that the traffic system support and evolve the unique character of the population centre. (SKL, 2005)

The main purpose with the project TRAST is to develop a manual leading the user through a city planning process containing consideration towards interests of house planning as well as traffic planning. Areas like environment, traffic safety, aesthetical design and accessibility, that in the past weren't considered important, nowadays play a significant role. (Vägverket (2), 2004)
The first edition, from 2004, is divided into seven chapters in the following areas:

1. The city character – how the traffic and street spaces influence the character of the city and vice verse.

2. Travel needs – well-presented description of person travels primarily in population centres and how travelling can be influenced.
3. Accessibility – description of the concept, influences and improvements.
4. Security – what creates security, how to measure it and how it can be improved.
5. Traffic safety – claims on traffic safety, how to judge and improve it.
6. Environmental effects from traffic – the different types of environmental effects the traffic contribute to and solutions to decrease them.
7. Networks – pedestrian, bicycle, public transport, travel centres, car traffic, goods traffic and emergency services traffic.

(Vägverket (3), 2005)

At the moment various projects are going on with the aim to show the possibilities of working with the tool or parts of it and at the same time evaluating it. (SKL, 2005)

In Botkyrka city, a suburb to Stockholm, an inventory has been made considering accessibility. Six passages going through the centre has been chosen, measures has been suggested and a consequence appraisal been made.

In Huddinge, another suburb to Stockholm, a study has been made investigating adequate indicators that can be used in the planning of a new exploitation area in order to increase the competitiveness of the sustainable traffic networks for pedestrians, bicycle and public transport.

Figure 22: Accessibility? Illustration from the TRAST-report in Botkyrka. Source: Exempelbanken, 2005

In Leksand, a picturesque city in the County of Dalarna, an overall picture for public transport is being created with the help of TRAST. Alternative route networks and the establishment and design of a central bus stop and their consequences are the main studies. (Exempelbanken, 2005)

5 Comparison

5.1 Future situation

In this chapter future scenarios for Spain and Sweden are brought up together with goals that will be hard to fulfil and goals that will be easier. New planning has also a part.

5.1.1 Spain

Urban expansion

Spain and Europe in general have problems with the urban expansion occurring. More and more people prefer to live on the outskirts of the cities. At the same time the concentration of workplaces and commercial centres situated on the outskirts is increasing, provoking a continuous increase of the distance of movements for all modes of travelling in general, but trips to work in particular. Moreover it is predicted that the distance will increase further on the next coming years. The access to basic services, like supermarkets, is getting more dependent to the private vehicle leading to an increase of index of motorization. As the transport gets more efficient, the distances grow, while the time of movement stays more or less constant. As a consequence the negative effects of transports augment. (Monzón et al, 2005)

An extended urban area, increment of the dependency of the private vehicle and reduction of the efficiency of the public transport are bad conditions for a sustainable mobility.

Road safety

Spain has severe problems with road accidents. Road Safety Programmes in Spain are decided on annual basis. Most measures are defined fairly generally and don't give and specific targets or time frames. Some of the measures include education at schools, road safety campaigns, improvement and construction of roads and review of the current legislation. (EU-commission (2), 2005)
The main reasons of killed or injured are:

- a low use of seat belt
- high speed
- driving under the impact of alcohol or other drugs

Many accidents happen during weekends when a lot of people are visiting friends and relatives, why large campaigns are being carried out especially during these times. Real time information signs on the motorways are suggesting an adequate speed based on traffic circumstances, visibility and weather and also telling when there is risk for congestions, reminding to put on the seat belt, accidents that have happened, road works being carried out and how many people that died during the same time last year.

Emissions

As seen in the previous chapter, Spain is facing problems with fulfilling the European directives on emissions of pollutants and greenhouse gases, especially PM_{10} and CO_2. The Environmental Department has lately started publishing decrees and strategies over how to lower the emissions of CO_2, whereof the National Plan and Law of Emission is one decree including actions. In order to meet the goals put up, further measures, probably stricter ones, have to be implemented. In this case the transport sector is a key sector. Future objectives will follow the European directives taken.

5.1.2 Sweden

Urban planning

A new point of view is being established for medium sized cities, where traffic and urban planning have to be looked at as a whole when developing the city. In the new planning

- All cities should represent a pleasant and healthy environment for all inhabitants; children, elderly and handicapped included.
- Men's and women's values should have equal importance.
- Emissions from CO_2 and pollutants originating from traffic have to be reduced.
- The national traffic safety programme "the 0-vision" with zero killed or severely injured persons in traffic accidents will continue.
- The Swedish Government believes that public transport should be made more competitive
- Bicycle traffic should augment and be made more secure.
- Everybody working with transports, roads and planning should take more responsibility for the effects on environment and safety transports constitute.

These decisions are basically based on new knowledge about traffic effects and human needs of accessibility and positive experiences in the city. But it is also a manifestation of a new value of the roles of the car and other modes of transports in the development of a long-term sustainable society. It has also been more important to let the citizens be a part of the progress of their living space, where the traffic system is an essential part. (Västerås stad, 2004)

Traffic safety

The goal for the 0-vision 2007 of maximum 270 killed in the traffic will be hard to reach. Even if the number is decreasing, recently figures indicate a preliminary number of 440 killed during 2005, the lowest number since the II World War. (Vägverket (5), 2006) Despite this the leap to 270 is probably too much.

Emissions

According to a follow up made in 2004 by the European Environment Agency (EEA) only Sweden and Great Britain will succeed their part of the measures reducing the greenhouse gases according to the Kyoto protocol by 2010. A prognosis made by the National Environment Protection Board calculate that the emissions of CO_2-equivalents will decrease to 1 % under the levels of 1990 by 2010, but then start increasing by 2020, mostly because of increased emissions from the transport sector and the production of electricity and heat. (Miljömålsportalen (2), 2005) If no further measures are done for NO_x, it will be hard to reach the goal, despite the decrease the last years. (Naturvårdsverket (2), 2004)

A challenge for Sweden is to break the pattern between increased economical growth and increased impacts from goods transports. The transport work has increased the last 10 years and though the engines are more effective the increased traffic counteract the trend. (Naturvårdsverket (1), 2004)

5.2 Spain vs. Sweden

In order to see more clearly the similarities and differences between the two countries this chapter is focusing on the comparison subject by subject.

5.2.1 Urban and traffic characteristics

Table 4: Comparison between Spain and Sweden

	Spain	Sweden
Inhabitants (persons) (2004)	44.108.530	9.011.392
Area (km^2)	505.182	450.295
Municipalities >100.000	58	13
Motorization index (2003)	596	498
% of households with >1 car (2001)	70	74
Modal distribution (%)		
- Car	49	55
- Public transport	11	10
- Walking and biking	35	30
- Other modes	5	5
% of work/study trips	53	49
Length of round trip to work/day (min)	47	49
Number of trips/day	1,9	1,7

When comparing the two countries, there are of course a lot of differences, but also surprisingly a lot of similarities. Both countries have a similar distribution of people; vast depopulated areas and cities and regions with high density. However, the number of people in Spain is almost five times larger while the area doesn't differ much at all, which means that there are many more large cities in Spain.

