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The effects of parking accessibility on work commuting

Considering parking policies as a mobility management tool for Lund

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Abstract

This thesis addresses the effects of parking accessibility on work commuting and the potential to use parking policies as a tool to support mobility management and enhance sustainable commuting in Lund. The structure rests on two folds: first, it provides a theoretical background on different parking policies and factors influencing work commuting; second, it provides an analysis of Lund as an empirical case study. The main factors affecting parking accessibility consist of the pricing, the parking distance to reach the destination and the parking supply. Three working areas with different levels of parking accessibility and practices are analysed: the Centre, the Lund University Hospital, and the Science Park. The main component observed is the relation between the modal split and the type of pricing. Emphasis is made on the site located on the outer part of Lund.

It was found from the theories and empirical analysis that the accessibility factors have an influence on the modal split for commuting. A shift reducing car-use up to 30% can occur through parking levies, which could potentially result in a CO_2 reduction of around 2,000 tonnes for the Science Park, contributing to attain approximately 15% of the LundaMaTs goals in this matter. A key finding is that parking measures and pricing instruments need to be implemented further in the outer part of the city. The main recommendations are addressed to the City of Lund and consist of enhancing the collaboration with neighbouring cities on parking standard settlements. On their side, private companies are encouraged to improve design regarding the location sites and parking facilities in order to support alternative modes of transportation.

Executive Summary

Finding a way to reverse growth in demand for unsustainable transport and to reduce emissions from the transport sector remains a clear challenge for policy makers. While cities try to reduce congestion traffic and improve urban environment and safety, the motorized vehicle market continues to grow considerably. In Sweden, the road traffic is growing at an average rate of 1.5% per year, and the GHG emissions from this sector increased by 2% in 2007 (300,000 tonnes). Around half of this increase is accountable to cars. Strategies developed on the national level to cope with emissions in the transport sector include: a decrease in fuel consumption for new cars; a raise in the proportion of biofuel; and curbing the trend of road traffic through change-over from cars to alternative modes of transportation. This thesis deals with the latter.

Concerns related with parking issues

One way to support these strategies at the local level is through parking policies. In recent years, parking measures have been used as instruments to reduce congestion problems and subsequent GHG emissions. However, attention has been mostly paid to parking policies affecting the city centres, rather than the outskirts of urban areas. Inclusion of parking policies in areas located outside the centre must be considered as well in order to facilitate the achievement of a comprehensive sustainable transport system.

Since parking regulations are usually more restrictive in the centre and public transport provides better services in the centre than in the peripheral area, municipalities are frequently faced with traffic and parking problems, mainly caused by an over-supply of parking in the outskirts leading commuters to choose their car as the main mode of transportation. This is the case for Lund. Growth in car traffic due to extensive economic development is expected, making commuting for cyclists and pedestrians less attractive and safe. Furthermore, the consequences of extensive parking construction lead to an increase in soil sealing and land consumption. For the region of Skåne, parking also impacts another important economic activity: the growth of field crops. The soil is reputed as among the most fertile of Sweden and represents the main agricultural region for the country.

In order to avoid these problems, the City of Lund is looking for instruments to mitigate these effects. One of which proposes projects involving *producing parking and charging strategies* (through LundaMaTs). However, there is not a clear understanding of the relation between the parking conditions in different working areas and the influence on transport behaviour.

These concerns suggest the following research questions:

1. <u>What are the effects of parking accessibility on work commuting?</u>

2. <u>What is the possibility to use parking policies as a mobility management tool?</u>

   2.1. What is the effectiveness of various parking measures in reducing car dependency for work commuting?

   2.2. What is the current situation of parking policies in Lund?

   2.3. How do corporate parking policies affect the employees' commuting behaviour?

Scope and objectives of the research

This thesis focuses on the case of Lund, examining the relation between parking accesses and the transport behaviour for personal work commuting for three working places: the City Centre, the Lund University Hospital and the Science Park. Focus was also put on off-street parking rather then on-street parking. This thesis seeks to fulfill the following objectives:

1. To understand how parking policies (pricing, regulations, etc.) can promote sustainable transportation;

2. To evaluate different practices of parking management and learn from these experiences;

3. To contribute to the field of sustainable transportation with empirical data. It is hoped that this work can provide information to decision-makers to support effective policy tools promoting sustainable transport.

Methodology

The methodology consists of a "mix method" approach (Tashakkori, 1998), combining quantitative analysis and qualitative analysis resting on three case studies in Lund: the City Centre, the Lund University Hospital and the Science Park. The quantitative part presents the results from a survey made in 2007 for the population in the region (Skåne) on transport behaviour. A filter has been created to extract a sample of 358 commuters travelling in the three case studies areas. The qualitative approach constitutes a literature review and interviews with stakeholders from the public and private sectors and commuters.

Findings

The main factors affecting parking accessibility are distance, supply and pricing. All of them influence the notion of time, being a pivotal factor in transport decision for commuters. Regarding the effect of these factors on work commuting, it was found that employer-subsidized parking, and underpriced parking, clearly increases the share of solo-drivers and car-users (up to 30%).

Besides, parking policy acts as a powerful tool in mobility management, but is still under-developed in urban peripheries by the main actors involved: the public authorities, the developers, and the employers. Several parking measures can be of use for these stakeholders, but pricing is one of the most effective measures to reduce car use for commuting. Furthermore, land-use planning appears to be the most important step in supporting sustainable transportation system.

Of the three cases studied, the Science Park, located in the city outskirts, is the site with the largest number of car-users and highest rate of free parking available. Around 59% of the commuters are coming from Lund Municipality, in which one quarter is solo-driver. It was found that the real estate companies hold a central position through their parking strategy in affecting the transport planning and future travel behaviours. Some developer companies are beginning to consider stricter parking measures in terms of supply and pricing. On the employer side, no concrete sustainable parking strategy has been found, although collaboration is undertaken with the City of Lund to elaborate greener commuting conditions. Corporate parking policies are isolated from each other. If transport policy will be undertaken by employers, this will only relate to business travel, rather than personal travel. Furthermore, in the case where environmental practices are included in the corporate policy, it generally relates to the direct impacts of the business activities. Therefore, it was underlined that there are inefficiencies in the parking management for private companies. Finally, it was found that a potential reduction of around 2,000 CO_2 tonnes could occur if parking levies were implemented in the Science Park. This could contribute to attaining the LundaMaTs goal of 15.8% in CO_2 reduction.

Recommendations

There are three sets of recommendations elaborated upon. The first set is intended for the City of Lund, the second for the developers and real-estate companies, and the third for the employers. All of the recommendations relate to the Science Park, it being the location presenting the greatest opportunity to implement further sustainable transportation.

City of Lund

1. Collaborate with neighbouring municipalities on standard settlements

As a part of *LundaMaTs II*, a new parking management strategy could include collaboration with other municipalities, like the City of Malmö, on standards setting to prevent competition on future investments based on parking norms. There are many examples where regional collaboration has been used on parking management and standards setting. In most of the cases, the common agreements relate to maximum standards.

2. Improve public transit (through public parking revenue)

Around half of the commuters are using their car to go to work, against 9% opting for public transit. This illustrates that the public transport system is not able to reach the commuters in this area. A way to make public transit more competitive and attractive could be to implement a pilot project which uses the revenues from public parking sites in a revolving fund system to finance public transportation or non-motorized modes.

3. Target policies towards Lund's commuters and enhance collaboration with companies located in Pålsjö to promote sustainable commuting.

There is a high percentage of car drivers commuting to the Science Park and this portion is especially significant in Pålsjö. It is believed that an information campaign targeted towards specific working groups could be an appropriate way to influence the commuting behaviour in the Science Park.

Developers

1. Design sites to support alternative mode of transportation

Future parking facilities should include design criteria to promote the use of carpool, public transit and non-motorized modes of transport. This can occur directly through reserved parking places for car-poolers or environmental vehicles. Reducing parking fares for these types of commuters could also be an opportunity to consider.

2. Implement a car-pool system

In order to increase the share of car-poolers and reduce the share of solo-drivers in the Science Park, a car-pool system could be implemented by the real estate companies in Idéon. This could be done within the new contract lease policy framework. By having the developers operate such systems, it would create opportunities to increase the contacts and business relations among the different companies which could enhance business development.

3. Monitor and evaluate the effects of the parking levies on the modal split

It appears that parking pricing will slowly be introduced in the properties owned by some developers. An ex-post evaluation once parking levies have been implemented would provide empirical figures on the direct effects of the pricing system on the modal split. It would also give an indicator on how the diverse actors can contribute to supporting sustainable transport systems. Furthermore, this thesis could serve as a base for ex-ante evaluation. This recommendation can also be appropriate for the municipality.

Employers

1. Improve the site design for environmentally friendly commuting

1.1. Regulate and redesign car parking facilities

Regulating and redesigning parking facilities can occur either through parking levies or through supply reduction. Soft instruments that can also be used and considered as positive incentives is to provide bicycles or financial incitements on transit pass, implement reserved parking for car-poolers, or environmental cars, and enhance shared parking sites. To help promote the use of buses, sites can be redesigned so that the walking distance for car parking is the same as the distance to public transit stops.

1.2. Enhance bicycle facilities

The Science Park presents a high share of bicycle users and the private sites have to be designed to support this need. An example could be to improve the infrastructure by making bicycle parking closer to the entrance than car parking. Other measures can be to provide changing room facilities and showers, maintenance services on-site (like air pump and repair tools), or simply to replace some of the car parking lots close to the entrance for bicycles parking.

Table of Contents

List of Figures

List of Tables

1 Introduction

The growing demand for mobility presents an important challenge when it comes to implementing sustainable development in the sector of transportation. While cities try to reduce congestion traffic and improve urban environment and safety, the motorized vehicle market continues to grow considerably. If we also considered constant urbanisation[1], achieving sustainable transport system becomes a task even more difficult to realise.

In contrast to its overall decrease in greenhouse gases (GHG) emissions at a level of 8.7% below 1990 (71.4 millions tonnes), Sweden still presents a steady increase in emissions from the sector of transportation (SEPA, 2008). This is partly due to the affluent economy of the national transport industry, and a rise in road traffic (SEPA, 2008; SRA 2008). The road traffic is growing at an average rate of 1.5% per year, and the GHG emissions from this sector increased by 2% in 2007 (300,000 tonnes) (SRA, 2005; 2008). Since 1990, the emissions attributable to the transport sector rose by 12% (2 million tonnes), while the vehicle mileage increased by 21%. According to the Swedish Road Administration (SRA), around half of this emission increase "is accounted for by cars, a quarter by light trucks and a quarter by heavy trucks" (SRA, 2008). The number of personal cars was established at 4.2 million in 2006, which represent 0.45 car per inhabitant (SI, 2006)[2].

In short, the challenge for policy makers remains clear: how to find a way to reverse growth in demand for unsustainable transport and reduce emissions from the transport sector? In that sense, municipalities together with other pillars of governments must develop plans and policies oriented towards sustainable mobility.

In Sweden, there are three main strategies that have been developed on the national level to cope with emissions from the transport sector: decrease fuel consumption for new cars; increase the proportion of biofuel; and curb the trend of road traffic through (among other measures) change-over from car to public transport, walking and cycling (SRA, 2008). In addition, one of the environmental objectives for the country (Miljömål 15) is to build a good urban environment that promotes wealthy and diverse housing, workplaces, services and culture, while reducing the transport needs and improving "the scope for environmentally sound and resource-efficient transport" (EOP, 2007). This has to be achieved by 2010.

This change-over from car use to alternative modes of transport requires policy instruments to tackle the dependant components of personal vehicles: fuel, roads, and parking (all the components that a car needs to achieve its functions). In this thesis, the focus will be on parking issues.

1.1 Problem definitions and research questions

In recent years, parking policies have been used as instruments to reduce congestion problems and the GHG emissions related to it. However, attention has been mostly paid to parking measures affecting the centre of cities, rather than outskirts of urban areas (Martenss, 2006; Klementschitz et al, 2007). Nevertheless, to facilitate the achievement of a comprehensive

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[1] The urbanization rate between 1950 and 2005 rose from 52.6% to 74% for the most developed regions of the world. For Sweden, the percentage reaches 65.7% in 1950 and 84.3% in 2005. Ref: UN, World Urbanization Prospect, 2007.

[2] As a comparison, the figure for the former European Union (EU 15) is 0.5 car per inhabitant (Eurofound, 2007)

sustainable transport system, inclusion of parking policies in areas located outside the centre must be considered as well.

Often, lands located in the outskirts are less expensive making the location more attractive for investors and potential employers. Since parking regulations are usually more restrictive in the centre and public transport provides better services than in the peripheral area, municipalities are frequently faced with an over-supply of parking in the outskirt leading commuters to opt for cars as the main mode of transportation. When dealing with the urban outskirt, most researches have emphasized shopping malls rather than working areas. However, there is no clear understanding of the relation between the parking conditions in different working areas and the influence on transport behaviour.

The City of Lund, with a population of 105,000 inhabitants, is located in the region of Skåne in southern Sweden. A large part of the city's economic development is being expanded in the surrounding areas (industrial zones), where lands are available at a better price than the centre. This situation can lead to an increase in soil sealing and land consumption through extensive surface parking construction. An increase in car traffic due to extensive economic development can also be expected, making commuting for cyclists and pedestrians less attractive and safe. It also has an impact on another economical activity important for Skåne region: the growth of field crops. The soil is reputed as some of the most fertile of Sweden and represents the main agricultural lands for the country (Skåne, 2002, 4). In order to avoid these problems, the City of Lund is looking for instruments to mitigate these effects and wants to optimize the transport infrastructure. Generating proper conditions for companies with a sound environment and attractive new workforce represents some objectives to reach by the municipality (Hyllenius et al. 2004).

Lund is known for the development of progressive transport policies oriented on sustainable development. The implementation in 1998 of the transport plan *LundaMaTs* (Miljö Anpassat Transport System[3]) and other transport programmes over the past four decades has brought a package of restrictions towards private car use, which has resulted in a stabilisation of road traffic (Lungberg, 2007; Ingo et al, 2007). As a part of LundaMaTs, two reforms involved a new parking management strategy as a tool to create a sustainable transport system: "The Environmentally Friendly Car Traffic"; and the "Commercial and Industrial Transportation". The former is seen as the stronger reform to affect CO_2 emissions, while the second one aims at involving firms as a catalyser in environmentally friendly transport system (Lund Municipality, 2001, 3).

LundaMaTs II, being more recent, involves reforms for Urban Planning that integrates development of transport and land use. It includes measures which in the long term should reduce transport demands and increase accessibility (Lund Municipality, 2007, 5). It also includes projects reducing the need for car transport. The proposed project involves *producing parking and charging strategies*. The actual parking strategy of the municipality is seen as a tool to solve car dependency and increase sustainable transportation rather than a way to solve the "parking problem" as such. It is considered as a mobility management strategy with a holistic perspective. Attempts to consider this important aspect were made during this research, as an overarching concept for the analysis.

Indeed the problem is not the parking itself, but rather the demand for unsustainable means of transport (cars) indirectly fed by the parking supply. Parking policies can thus serve

[3] Environmental Adapted Transport System

two-fold, first of all coping with GHG emissions, and second land-use management. GHG reduction appears as an overall aim but parking issues are considered of more practical relevance in cities since they directly relate to land use. Therefore, there is a need for Lund to have a better comprehension of the current parking conditions and their effect on travel behaviour. These concerns suggest the following research questions:

1. What are the effects of parking accessibility on work commuting?

Parking accessibility can be interpreted in different ways. In the present context, the term refers to the ability to access a destination according to the distance, the pricing and the parking supply. See Section 1.6 for a complete definition.

The answer to this question remains in a narrow topic. In order to provide some perspectives, it is relevant to raise the following questions:

2. What is the possibility to use parking policies as a mobility management tool?

   2.1. What is the effectiveness[4] of various parking measures in reducing car dependency for work commuting?

   2.2. What is the current situation of parking policies in Lund?

   2.3. How do corporate parking policies affect the commuting behaviour of employees?

These three sub questions also address an issue of scales where different stakeholders are involved: the State at the national level, the municipality and private companies (employers and developers) at the local level. These components will be integrated in chapters 3 and 5.

Finally, as an indicative complement to bringing a comprehensive approach to parking policy within a mobility management perspective, a third concern could also be suggested relating to the environmental impacts: what is the potential change in CO_2 emissions and gasoline when implementing parking levies? This question will be addressed briefly at the end of the research (Chapter 5), although the focus of the thesis remains on work commuting.

1.2 Justification of the research

There are several reasons why this research topic has been selected. As explained below, the needs in research regarding the link between parking policies and work commuting are unsatisfied, despite that these two elements can have significant influence on sustainable transport.

Why parking policies?

Parking policies are studied and researched by several groups and organisations and justified in many respects:

1. It is probably the European Technical Committee on Transport (action 342) that gives the strongest justification of parking policy in a report on the effects of parking

[4] Even though it would be interesting to know about the efficiency of different parking policies, no costs-benefits analysis hasbeen attempted in this thesis. Thus, the focus will remain on effectiveness, understood as the capacity to produce the desired effects and to reach the desired goals.

policies on mobility and economy: "Parking policy and parking management play a very important role in urban mobility, both in enhancing accessibility and in competing urban congestion. In modern 'mobility management' parking is the largest single management tool" (COST, 2006, 11).

2. Access to parking is a key determinant when it comes to transport demands, modal split, the amount of traffic entering a city and GHG emissions. For instance, cars spend on average 80% of the time parked, which shows the level of dependency towards parking places (Shoup, 2004).

3. Economic instruments are known to be efficient when it comes to change behaviour. According to the Intergovernmental Panel on Climate Changes (IPCC), to reflect the true costs of driving and internalizing the costs of congestion and pollution, parking surcharges and restrictions should be promoted further (IPCC, 2007, 352).

4. Many cities raise their parking restrictions in order to reduce congestion. However, parking restrictions start to be used further for environmental purposes (the case of Singapore for instance), and is a valuable tool for shifting journey from the car to less polluting modes of travel (IPCC, 2007).

Why work commuting?

1. Work-related commuting accounts for around 21% of passenger km travelled in Sweden (Arnfalk, 2002). Thus, it represents a great potential for reducing fuel consumption and GHG emission. In that sense, employers can extensively influence the travel demand depending on which type of parking management they promote. The solo-driver ratio can be cut by 13% with voluntary instrument such as *cash out programme* (the option to choose cash in lieu of a leased parking space) (Shoup, 1997, 204). Such instrument can lead to a reduction of 12% in vehicle-km for commuting (IPCC, 2007, 375).

Research needs

There are important needs for further researches in the area of urban mobility, especially from practitioners to understand preferences behind commuters' modal choices. Many factors play a role when it comes to make change-over from one mode to another. The notion of time is an important one and parking policy can be directly involved in that way. According to the Memorandum of Understanding of the European Cooperation in the Field of Scientific and Technical Research (COST, Action 355), there are two main areas that need to be researched further to promote a more sustainable transport system:

"In order to promote a more sustainable transport system, it is essential to (a) understand the determinants of individuals and firms travel and transport decisions and how these could be influenced in various time perspectives and (b) to monitor in an accurate and timely fashion the effects of specific policies, so that an optimal policy mix can be assured. This requires the development and implementation of observational and analytical tools, which enable the investigation of changes in transport and travel behavior and the conditions necessary to promote these changes."(COST, 2006a)

Following that, the Action 342 on parking policies suggest that further evidences are needed: 1) "to support any parking policy measure with pre- and post implementation research; [2] to clearly identify the primary, secondary and tertiary effects of measures in the research; [3] to relate any research to a quantitative description of the environment within which measures are taken (COST, 2006b, 15).

Besides, a recent study has reviewed parking policies and identified areas for further researches. Among these areas, two of them are worth mentioning in the context of this thesis: "Understanding the zones of influence of parking restraint policies, particularly for commuter traffics" and "Evaluation of the impacts of residential new build parking standards on mode choices" (Mardsen, 2006).

A concrete example illustrating this research need comes from the professionals at the City of Lund who want more information about the implication of parking access, standards and regulations, and their impact on sustainable transport system. Even though there has been a very strong focus on minimum standards[5], the connection between parking standards and sustainable transport is rarely made, even less when it comes to evaluate what is politically and socially feasible in terms of policy making. There is a fragile equilibrium to keep for the policy makers between the implementation of strong requirements and the social acceptance that could imply economic consequences. Thus, the challenge underlined remains the connection between the reality and the environmental goals: how to find a way to make the parking pricing better related to the socio-economic costs of the cars, while organizing parking facilities to make prices more visible without scaring the population (Rube and Rydén, 2008).

Purpose and audience

It is in this context that this thesis wishes to contribute. First, understanding to which extent parking policies influence transport decisions for individual travel will be explored. Second, researching what are the effects of different parking policy on work commuting will be investigated. The study aims at reaching the following objectives:

1. To understand how parking policies (pricing, regulations, etc) can promote sustainable transportation;

2. To evaluate different practices of parking management and learn from these experiences;

3. To contribute to the field of sustainable transportation with empirical data. In that respect, it is hoped that further information could be provided to decision-makers in order to support effective policy tools promoting sustainable transport.

The target audience is practitioners dealing with urban policy-making in the field of transportation, as well as private stakeholders and actors interested in mobility management and parking policies, in a Swedish context. The expected effect is to provide a good picture of the potential offered by parking instruments and the change in modal split. Through interview and information sharing, another expected effect is to increase awareness in the business community about the role of parking in transport behaviour.

[5] The minimum number of parking places that needs to be provided.

1.3 Research method

The methodology used in this thesis is composed of a "mixed-method" approach, combining quantitative and qualitative data (Tashakkori, 1998). This approach allows better triangulation and validation for the present research.

Additionally, three case studies act as the overarching frame and constitute the main component characterizing the thesis. A comparison of three sites in Lund is made: Centre (Centrum); Lund University Hospital (Sjukhuset); Science Park (LTH, Idéon, Pålsjö, and Brunnshög). These areas were identified in consultation with the City of Lund. The areas present different conditions on parking that can provide data for evaluating the effects of different degrees of accessibility and support the validity of the conclusions. On the other hand, one drawback of employing case studies is the difficulty to control the external factors (local conditions that are equal for all users). By having three case studies presenting very different parking conditions, it also increases the fluctuation in the external factors. In the present context, the external factors are mainly related to access to public transportation, bicycle lanes, facilities offered by the employers, sector of activities, etc. These factors influence the transport decisions as well, which are not exclusively related to parking conditions. To reduce the fluctuation's measurement, one attempt has been to integrate these external factors in the sites description, so that they can be considered and better understood. Site visits have also been done to observe the current situation regarding parking and biking infrastructures.

The first part of this research is based on a literature review and interviews with city planners and actors involved in parking policy-making. The second part observes the behaviour for work commuters according to a survey made in Skåne on transport habits. This section therefore constitutes quantitative data sources. Finally, a series of interviews have been conducted with employers, developers and commuters to complete the quantitative analysis. The selection of these interviews was mainly based on the results from the quantitative analysis and on the size of employers (it was attempted to select large employers). Thus, two interviews were conducted with site managers from Astra Zeneca[6] and Ericsson[7], one interview with the environmental manager of the LUH[8], one interview with the real estate company, IKANO, and two with commuters. These consultations were made in order to cope with measurement errors that could occur from the quantitative analysis, and to enrich the analysis.

In addition, the methodology was greatly inspired by Shoup 1997, a researcher from the Institute of Transportation Studies in California who has evaluated the effects of a parking policy tools: the Cash Out Employer-Paid Parking using eight case studies. Besides, the *System for Evaluation of Mobility Projects* (SUMO) developed by the Swedish Road Administration adapted for Swedish conditions was also used as a methodological base (Hyllenius et al. 2004). This evaluation method provides support for projects that aim to influence attitude and behaviour in the field of transportation and traffic. It has been used previously in Lund for the evaluation of LundaMaTs. In the present context, it is question to see whether different parking accesses in Lund can cause demonstrable effects on transport behaviour (i.e., outcome evaluation).

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[6] ±2,000 employees.

[7] ±3,000 employees.

[8] ±7,850 employees.

By describing, explaining and appraising a change or a result, the evaluation can help to demonstrate the following benefits:

"• knowing that we are actually heading towards the goals

• showing the benefits of our efforts and whether we are effective

• providing an opportunity for benchmarking

• providing input to enable a change in direction

• providing input for future investments

• sharing experiences from the project

• increasing the knowledge base in order to produce cause and effect relationships." (Hyllenius et al., 2004, 7)

The analytical framework consists of evaluating the different parking policies and the link between access factors (pricing system, distance and supply), work commuting and the modal split (in which solo-drivers share is emphasized) according to the theoretical evaluation (literature review) and empirical evaluation (three case studies) using qualitative and quantitative data.

Table 1-1 Analytical framework and data sources

	Theories	Practices		
		Lund City Centre	Lund University Hospital	Science Park
Parking Policy Instruments and characteristics	Qual	Qual/Quant	Qual/Quant	Qual/Quant
Work commuting – Modal Split				
Supply	Qual	Qual / Quant	Qual/ Quant	Qual / Quant
Pricing	Qual	Qual / Quant	Qual / Quant	Qual / Quant
Distance	Qual	Quant	Quant	Quant
Environmental effects (CO_2)	Qual	N/A	N/A	Quant

Qual: Qualitative data sources (literature and interviews).
Quant: Quantitative data sources (statistics).

1.3.1 Survey method

The data was mainly obtained from the RVU 07[9], a recent poll conducted by public and privates actors in Skåne towards the population on their transport behaviours. These data provide detailed information on different type of travels, including the distance, the purposes, the modes, the period of time, etc. A questionnaire was sent to the population of Skåne.

All the results presented in this research are weighted according to the representativeness of the Skåne population. This weighting can thus influence the number of survey respondents and make the figures varying of more or less one point. For further information on this poll, see Appendix 1.

[9] Resvaneundersökning 2007 (Travel Survey).

1.4 Scope and limitation

This thesis focuses on the case of Lund looking at the relation between parking accesses and the transport behaviour for personal work commuting for three working places: the city centre, the Lund University Hospital and the Science Park (for a description of the sites, see Chapter 4). For each of them, particular attention was paid on car user (especially solo-drivers), and on sites presenting high access to free parking. Thus, only one type of travel is examined here, being work commuting to Lund. According to COSTs' researches, there are three types of effects related with parking measures: 1) primary: effects on the parking system (location of parking, changes in use, etc); 2) secondary: effects on the traffic and transport system (modal shift, traffic flows, etc); 3) tertiary: effects on the socio-economic system (town planning, land use, economy, etc) (COST, 2006, 88). The effects of parking accessibility on the secondary level are thus observed here, although some attention is paid on the economical effects of parking policies.

Focus was also put on off-street parking rather then on-street parking[10]. The reason for that boundary is that off-street parking remains a challenge in Lund contrarily to on-street parking that is better understood due to the implementation and regulation experiences. Very little attention was paid on residential parking and travellers commuting for other purpose than work. Furthermore, the study does not deal with specific parking garages, including different pricing rate and its influences on transport behaviour.

Collaboration was undertaken with the City of Lund and the whole period of the research was four months. Part of the data was collected from a poll made during the fall of 2007 by different actors working in the field of transportation in Lund. The sample size is 358 commuters' participants[11]. This only gives a limited view of the travel behaviour for that period. Therefore, the conclusions drawn from the results of the poll should take into consideration the time period in which the survey has been conducted as well as the sample size. Another aspect to be noted is that the changes in transport behaviour did not occur from a situation before and after but was rather the observation of a current situation with different policy contexts (or parking accesses). One advantage of this methodology results in a reduction of responses bias, since the survey was not focusing on parking policies in a specific context (work commuting) but rather on travel behaviour in the everyday life. It should be noted that the total population for the region of Skåne is 1.1 million, that there are about 23,000 people commuting to Lund, and about 14,000 people commuting from Lund (Lund Municipality, 2005).

Finally, one of the biggest limitations remains the language barriers. The interviews were conducted in English, being the second language for the author and the interviewees. Thus, a bias may have occurred regarding the interpretation of the information. Most of the literature consulted was also in English and the review of documents available in Swedish may be lacking.

1.5 Outline of the study

There are four main parts covered by this thesis. The first one introduces the main findings from the literature review on parking policy and presents some best practice cases (chapter 2).

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[10] Off-street parking: parking that are not on the street (parking houses, parking garages, parking sites). On-street parking: parking lots located on the street.

[11] For indication, the theoretical margin of error is ±5.13 percentage points, 95% of the time (Meaning that in 95% of the cases, the margin of error is ± 5.13 percentage points)

The second one portrays the transport policy tradition in Lund (chapter 3). The analysis of the three case studies is covered by chapters 4 and 5, and therefore constitutes the two last parts. Chapter 4 presents the transport behaviour observed whereas chapter 5 provides a discussion of the different strategies offered for Lund and the role of the various stakeholders in parking policy and sustainable commuting. Finally, some recommendations and a conclusion complete the thesis (Chapter 6).

1.6 Concepts definition

Accessibility and Parking Accessibility

There are several definitions given to the concept of accessibility in the field of transportation. This concept is also closely related with mobility, which is defined below. Nonetheless, many of these definitions fail to include the relationship between the accessibility and the need to reach a specific function, rather than a spatial location. In that sense, many definitions will only include the access to physical destination, but virtual mobility can also provide (and increase) access to activities by the means of ICT (Information and Communication Technologies)[12]. The object of this thesis is related to parking accessibility, which implies physical movements. However, it is worth mentioning that different levels of parking access can add to the factors affecting virtual mobility. For the current context, the focus will be rather emphasized on the condition affecting the physical accessibility. According to Handy and Niemeir, the concept of accessibility in the transport field refers:

> "[…] to the spatial distribution of potential destination, the ease of reaching each destination, and the magnitude, quality and character of the activities found there. Travel cost is central: the less time and money spent in travel, the more places that can be reached within a certain budget and the greater the accessibility. Destination choice is also crucial: the wider the variety of modes for getting to a particular destination, the greater the choice and the greater the accessibility" (Handy et al, 1997, 1175).

In short, the ease of travel is determined by travel distance, time and cost, and the levels of accessibility are very sensitive to the notion of travel distance and time (Ibid, 1180).

Furthermore, land-use and the nature of the transport system are the two patterns that determine accessibility. According to the authors, there are four parameters used to measure accessibility: 1) location choice; 2) the definition given to origin and destination; 3) the measurement of attractiveness; 4) travel impedance (distances, time and cost) (Ibid., 1177). Associating that to parking accessibility, it means that the closer parking is to the destination (or working place) the greater is the accessibility.

In the present study, parking accessibility refers to the following type of access: pricing (access to free parking vs. access to parking-fees), distance to the nearest parking, and the parking supply. No measurement methods are used to evaluate the accessibility level, and the access level is greatly determined by the response provided by the survey participants, which is based from subjective judgments.

Mobility Management

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[12] For a complete definition of virtual mobility, see Arnfalk 2002.

According to MOST (MObility Management STrategy for the next Decades)[13], mobility management is a package of soft measures intended to influence a journey before it begins.

> "Mobility management is primarily a demand-oriented approach to passenger and freight transport that involves new partnerships and a set of tools to support and encourage change of attitude and behaviour towards sustainable modes of transport. […] Mobility management addresses specific target groups and has developed a range of instruments, best known are the mobility centre and the mobility plan." (MOST, 2003)

For the Swedish Road Administration, the concept implies a way to avoid major investment by increasing the efficiency in the use of transport modes, roads and other infrastructure.

"It is an outlook on travel and transport, entailing joint and concerted action to try to change the demand for travel and transport towards a more sustainable transport system.

Key goals include:

- greater use of more environmentally-sound modes of transport;
- better accessibility;
- more efficient transports and use of land; and
- less demand for travel in motorised vehicles" (SRA, 2005)

Accessibility vs Mobility

An important aspect that needs to be distinguished is the difference between mobility and accessibility. According to Levine and Garb, "'[m]obility is defined here as ease of movement; accessibility is defined as ease of reaching destinations. The concepts are related but readily distinguishable. Where destinations are close by, greater accessibility can be afforded even if mobility is constrained; where destinations are remote, mobility may be high without high level accessibility."(Levine and Garb, 2002, 179)

Parking demand

The quantity of parking demanded at a particular time, price and location. Parking demand is affected by factors like "vehicle ownership, trip rates, modal split, duration and geographic location, the quality of travel alternatives, […] fuel and road pricing". (TDM, 2008) On the other hand, travel demand is derived from "the trade-off between the advantages or benefits from being at a destination and the disadvantage or costs involved in travelling to that destination" (Goodwin and Hensher, 1978, 25, in Handy and Niemeir, 1997).

Parking policy

Parking policy refers to parking regulations, pricing, management and design decisions. (TDM, 2008).

[13] MOST: http://mo.st/

2 Parking policies: an overview

This chapter provides a theoretical background on parking policies. It is divided in two sections. The first one is a general presentation of the role of parking policy in mobility management systems. The second one provides background information about the different tools and instruments related to parking in a context of work commuting.

Although parking policy can appear as a narrow topic, the literature covering the subject embraces a wide range of sub-topics, issues, and remains abundant. Interest in this field of research started in the early 70s and the focus has evolved mainly from an end-of-pipe perspective, (i.e. how to deal with parking from a supply management), to an up-stream perspective, having more holistic approach (i.e. how to deal with parking from the demand side). Because the field is influenced by policy tradition and cultural context, the literature varies widely from country to country. For instance, the American literature on parking policy slightly differs from the European one, where the context diverges in terms of urban planning but also in terms of life-style (Mardsen, 2006). These differences affect the way to analyse and the approach taken to tackle parking issues. In general, the American literature was more abundant than European literature[14]. From what was reviewed, it can be said that there are two main portals acting as a resources-base for parking management: the *Transport Demand Management (TDM) Encyclopedia* from the Victoria Transport Institute on the North-American side and the *European Technical Committee on Transport* (COST) on the European side[15]. It should also be mentioned the EPOMM (European Platform on Mobility Management). Therefore, a great deal of studies are being performed recently with the implementation of various international projects oriented toward sustainable transportation.

2.1 Role of parking policy in mobility management

From a general point of view, authors and researches confer an important place of parking policies in mobility management. TDM Encyclopedia suggests that parking policy has the potential to affect the frequency, timing and destination of vehicle trips (TDM, 2008). As stated earlier, COST plays a crucial role in parking instruments in urban mobility when stating that parking is the largest single management tool in modern mobility management (COST, 2006b). According to the European Parking Association (EPA), parking policies should be seen as a part of the solution in mobility management rather than a problem. The organisation claims that cities' policy on mobility and accessibility should include parking charges in which on-street parking should be more expensive or equal to off-street parking fares (COST, 2006b, 80). They state that the "overall accessibility to a city centre and the quality and range of activities in the city centre are more important [than the parking conditions] for economic vitality" (Ibid).