As can be seen in figures 6 and 12 over the development of motorization Sweden had a high increase between 1975 and 1995. After that the raise is lower with several plateaus though it is not saturated. Spain has a curve looking like a straight line starting around 1970 and still continuing. Every year is a new top year.
When I first saw the numbers of motorization index, it surprised me that Spain has a higher index than Sweden. After further investigation I found out that Sweden was only counting private cars while Spain included motorbikes as well. The number of motorbikes in Spain exceeded 1.500.000 in 2003 (DGT, 2004). When adding the numbers of motorbikes and snowmobiles to the Swedish rates it still didn't reach the Spanish index but stay on 498 vehicles per 1000 inhabitants. But, when counting private cars only the indexes are 457 and 454 for Spain and Sweden respectively. This number also corresponds to the similar distribution of cars per household (where motorbikes are excluded).

Spain has opposite to Sweden a higher rate of cars in urban areas than on the countryside. According to the mobility inquiries presented earlier Madrid community has the highest motorization index and also the highest use of public transport. Stockholm on the contrary, and to me more logical, has the lowest motorization index and the highest use of public transport.

In general the modal distribution is very similar as well as the percentage of trips destined to work or studies. A slight difference, not seen in the table, might be that within the mode "walking and biking" more people in Sweden go by bicycle compared to Spain. Also the time spent on movements to work and the average number of trips during one day is similar.

When reading the two mobility inquiries, Movilia 2000 and RES 2001, many more similarities can be concluded: the motives for a trip, time dedicated each day, modal distribution, which categories that do which kind of trips and so on. All of these values indicate that these are two countries from the same culture.

5.2.2 Road safety

A large difference however is the number of traffic accidents. Even if Spain has more inhabitants and more motor vehicles the following table talks for it self.

Table 5: Statistics over the number of killed people in Spain and Sweden in 2003. Source: Vägverket (4), 2005

	Killed	Inhabitants (1.000.000)	Motor vehicles (1.000)	Killed per 100.000 inhabitant	Killed per 100.000 motor vehicle
Spain	5399	42,2	25.170	12,8	21,5
Sweden	529	8,9	4.998	5,9	10,6

Sweden has together with Norway one of the lowest rates in the world. Spain on their behalf is situated among the ones with highest death rate in Europe, slightly better than Portugal, Greece and Belgium.
In order to achieve a reduction of the number of accidents in general and the number of killed and severely injured I think Spain has to adopt a traffic safety strategy to be valid in the whole country. The information campaigns that are carried out are a beginning that has opened the eyes to many persons. Stricter controls and information about the effects of careless driving together with reconstruction of dangerous road intersection is the only way to reduce the fatalities. Despite this the news continues to report about fatal accidents everyday.

5.2.3 Emissions

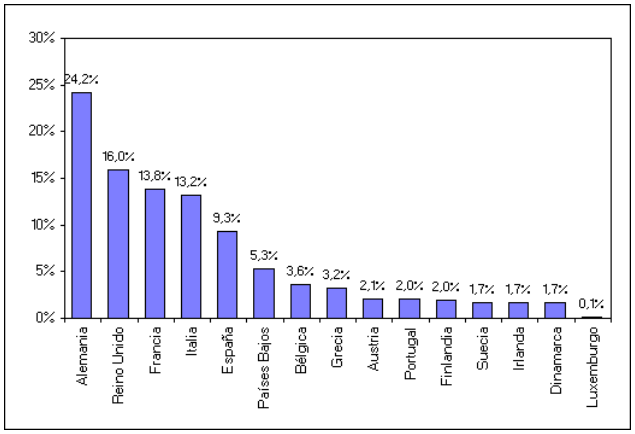

Figure 23: Total contribution of CO2 from each EU member of the total emissions in 2001. Source: MMA, 2004

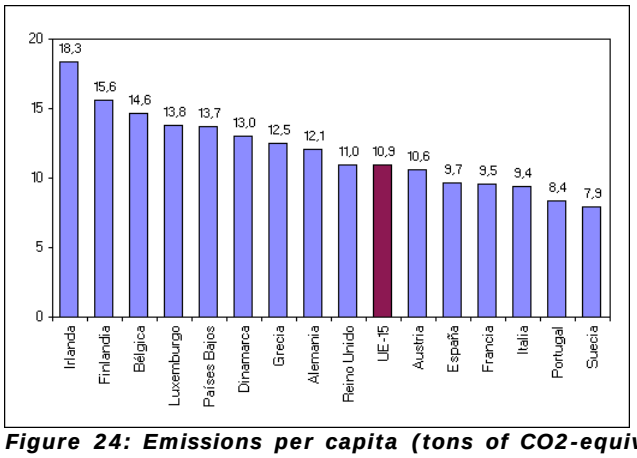

Figure 24: Emissions per capita (tons of CO2-equivalents per inhabitant) for each member state in the EU the year 2001. Source: MMA, 2004.

Spain has large problems with emissions from transports, both noise and pollutant contamination. Of the total contribution Spain is on the fifth place of the EU-15 countries that emit most CO_2, with 9,3 %. Sweden contributes to 1,7 %. However if comparing emissions per capita Spain emits below the average of the EU-15; 9,7 tons and 10,9 tons respectively. Sweden is on the last place with 7,9 tons of CO_2-equivalents per inhabitant. Still the CO_2 emissions are increasing in Spain and not decreasing enough in Sweden, making it hard for both countries to reach the goals on a long-term view. Acidifying substances and particles are another big problem. Despite all measures done the increase of traffic appears to offset them and there is no tendency of improvement. Good news is that both countries fulfil the goals respectively for SO_2 and O_3 and that ozone precursors are decreasing. Regarding noise high levels are much more frequent in Spain. An estimated 23 % compared to 3 % of the population is subdued to noise higher than 65 dB(A). In real numbers it means that over 1 million Spanish citizens are suffering from high noise levels.

5.2.4 IT

Sweden in general has quite a lot of Internet information about traffic available. The web page www.trafiken.nu tells about the present traffic situation in the whole country in general and the metropolitan area of Stockholm in particular. On the homepage of the National Road Administration is offered a theoretical course in eco driving. Many municipal homepages also offer viewers to calculate how much CO_2 they emit based on travel habits and energy consumption in their homes. On the Stockholm bus company homepage it is possible to plan your trip using bus and metro within the metropolitan area; mode of transports, time of departure and arrival, where to change and time of travel is calculated.

The municipality of Madrid has a web page, www.munimadrid.es/movilidad/, telling about the traffic situation on the streets of the capital, e.g. if they are dense or fluid, where there are road works or accidents, and so on. It also has a link to traffic planning within Madrid. The General Board of Traffic homepage, www.dgt.es, tells the situation on national motorways, more biased towards weather conditions but also the situation of road works. Spain has apart from this a rather well functioned and developed real time information system on motorways.

5.2.5 Opinions from inhabitants

This part is completely speculative from my point of view. The opinions from Spanish inhabitants don’t come from any special person but is a summary of the atmosphere.

Since the people I know here are from Madrid capital it might not represent the general Spanish attitudes.
Starting with Sweden I would say that most citizens know that transports cause unwanted effects and how these effects affect themselves and the environment. Many are also aware of how these effects can be avoided to some extent. Swedes have a special relationship to the nature. If something is enduring their environment or their health it affects them strongly. Therefore carrying out measures improving the environment of people are quite well seen, even if it means to give up commodities or change habits. They like peace and quiet and appreciate surroundings without noise or contamination.
Spanish inhabitants are rather egoistic and comfortable and few people can consider sacrificing their commodity for such an abstract theme as improved environment. Measures that could entice them to change habits are such giving them better economy or accessibility. If a certain measure leads to a better private economy or that the congestion on their way to work is reduced they could accept it, but still they prefer that someone else do the sacrifice to achieve the benefits.

6 Measures

When talking about the problems and what has to be done in an area the focus is often put on the goals that have to be reached and the way to reach them is put on second place. In appendix 7 are measures and activities listed that can be used in order to reach the goals that could be included in a sustainable urban mobility plan. For some of the measures a comment of when to use it has been added.

6.1 Different measures in different places

In order to conclude all the measures that has been and will be carried out in the European projects described in earlier chapters I have done a cross table summarizing them. I have tried to gather the measures into some headlines where improved bikeways include new bikeways and bicycle plans, safer bikeways include rebuilt intersections, better illumination and new asphalt and alternative fuel mean all kinds of no conventional fuels.

Table 6: Measures planned or carried out in European mobility/transport plans

	Grenoble	*Leeds*	*Apeldoorn*	*Graz*	*Terrassa*	*Burgos*	*Lund*	*Skåne*	*Västerås*
Mobility Centre/Office	*X*			*X*			*X*	*X*	*X*
Mobility Management		*X*	*X*	*X*		*X*	*X*	*X*	
Real time Information	*X*			*X*	*X*	*X*			
Pedestrian Zones/Plans			*X*	*X*	*X*	*X*			
30-zones	*X*	*X*	*X*	*X*	*X*				
Improved Bikeways		*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*
Safer Bikeways	*X*		*X*				*X*	*X*	
Bicycle Parking	*X*			*X*			*X*		
New PT routes	*X*			*X*	*X*	*X*	*X*	*X*	*X*
Improved PT routes	*X*	*X*		*X*					*X*
Increased PT accessibility			*X*		*X*	*X*		*X*	
HOV-lanes and bus priority		*X*		*X*			*X*		
Park&Ride	*X*	*X*		*X*			*X*	*X*	
Alternative fuel				*X*		*X*	*X*		*X*
Carpools/Car sharing		*X*				*X*	*X*		
Ring Roads	*X*				*X*				

The two most common measures are as can be seen new bikeways and improved public transport routes, which almost all cities think are worth investing in. Another popular

measure seems to be pedestrian zones and 30-zones – measures for the weaker and more vulnerable traffic users as well as Park&Rides and special bicycle parking. A new tendency that can be seen is the importance put on parking policies, especially in city centres. Ring roads for car traffic and similar measures haven't got high priority, neither to use IT offering traffic information and realising campaigns, etc. However the mobility centres and mobility management seem to gain importance.

6.1.1 Comments on plan objectives

Something all European cities in the study are mentioning as important objectives is the increase of alternative modes of transport and the integration of different transport modes in the planning. The most important mode seems to be public transport, which is mentioned as an objective in almost all plans. An increase of traffic safety is also a prioritised measure. The improvement of air quality with less emission of greenhouse gases, pollutants and noise is also mentioned together with reduced traffic levels and creating open spaces and pedestrian zones for the citizens. Objectives mentioned in lower extent are collaboration in different kinds of planning, increased responsibility among citizens and making sure a competitive economical growth is possible with sustainable development.

6.2 Cases

When taking a position to how and where to implement the mobility plans many different aspects have to be taken into consideration. I think the most important start is to state in what kind of region the mobility plan should be implemented; is it a dense solitaire city, a region with close connection within various population centres, etc. The second statement is to find out which problems this area has and which improvements would have the best effect. After that, measures, indicators and an appropriate implementation should be selected.

To show different kinds of measures that can be implemented, three cases have been made up. In these three cases the measures are suggested in such a way that they are already implemented in a sustainable urban mobility plan. First the characteristics of the city are described briefly and after that measures are suggested that can be adequate and the result they are supposed to give. The measures suggested can be found with a more detailed description in appendix 7. The cases are just suggestions from me that I think would be efficient. Most measures suggested are activities within management, organisation and change of behaviour; not so many suggest construction or reconstruction.

6.2.1 Average city with large residential areas

Case 1 is an average city with large residential areas and a quite disperse structure, a small city centre where the commerce is concentrated and with few own workplaces why there is an intensive commuting to other cities.

The supply of public transport in many cases can't be satisfied in cities with disperse structure because of large distances and low density in the residential areas. In this case the bus routes have been restructured to cover as many inhabitants as possible, without loosing time on longer routes or more stops. By letting the bus go through the residential areas instead of around them the number of users has augmented. To cover up special groups flexi routes for disabled and elder people and a "Yellow school bus" taking children to school and back home have been established. The service to the

inhabitants commuting every day have been increased by e.g. adjusting the timetables for urban and interurban public transport to working hours and offering a fast trip without to many stops on the way. The bus route frequency has been augmented on the afternoons and evenings for people who want to stay a little after work.

The affected neighbour municipalities cooperate more leading to a transport system going from “door to door” with one ticket valid in the whole region. In connection to regional public transport stations Park&Rides and Bike&Rides have been established to offer inhabitants to use public transport parts of their trip. All new and restored car parks have engine pre-heaters. Another interesting measure for this city is the implementation of carpools and campaigns about car sharing.

An extensive bicycle network has been established with safe, separated bikeways, well illuminated. The bikeways have targets like schools, bus and train stations, sports centres and residential areas. The residential areas are considered 30-zones.

Since this is a commuting city the information technology is used to reduce trips to work. An IT-centre within the city boundaries gives the possibility to work from home with all the office equipment necessary. This is also a way for the private person to save time and money to use for other interests. A recently opened mobility centre is coordinating the municipal councils and the companies, public transport, car pools and the IT-centre.

6.2.2 Average city, important commuting centre

The city in case 2 is a little bigger than its neighbour in case 1. Still it is an average city, but more dense and with a higher economical importance and a lot of workplaces. It receives quite a lot of commuters from the neighbouring municipalities causing a lot of traffic followed by congestion at rush hour.