On his side, Mardsen argues that the transport research community has concentrated its effort mostly on vehicles in motion and roads rather than parked vehicles. The reason given is that road policy reaches a wider range of trip characteristics than parking policy (Mardsen, 2006,

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[14] That might be due to the language difference and the amount of literatures available in English.

[15] Victoria Transport Institute, Online Transportation Demand Management Encyclopedia: http://www.vtpi.org/tdm/index.php

European Cooperation in the field of Scientific and Technical Research, Transport and Urban Developement: http://www.cost.esf.org/

447). According to him, there is a relation and a competition between road pricing and road space rationing versus parking pricing and supply management.

2.1.1 Parking policies: effective instruments tackling traffic and environmental impacts?

Parking policies are seen by many academics and authors as effective instruments tackling congestion and environmental impacts (Calhorp & al, 2000; Verhoef & Al, 1995; Shoup, 2005). Many researches have shown the link between parking policies and the environmental effects. While Stubbs argues that proper parking policy can contribute to lower emissions, Shoup claims that the effects of bad parking planning can lead to an increase in 30% of traffic in average[16]. On a larger base, COST recommends in its explicit report on parking policies that national transport policies should include a section on parking, being a sound instrument able to play a steering role in car mobility (COST, 2006b, 11). Furthermore, it is mentioned that commuter parking may be controlled relatively easily as compared to residents or visitors parking. The effects of proper parking instruments on mobility result in less cruising traffic, and improvement in the parking place available (Ibid,. 14) (see also section 2.4). Besides, it is suggested that the behaviour of commuters towards new parking conditions will either be to use alternative modes of travel or to park their vehicle at longer distances from their destination (Ibid, 15). Regarding the effects of parking policies on the economy, "evidence brought together clearly indicates that proper parking policy measures support the economy rather than hamper it" (Ibid; Martens, 2005). Finally, as we have seen, parking measures play a very important on mobility management.

2.2 Factors influencing parking accessibility

As it was mentioned in the concept definition, there are few key factors that need to be considered in parking policy to influence modal split: the pricing, the distance (parking location), and the parking supply and the location of the destination. All of these also influence to different extent the notion of time spent for travel. The following sections explain these factors.

2.2.1 Pricing and Price Elasticity

Pricing is a central factor influencing the accessibility. How does different pricing affect transport behaviour? To answer that the first part of this section discusses the issues related with free parking, and the second part describes price elasticity.

Providing *free of charge parking* impacts travel behaviour, transportation decision, and the general economic activities and the environment. In fact, talking about free parking is not completely right, since somebody has to subsidise and pay the cost related to it. One of the renowned authors that put "free parking" issues under the spotlight is Donald Shoup. With his book "The High Cost of Free Parking" (Shoup, 2004), Shoup brought significant contribution in the field of transport and urban policy, mostly in terms of design and economic impacts of diverse parking management. He mainly analysed, under an economic angle, the effects of different parking management systems and the cost related to it.

[16] The average time spend for park cruising due to bad parking condition can reach 8.1 minutes according to the author.

According to the literature, the total costs related to parking facilities comprise land cost, construction costs, operation and maintenance, transaction cost and the environmental costs. The latter cost results from paving land, which cause loss of green spaces, decrease in farmland, gardens, wildlife habitat, increased in impervious surfaces and related stormwater management costs as well as aesthetic degradation (TDM, 2008a, 9). Excluding indirect and environmental costs and depending on the type of facilities, parking cost varies between €125 to more than €1,500 per year per space (Ibid). Although the cost tends to be cheaper in rural and suburban areas due to land value, there are usually more spaces per vehicle so the cost ends up being about the same. In other words, this means that free parking, and even priced parking, are not directly paid by the users. The costs are internalised in other products and services and represents an increase in other prices finally bore by consumers. Indeed, "the real choice motorists face is not between free or priced parking, but between paying for parking directly or indirectly." (Ibid, 11)

Another aspect to consider when talking about free parking is the impact on economic development. In fact, it appears that there are a series of myths around the perceived advantages of free parking for developers. Although employers often promote un-priced parking as a competitive advantage, try to attract potential employees or customers through it, and believe that being located in an area with limited or priced parking appears as a disadvantage, the reality is often different. According to TDM, there are a series of inconveniences related with free parking. First, "businesses ultimately bear the costs of unpriced parking, directly or through taxes that they must pass on to customers" (TDM, 2008, 13). If we compare with a company located in a more regulated areas in terms of supply and pricing, the costs will be much lower and not assumed by the company. Second, supplying with generous parking facilities may prevent the company to develop further its building or opting for an optimal location. Third, offering free parking for employees can reduce the supply for customer parking. Free of charge parking encourage drivers to park for long-term periods, occupying spaces that could be use for visitors or customers and reducing the accessibility of parking spaces (Evenäs et al, 2005; COST, 2006, 15).

In short, free of charge parking (i.e. business as usual) result not only in a deficient parking management, but also and mostly in an inefficient business strategy. Some studies suggest that businesses located in areas with a more regulated parking policy observed a greater economic growth than suburban areas (LLREI, 2000, in TDM 2008).

A second aspect to mention related to parking pricing is to which extent the pricing level influences the use of other transportation means: i.e. the *price elasticity*. Studies researching the price elasticity for parking diverged. According to Feeney, there are several problems related to parking studies when it comes to determine the elasticity. First, the definition of the demand variable is inconsistent; second, there is the possible substitution between different elements of parking demands (short vs. long stay); third, there is considerations of the non-monetary costs (like time variable); fourth, the money and time costs for competing travel option; and finally, the possible supply effects where there are reasonable competing alternatives (in Mardsen, 2006, 449). On its side, the Transport Cooperative Research Program (TCRP) reviewed parking pricing and observes that "empirically derived as well as modeled parking demand elasticities (number of cars parking) for area-wide changes in parking price generally range from -0.1 to -0.6, with -0.3 being the most frequently cited value". (TCRP, 2005, 13-14). However, the group states that there are substantial variations according to the local circumstance and the area-wide average: "higher elasticities often correspond to site specific elasticity estimates where other parking options were available as a substitute. The determination of sound price elasticity estimates are also further complicated by the application of other supporting public transport measures as part of package" (in

Mardsen, 2006, 449). Having similar findings, related researches from the IPCC show that the price elasticity of parking demand for commuting reach between -0.30 to –0.58 (Deuker et al., 1998; Veca and Kuzmyak, 2005, in IPCC, 2007, 375).

To know about the price elasticity for urban transit, a Canadian study states that it is generally inelastic, despite fare increase (Kohn, 2000). This also corresponds to the findings from a Finnish survey on the effect of parking policies on travel behaviours (in COSTb, 2006). In that sense, transit fares and price sensitivity related to it are not the key factors governing mode choice for ridership as compared with parking fares. On the other hand, reliability, comfort, and convenience would rather be the primary reasons choosing or not transit mode (Di Domenico, 2006). Nevertheless, parking rates and distances to work still represent factors influencing the supply and demand for public transit. This also correlates with COST's findings (COST, 2006b).

To sum-up, free of charge parking impacts on modal splits but also on economies, whereas the elasticities of different level for commuting varies between -0.30 to -0.60. This variation greatly depends on the site conditions, parking options and public transport services.

2.2.2 Parking supply

Regarding the *parking supply*, there is a common agreement coming out of the literature regarding the link between the parking capacity and the transport mode choice (COST, 2006b; Martens; Klementschitz et al, 2007). COSTs' authors remark that "the higher the supply of parking places, the lower transit ridership is" (COST, 2006b, 21). A review of best practices regarding the implementation of off-street parking regulations within mobility management also mentioned that limiting the supply has very good influence in reducing the private car traffic demand (Klementschitz et al, 2007, 4). A way to manage parking supply can be through the implementation of maximum standards (see section 2.3.1).

2.2.3 Distance

Studies revealed that the *distance* of the parking can have a considerable effect on modal split. The parking distance also relates to the location of the parking. The more the parking is closer to the destination, the more it makes this option attractive. According to Mardsen, commuters are less responsive to parking location as compared to leisure and shopping trips, since they have a far greater range of options available to respond to parking restraints policies (Mardsen 2006, 456). According to him, there are two key issues relating to parking location. The first one is that "the principal choice options facing commuters are to change parking destination, mode of travel or departure time". The second one is related to the walking time to the destination being valued more highly "than search time for a space which in turn is valued more highly than in-car access time" (Mardsen, 2006, 450). After having screened the literature on the subject, he concludes that a "shift in parking location appears to be the primary behavioural response of commuters to parking restrictions". An Israeli study found that 47% of car users walk up to 5 minutes, 39% walk between 5-10 minutes and 14% walk more than 11 minutes (Shiftan, 2002). On the other hand, European surveys show that for shopping and leisure purposes, car drivers are prepared to pay between EUR 0.50 and 0.65 extra if they can park 100 metres closer to their destination (COST, 2006b, 83)[17]. In other words, commuters would be willing to spend more time to find unrestricted parking sport that can be located further, in contrast with shoppers for instance.

[17] Cases of Helsinki (Finland) and Zuid-Limburg (Netherland).

2.2.4 Location of building sites

Following the explanation of the three main access factors for parking, one can wonder how parking access influences the location choice for the employers. The *location of the business site* is therefore an important factor for the employers that relates to the policy location. According to some studies made towards employers, key elements influencing location choice for employers are determined to be first road links and second parking facilities (Gerrard et al., 2001; Van Geenhuizen et al, 2007, 221-222). Gerrard ranks at 16% road connection and 15% staff parking. Nonetheless, Mardsen concludes on that aspect that the review of studies and literatures does not hold strong evidence on the migration of parking problem. Mardsen also underlines that "the evidence on the impact of parking (and other demand restraint) policy location decisions is weak. Integrated transport demand management strategies at a site and city level can do much to offset the impacts of reduced spaces or increased charges". (Mardsen, 2006, 455) COST's studies also reach the same conclusion (COST, 2006). On the same line, Martens's researches on the effects of parking restriction on economy found that the office market is largely driven by other considerations than parking (Martenss, 2005). The author states that determinant factor to office location decision include proximity to clients, proximity to decision-making center , attractiveness of the city center for employees, as well as the status and image of the city centre. The in-depth interviews he conducted with experts revealed that "there is common agreement among the experts about the limited role of parking in the location decisions of offices. All agree that parking does play a role, but only a limited one, and that other factors tend to prevail over parking" (Martenss, 2005, 8). Some even states that the restrictive parking policies help at preserving an attractive urban environment, which contributes to economic prosperity. These positions contradict the findings from the studies presented above. The difference perhaps results from the methodology employed, in-deepth interview versus quantitative data from survey that might influence the position of the respondents.

Another example highlighting the importance of other factors than parking access is illustrated by the case of Orange Telecommunication. The company relocates its offices to central Bristol in UK to the centre with 105 parking places for 700 employees. To compensate the reduction in parking places, Orange Telecommunications as offered advantages displayed over four years to the staff working at the previous office to give up their car: £ 1,200 for the first year, reducing at £300 per year. Four hundred workers were targeted to give-up their car in year one (Enoch, 2002).

2.3 Instruments affecting parking systems

The types of literature covering different parking policies comprise mostly empirical studies, modeling as well as some theories supporting them. In general, there are two set of policy theories (or methods) affronting and completing each other: regulatory instruments and market-based instruments. Parking pricing and supply restriction illustrate these tools. There are also widely accepted methods to limit car use. On the other hand, other measures can be applied, such as voluntary instruments (incentives provided by the employers). The subsequent parts will introduce and define these different types of instruments. It must be mentioned that the allocation of some of the instruments in one category remained challenging, since there is no clear boundary between each other (the cash-out programme or the tax on fringe benefits for example). To take back Ramstedt's point: "Even if transport policies are divided into economic and regulatory transport policies, there are no clear bounds between them. Regulatory policies define the limits for economic transport policies, for instance by legislation. Economic transport policies are therefore tightly bound to regulatory policies." (Ramstedt, 2008, 19).

In addition, although the literature on the subject is abundant, a census of the different parking policy tools categorized according to the following has not been found through the literature review. There is rich information coming from COST or TDM Encyclopedia, but the categorisation is somewhat different, rather comprising technical tools or being heterogeneous. Usually, the evaluation made on parking policy is done case-by-case, or instrument by instrument. On the other hand, TDM Encyclopedia provides an extensive range of instruments and approaches related to parking management. Among them, a webpage is exclusively devoted to "Commuter Financial Incentives" and to "Commute Trip Reduction"[18]. Their authors also mentioned the diverse impacts associated to parking policy, such as on consumer, equity, economic development, and land use (TDM, 2008, 11-14). There is also COST that divides parking tools between legal and financial categories (COST, 2006b, 23)

On its side, Martens's research distinguishes four type of parking policies. The first one is based on the 'predict and provide' approach, which consist in estimating the parking demand and supply it in consequence. The author states that the revenues coming from parking fees serve to cover the expenses related to provision and maintenance of car infrastructure rather than to manage car traffic (Martens, 2005, 11). The second type of parking policy aims to limit the use of public parking by commuter in favour of customers and visitors. The third one relates to management of private parking to limit the use of private car and the last one consist "of management of private parking spaces with a location policy for specific land uses". (Ibid, 13).

2.3.1 Regulatory instruments

- *Minimum and maximum standards*

Parking standards is probably one of the most effective instruments, since it is the most "up-stream" intervention tool. In parking regulations, there are two types of standards that can be applied in order to comply with a building permit: maximum standards and minimum standards. The *minimum standards* insure that building developers will provide a minimum ratio of parking available without specification on the maximum number of parking that can be built. Some authors dispute the relevancy of minimum parking standards and claim its abolishment under certain conditions, like good access to public transports (Muhija and Shoup, 2006). According to them, "removing or reducing off-street parking requirements does not restrict or reduce the market incentive for developers to provide an adequate supply". As examples, the city of Seattle has eliminated the minimum standards in some parts of the city centre, and there are no minimum parking requirement for sites located less than 152 meters (500 feets) from transit streets in Oregon. It should be noted that North American figures show that typical parking requirement for office building is set at 3.2 spaces/100 sqm; 2.2 spaces/100 sqm for light industry, and 2.6 spaces/ beds for hospital (TDM, 2008, 5).

On the other hand, *maximum standards* put a ceiling on the number of parking places that are allowed to be built on the site. This practice is rather recent and city planners were (and are) usually dealing with minimum standards only. One fear that emerges from the maximum

[18] See: "Commuter Financial Incentives, Parking Cash Out, Travel Allowance, Transit and Rideshare Benefits", http://www.vtpi.org/tdm/tdm8.htm

"Commute Trip Reduction (CTR), Programs That Encourage Employees to Use Efficient Commute Options", http://www.vtpi.org/tdm/tdm9.htm standards is related with the economic impacts on businesses and commerce. City planners do not want to design policies that will scare off business actors causing them to start speculating about possible relocation. A way to deal with this issue is to initiate regional cooperation with the neighbour municipalities to harmonize the standards. Furthermore, the effects of maximum standards are rather positive according to the literature. Mardsen states that there "is evidence that strict maximum parking standards in the inner areas do not drive businesses out of the city centres" giving in example the case of Orange Telecommunication (Mardsen, 2006, 451). In the USA, some cities have implemented maximum standards such as Boston Chicago, and New York. Moreover, many reports and researches recommend the application of maximum standards (COST, Shoup, TDM Encyclopedia). COST's recommendations specify that maximum standards should be mentioned in the national legislation, acting as a guideline, although the specification of the values should be fixed on the local scale (COST, 2006b, 11).

- *In-Lieu Policy*

This type of instrument results in a mix of regulatory, economic and negotiated agreements. Indeed, the local authorities offer the opportunity to the employer (or the developer) "to pay a fee in lieu of proving all the parking spaces required by the zoning." (Mukhija and Shoup, 2006, 299). A case study made in Indianapolis suggests that for a retail centre that would have initially require 6,000 parking spaces, 2,815 lots were finally built to meet the demand (Mukhija and Shoup, 2006, 299). The authors suggest the public revenues can then be used to provide shared public parking spaces to replace those that the developers would have provided.

- *Urban design and location requirement*

Apart from the parking standards, there are also regulations affecting the design of the parking. Once more, Shoup amply criticizes the fact that too few planners impose urban design requirement on parking lots (Mukhija and Shoup, 2006). The authors argue: "market provides fewer incentives to improve parking design because many of the benefits of better parking design accrue to the community rather than to the property owner" (Ibid, 296). Five strategies are suggested in order to improve parking design:

1. Limit the parking capacity
2. Improve the location of the parking;
3. Improve the design surface;
4. Improve the design of parking structures;
5. Improve the design of residential garages. (Mukhija and Shoup, 2006, 298)

These measures can be particularly useful for employers when designing parking facilities. Their roles within the parking life cycle begin at this point.

2.3.2 Financial instruments

Financial instruments are economic incentives initiated by an authority in charge. It can be introduced by the municipalities, the owner of the site, or a parking company responsible. In most cases, it is not a requirement explicitly required by the law, although COST recommends that national legislations should make possible for local governments to touch the incomes from parking fees, since they are those bearing the burden of urban car-mobility and are in charge of the enforcement (COST, 2006, 12-13). Parking pricing acts as the most popular market-based instrument (and the overall parking tools as well), although other incentives like taxation of employers-paid parking as fringe benefits could also enter in this category.