The first measure that was implemented was trying to organize all the working trips entering and leaving at special hour’s everyday. By introducing Park&Rides outside the city and special work buses leaving from there at rush hours, apart from the regular public transport passing, some traffic have been reduced the last way. One lane entering and leaving the city on the largest entrance roads is reserved for bus and HOV at rush hours in order to increase de accessibility for public transport. On the entrances real time information signs show where to find available car parks and even information about the present traffic situation.

The thoroughfare traffic doesn’t have to enter the city centre since it’s distributed on ring roads and radial axes. However, the centre activity is still high with especially a lot of goods transports delivering at all hours. To decrease the amount of lorries a distribution central has been established where all goods are redistributed and the lorries filled up. The routes are planned to be as efficient as possible and it is only allowed to unload before 11 o’clock each morning.

It is obviously as impossible to have public transport to all workplaces, as it is to cover all residents. Therefore the public transport company allows people to bring bicycles on some departures. The owner can in this case go by bicycle from home to the bus station, go by bus and then when reaching its stop continue by bicycle to the workplace. Another alternative has been to establish Bike&Rides at large interchangers, guarded to

avoid thefts and destruction. Since this is a quite dense city the supply of bike roads is a good measure. Well prepared surfaces, good illumination and separated from motor traffic and pedestrians the bikeways serve the workplaces as well as the city centre.
In cooperation with companies "Try it-periods" on public transport will be offered to routine-car drivers to see if they might change habits.

6.2.3 Large city with great economical importance

This is a large city, an economical centre in the area attracting people from all its surroundings. A major problem is the traffic in the city centre. The city centre is a commercial centre where pedestrians have to share space with goods transports, buses, cars and motorbikes. Museums and specific attractions are situated there and within walking distance. The high noise, air pollution and unsafe surroundings can be highly unpleasant some days.

The first measure that was implemented was to transform some areas into pedestrian zones and apply the "onion skin model" from Graz on the centre core. Large passages only permitted for pedestrians are combining attractions, museums and the pedestrian zones. Goods transports have been restricted**,** just being permitted some hours per day – before 10 o'clock in the morning. Several studies indicate that business increase their benefits in areas where motor traffic is prohibited or limited. The motor traffic has been directed to ring roads in several levels and thoroughfares in between all according to the onionskin model. Barriers of traffic have been avoided as much as possible through creating tunnels for car traffic and pedestrian crossings at different levels. Green spaces and new-planted trees are augmenting the city quality, creating a calmer atmosphere on the streets.

One known effective measure to reduce car traffic in city centres is by parking restrictions. Vehicles searching for a parking lot create a lot of traffic. By limiting the pavement parking and even banning it the searching traffic has diminished. At the same time signposting to parking houses show the nearest way to an available parking lot. Another measure has been to increase the prices in the city centre and indicate to parkings outside the centre core. People leaving their car there to transfer with public transport the last part get a discount on their ticket. Real time information about free parking spaces put up at entrance roads give travellers easy option.

Since the traffic is very dense in this city, public transport measures have been prioritised bicycle measures for security reasons, since cyclists are more vulnerable than motor traffic users and for economical reasons. Many road sections would have to be reconstructed to include bike lanes too. For public transport one of the principal targets has been to create an attractive mode as fast and uncomplicated as a private one. Therefore special bus lanes have been created and bus priority installed in the traffic lights. In order to increase the commodity all buses have been equipped with low platform and the frequency of the bus routes have been augmented. Real time information systems at bus/train and metro stops are appreciated details making it so much easier for a traveller, and integrated taxes for all existent modes of public transport in the region are facilitating for people living or working in suburbs.

To reduce work trips within the city a campaign for video- and telephone conferences have started, hoping for good result. The mobility centre works with information about

public transport, tourist information, renting eco cars and coordinating marketing to travel in the most environmental mode as possible.

6.2.4 Comments on cases

For the three type cases I have tried to describe cities that actually exist. The first two ones can be compared to Swedish average towns, in reality they can be neighbour cities as mentioned in the beginning of case 2, where city number 1 would be the suburb to number 2. For case 3 I thought of a large metropolitan city, maybe even as large as Madrid or Barcelona.
It will not be possible to implement all measures suggested for each case due to the urban planning and construction of the cities, but they are real suggestions that can be combined and implemented in real cities.

The Stockholm trials
A highly topical case where different measures are integrated to get a higher effect is the attempt with car-tolls in Stockholm. The main objectives are to see if car-tolls or environmental fees, as they are called can contribute to the reduction of congestion, increase the accessibility and improve the environment.
18 pay stations have been put up at the entrances to the centre and all vehicles entering or leaving the city centre have to pay 10, 15 or 20 SEK depending on the point of time between 6.30 and 18.30. At the same time 16 new bus routes and 197 new buses have extended public transport and the frequency of buses, subway and commuter trains have been extended. New Park&Rides have been constructed in connection with the entrances and the public transport routes. (Stockholmsförsöket, 2006)
When writing this trials have been going on for a month and it is still too early to draw any conclusions, even if the first results are showing a reduction of traffic in the city centre.

7 Conclusions

Is a comparison possible?

After doing this study about sustainable urban mobility plans I would say that it is possible to compare the two countries. Since both are European countries with similar characteristics, economically and in urban distribution the similarities are more than the differences. What is more important than the country characteristics is the type of city, as presented in previous chapters.

The same model would be possible to use in traffic planning in cities in both Spain and Sweden and probably the whole Western Europe. However, when making a sustainable urban traffic plan, it has to be made considering the different types of cities existing. Therefore a handbook, similar to the one being made in Spain is my suggestion. In the handbook the authorities get ideas of the kinds of measures they can implement and the best ways of doing it for their case.

The guide being developed in Spain is a very good idea. Its aim is to help Spanish municipalities reach a better traffic situation, giving ideas of how to change special problematic areas. I also think that it is a good idea that it won't be an obligation to implement these plans, but an enticement for the municipalities. The subsidy follows the same line as the financial rewards being handed out in the UK. This is a good way to encourage continued work and the improvement of already reached goals. It can also be used as marketing within the municipality, so that the citizens can measure the achievements of the activities being carried out.

The role of the European Union

The European Union could be responsible for writing and publishing such a handbook. They have collected experience through many of the projects being carried out in European cities since the end of the last century that can be summarized and used for future work. I am not sure though, that a decreeing directive from the EU would be the best solution for implementation of sustainable urban mobility plans. If it would be possible to agree of a traffic plan within EU is more a political than technical question. The European Union programmes like CIVITAS and Smile are good. EU should continue subsidise such programmes in the future too. They bring the cities closer to each other, are perfect ways to learn from other's mistakes and a help to quickly get knowledge of an area and what could work and what could not work. However all results obtained have to be analysed for the area of research, what work in one city might not work in another and vice versa. And by changing a way of implementation of an activity just a little the outcome could be completely different.