The effects of market based instruments

According to the TCRP, the notion of parking charging can have an impact on commuter behaviour but the effects in mode shifting can be mitigated. The group states that "fee surcharges or increase in prices for commuters were "found to decrease peak accumulation or reduce long-term parking by some 20-50%... much of the impact observed as a response to such strategies is often attributable to shifts in parking location or behaviour rather than changes in mode or travel demand" (TCRP, 2005, 13–15)" (in Mardsen, 2006, 449). On their sides, TDM Encyclopedia and COST advance that commuters are fairly price sensitive as compared with other type of travellers, since they need long-term parking making them bigger user (TDM, 2008a, 4; COST, 2006). It is said that shifting from free parking to cost-based parking ("i.e., prices set to recover the full cost of parking facilities") can reduce car commuting by 10-30%, particularly if the implementation is done simultaneously with improvement in alternative transportation choices (TDM, 2008b,c). The effectiveness rises for peak periods when the pricing is targeted on commuter with differentiated time-rates, while charging drivers directly "is more economically efficient and fair (horizontal equity) than unpriced parking" (TDM, 2008c). According to Kuppan, Pendyala and Gollakoti, charging $20 (SEK 120) per month would reduce solo-share by 35% (in TDM, 2008b).

A Finnish survey illustrated the effects of different parking scheme on transport behaviours. The result shows that increasing parking costs by 30% produces a reduction between 8 to 10% in car share (COST, 2006, 83). "The effect is somewhat bigger in commuter traffic than in other segments" (Ibid). Additionally, the survey also has the following findings:

- A car share decrease of about one fifth (21%) after doubling parking costs;
- A car share decrease of 8% if parking costs equal the fares of public transport;
- A car share decrease of 2% if public transport fares decrease by 30% [meaning that decreasing public transport fares is not as efficient as increasing parking fares];
- A car share decrease of 9% if the walking distance from parking space to destination would always be 400 metres (which is usually less);
- A car share decrease of 13% if the walking distance is the same than the public transportation alternative [meaning that the walking distance is a significant factor];
- A reduction in car share of 2% if public transport in vehicle time were decreased by 15%.

In short, these results underline the fact that parking costs and parking distances act as the most significant factors to shift the modal split when compared with transit fares and transit distances.

A successful case where parking pricing has been introduced is Singapore. According to the IPCC and the related studies, the results showed a reduction of 75% in private vehicular traffic, and 1.043 GJ per day in energy savings (IPCC, 2007, 370).

On the other hand, implementing pricing in only one area can simply shift vehicle trips to other locations, resulting in a small decrease of the overall vehicle travel (TDM, 2008b). An example of relocation phenomenon can be illustrated by the case of Wiener Neustadt (Austria), a city of 40 000 inhabitants with high share of bicycle and walk (COST, 2006, 73). A new parking management scheme has been introduced in 1997, in which paid parking was the main feature implemented. After a user survey, it was found that 38% of the employees who were used to parking their car in the area before parked in a neighbouring area (COST, 2006, 73). Thirty-three percent change their location for private parking garages and 23% shift their means of transportation.

Concerning the implementation of taxation of employers-subsidized parking, in most countries, every benefit provided to employees must be taxed, as it is an advantage added up to the incomes. One problem raised by free parking is that the benefit the car-user profit from is usually not taxed. For instance, an employee that receive a free transit pass from his/ her employers will have to declare it, as a fringe benefits, whereas, free parking users often escape this principle.

There are two ways in order to orchestrate this instrument: either by creating a tax exemption on transit pass, or to create taxation on free parking. The former is seen as a solution to compensate with the free parking privilege. Many countries currently elaborate legislation (which is at the edge of legislative and economic instruments) to fix the "undertaxation" of employer paid-parking. It is the case of Australia, USA, France, Germany and Sweden for instance (see section on *avdrag förmåns*). In some cases, the revenues are used in a revolving fund financing environmental initiatives, to finance transit pass for instance. According to some studies, the reduction in car use can range between 2.4% and 7.5% and potentially decrease GHG emission of 1.6 to 4.8% with this legislation (IBI Group, 2005; Di Domenico, 2006). Regarding the shift from personal vehicle to public transportation, it reached 21% (Di Dominico, 2006).

2.3.3 Voluntary instruments

Voluntary instruments can be defined as incentives initiated voluntarily by the employer. There is one renowned instrument associated to it being the cash-out employers-paid parking.

Cash-out employers-paid parking

Basically, this instrument consists in a cash in-lieu of free parking. The employer pays the value of the "free parking" to the commuter that uses another alternative than parking. This incentive usually acts as a compensation tool in order to reduce the parking demand. Thus, employees who are not parking users cannot benefits from such programme. In this type of incentive, the only target is the car-users rather than other type of commuters. Also, it should be mentioned that a legislation is in place in the State of California, where employers with more than 50 employees have to offer employees the option to choose cash in lieu of a leased parking space (being the cash-out programme) (IPCC, 375).

According to Shoup, there are many benefits found in this type of instruments. His studies showed that it can reduce solo-driver by 17% and increase carpooler by 64%. Shoup compared eight firms located in California covering a sample of 1,694 employees. The State did not required firms to comply with the cash-out law because of uncertainty regarding the income tax consequences of the subsidies. Thus, the employers have to declare the subsidies given from parking: "the employer should have reported the parking subsidy itself as taxable income for the employee if the employees took the parking" (Shoup, 1997, 203). The author also argues that employers paid parking stimulates 36% increase in the number of cars driven to work. Overall, the cash-out programme reduced vehicle trips to work by 11% in average, which also decrease the demand for parking by 11% and around 234 kg of CO_2 emission per employee per year (Shoup, 1997, 205). Finally, he argues that new employees that did not make their commuting choice are more willing to choose ride-sharing to start if they can take cash in-lieu of free parking.

On the other hand, even if it has a positive effect on work commuting, cash-out program can be still seen as a part of parking subsidies, since the incentives is related to parking and it is subsidizing it in an indirect way. It can be seen as a soft instrument related to parking cost. Nonetheless, it should be mentioned that the cost for the employer comes when a subsidized parking place is offered for an employee but that person does not take it, and because of that, cash-out is not a new cost for the employer; it remains a "parking cost" at the end.

On a different note, a study conducted in 1997 at an American university reached distinct conclusions regarding the effectiveness of voluntary instruments (Watts and Stephenson, 2000). The authors have evaluated the effects on travel behaviour of parking charges and associated measures at the University of Sheffield. The reduction in car use reached a marginal 7%. Unsurprisingly, they noted that the primary interest for employers to implement an employer transport plan is related with commercial benefits. They noticed that successful cases influencing modal split are those directly related on parking supply or congestion, rather than parking-fares. Nevertheless, according to Rye & MacLeod, parking-fees are unpopular among the employers, compared with positive incentives being more often undertaken (Rye and MacLeod, 1998). The authors are not able to conclude which elements of Employers Travel Plan (ETP) have the greatest impact on modal split and that it is difficult to assess the cost-effectiveness. Organisational culture, management commitment and combination of the right policy packages are key factors contributing to the success of the measures.

In short, it seems that voluntary incentives appear less effective than regulatory instruments. Employers might not always see the commercial benefits related to parking restrictions.

2.3.4 Informative instruments

Another type of parking policy tool is related with the information provided to the user of parking. Several authors have demonstrated the benefits and efficiency of informative parking instruments (Litman, Shoup, Chinrungrueng et al.). Examples of such instruments can be informative panel showing the number of parking place available in a parking garage.

2.4 Summary of effects of parking measures on mobility and economy

Several studies have observed the effects of parking policy and work commuting. It is the case of Bianco (2000) who has studied a package of policy instruments on work commuting with a sample of 1,000 employees in Portland (Oregon). The author finds that a combination of priced on-street meters added to discounted transit passes packaged with other measure can reduce solo-driver by 7% and an increase car-pooling by 38%.

The reaction of commuters upon parking policy measures can result in several possibilities of behaviours. COST has enumerated them:

- "remain using the car, and accept a great walking-distance or a higher price;
- change travel-mode and use alternative modes more often;
- travel less (tele-working)
- find another job." (COST, 2006, 88)

Furthermore, COST has summarized the effects of six different parking measures on mobility and the economy towards diverse target groups (residents, workers and visitors) (see Table 2-1). According to their researches, the effects of parking measures on work commuters demonstrate considerable responsiveness on mobility. The change in car-trips and modal split toward public transportation is clear. Introduction of parking fees and resident parking schemes are the two most successful measures according to the organisation. As for the economic effects, all the parking measures demonstrate that there are hardly any perceived shifts in workplace. Creating Park & Ride facilities improved the accessibility.

Table 2-1 Summary of effects of diverse parking measures on mobility and economy

Type of measure	Target group	Change in number of car-trips	Modal split change towards PT	Effects on economy
Reduction long-term parking	Residents	Minor reduction	Hardly	Enhancement of residential quality (property values)
	Workers	**Clear reduction**	**Recognisable**	**No (hardly) shifts in workplace perceived**
	Visitors	Restricted reduction	Limited	Might reduce the number of visitors unless occupied by other measures
Introduction of residents parking scheme	Residents	No effect	None	Enhancement of residential quality (property values)
	Workers	**Clear reduction**	**Clear**	**No (hardly) shifts in workplace perceived**
	Visitors	No effect	Limited	Might reduce the number of visitors unless occupied by other measures
Introduction of time-restrictions	Residents	Restricted effect	Hardly	None if accompanied by residents parking scheme
	Workers	**Reduction**	**Clear**	**No (hardly) shifts in workplace perceived**
	Visitors	Limited reduction	Limited	More place for visitors
Introduction of paid parking	Residents	Restricted effect	Hardly	None if accompanied by residents parking scheme
	Workers	**Clear reduction**	**Clear**	**No (hardly) shifts in workplace perceived**
	Visitors	Limited reduction or even growth*	Limited or none at all	More place for visitors
First half hour Free parking	**Workers**	NA	NA	**No (hardly) shifts in workplace perceived**
	Visitors	NA	NA	Creates more traffic

				without adding visitors
Creating Park & Ride	**Workers**	NA	NA	**Enhances accessibility**
	Visitors	NA	NA	Attracts in principle visitors and enhances accessibility

* "A proper introduction of paid parking, means in those situations where demand exceeds supply, will turn a usage of 100% and over into a usage of 80-90% of the available parking space, meaning spaces are available for the new arriver. The result will be a raise in turnover, which in itself might show as a raise of the number of car-trips".
Source: Adapted from COST, 2006, Tables 7.3.1 and 8.2

2.5 Best practices and other cases

This section presents different cases and practices related to public parking policies and corporate parking policies. The literatures reviewed comprised a plethora of cases and diverse experiences across Europe and North America. Indeed, it was found that the majority of the literature on parking policies takes its source from empirical cases and builds the knowledge from these results. It was tried to opt for examples presenting interesting policy instruments that could be of use for Lund and the selected case studies in a context that relates to peripheral areas, commuters, employers and developers.

2.5.1 Switzerland: an example to follow in parking policies?

Switzerland presented many cases and examples where parking policies have been implemented. The following section introduces some of them taken from the literature available within COST. It should be mentioned that this country, being relatively the same size as Sweden with 7 millions inhabitants, has introduced in 1999 a legal framework that allows public authorities to force private companies to implement parking policy measures on existing car parks in order to stimulate sustainable commuting. According to COSTs' studies, the outcomes in 2006 of this measure remained weak, but some municipalities took the initiative and signed voluntary agreements with private employers. It was the case of Bern. There are also national norms regarding the parking standards (EPOMM, 2007). For instance, the Environmental Protect Act (Umweltschutzgesetz, USG) allows a framework to conduct an Environmental Impact Assessment (EIA) for new parking counting more than 300 places in order to obtain the building permits. Therefore, the local authorities have the possibility to reduce the number of required space if they consider that the impacts of the future parking plan are too severe. It is suggested that EIA is a "very good basic condition for the implementation of mobility management at companies" (EPOMM, 2007).

Besides, following a public procurement philosophy, public administration started to introduce parking fees for car users in institution like municipal office buildings, schools, colleges, museums, and hospitals. It was the case of Thurgau, where the main goal was to "generate revenues and to eliminate an inequity between employees in the public and private sectors […]" (COST, 2006, 45). The turnover reached Sfr 600,000 per year, but the shift in modal split remained weak, since Thurgau is a rural area.

2.5.1.1 Basel: Corporate Parking Management for large employers

Representing a large employer in the city of Basel, the pharmaceutical company Novartis decided to introduce a parking management system consisting of parking-fees and to promote the use of bicycle for its employees[19]. The city counts around 165,000 inhabitants and comprises five main industrial sites generating heavy traffic during the commuting hours. The company took the lead and implemented a parking policy based on three pillars (COST, 2006, 84):

1. Reduction of the parking supply, in which each division of the plant has been allocated a fix number of parking places according to the access to public transport and the distance to be travelled.

2. Introduction of parking fares for each division of the plant in which the fund goes to a common driver's pool. This is paid by the division and is free of charge for the employees' users.

3. Alternatives offered: a bicycle is offered free of charge to the commuter choosing to give up their cars for commuting and business trips. Several measures has been implemented to improve the bicycle infrastructures and its utilization (internal working group, network of bicycle paths at each location connecting to the different sites, special bicycle gates at the entrance, repair service, company-bicycles).

The results of this new parking management system has risen the use of bicycles by 25%. In 1998, the company was awarded as the most "cycle-friendly" company of Switzerland (Ibid).

2.5.1.2 Zurich: access contingency to urban renewal project and maximum norms

Located in the northern part of Zurich, Zentrum Zürich Nord (ZZN) is holding one of the largest urban renewal projects being developed in the city. The project consists of a mixed-use environment dealing with offices, residents, and retail shops. A new concept has been developed by the Swedish group *ABB Real Estate Ltd*: the access a contingency model (Fahrtenbegrenzings-Modell). This model mainly consists of restricting the access by allocating a number of user-rights (COST, 2006), which provide a number of parking spaces to the user: "A user-right fixes the number of car rides in and out of the area and the time frame in which these trips can be done." (COST, 2006, 52) Badges are provided to tenants and visitors while parking fees are applicable for short-term visits like shopping. The tariffs are fixed according to the level of utilization of the tenants. To guarantee the rotation and multi-functional use of the parking capacity, the users do not hold the parking space for an unlimited time-span and do not have their own parking either. The number of car rides has been negotiated between ABB and the municipality and is established at 9,900 per 24 hours. In the case where the number of trips is exceeded, a penalty is applicable to ABB payable to the municipality. The company operates nine multi-storey parking garages serving the whole Area D of the ZZN's project. A parking guidance system leading car drivers as close as possible to their destination is also operated by the real estate company, where parking facilities are organised in a parking network (Ibid). By this, it is believed that the optimal capacity will be achieved and the traffic minimized.

In fact, Zürich is not only known for the example presented above, but also for the implementation of maximum standards. This city has implemented maximum standards for

[19] See also: Toolbox for Mobility Management Measures in Companies. (1997) "Famous Examples Successful mobility management measures implemented by well-known companies: Basel, Switzerland". TaxiStop. http://www.taxistop.be/toolbox/english/famous/fmsnova.htm

all type of land-use (office, retail, and light industry/ storage/distribution) in context where the public transportation system is easily accessible (Martens, 2005, 5).

2.5.2 Other cases

Following the case of Zurich on maximum parking norms, many other cities have also undertaken this strategy like Edinburgh, Frankfurt, Rotterdam and Seattle.

The City of Edinburgh is probably one of the pioneer cases in terms of parking policies, that started to be implemented at the beginning of the 70s, being the same period than the development of the Traffic and Environment Plan for Lund (see the following chapter). As early as 1974, Edinburgh introduced the Controlled Parking Zone (CPZ) in order to cope with traffic growth. The implementation of maximum norms for parking started no later than 1978. At that time, the standard was fixed for offices located in the city centre (1ppl/500m^2 gross floor space). In 1994, the maximum norms for this sector was lift for the entire municipality, but adapted according to the location of the area (spatial differentiation) and public transportation (Martens, 2005, 25). Five years later, in 1999, the retail sector was integrated in the maximum standards approach. According to Martens' researches, the share for commuting trips made by car was around 42% in 2002 (Ibid).

The city of Frankfurt is another example where parking restrictions have been strongly implemented. They rest principally on two legislative instruments: the Building Act of the State Hessen and the Parking Limitation Ordinance (*Stellplatzeinschraenkungssatzung*). The Act enables local authorities to limit the number of parking spaces and to charge financial compensation for the parking places that are not realized (Ibid, 39). The Ordinance relates to maximum standards and is based on a percentage system to limit parking place according to the location of the area. For example, the city centre is limited to 10% of the minimum standards applicable, whereas the areas located in the outskirt are limited to 80% of the minimum standards. In short, there is a maximum norm applicable for all the areas and all the business sectors, including offices, shops and retails. By having a percentage system, the maximum standards allows on one hand flexible mechanisms responding to the local conditions, and on the other limitation of parking supply.

On its side, Rotterdam has decided to implement maximum standards only for one type of land use (office buildings). Finally, should also be noted the case of Seattle in USA, where the minimum standards has been removed in the city centre (Shoup, 2005).

3 Transport policy tradition and parking policy in Lund

As it was presented in the introduction, Lund holds a long tradition of transport policies oriented towards limiting car use. However, that has mostly been design for the inner city, rather than the outskirt. Thus, the parking situation is mainly controlled in the city centre but a great deal remains to be done in the outer parts of Lund. The main instruments that the municipality holds are transport policies and parking regulations.

3.1 Policy tradition

LundaMaTs takes its roots from the transport policies designed for the city centre at the beginning of the 70s with the introduction of parking fares in 1972 and the creation of the Traffic and Environmental Committee. Therefore, parking instruments are a part of the policy culture in Lund for some decades already. It is also interesting to note that the traffic volume at that time was around 25 000 cars per day, which is considerably higher than the current level (Ingo, S. et al., 2007). Currently, the city centre is highly regulated, partly due to the desire to preserve the medieval road net. In 1985, the Inner City Plan was elaborated and aimed to make the inner city « car-free ». Ten years later, a new Transport Plan is launched integrating a long term planning vision with considerable focus on environment. The goals were the reduction of transport volume, lower emission and diminution of resources. Table 3-1 illustrates the major transport policies and initiatives that have been deployed over the past decades, according to Christer Ljungberg[20].

Table 3-1 Major transport policy-making and planning initiatives from an environmental perspective in Lund

1969	Municipal Council decision: Abandoning of plans for 4-lane road through city centre
1972	Traffic and Environmental plan: Restriction for private cars in city centre, introduction of parking fees.
1985	Traffic in the inner City of Lund, plan: Pedestrian areas, public transport initiatives, new bus station at railway station, bicycle facilities
1999	LundaMaTs, plan: Ambition to establish an environmentally adapted transport system in Lund
2007	LundaMaTs II: Pursue the orientations of LundaMaTs towards sustainable development of transport system and accentuates the possibility of increasing regional co-operation.

Source: Adapted from Ljungberg, 2007, Table 1

As it was explained in the introduction, LundaMaTs is an environmentally adapted transport plan that was adopted in 1998 and launched in 1999 in Lund. The history of the transport plan started in 1996 on a national level after the publication of a series of reports on environmentally adapted transport systems (MaTs) developed in collaboration with diverse authorities working in the Swedish transport sector. MaTs is inspired by the framework taken from the Natural Step organisation (the Four Environmental Systems Conditions[21]). A series of measures has been undertaken during the first implementation phase (2001-2004) that mainly aimed at influencing travel needs, modal split, and the operation and maintenance of the infrastructures (Ljungberg, 2007). The final version of the LundaMaTs plan included a

[20] CEO at Trivector Traffic, a transport consultant company closely working with the Lund Municipality and the Lund University.

[21] The Four Environmental System Conditions state that : Substances from the Earth's crust and those produced by society must not systematically increase in the ecosphere (conditions 1 and 2); the physical basis for productivity and diversity of nature must not be systematically diminished (condition 3); just and efficient use of energy and other resources (conditions 4) (Natural Steps, 2003)

study of the situation "before" the implementation, target settings and an action plan covering 8 main projects. The overall responsibility to achieve LundaMaTs is given to the Technical Service Administration and the Planning and Building Department. In 2005, LundaMaTs was reviewed for evaluation and further development. This evaluation gave birth to LundaMaTs II. So far, the evaluation covering the period 2001-2004 demonstrates that 20% of the inhabitants in Lund have been influenced to change their transport behaviours (Ibid). According to Ljungberg and the evaluation conducted by Trivector, it is estimated that LundaMats has contributed to reduce 2,500 tonnes of carbon dioxide (CO_2) and that car travelling has been reduced by about 10 million km (Ibid, 10). The main realizations leading to these results have been the implementation of Lundalänken (a route system for buses); a series of bicycle measures to make the city a bicycle-friendly town, and the related activities from the Mobility Office (a centre supported by the EU project MOST that informed households about sustainable transportation options). It should also be noted that Lundalänken was operated in parallel with TravelSmart, a project directed towards companies to encourage sustainable commuting. In short, the literatures reviewed and the interviews conducted within this research demonstrate that LundaMaTs has been successful and widely accepted by the population. It also gained international recognition[22].

More recently, a programme has been designed by the City Planning Office and the Technical Service Department within the framework of LundaMats II. The *Urban Planning To Reduce Car Use* elaborates a series of potential measures that can be developed to raise sustainable transportation and commuting in Lund. Among them, some are important to highlight and relate directly to car use:

- "Design residential areas with few car-parking spaces
- Create parking reserves
- Create adequate cycle parking with high standards and good situation
- Use maximum numbers in parking standards
- Use opportunities to mark out "No Parking" areas to prioritise pedestrian and cycle traffic near entries" (Technical Administration & CPO, 2007, 14-15)

The main strategies undertaken by the municipality in order to achieve these measures are related to the management of land-use (structure, density, and location of buildings for business and residence); the improvement and simplification of sustainable modes of transport; the introduction of restriction on car usage (financial and physical control including parking restriction); and the analysis of measures to solve problems and deficiencies provided by the SRA (Four Stage Principle) (Ibid, 5). The strategies illustrate the orientation that Lund is taking in terms of transport planning realization and future parking policies.

3.2 Parking regulations and standards

Regarding the parking standards, they only concerned minimum norms at the time of writing[23]. The norms diverged according to the different zones of the city, being located in the Centre, close to the Centre (half-centre), or the outer parts. The current standards are 12.5

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[22] One example is the presentation of the project at the World Conference on Transport Research.

[23] See the section 5.1 about the policy proposal on maximum parking standards currently in the adoption process.

parking places (ppl) per thousands square metres in the Centre, 18 for the half-centre, and 21 in the periphery (Lund Municipality, 2008b). There are also standards for bicycle parking places. Compliance to these standards is required to obtain a building permit. It should be noted on that point that a single parking space covers 25 sqm in average, which could be used by residents and property owners for other purposes, like green areas, recreational areas or barbecues (Technical Administration & CPO, 2007, p. 15).

Today, the parking system is divided between four main actors. The *City Planning Office* (CPO) is responsible for elaborating the policy proposals, and to set the norms and requirements for parking standards. On its side, the *Technical Service Administration* (TSA) of the city is responsible for operating and managing the on-street parking as well as supporting the Planning Office in its work. The rules for on-street parking are diverse and depend of the period of time (season and period of the day) as well as the area. On-street parking is mainly conceived for short term periods where the fare is more expensive during the weekdays. During nights and week-ends, most of the on-street parking is free. There are also special parking permits, which cost, depending on the area, between SEK 200-300 per month.

The Technical Service Administration acts somehow as a bridge between the Planning Office and the public company *Lunds Kommun Parkerings AB*. The latter organisation is a municipally owned company responsible for operating the five off-street parking garages in the city. Lunds Kommun Parkerings AB has a separate political board for the decision-making even though they are collaborating with the City. *Private companies* can also operate off-street parking garages. In the inner city, there are nine public parking garages in total[24]. The figure below shows the organisation of the parking management system for the City of Lund.

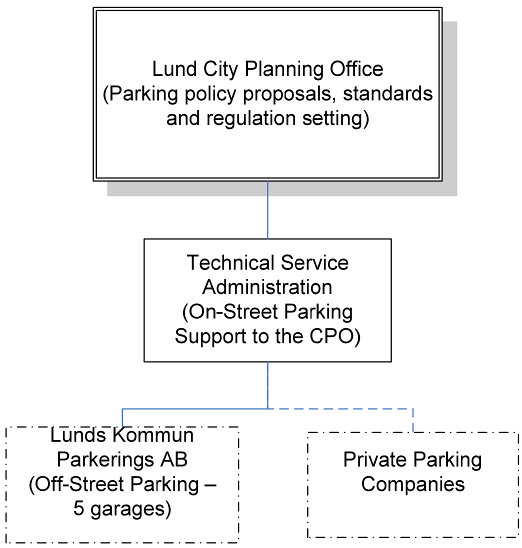

Figure 3-1 Parking Management System (Lund)

Although the parking conditions differ from area to area, the general situation remains that priority is given to pedestrians, bicycles and bus traffic. However, free parking place is a common situation for many employers. For instance, the main sector of activities in the outskirt of the city relies on high technology industries including large international employers. Most of these companies hold free parking spots for their employees. According to the municipal representatives, employers have build about twice as many parking places as they

[24] See Parkeringskarta: http://www.lund.se/upload/3472/Parkeringskarta.htm

were required in some case (up to 30-35 ppl/ 1,000 sqm). It should be noted that the municipality does not have a really good picture about the exact modal split. The estimation is that a majority commute by car. The balance between the supply and demand of parking has often been a part of discussions with shop owners the centre of Lund, but starts now to also be directed towards companies operating in the outer part of the city. The traffic planning has to be dealt in a special way mainly because of the medieval city and the access to the centre that has to be easy to reach without increasing car traffic. Consequently, parking facilities have to be designed so they are easily accessible for the right period of time. The city planners seek to develop policies that make parking garages the first choice for car-users, rather than on-street parking (Lockby, 2008). The latter being prioritized for pedestrians and cyclists. It should also be noted that there are parking restrictions on all the streets in Lund to encourage residential parking in private places. On that point, the results presented in section 4.4.4 and the related appendix showed that the distance from the residences to the nearest parking are further located than from the workplace to the nearest parking. In other words, residential parking is more restricted than commercial parking.

The main problems now emerging from the parking situation are that people relocate their vehicles in the outer part of the city. According to Håkan Lockby, Chief Executive Director of the Road and Traffic Department at the City, a change in the driver's behaviour occurred when on-street (but not on the parking garage) parking fares changed. Users tend to park more in the parking garages. Although there is collaboration between the local authorities and the private parking owners, it remains challenging to find an optimal price where most people will tend to use the garages. On one hand, parking companies have a tendency to raise parking fares, which have the effect of discharging the parking acts on the street. On the other hand, attempts have been made to develop policies where it is cheaper to use the parking garages rather than on-street parking. However, the latter option greatly depends on the type of government in power. For instance, a right wing coalition will tend not to increase the taxes, regardless of the effects.

Regarding the financial management, the incomes coming from the public parking are going in the general municipal accounts (in the "black holes") although there have been some thoughts to use the money to finance further alternative modes of transportation. The current figure for the cost to maintaining the public parking sites is about SEK 6.5 million, where the greatest expenditures relate to human resources including traffic inspectors and personal (Lockby, 2008). In 2007, the revenues turned around SEK 15 million (on-street parking), in which SEK 9 million came from the fares and SEK 6 million from the fines.

The current approach of the municipality is to keep control on the parking and the fares in order to be able to further develop the parking garages. Keeping in mind that the objective is to manage the traffic properly and have something to offer to the developers during the negotiation process (the developers can hire public parking lots and not have to provide parking lots for every building). This is also promoting shared parking. Thus, the local authorities are considering keeping this strategy for the new development in Lund North-East (See Case # 3: the Science Park). One of the main challenges remaining for them is to place the parking facilities in the right location, ensuring that it is accessible but at the same time support use of public transit and bicycles. The public officials think that the key alternative can be found in small and shared parking garages.

To sum up, parking regulations and standards are stricter and better controlled regarding on-street than off-street parking. It should also be mentioned that the pricing levels on on-street parking affect the demand on off-street parking and vice-versa.

National instruments: Swedish regulations related to parking

Taxation – regular law of benefit (avdrag förmåns)

According to the Swedish Tax Act, if a company offers its employees a free parking space, it should be considered as a benefit to be taxed (at the market price) as if it is a higher income (Skatteverket, 2008). If employees have free parking spaces that they can use and the company follows the law, a market price should be declared to the federal tax organization and the employees should be taxed around 30%-50% for these benefits, depending on the tax level and tax bracket. However, according to the CPO representatives, this situation is very uncommon and this section of the law is not enforced. Only a few percent of the companies have implemented it (Rube and Rydén, 2008). It is believed that enforcing the law could potentially represent important public revenue for the Swedish Tax Authority. Nevertheless, it is difficult to monitor and to put a market value on the "free" parking space. For example, the area located on the North East of Lund (Brunnshögområdet) count a few companies with several free parking lots. Those parking spaces have no "real" market values. Only a change in regulation could help to determine a market value.

On the same note, benefits for alternative modes of transport should also be taxed (like subsidized transit pass for instance). Consequently, it is easier not to tax benefits related to free parking since the cost does not really appear in the economic system, contrarily for example, to a transit card valuing SEK 1,000 per month. Users of public transportation are thus at a disadvantage compared to drivers benefiting from "free" parking.

Moreover, the City of Lund acknowledges that on the national level there are diverse instruments that can be used to reduce car use, stating that, among other measures, charges or fringe-benefit taxes for workplace parking can have considerable effect on the amount of car use (TSA and CPO, 2007, 5). In that way, it is suggested that the national level can significantly support the local level at achieving sustainable transport more rapidly.

The Planning and Building Act

The Planning and Building Act requires that companies that want to build an office house should make sure that there is sufficient parking place, either underground or at other sites (Boverket, 2006). Such minimum standards are required when an employer or a developer requests a building permit at the municipal level. Generally, parking places located in the outskirt of the city are owned and arranged on the site and by the employers. This is contrary to the centre, where it is more difficult to find a site for parking. Then the employers would usually buy the required parking places from a central garage that is commonly managed by the public company.

4 Work commuting in practice: comparison of three case studies in Lund

This chapter is composed of two main parts. The first one describes the case studies including the working activities of the areas, transport and parking conditions (Sections 4.1 to 4.3). The second part (Section 4.4) presents the commuter's behaviour. That covers the modal split and the link between the parking accesses (pricing and distances). A description of the type of commuters is also included at the end. The information used includes quantitative and qualitative data sources.

The sample

The quantitative analysis is based on a sample comprising a population of 358 people (weighted values[25]) distributed into three areas: the city centre, Lund University Hospital and the Science Park. The reason why these locations have been chosen rests first on the differences assumed in parking conditions, and secondly on the level of employments (as working areas). Besides, the population of the sample is only composed of people travelling to work to the three locations. The data was processed with the support of statistical software (SPSS) and the sample was selected by filtering first the respondents according to their purpose of travel (work)[26], and then the respondents travelling to the three areas. Therefore, it constitutes processing of secondary empirical data source taken from the RVU survey. The margin of error is estimated at ±5.13 percentage points, 95% of the time and the total working population for the three areas selected is 17,460 (SCB, 2006). Besides, some explanations are taken from literatures and the interviews. It is mostly the case for the site descriptions and the validation of some statistics compared with other studies. To observe the link between parking pricing and the modal split, the data analysed represent the answers to the question "Can you access one of the following to your working place", in which the option of free parking and parking levies are proposed (see Appendix 1, Question B2 for more details). The central purpose of the requested data is to understand the effects of parking pricing for different working areas.

As the focus is emphasized on this area, the Science Park is divided in smaller lots, which support the analysis and provide better indications of particular parking situations and the differences in transport behaviours. This division is based on the municipal districts. The split in smaller areas was also used in the RVU. Finally, the proportion between these three areas is representative of the level of employment, i.e. that LUH and the Science Park are locations attracting more employments than the centre. Table 4-1 provides detailed information of the population and the sample size.

Table 4-1 Working population and number of survey respondents per working areas

	Centre	LUH	Science Park	Total
Number of survey respondents weighted (*n*)	40	189	129	358
Number of survey respondents non-	(66)	(282)	(210)	(568)
Working population (*N*)	2,210	7,850	7,400	17,460

[25] As it was explained earlier, the data are weighted according to the population representativeness (age, sex and the area were the participants live).

[26] Sammanslagning ärende till färre klasser (Purpose of travel aggregated by classes).

Source: RVU, 2008; SCB, 2006

4.1 Case # 1: The Centre (Centrum)

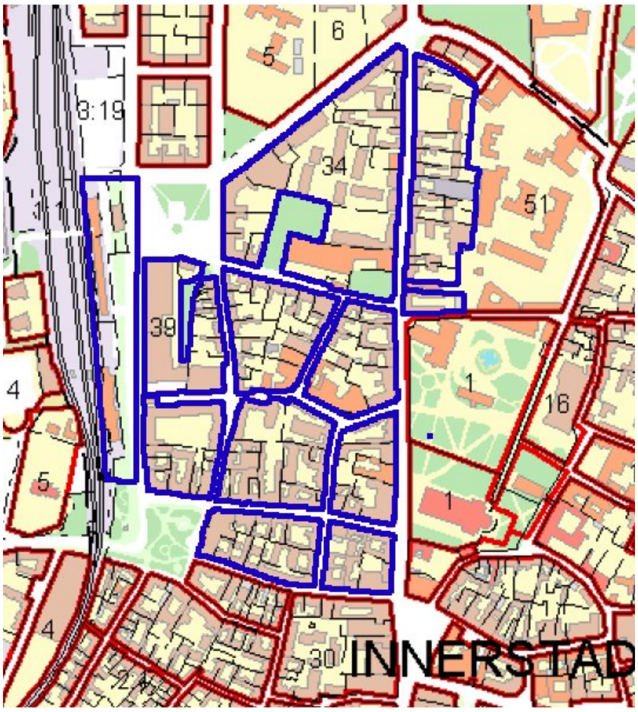

Figure 4-1 Area covered for the City Centre (Map)

Source: Adapted from City of Lund, Planning Office, 2008

4.1.1 Characteristics

The transport conditions in the Centre of Lund is characterized by its medieval roads, in which many streets and roads are car-free (or restricted) and reserved for pedestrians and bicycles. It is the case of *Knut den Stores Gatan* and *Bytaregatan*. Apart from that aspect, it should be mentioned the Central Station comprises the train station and the bus station. It serves the surrounding population but also connects the city with the Öresund region and the Swedish railway network. Special consideration needs to be taken regarding that point when analysing commuters' behaviours in the centre: the access to public transport is high. In addition, there are three bicycle lanes crossing the areas: the "red" lane (going across the train station and continuing on Sankt Petri Kyrkogata); the "yellow" lane and the "green" lane (being on Bytaregatan). There is one large covered bicycle parking near the train and bus stations.