A problem could be that the new members in EU in Eastern Europe have a different traffic distribution and urban tradition than the west and even if it would be possible to use the same plan, it might not be recommended. More research should be done in this area. One thing to try to avoid is that the countries in Eastern Europe convert their present transport distribution into a western style of living. At present they have a high percentage of public transport and a relatively low use of the private vehicle. With the economical development expected in this region after the entrance in EU, a change in modal distribution is likely to occur. These countries need help to develop their public transport and maintain their users, continuously replace old vehicles to newer ones and make the citizens conscious of problems caused by traffic.

Ways of implementation
If it would be possible to do the implementation in a similar way, I don't know. I think this is the key question for a successful mobility plan in what so ever the country or city. We have reached quite far in Europe with developing measures, improving motor vehicles, etc. while the next step on the agenda has to be how to implement this. Marketing and get authorities to understand the necessity of changing transport travel habits are important steps of continuation. To speed up the development a directive from the EU might be a good suggestion. For the plan to get legitimacy from the beginning the implementation should be concentrated on key issues for the area. The plan should of course consist of other measures too, but maybe be applied with a lower profile than the key measures and when being evaluated call the attention on the effects and improvements they have contributed to.

None of the European plans can be considered real sustainable mobility plans that can be implemented right away. They are on a good way though, using a lot of interesting means and measures and shouldn't be forgotten in the future. The most important thing is to evaluate the measures that have been carried out and see what improvements that can be done. The key activities and indicators depend completely on the characteristics of the municipality and what it wants to achieve. This is also an area that needs more research.

One of the most important means of implementation is a strong organisation and management that can conduct the measures and activities and spread information before, during and after applying them. The information should consist of advantages, disadvantages and why a special measure is implemented in a certain way or on a special area. Commitment is needed from politicians and traffic authorities in order to reach acceptance from the citizens. The case of Graz is a good example of where political commitment have led to good results and Lund is a good example of where large information campaigns have made inhabitants aware of their travel habits. I am also in favour of citizen forums, where the people are given the opportunity to say their meaning and maybe even be a part of the planning. After all, the measures are supposed to lead to an improvement for them.

Urban planning
Traditionally urban planning in Sweden hasn't been very sustainable. The typical characteristics of a municipality is a small city centre with a thin ring of blocks of flats, outside that starts the residential area consisting of individual houses with their own garden. These residential areas are quite dispersed and it can be hard to know where they start or end. They are occupying a lot of land creating longer distances to workplaces, commercial centres, free time activities, etc. The disperse extension also makes it difficult to create a competitive public transport covering the area in an effective way. Apart from that many people still live outside the population centres. These characteristics are not the best to form a sustainable mobility.
Spain on the other hand has rather good conditions. People live in well-defined population centres, close to each other and in blocks of flats. A Swede could wonder why they don't use all that land around that doesn't seem to be used for anything. This means that within a population centre it would be possible to create an efficient public transport system and bikeways. Between the population centres it would also be possible since there is only one goal for the trip. In a more diffuse urbanity it can be

difficult to decide where the goal is and the difference between urban and interurban transport.

Spanish cities, however, have had a tendency the last years to spread out. A diffuse city is much less ecological than a compact one from a transport point of view. There is a risk that the population centres get more similar to Swedish ones increasing the dependency of the private vehicle even more. A general norm is that the average time of movement in private vehicle augment with the size of the urban area while the average time of movement in public transport decrease with the size. Therefore a dense city is preferable for public transport.

Public transport

For public transport to be able to compete with the private car the accessibility, the time saved and the comfort have to be much better. For a car user to abandon his car in favour of another mode the cost has to increase, both for insurance, petrol and additional costs such as car tolls or parking; the accessibility has to be low or time spent on the road and in congestion to long; the commodity is also important, it's not the same commodity to sit in your own car as on a seat in a bus or standing in a metro; using a car gives more freedom, you can go wherever you want, stop to fetch or leave children, do errands, and so on. The public transport has to offer reliable, frequent and fast service, access to work, school, service, commerce and spare time activities and be cheaper than the car. A covering network is of course the basis to offer a good service.

For the public transport to be more competitive in Sweden it is indispensable to improve the regularity and speed of the services, especially at working hours in order to increase the number of travellers, but also offering later returns for those who want to stay a little longer. Large, growing cities in Spain have to include public transport routes when planning new urban areas. If the routes are not included from the start the trajectory might be very inefficient, longer than necessary and without covering the populated areas well enough. If the routes are not prepared when the first inhabitants arrive, the risk is that the people get the habit to use the car and won't change even if the public transport services are very good.

Since the supply of public transport is easier to fulfil in urban areas, measures increasing public transport and at the same time decreasing the use of private vehicle should have large impacts there.

Suggestions

I suggest that intermodality should be promoted. A good urban city is one were all modes of transports are used to the same extent, no mode forgotten. The mentality of when and how to use the car has to be changed though, the car shouldn't be used for trips shorter than 5 km. In this case public transport, walking or cycling are alternatives better or as good as the private vehicle considering the environment as well as the time of the trip. However for trips of middle distance the mobility of the car is incomparable. For longer trips, e.g. when going on vacations a choice of train should be considered.

I think that in order to achieve a major use of a new mode of transport, as in the case of bicycle use in Spain, it is indispensable to facilitate the use as much as possible in the beginning. This means that it is unavoidable to venture constructing the bikeways in the beginning in order to gain users and general acceptance. Examples that can be done are

offering an extensive network, illumination and safe surroundings, close and safe bicycle parkings, and very important give the ones using the network appreciation and credit. Massive cycle campaigns and letting bus lanes and parts of the road sections be used as bike lanes are other suggestions. Spain has after all a better bicycle climate than Sweden, even if there is a lack of tradition.

Swedish traffic and urban planning is concentrating on finding solutions for a better environment, better health and the damages the traffic is causing. A great deal of work is put on traffic safety. Swedes are well aware of the negative health and environmental aspects of traffic and also how to diminish them. The public discussion in Spain doesn't treat as much the negative aspects of the environment the traffic causes but more how to solve physical problems such as congestion and accidents. Emissions from transports are effects that come on second place thinking "if we solve the congestions the environment will benefit from that." This isn't a bad thought from the beginning, but I think it lacks future strategy.

I think that if traffic and urban planners don't start thinking and planning with an overall view, the problems we have in European cities at present won't be solved. Just thinking of one problem at a time, signify a continuation of the traffic, urban, social and environmental planning we already have. In order for a trend break to occur, the way of thinking and planning has to change. Lund has shown that a plan has importance as a means to follow the goals decided. As one of few cities the traffic hasn't grown over the last years. A plan is also efficient when evaluating the activities and its effects. This has been proved in England, where several indicators had to be changed after the first plan since it wasn't possible to compare the results obtained.

Most Swedish municipalities have some kind of plans for traffic, but an overall strategy is missing. It is possible that TRAST (Traffic for an Attractive city) might be an alternative in the future. Both Helsingborg and Umeå are elaborating urban strategies with the basis of TRAST. Other possibilities are to extend PBL (the plan and construction law) to include sustainability matters or to integrate them into the comprehensive plan. I don't recommend including sustainability in detail plans since the overall planning point of view would disappear. Of course a sustainable thinking should pervade all planning but the guidelines should be integrated on a higher level.