The main sectors of employment for this area is composed of retailer shops, banks, offices, café and food stores. The total number of employees for the area covered is estimated to be around 2,210 workers (SCB, 2006).

4.1.2 Parking conditions

The parking conditions in the areas are restricted on both pricing and supply. The area contains underground parking garages and three public sites that account for 515 places

(Lunds Kommuns, 2008a)[27]. The price varies between SEK 10 and 15 per hour, SEK 100 per day and SEK 600 to 900 per month (Ibid). Regarding the standards, the minimum norm is established at 12.5 ppl / 1,000 sqm for offices and 20 ppl /1,000 sqm for retail shops Lunds Kommuns, 2008b. Eleven lots have been selected near the train station (see the map above).

4.2 Case #2: Lund University Hospital (Sjukhuset)

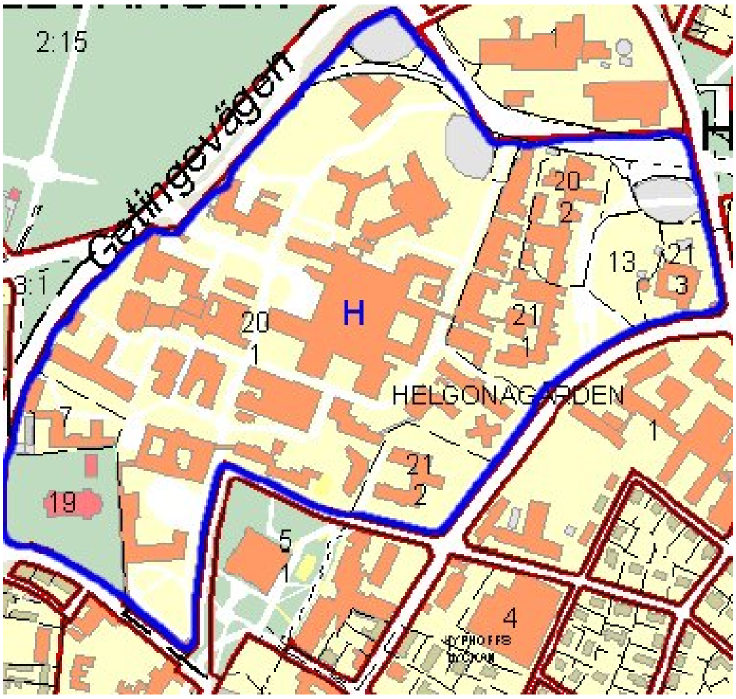

Figure 4-2 Area covered for Lund University Hospital (Map)

Source: Adapted from City of Lund, Planning Office, 2008

4.2.1 Characteristics

Universitetsjukhuset (Lund University Hospital) is located North East from the Centre. The location is served by almost all the bus lines available in Lund, all passing on Getingevägen (lines 2, 3, 4, 6, 20, 21, 10, 12) at *Universitetsjukhuset* bus station. In addition, there are several bicycle paths crossing the sites, especially with good infrastructure on Getingevägen, Lasarettsgatan and Entrégatan. There is also the "Blue lane" passing on the east side of the site. The area comprises a covered bicycle parking next to the bus station. The site under observation includes mainly buildings associated with the hospital but also other offices related with Lund University (Faculty of Medicine) and a biomedical centre. The hospital itself employs around 7,850 people.

[27] It should be noted that the total number of public parking in Lund (available parking sites for the public/visitors) reaches 1,580 places according to the Lunds Tourist Information Office.

4.2.2 Parking conditions

There are four public parking houses and 25 parking sites comprising around 1,200 parking places in total. The availability of parking place is abundant and accessible[28]. The prices vary between SEK 6 to 15 per hour, SEK 40 per day, and SEK 180 per month, which is less expensive compared to the centre (LUH, 2008). It should be noted that the LUH is the owner of the parking places and administrates them. According to the Environmental Manager of the hospital, Nils Topphem, the revenues remain in the parking management system and are redistributed for maintenance and operation of the parking. In order to be more optimal, the price is adjusted in regards to the price for parking in the city centre.

Additionally, it should be mentioned that the LUH closely collaborates with *Region Skåne*. This regional organisation is responsible to coordinate operations related with health, medical cares, trade and industries, public transport as well as environmental matters. Thus, the transport system operated at LUH is overarched by Region Skåne on certain aspects. It is the case of the parking and transport benefits offered for the travellers going to LUH (patients or employees). For instance, SEK 20 is offered to travel by public transit for patients that need to go to the hospital. The LUH also collaborates with Region Skåne to encourage the employees to use the transit system (Thoppem, 2008).

The collaboration also extends to the Objective 3 of Skåne Region environmental policy seeking to reduce the environmental impact from transport. To achieve it, all administrations (including the LUH) "should have their own environmental objectives in the area of transport" and the pool of vehicles should contain a higher proportion of green vehicles. It is hoped that in the long-run, all Region Skåne's vehicles will be green.

On a different note, a carpool system has been introduced where a platform system was made available for employees over the Intranet. This has been launched in partnership with the City of Lund, but the success has been mitigated due to its unpopularity according to the Environmental Manager of the LUH.

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[28] See Skåne Region. (2004) *Universitetssjukhuset i Lund, Parkeringkarta*, http://www.Skåne.se/upload/Webbplatser/R_Fastighet/regionfast2.0/dokument/startsida/parkering/USIL_Kartor-USIL%20Karta%20Parkering.pdf

4.3 Case # 3: the Science Park

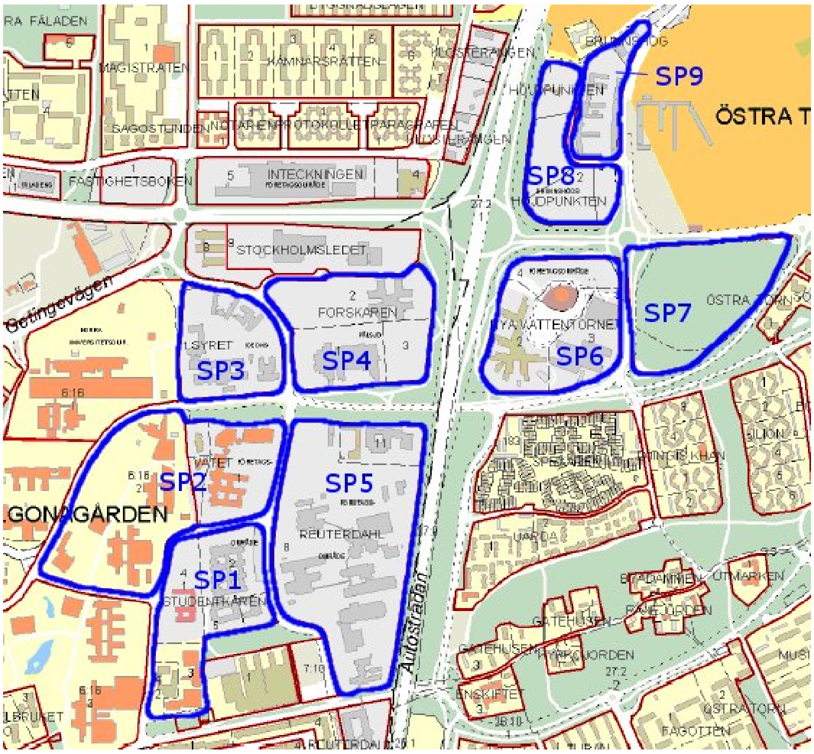

Figure 4-3 Area covered for the Science Park (Map)

Source: Adapted from City of Lund, Planning Office, 2008

4.3.1 Characteristics

The area selected for the Science Park comprises nine lots, SP for Science Park, of which two are without any survey respondents. These two lots are thus withdrawn from the behaviour analysis below (SP7 and SP8). However, there are four areas of importance usually recognized: LTH (The Faculty of Engineering, LU), Idéon, Pålsjö, and Brunnsshög. LTH is represented in block SP2 on the left side, whereas Idéon corresponds to SP3, a part of SP1, and the right side of SP2. Pålsjö includes SP4 and SP5 and a part of another block below (not selected). Brunnsshög covers sites SP6 to SP9.

The Science Park is located in the Northeast of Lund and is surrounded by one main boulevard, Norra Ringen (being the regional road E6), and one main highway, the E22. This situation makes the Science Park attractive for employers, since it comprises many arterial roads and access points. Public transport comprises two bus lines, the 20 and 21 that pass through Idéon, Pålsjö and Brunnshög on Sölvegatan (see the next paragraph for a description of these areas). Line 21 starts from Brunnshög, goes to the Central Station and ends-up in Stångby (Lund up North). Line 20 starts from Brunnshög too, but crosses the city East/West towards Gunnesbo in the Western part of the city. In addition, there are two other lines brushing the southern part of the selected lots (line 1 and line 11). There is also the express bus travelling to Malmö (*Skåna Expressen*). Regarding the bicycle paths, the infrastructure comprises several lanes surrounding almost every lots selected in this research. There are also three covered parking garages for bicycles connected to the bus station (two on Pålsjö (SP4 and SP5), and one on Brunnshög (SP6)). From a bicyclist's point of view, it appears to be easier to bike in this part of the city compared to the centre.

The Science Park houses a wide range of private companies operating in innovation development, mobile communication, information technologies (IT), clean technology and life sciences. Examples of firms established in the Science Park are Sony Ericsson, Axis Communication, and Astra Zeneca.

The area represents an important role for economic development and employment in the city, but in the region as well. Idéon itself attracts around 3,000 employees and 250 companies (Idéon, 2008) and the total labour force in the area covered is estimated at 7,400 employees (SCB, 2006). These sectors of activities bring a highly educated working force holding expertises in science and technology. The stakeholders involved in the Science Park promote amply the area and try to make it attractive for new entrepreneurs and investors[29]. While the Faculty of Engineering (LTH) appears fully developed and mature in terms of building age and infrastructure, most of the sites in the Science Park remain under construction. It is the case for Idéon, Pålsjö and Brunnshög, where several projects are in development. An example is *Idéon Gateway*, a building project of 18 floors comprising apartments, offices, retails shops and services[30]. The expansion area in Brunnshög is another case of project development seeking to combine 30% housings and 70% of service activities. Thus, all of the above suggest that an integrated transport planning strategy and mobility management is required, in which parking accesses have to be considered.

4.3.2 Parking conditions

The parking conditions in the Science Park vary extensively, but the majority of the sites have their own parking places provided free of charge. The minimum norms for the area are 21 ppl/ 1,000 sqm for offices, 14 ppl /1,000 sqm for industry, 10.5 ppl /1,000 sqm for laboratory (Lund Municipality, 2008b). In case where facilities are located close to good transit services, walking and cycling conditions, the requirement stipulates that the minimum standards can be lowered by 20%. For the area of Idéon itself, the total parking capacity is estimated to be around 1,800 parking spaces (IKANO, 2008).

Before the rapid business development in the area, the traffic conditions were largely supporting car-use, since the infrastructures were able to receive it. During the past few years, the business sector growths considerably which pressurizes the road infrastructures by the large number of vehicles travelling through the area. According to one of the developers in the area, the traffic during morning rush hour is considerable and the current road infrastructures are not able to carry this amount of vehicles (Åksson, Tufvesson, 2008). So far, the way the developers have been coping to this growing demand was to provide a new five stories parking garage.

Three different parking conditions

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[29] Extensive communication is made through these following websites:

- Lund North East: http://www.lundne.se/
- Ideon: www.ideon.se
- Ideon Gateway: http://www.ideongateway.se/English/

[30] See Ideon Gateway. (2008). *Eighteen floors of new possibilities,* http://www.ideongateway.se/English/AboutIdeonGateway.aspx

The two figures below (Table 4-2 and Figure 4-4) summarize the parking conditions for the three cases. Table 4-2 presents the difference in prices and norms and Figure 4-4 demonstrates the access level for the commuters. (see Appendix 3 for data details).

Table 4-2 Parking pricing rate and Minimum Parking Norms. Comparison between the Centre, LUH and the Science Park.

Pricing Rate and Minimum Parking Norms			
	Centre	LUH	Science Park
Pricing in SEK			
Per hour	~10-15	~6-15	NA
Per day	~100	~40-50	NA
Per month	~600-900	~180	NA
Minimum parking norms			
Office	12.5ppl/ 1,000sqm	NA	21ppl/ 1,000sqm
Retail shop	20ppl/ 1,000sqm	NA	NA
Industry	NA	NA	14ppl/ 1,000sqm
Laboratory	NA	NA	10.5ppl/ 1,000sqm

Source: Lund Municipality, 2008a; 2008b; Lund University Hospital, 2008; Region Skåne 2008

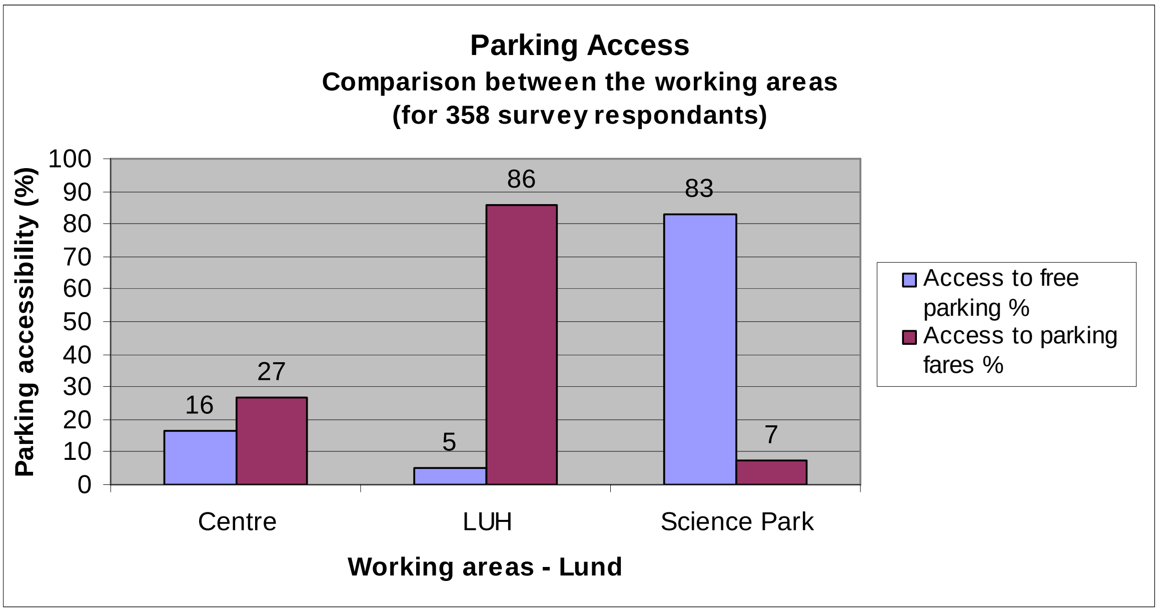

Figure 4-4 Type of Pricing Access. Comparison between the Centre, LUH and the Science Park (for 358 survey respondents).

As we can see, most commuters in LUH can access parking fees (86%) and 5% can access free of charge parking. This proportion is completely reversed in the Science Park, with 7% of them having access to parking fees and 83% of the commuters have access to free parking. On its side, the Centre presents much lower shares for both accesses, standing at 16% for access to free parking and a bit more than a quarter for commuters accessing parking fares (27%). If we combine the access for each area, we can observe that LUH and the Science Park reach the same level, at 91% and 90% respectively. The Centre attains 43%. To give an idea, 58% of motorists in London received employer-paid parking (Shoup, 1997, 201).

In short, two areas with the same level of access to parking, but with two opposing pricing conditions (free parking vs parking fares). The other area (Centre) presents a lower level of parking access. These results confirm that parking conditions are different enough to be compared for evaluation. The following sections present the various modal split for commuters and how these behaviour choices can be influenced by the parking access.

4.4 Commuters' behaviours

This section presents a quantitative analysis of the transport behaviour for work commuters for the Centre of Lund, the LUH and the Science Park. The aim remains to see whether there is a relationship between access to parking and car use; if different conditions of parking access can cause modal shifts. There are two types of access factors observed: the parking pricing and the distances travelled. Special attention is given for solo-drivers and the relation with the type of pricing access (free or charged). For the distances travelled, two types of variables are observed: the vehicle travel to work (VKT) and the distance from work to the nearest parking. First, the general behaviour of the commuters can be studied in order to have a better understanding of the general situation.

4.4.1 Modal split among the three areas

Figure 4-6 and Figure 4-5 present the modal split for the different working areas. Figure 4-6 illustrates the different modes in details, whereas Figure 4-5 shows the mode in aggregate categories (car, transit and non-motorized vehicle).

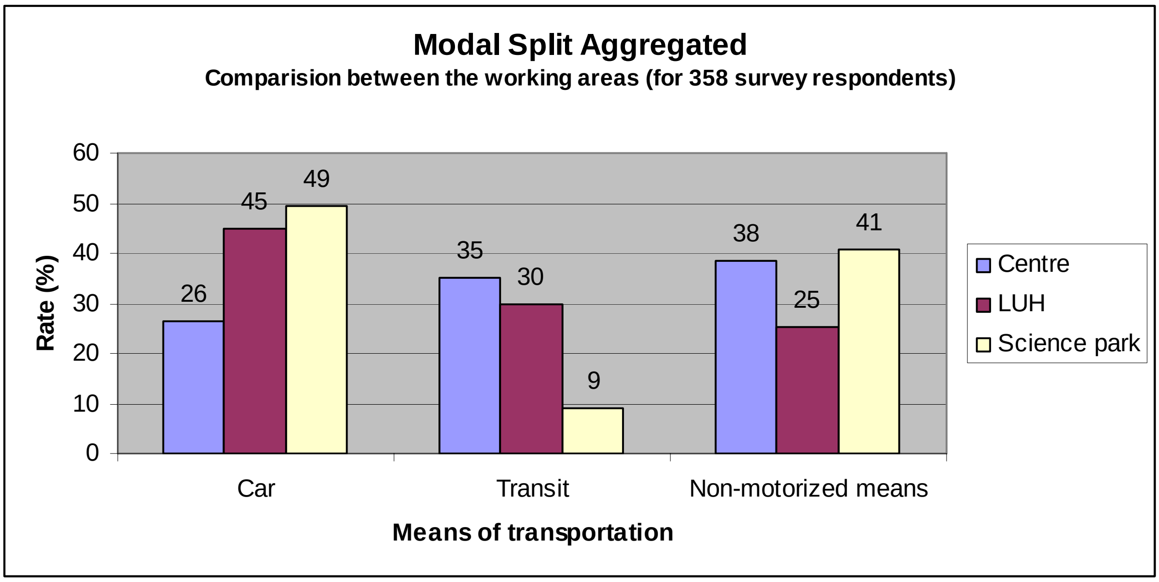

Figure 4-5 Modal Split Aggregated, Comparison between the working areas (for 358 survey respondents)

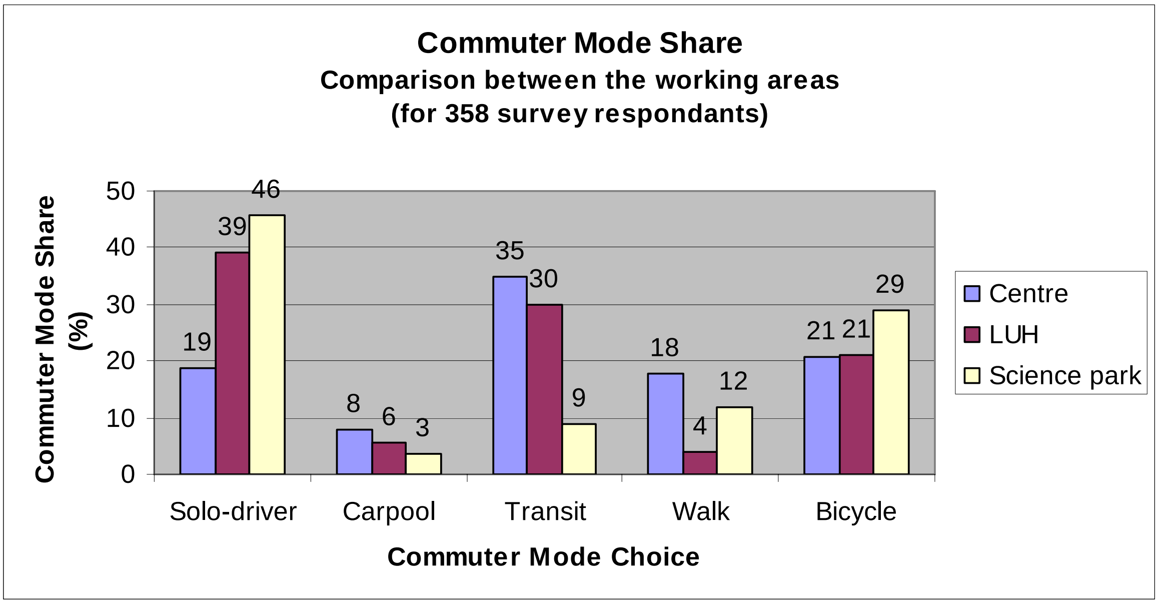

Figure 4-6 Commuter mode shares. Comparison between the Centre, LUH and the Science Park (for 358 survey respondents)

As it can be observed, the majority of the commuters are car users and solo-drivers. However, as Figure 4-6 indicates, there is considerable variation between the commuters in the Centre, the Lund University Hospital and the Science Park.

Figure 4-5 clearly underlines the low share of transit user for the Science Park when the other means are combined. It also shows that non-motorized means are the preferred modes of the commuters from the Centre, followed by transits and cars on the third place. Private vehicles are the favourite modes for the LUH, followed by transits and non-motorized means respectively.

Commuters working in the *Centre* travel mainly by public transit (train and buses), where 35% of them choosing this mode. This rate is higher compared to LUH and the Science Park. The share for the other modes (solo-driver, bicycle and walk) is quite equal, where all the modes stand between 18% and 21%. Overall, the share for the different transport modes in the Centre is more equally spread compared to the other locations.

On its side, the workers commuting to the *LUH* primarily chose solo driving with a share of 39%. This rate represents one fifth more than the Centre. Thirty percent of the people opt for transit and a fifth of the population is commuting by bicycle whereas carpool and walk hold a minor share, being respectively 4% and 6%.

For the *Science Park*, solo driving is the preferred mode for commuters (46%). It also represents the highest share among the three areas for this mean of transport. However, bicycle mode also carries the highest share when it is compared with the Hospital and the Centre. Then comes walk at 12%, transit at 9%, and carpool merely reaches 3%. It should be mentioned that transit is rather unpopular for this area, moreover when compared with its counterparts. If the figures for non-motorized transport means are combined (walk and bicycle), the Science Park hold the highest share, being 41% against 38% for the Centre and a quarter for the LUH. Doing the same for car use (carpool and solo-driver), it brings the share at around 49% for the Science Park. In fact, this illustrates the weakness of the worker in the Science Park at commuting by transit, since around four out of ten commuters will opt for non-motorized vehicles, five will take their car, but only one will choose to travel by public transportation. Compared with the other areas, there is a clear disproportion on that point.

In addition, an interesting aspect appearing from Figure 4-6 is the low amounts of commuters opting for car-pool, for the three working areas. All of them stand below 8%. As an overall observation, there are two modes of transportation presenting an important gap (where the difference in proportion between the location is considerable) being solo-drivers and transit. The difference between the Centre and the Science Park for these two modes is more than a quarter each in proportions (35% vs. 9% and 46% vs. 19%), meaning a total gap of around 50%. It also denotes an important deficit for the Science Park in reaching sustainable transport through more public transit use and less solo driving. Keeping in mind that the share for solo-drivers in the Science Park remains the highest compare to the other mode choice but also compared with its counterparts (the LUH and Centre). Many factors can contribute to this situation, such as access to public transportation, but it is relevant to investigate how parking access can play a role in it.

Following that, Figure 4-7 shows the modal split for the different lots in the Science Park. It illustrates the share in percentage with a descendant count for solo-drivers.

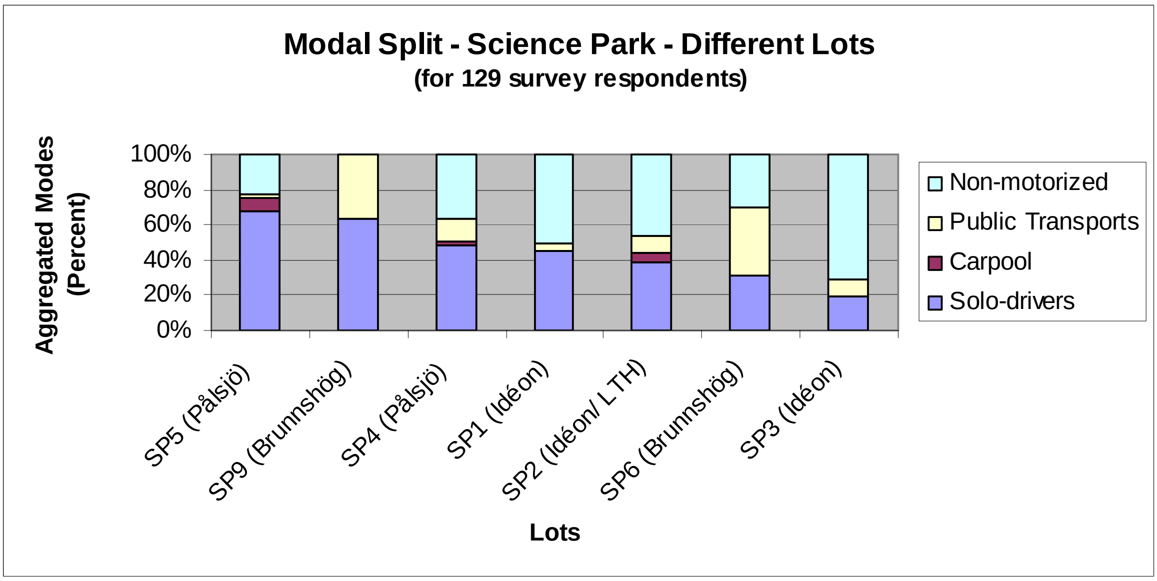

Figure 4-7 Science-Park: Modal Split for the different lots (for 128 survey respondents)

As it can be observed, the lot in which the share of solo-drivers and car-users is the highest is Pålsjö (lot SP5). Car users reach almost three-quarter of the commuters (73%). On the opposite, Idéon (lot SP3) presents the highest portion of commuters opting for bicycle or walk (non-motorized means) being 71%, as well as the lowest share of solo-drivers (reaching 19%). Besides, it should be noted the small sample size when looking at one lot in particular (see appendix 3 for more details). Nevertheless, it gives an indication of the difference in modal split between the lots.

4.4.2 Link between modal split and parking pricing

A way to analyse the effects of free parking and parking fares is to look at the change occurring for the modal split. Table 4-3 and Figure 4-8 indicates the shift in modal split for commuters having access to free parking to those having access to parking-fees. The modes of travel are aggregated in three categories (car, public transit, and non-motorized transport). The data have been derived by subtracting the difference in modal share (valid percent) between those having access to free parking and commuters having access to parking fees. However, it should be noted that for some cases, the sample was very small. More the access level to parking is low, less participants there are in the in the sample. Thus, for the Centre, the sample size is very low (18 participants), whereas for the LUH, it is the sample relating to the access to free parking which is small (9 participants for access to free parking against 161 for access to parking fares). It is the opposite for the Science Park (106 participants access free parking against 10 for parking fares). In order to overcome this issue, it was decided to attribute an equal share to balance the variation. See Appendix 3 for more details.

Table 4-3 Change in modal split from access to free parking to access to parking fares

Change in modal split from access to free parking to access to parking fares (for 305 survey respondents)					
Locations	Car (Solo-drivers +Carpool)	Public Transports (Bus+Train)	Non-Motorized Transports	Weights	Survey respondents
Centre	-22%	36%	-14%	1/3	11%
LUH	-32%	14%	17%	1/3	53%
Science Park	-37%	-11%	48%	1/3	36%
Average changes	*-30%*	*13%*	*17%*	--	--

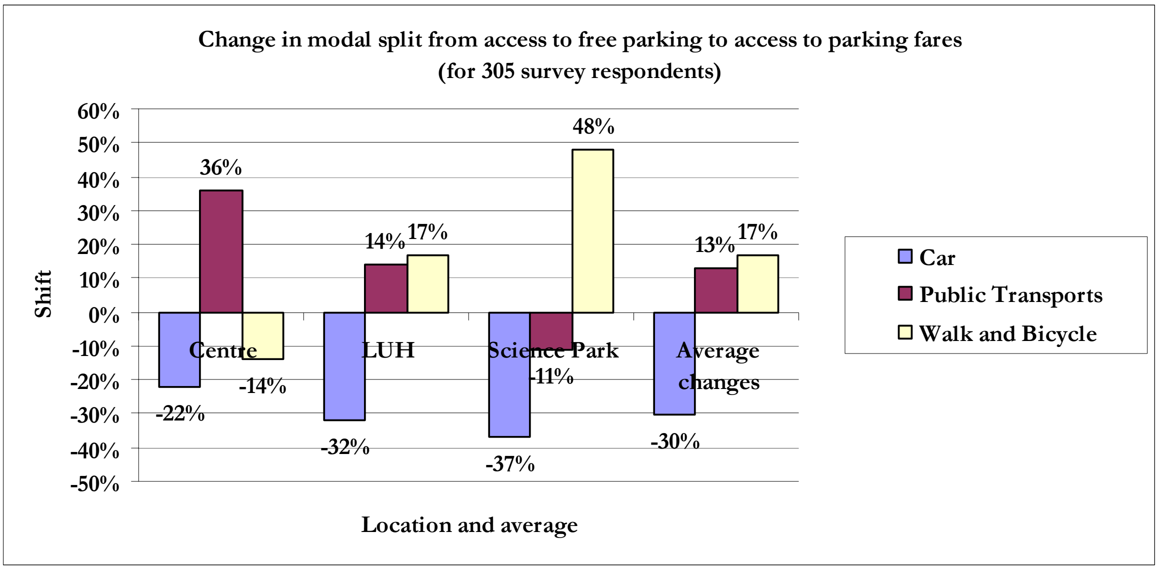

Figure 4-8Shift in modal split between commuters having access to free parking and parking-fares (for 305 survey respondents)

The main element that can be observed is the reduction in car use for all the locations. This reduction presents an average of 30%. For comparison, the figure provided by Shoup is 36% of car increase when parking is employer-paid (or "free"), which is fairly close to the figure demonstrated above (Shoup, 1997, 202).

4.4.3 Link between solo-share and parking pricing

Table 4-4 summarizes the changes between the solo-drivers having access to free parking and those having access to parking fees. By doing so, it is possible to observe how parking pricing can stimulate the rate of solo-drivers. The methodology used was to observe the modal split for all commuters having access to free parking and parking fees, rather than looking only at solo-driver category and then observing those who have access to free parking and parking fees. This way is more representative. The total number of survey respondents for solo-drivers is 128 on a total of 305 respondents including all the commuters.

Table 4-4 Change in solo-share from access to free parking to access to parking-fees

Change in solo-share from access to free parking to access to parking-fees (for 305 survey respondents)					
Cases	Free parking	Parking- fees	Change	Weights	Survey respondents
Centre	40%	18%	-22%	1/3	11%
LUH	47%	43%	-4%	1/3	53%
Science Park	47%	15%	-33%	1/3	36%
Average	45%	25%	-20%	--	--

Source: RVU, 2008 (for 305 survey respondents)

First, what can be observed is that in all cases, there is a drop in the share of solo-drivers for commuters having access to parking-fees. Furthermore, it clearly demonstrates that access to free parking attains a solo-rate of at least 40%. One interesting aspect to observe is the situation in the Centre. The solo-rate for this area reaches 40% for people having access to free parking. In other words, access to free-parking seems to increase the solo-rate by 21% for this area, which also correspond to the average change. Access to free parking appears to increase the solo-share by one third for the Science Park. Nonetheless, this situation is completely different for the LUH with only 4% reduction.

On one hand, these results can show the potential for the Science Park to increase the portion of parking-fees if a reduction in solo-drivers wants to be reached. It is in this area that parking fares have the biggest influence on mode choice. On the other hand, when we look at the hospital area, such conclusion barely hold the road. In spite of this, if we take the average of accesses for all the locations, the solo-rate reaches 45% for free parking, whereas the rate of solo-drivers for commuters having access to parking fares is established at 25%. In other words, it means an average drop of one fifth in solo-drivers, or that free parking increase solo-share by 20%. Being conservative and taking this logic, it could also mean a potential reduction of 9.5% for the Science Park if this 1/5 portion would be applicable through a shift from free parking to parking-fares. This decrease in solo-drivers would bring the rate around 37%, which is below the current rate at the hospital area.

The example below observes the share of solo-driver and the parking access for the different lots in the Science Park. It also indicates the main mode of transportation used by the commuters in the lots.

Table 4-5 Science Park, individual lots: type of pricing access and preferred mode of transportation

Science Park, individual lots: type of pricing access and preferred mode of transportation (Number of survey respondents and percentages, for 129 participants)

Lots	Number of respondents	Access to free parking	Access to parking fees	Main mode of transportation used	
SP5 (Pålsjö)	25	22 (89%)	0	Solo-driver	66%
SP9 (Brunnshög)	3	2 (61%)	0	Solo-driver	63%
SP4 (Pålsjö)	16	16 (98%)	0	Solo-driver	48%
SP1 (Idéon)	29	21 (73%)	5 (17%)	Solo-driver	45%
SP2 (Idéon/LTH)	43	35 (82%)	4 (9%)	Solo-driver	39%
SP3 (Idéon)	7	7 (100%)	0	Bicycle	37%
SP6 (Brunnshög)	6	4 (62%)	1 (12%)	Train	39%

First, what can be derived from these results is the high portion for commuters accessing free parking and the low portion for accessing parking fees. The percentage for the workers with access to free parking varies between 61% up to 100%, whereas it attains between 0% and 17% for those having access to parking fees. In addition, the lot seems to have the highest share of solo-drivers is SP5, which correspond to Påsljö, with a rate of 66%. This also denotes further unequal distribution with the other travel modes. Another element interesting to observe is that the three lots presenting access to parking fees are those with either the less solo-driver shares, or another main means of transportation (SP1, SP2 and SP6). In short, the areas presenting fewer problems in terms of sustainable travel modes are Idéon and the LTH (SP1, SP2 and SP3). For its part, Brunnshög (SP9 and SP6) is somewhat ambiguous presenting low amount of respondents and inconsistent results; altering between one of the highest rate of solo-drivers (63%) and train commuting as the main mean chosen (39%). In addition, care must be taken when interpreting results with low number of respondents. The next chapter, presenting qualitative data from interviews, will provide more informative details about the Science Park.