Spain should concentrate on solving the problems in the big cities and to do something about the depopulation of the countryside. In the last matter Sweden could be a good partner since they are in a similar situation. Sweden could be their model for bicycle implementation, both for construction and information. Sweden could learn from Spain about building large infrastructure systems such as ring roads and radial entrances, managing public transport.

Areas of continuation

This is just the beginning of the era of sustainable urban mobility plans, integrated plans that hasn't existed before, and a lot of investigation has to be made in order to make them an exit.

- The investigation about activities and measures has to continue.
- Ways of implementation have to be found out for different types of cities.
- Key indicators that can be used to evaluate and follow up the studies have to be decided.

- Type cases should be developed and applied on municipalities and cities as tests.
- Economical measures are important for the municipalities. Ways to cover expenses and system for awards should be developed.

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Appendices

1. Map of Spain and population and density for each region
2. Spanish cities with more than 100.000 inhabitants (2004)
3. Map of Sweden and population and density for each region
4. Swedish municipalities with more than 100.000 inhabitants (2004)
5. The National Swedish Environmental Policy
6. The Swedish Transport policy
7. Measures

Appendix 1: Map of Spain and population and density for each region

Source: Map of Spain, 2006

	Population	Area (km2)	Density (inhab/km2)
TOTAL	44.108.530	505.182	87
Andalucía	7.849.799	87.591	90
Aragón	1.269.027	47.698	27
Asturias	1.076.635	10.604	102
Balearic Islands	983.131	4.992	197
Canarias	1.968.280	7.447	264
Cantabria	562.309	5.253	107
Castilla-La Mancha	1.894.667	79.409	24
Castilla y León	2.510.849	93.814	27
Cataluña	6.995.206	32.627	214
Comunidad Valenciana	4.692.449	23.254	202
Extremadura	1.083.879	41.634	26
Galicia	2.762.198	29.574	93
Madrid	5.964.143	8.022	743
Murcia	1.335.792	11.313	118
Navarra	593.472	9.801	61
País Vasco	2.124.846	7.089	300
Rioja	301.084	5.029	60
Ceuta	75.276	19	3962
Melilla	65.488	13	5038

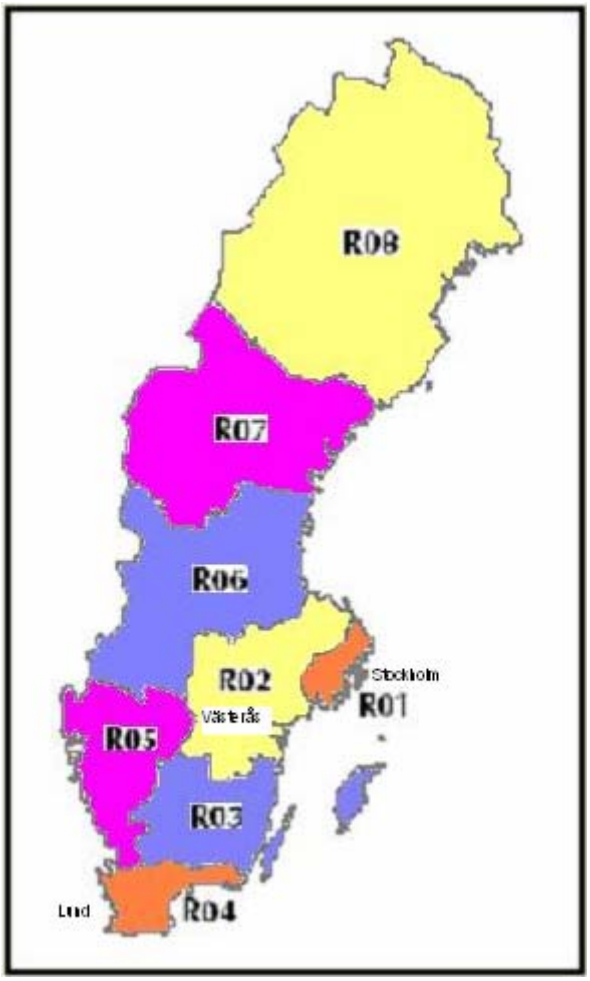
Source: INE (2, 3), 2005

Appendix 2: Spanish cities with more than 100.000 inhabitants (2004)

City	Population	City	Population
Madrid	3.099.834	Jerez de la Frontera	192.648
Barcelona	1.578.546	Pamplona	191.865
Valencia	785.732	Santander	183.799
Sevilla	704.203	San Sebastián	182.644
Zaragoza	638.799	Leganés	181.248
Málaga	547.731	Almería	177.681
Murcia	398.815	Burgos	169.982
Las Palmas	376.953	Castellón	163.088
Palma de Mallorca	368.974	Alcorcón	162.524
Bilbao	352.317	Salamanca	160.415
Valladolid	321.713	Getafe	157.397
Córdoba	319.692	Albacete	156.466
Alicante	310.330	Huelva	144.369
Vigo	292.059	Logroño	141.568
Gijón	271.039	Badajoz	139.135
Hospitalet De Llobregat	252.884	San Cristóbal de la Laguna	137.314
La Coruña	242.846	León	135.789
Granada	238.292	Cádiz	133.242
Vitoria	223.702	Tarragona	123.584
Santa Cruz de Tenerife	219.446	Lérida	119.935
Badalona	218.553	Santa Coloma De Gramenet	118.129
Oviedo	209.495	Marbella	117.353
Elche	209.439	Mataró	116.698
Móstoles	204.463	Jaén	115.917
Alcalá De Henares	197.804	Algeciras	109.665
Cartagena	197.665	Dos Hermanas	109.595
Sabadell	196.971	Torrejón De Ardoz	109.483
Fuenlabrada	195.131	Orense	108.600
Terrassa	194.947	Alcobendas	103.149

Source: IDAE, 2006

Appendix 3: Map of Sweden and population and density for each region



RO1: Stockholm County
RO2: The counties of Uppsala, Södermanland, Östergötland, Örebro and Västmanland
RO3: The counties of Jönköping, Kronoberg, Kalmar and Gotland
RO4: The counties of Blekinge and Skåne
RO5: The counties of Halland and Västra Götaland
RO6: The counties of Värmland, Dalarna and Gävleborg
RO7: The county of Västernorrland and Jämtland
RO8: The county of Västerbotten and Norrbotten

Source: SCB (1), 2002

	Population	Area (km2)	Density (inhab/km2)
Total	9.011.392	450.295	20
RO1	1.872.900	6.519	287
RO2	1.514.549	38.603	39
RO3	799.739	33.330	24
RO4	1.311.254	13.981	94
RO5	1.803.532	29.409	61
RO6	826.188	45.780	18
RO7	371.619	71.025	5
RO8	509.460	153.431	3

Source: SCB (4, 5), 2005

Appendix 4: Swedish municipalities with more than 100.000 inhabitants (2004)

City	Population
Stockholm	765.044
Göteborg	481.410
Malmö	269.142
Uppsala	182.076
Linköping	136.912
Västerås	131.014
Örebro	126.982
Norrköping	124.410
Helsingborg	121.179
Jönköping	119.927
Umeå	109.390
Lund	101.423
Borås	98.886

Source: SCB (6), 2005

Appendix 5: The National Swedish Environmental Policy

The Swedish Government took the National Swedish Environmental Policy in 1999. It contains 16 goals describing what quality and state of the environment that is sustainable in the long term.

1. Reduced climate impact
    a. Reduced emissions of greenhouse gases (2008-2012)
2. Clean air
    a. Content of sulphur dioxide, SO_2 (2005)
    b. Content of nitrogen dioxide, NO_2 (2010
    c. Content of ozone, O_3 on the ground (2010)
    d. Emissions of volatile organic compounds, VOC (2010)
    e. Content of Particles, PM_{10} and $PM_{2,5}$ (2010)
    f. Content of Benzene (2015)
3. Natural acidification only
    a. Less acid waters (2010)
    b. Break of trend for ground acidification (2010)
    c. Reduced emissions of sulphur and nitrogen (2010)
4. A non-toxic environment
    a. Knowledge and information about chemical substances characteristics (2010-2020)
    b. Reduction of the health and environmental risks with chemicals (2010)
    c. Goal value for environmental quality (2010)
    d. Activity programme in contaminated areas (2005-2050)
5. A protective ozone layer
    a. Cease of emissions of ozone decaying substances (2010)
6. A safe radiation environment
    a. Emissions of radioactive substances (2010)
    b. Cases of skin cancer caused by the sun (2020)
    c. Risks with electromagnetic fields (continuing)
7. Zero eutrophication
    a. Reduced emissions of phosphor compounds, nitrogen compounds to the oceans, ammonia and nitrogen oxides to the air (2010)
8. Flourishing lakes and streams
    a. Activity programmes nature and culture surroundings, restoring waterways, for endangered species (2005-2010)
    b. Establishment of water supplying plans (2009)
9. Good quality groundwater
    a. Protection of geological formations (2010)
    b. Consequences of changes in level of groundwater (2010)
    c. Groundwater quality demands (2010)
10. A balanced marine environment
    a. Protection for costal areas, fishing ban (2005-2015)
    b. Strategy for the preservation of costal areas (2005)
    c. Activity programme for endangered marine species (2005)
    d. Disturbance from boat traffic (2010)
    e. Emissions from ships (2010)
11. Thriving wetlands
    a. Strategy for protection and attendance of wetlands (2005-2010)

b. No forest roads will be built through wetlands (2006)
c. Restoration of wetlands (2010)
d. Activity programme for endangered species (2005)

12. Sustainable forests
    a. Protection for woodlands (2010)
    b. Reinforced biological multitude (2010)
    c. Protection for cultural remains (2010)
    d. Activity programme for endangered species (2005)
13. A varied agricultural landscape
    a. Attendance of meadows and pastureland (2010)
    b. Attendance of landscapes with cultural remains (2010)
    c. Genetic resources at domesticated plants and animals (2010)
    d. Activity programme for endangered species and biotopes (2006)
14. A magnificent mountain landscape
    a. Limit damages on ground and vegetation (2010)
    b. Reduced noise in the mountains (2010)
    c. Protection of areas with high natural and cultural values (2010)
    d. Activity programme for endangered species (2005)
15. A good built environment
    a. Urban planning (2010)
    b. Valuable historical settlement (2010)
    c. Noise (2010)
    d. Extraction of natural gravel (2010)
    e. Reduction and care taking of waste (2005-2015)
    f. Energy use in buildings (2010)
    g. No adverse impact on health from buildings (2020)
16. A rich flora and fauna
    a. Stop the loss of biological multitude (2010)
    b. Reduced percentage of endangered species (2015)
    c. Sustainable use (2007-2010)

Source: Miljömålsportalen (2), 2005

Appendix 6: The Swedish Transport policy

According to the Swedish Government the overall objective for the transport policy from 1998 is to assure a socially and economically effective and long-term sustainable transport supply for the citizens and the trade and industry in the whole country.
The objective is clarified in six secondary goals.

- An accessible transport system: The transport system should be design so that the basic need of transport for the citizens and the trade and industry can be provided for.
- A high transport quality: The design and function of the transport system should admit a high transport quality for the trade and industry.
- A secure traffic: The long-term goal for the traffic safety is that no one should be killed or seriously injured in traffic accidents. The design and function of the transport system should be adapted to such demands.
- A good environment: The design and function of the transport system should be adapted to the demands of a good and healthy environment for everybody, where nature and culture is protected against damages. Economisation with soil, water, energy and other natural resources will be promoted.
- A positive regional development: The transport system should promote a positive regional development by partly equalizes the possibilities for all parts of the country to develop, partly to counteract disadvantages of long transport distances.
- A balanced road transport system: The road transport system is designed representing the needs of transport of both women and men. Women and men should have the same opportunities to influence the establishment, design and administration of the transport system, and their values should have the same importance.

Source: Vägverket (1), 2004

Appendix 7: Measures

Below are listed measures and activities in order to reach the goals that could be included in a sustainable urban mobility plan. A comment has been added for almost all measures of when it can be used. This is just a suggestion.

Activity		Responsible part	Suitable area of implementation
Public transport			
Activities making more people go by public transport			
	Smart travel card: A combined season ticket with discounts at taxi companies, carpools and renting car companies.	Public transport/ concerned companies	
	Offer free season tickets as a benefit	Public transport	
	"Try-it"-periods for drivers by habit/Test travellers	Mobility office	All areas. Might be easier to evaluate in smaller cities
	Possibility to bring the bicycle on public transport	Public transport	All areas.
Accessibility			
	Build new stops and interchanges	Traffic department	All areas.
	Improve existing stops and platforms in the city traffic.	Public transport/ traffic department	All areas.
	Guided bus lanes and HOV-lanes	Traffic department	All areas. Especially cities with congestion on entrance roads.
	Bus priority signals	Traffic department	All areas. Especially city centres and entrance roads.
Restructure the public transport network			
	Short cut through residential areas instead of circling them. A more direct design of the transport route.	Public transport/ traffic department	Residential areas.

	New bus, metro, tram and commuter train routes.	Public transport	All areas.
	Increased number of routes, frequency, standard, accessibility, information	Public transport	All areas.
	Extension of public transport to include routes by water as well.	Public transport/ concerned companies	All areas with the possibility.
	Flexi routes: Mini buses with low platform and good accessibility as a complement to public transport and transportation service for elderly and disabled.	Public transport/ town hall	Areas without covering public transport.
Yellow school bus		Town hall/ public transport	Areas without covering public transport.
Biogas and bio diesel buses		Public transport	All areas.
Suit the timetable to working hours/suit working hours to the timetable.		Public transport/ companies/town hall	Suitable in smaller cities with one major industry and a lot of commuters from one city to another.
Information screens about next departure		Public transport	All areas.
Lower taxes or taxes that integrate several modes of public transport		Public transport	All areas.
Bicycle and walking			
Activities making more people go by bike or walk			One condition is sufficient expansion of bike and walkways.
	Organise bicycle challenges between or within	Companies/ town	All areas.

	companies to raise the percentage of commuting cyclists.	hall	
	“Try-it”-periods for drivers by habit/Test travellers	Mobility office	All areas.
	Encourage cycling to work and free time activities	Mobility office	All areas.
	Cooperation with citizens	Mobility office	Crucial at all moments.
	Walking school bus	Mobility office	All areas. Best organized for each school or within each residential district.
Accessibility			
	Give priority to bike ways in intersections	Traffic department	All areas without forgetting the safety.
	Place the bicycle parking close to entrances, under roof and safe from theft.	Concerned companies/town hall	All areas.
	Bus lanes allowing the use of bicycle	Traffic department/ public transport	All areas.
	Priority to pedestrians near schools and in the city centre	Traffic department	All areas.
	Pedestrian zones free from car traffic	Traffic department	City centres.
	Reduce barriers through the creation of passages	Traffic department	All areas. Especially between pedestrian zones, bus and train stops, etc.
Safety			
	Rebuild dangerous intersection with bike/walkways and motorised roads	Traffic department	All areas.
	Improve the standard and quality of the bike and walkways.	Traffic department	All areas.
	Safer surroundings for cyclists	Traffic department	All areas.
	Illumination on walkways	Traffic department	All areas.
	Separation of bicycles and pedestrians	Traffic department	All areas with risk for collision.

	Bicycle training with a special exam for children	Mobility office	
	30-zones in residential areas	Traffic department	City centres and residential areas.
	Offer free bicycle helmets	Companies/ town hall, etc.	
Offer places to pump the tyres		Town hall	For example in connection with petrol stations.
Introduce a system for renting bicycles		Mobility office	All areas.
Extension of the bicycle network to cover the whole area		Traffic department	All areas.
Information			
Change of behaviour and habits		Mobility office	Crucial for all areas.
	Information campaigns about young peoples' behaviour.		
	Changed attitudes and behaviour		
	"Smart Road user" visits/Personal visits		
	Stimulate the introduction of carpools		
	Help to find someone to car share with		
	Formation of walking school bus		
	Increased information to persons that recently changed residence or work		
	Awareness campaigns		
	Participation of citizens		
IT			

	Increased possibilities to IT-commute from home	Companies	All areas.
	Special IT-centres in residential areas with possibilities to “work from home”	Town hall/ companies	Residential areas with poor public transport connection and/or long distances.
	Telephone, TV and video conferences to reduce travels	Companies	
	Information about the impact of each person on the environment through e.g. CO_2-estimation on internet	Mobility office	Internet.
	Timetables, traffic conditions, and travel planners on internet	Mobility office	Internet.
	Making it possible to calculate and compare travel distance and time of different transport modes between home and work on internet	Mobility office	Internet.
	Commuter travel plans and school travel plans	Mobility office	All areas.
	Real time road information in order to use the infrastructure more effective.	Traffic department/ mobility office	All areas and Internet.
Mobility office/transport information centre		Town hall	One in each municipality or region.
Town and country planning			
Plans		Town hall/ government	All areas, both in detail and more comprehensive
	Use the 4-step principle in all planning		
	Long-term planning for bicycle and public transport		
	Mobility plans integrated with urban plans, plans for industrial areas etc.		

	Development of comprehensive plans to include transports		
	See the overall picture of social, environmental and traffic planning		
	Tree plans for nicer surroundings		
Planning			
	Distribution and exploitation of the existing road system considering all modes of transport	Traffic department	All areas.
	Concentrate the car traffic to ring structures and principal streets	Traffic department	Medium to large sized cities.
	Create green spaces for pedestrians and bicycles	Town hall	Dense built-up cities.
	Sustainable Safety according to the Dutch model	Traffic department	Medium to large sized cities.
	Increased interaction between road-users	Traffic department	All areas.
	Onion skin model	Town hall	City centres.
Parking			
	Elimination of parking by pavement to reduce traffic “searching” for free places.	Town hall	City centres.
	Real time information about available parking lots in parking houses.	Town hall	All areas.
	Increase the parking fee and reduce the parking free of charge	Town hall	City centres.
	Prioritised parking lots for car sharing	Town hall	All areas.
	Park&Pool	Town hall	Parkings in connection with bus/train stops.
	Guarded bicycle parking/Bike&Ride	Town hall	All areas. In connection with bus/train stops.
	Free or reduced Park&Ride parkings for public transport users	Public transport/ town hall	All areas.
Environment			

Fuel consumption			
	Formation in Eco driving for road carriers, civil servants, etc.	Concerned companies	All areas
	Information to households of how to lower fuel consumption	Mobility centre	All areas.
	Increase the number of petrol stations with alternative fuel	Town hall	All areas.
	Low mix of ethanol in petrol	Government	All areas.
	Increased use of bio diesel		All areas.
	Use eco cars for municipal activities	Town hall	All areas.
	Include engine pre-heaters in parkings and new residential areas	Landowners/ town hall	All areas.
	Lower the velocities: in urban areas as well as outside	Traffic department	All areas.
	Synchronise traffic lights	Traffic department	Entrance roads, without put safety at risk.
Restrictions			
	Road-tolls to enter the city centres.	Town hall/ government	For all kinds of cities with a lot of traffic in the city centre.
	Limited access to the city centre for private vehicles	Town hall	For all kinds of cities with a lot of traffic in the city centre.
	Preferential treatment of eco cars	Town hall	All areas especially city centres.
Anti-noise asphalt		Traffic department	Residential areas.
Make sure car washes consume short of water		Town hall	All areas.
Commercial and industrial transportation			
Planning			
	Use vehicles to bring together and distribute smaller flows of goods	Cooperation between	City centres and commercial areas.

		companies	
	Use vehicles adequate for the quantity of goods	Companies	All areas.
	Plan the route in an effective way	Companies	All areas.
	Offering shopping on internet with home delivery	Companies	All areas.
	Prioritise local consumption of goods and services	Cooperation between producers and companies	All areas.
	Distribution central	Companies/ town hall	All areas.
Make demands on fuel and influence on environment when putting out to tender		Companies	All areas.
Increase the possibility to shop locally		Cooperation between producers and companies	All areas.
Limited access for lorries to pedestrian streets		Cooperation between town hall and companies	City centres and commercial areas.
Traffic safety			
Installation of alcohol locks in private and trade vehicles			
Installation of speed controllers			

Sources: Vision Lundby, 2002, Lyborg et al, 2001, Trivector AB, 1998, Escudero et al, 2005, Ajuntament de Terrassa, 2003, De Bruin, nov. 2005, Marsden, 2005, IDAE 2006, Hyllenius et al, 2004, SMILE, 2006