4.4.4 Distance to access the nearest parking

Accessing the nearest parking plays an important role in transport mode decision. Although some authors argue that commuters are willing to cruise and walk a long distance to find free of charge parking[31], the fact remains that having parking near the working place increase its accessibility and thus boost its attractiveness. Table 4-6 presents the distance travelled including the mode, means and median. It also gives indication on the distribution of the data.

Table 4-6 Distance from the working place to the nearest parking place (in meter). Mean, Median, Mode.

(Q. B1_bil : How long, from your working place, is the nearest car parking place (in meter)?)

Centre			LUH			Science Park		
Respondents	Valid	32	Respondent	Valid	179	Respondent	Valid	117
	Missing	9		Missing	9		Missing	12
Mean		112	Mean		140	Mean		73
Median		50	Median		100	Median		20
Mode		50	Mode		100	Mode		10

At the question "How long is the nearest parking place" asked to the survey participants, the results show that commuters from the Hospital have to walk the longest distance, being 140 meters. The Centre ranges in the middle with an average of 112 meters. As for the Science

[31] Shoup, 2004.

Park, it presents the shortest average distance, being 73 meters. It is also interesting to observe the mode and the median and to compare the locations. The value being the most frequently given for the Science Park is 10 meters, as compared to 100 meters for the LUH and 50 meters for the Centre. Overall, it can be said that the distance gap between the Science Park and its two counterparts is important. The difference for the mean with the Hospital is 67 meters, and 80 meters regarding the median. It signifies that parking places in the Science Park are closer to the entrance. Thus, the distance factor for this area appears to play an important role and have an influence on the mode chosen by the commuters.

Finally, another interesting aspect worth underlining is the difference in distance between the nearest parking from home and the nearest parking from working place. At the question "How long from home is the nearest parking, in meters?", all the figures appears to be much higher than for the working place. For instance, the means vary between 349 and 405 meters, depending on the area were commuters are going for the nearest parking from home (see appendix 3). This underlines that it is easier to implement parking restriction in residential areas than commercial zones. There are around 250 meters difference between parking close to the residence and the workplace.

4.4.5 Vehicle kilometres to work

This section provides analysis on the distance travelled for car commuters from their point of origin to the destination. Table 4-7 shows the average distance travelled per mode of transport and per area. This information is useful to calculate other type of effects, like the CO_2 emission for instance (see next chapter).

Table 4-7 Average distance travelled (km) per mode of transport

Average distance travelled (km) (for 358 survey respondents)			
	Centre	LUH	Science Park
Car	14,0	22,1	27,9
Bus	10,5	17,6	13,8
Train	29,4	35,0	52,2
Bicycle	3,1	2,7	2,7
Walk	0,6	1,8	1,5
Mean	12,5	17,8	17,8

As we can see, the average distance for car is 21.3 km. American studies from 1994 showed that the average distance for one-way vehicle is between 23.8 to 26.6 kilometres (in Shoup, 1997, 205). This result partly corresponds to those on Table 4-7, although the figure for the Centre is low.

4.4.6 Who are the commuters: an overview

This last section provides information about the commuters travelling to the three different sites. The place of residence (origin) is observed as well as the age, gender, income, and education. This information is useful to learn more about the targeted groups to design future transport policy and to focus on groups that can produce the greatest effect according to SUMO (Hyllenius et al., 2004, 18).

Origin: where are commuters from?

The graphic below (Figure 4-9) shows the most frequent municipalities where commuters are from.

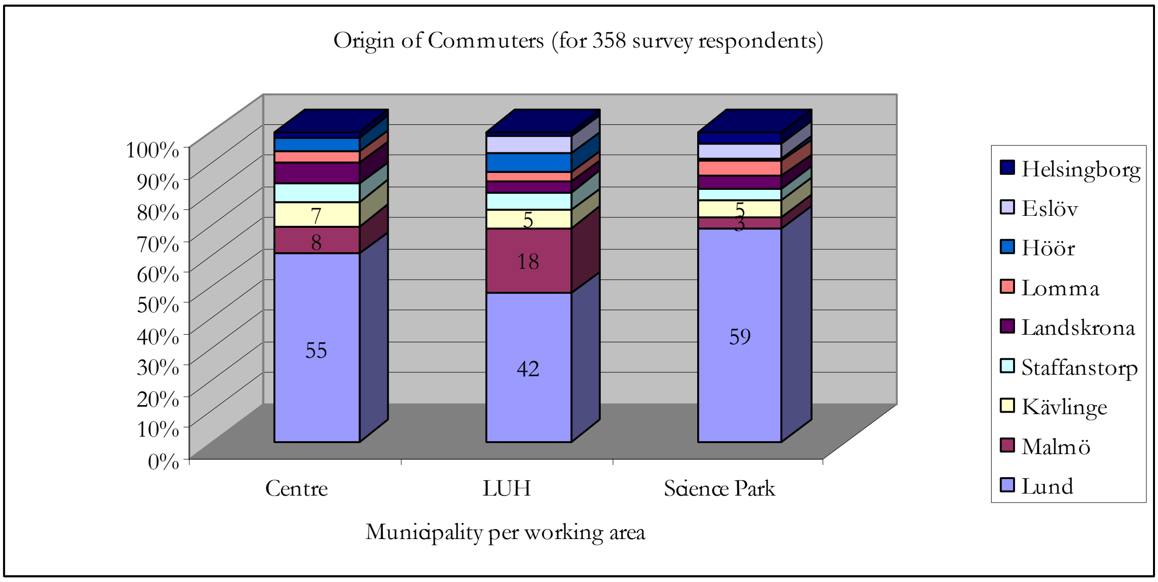

Figure 4-9 Origin of commuters

As we can see, most of commuters are from Lund Municipality and Malmö. The *Centre* presents a share of 55% commuters coming from Lund, 8% from Malmö, followed by the other municipalities.

For their parts, employees coming from Lund Municipality and going to the *LUH* presents the lowest share compared, standing at 42%. Eighteen percent of them are coming from Malmö, being the highest percentage for this city. This situation can maybe explain why the car mode is popular for this area.

The *Science Park* holds the highest portion of people coming from Lund Municipality reaching near 60%. This result is curious in a way and unexpected, since the Science Park is also presenting the highest solo-drivers percentage (46%). This means that there are many solo-drivers coming from Lund to work in Lund. Because of the high share of car-users, it could have been anticipated that a great part of commuters would come from other municipalities.

Transport behaviours for Lunds' commuters

Following that, it is interesting to observe what the modal split is for the commuters coming from Lund Municipality working in the three areas. The three figures below (Figure 4-10 Figure 4-11 Figure 4-12), provide an indication.

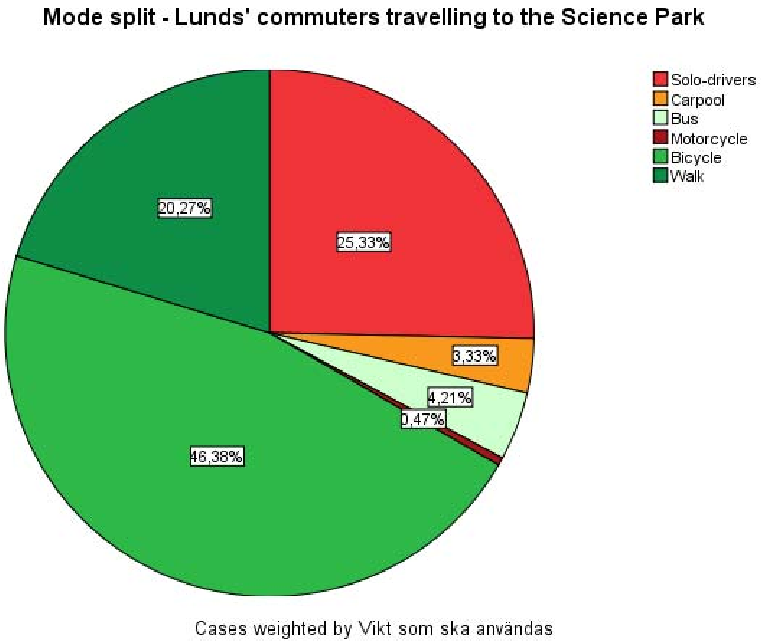

Figure 4-10 Science Park – Modal Split –Lunds' Commuters

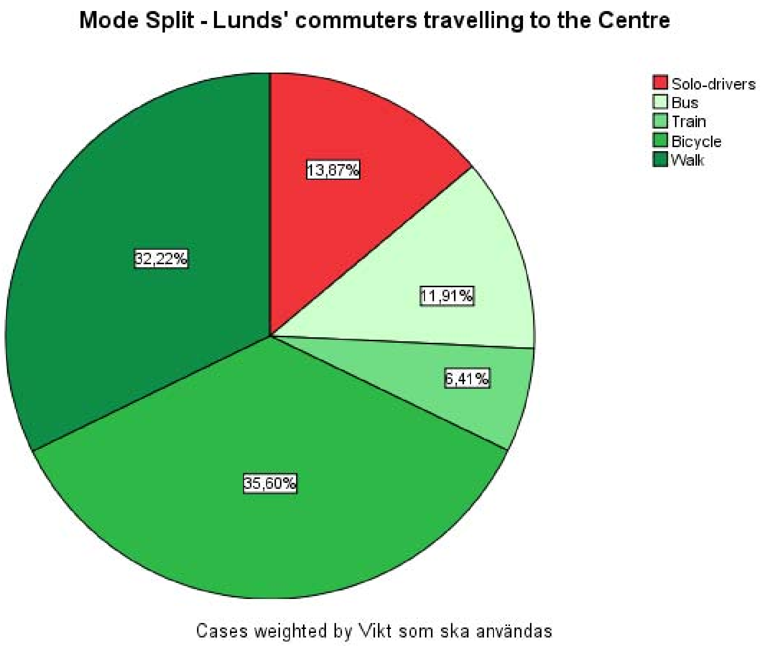

Figure 4-11 Centre – Modal Split –Lunds' Commuters

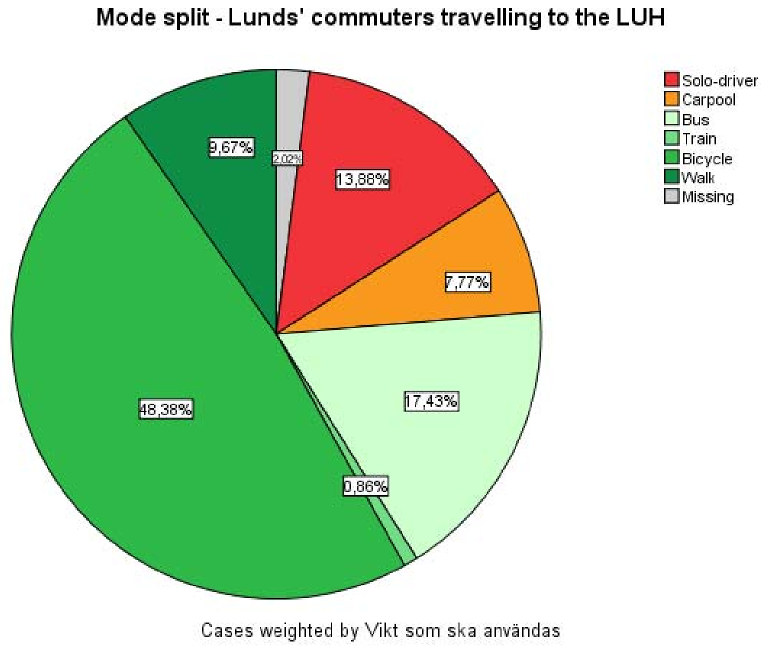

Figure 4-12 LUH – Modal Split –Lunds' Commuters

In fact, it appears that 29% of the commuters coming from Lund Municipality and going to the Science Park are car-users, in which one quarter solo-drive. As compared to its counterparts, this share is the highest one (car drivers represents 22% of the commuters for the LUH and 14% for the centre).

Besides, Table 4-8 presents the modal splits for the individual lots in the Science Park for commuters coming from Lund.

Table 4-8 Science Park – Lots – Modal split for Lunds' Commuters

Science Park – Lots – Modal split for Lunds' Commuters (for 76 survey respondents)

Lots		Frequency	Valid Percent	Cumulative Percent
SP5 (Pålsjö)	Solo-driver	4	32,9	32,9
	Carpool	2	16,8	*49,7*
	Motorcycle	0	3,2	52,9
	Bicycle	5	44,7	97,5
	Walk	0	2,5	100,0
SP1 (Idéon)	Solo-driver	5	27,1	27,1
	Bus	1	5,0	32,1
	Bicycle	11	56,7	88,8
	Walk	2	11,2	100,0
SP2 (Idéon/LTH)	Solo-driver	5	19,5	19,5
	Carpool	1	2,4	21,8
	Bus	2	8,0	29,9
	Bicycle	12	44,1	73,9
	Walk	7	26,1	100,0
SP3 (Idéon)	Solo-driver	0	1,3	1,3
	Bicycle	2	51,3	52,6
	Walk	2	47,4	100,0
SP4 (Pålsjö)	Solo-driver	2	21,7	21,7
	Bicycle	4	48,9	70,6
	Walk	2	29,4	100,0
SP9 (Brunnshög)	Solo-driver	1	100,0	100,0
SP6 (Brunnshög)	Solo-driver	2	46,1	*46,1*
	Bicycle	1	17,6	63,6
	Walk	1	36,4	100,0

Although the sample is small when divided in smaller areas, it still provides an approximate indicator[32]. Indeed, we can see that there are two main areas where car users present great share, being SP5 and SP6 (Brunnshög and Pålsjö)[33]. The cumulative percentages for these areas reach about 50% for Pålsjö and 46% for Brunnshög. Regarding the link with free of charge parking, Pålsjö was ranked on the second place, offering free parking to nine tenth of the commuters.

Overall, it suggests that there is great difficulty at supporting the use of alternative modes. The location of the Science Park is probably significant either being in the urban outskirt, but it denotes that either the infrastructure for public transport is not attractive enough, or the infrastructure for car-use is overly attractive. It is probably a mix of both, but after having seen the access to free parking (where 83% of the commuters have access to it), it appears clear that this factor is adding up to the attractiveness to opt for automobile.

[32] The variance in the percentages and figures is due to the weighting.

[33] SP9 being too small to indicate something.

Age, gender, income and education

Table 4-9 summarizes the data and information per location. It is included below: age, gender, income and education.

Table 4-9 Age, gender, income and education of the commuters for the working areas

	Age Categories %						**Gender**		
	15 - 18	*19 – 25*	*26 - 39*	*40 - 64*	*65 - 84*	*Total*	*Women*	*Men*	*Total*
Centre	2%	29%	21%	41%	8%	100%	64,1%	35,9%	100,0%
LUH	0%	4%	29%	51%	16%	100%	80,0%	20,0%	100%
Science Park	0%	7%	52%	41%	1%	100%	39,1%	60,9%	100%

	Income in SEK per year per houshold								
	100 000 and less	*100 001-200 000*	*200 001-300 000*	*300 001-400 000*	*400 001-500 000*	*500 001-600 000*	*600 001-700 000*	*700 001-800 000*	*More than 800 000*
Centre	8%	9%	17%	8%	19%	7%	6%	19%	7%
LUH	0%	1%	12%	10%	12%	13%	27%	8%	16%
Science Park	0%	3%	3%	9%	15%	17%	17%	16%	21%

	Education			
	Grundskola/ Folkskola (Primary School)	*Gymnasium/ Realskola (High School)*	*Eftergymn utbildn, ej högskola/univ (College and Professional)*	*Utbildning på högskola /universitet (University)*
Centre	3%	29%	14%	53%
LUH	3%	12%	12%	72%
Science Park	3%	8%	10%	79%

The Centre

The commuters in the Centre is characterized by a majority of women (64%) and the common age bracket is between 40 and 64 years old (41%), followed by the 19-25 years old (29%). One fifth of the commuters hold an average income per household between SEK 400,001 – 500,000 and another fifth between SEK 700,001 and 800,000. It should be noted that, as compared with the LUH and the Science Park, the Centre presents the lowest average income if we look at the cumulative percentage. Regarding the education level, more than a half of the population holds a university degree, whereas, the second half is spread among the other levels. On that side too, the Centre has the lowest education level compared to the neighbour locations. On the other hand, it must not be forgotten that most of the employments found in the centre are related with retail market and sales, which require lower specialization and are generally less well paid. Around seven commuters on ten hold a university degree.

Lund University Hospital

One of the first things that should be mentioned for LUH is the share between the number of men and women. The results show that four fifths of the commuters going to LUH are women. This exactly correlates with the official figures provided by the Hospital: 80% being woman (LUH, 2007). Half of the population ranges between 40 and 64 years hold. The average age is 47 years old, also closely corresponding to the official figure: 45 years old. These similarities indicate a good representativeness of the sample. Regarding the incomes per household, a little bit more than a quarter (27%) is in the bracket SEK 600,001-700,000 per year.

<u>The Science Park</u>

On the opposite side of the LUH is the Science Park. Opposite mostly in terms of gender proportions, where 61% of the commuters are men and 39% women. The average age is also lower, in that half of the population is between 26 and 39 years old (38 years old being the exact average). In addition, half of the commuters' households earns more than SEK 600,000 per year, in which one fifth earn more than SEK 800,000/ year, being the largest category and representing the highest income compared with the LUH and the Centre. The Science Park also counts the highest educated population, with 79% of them holding a University degree. In short, the person-type working in the Science Park will be a man living in Lund, mid-thirty, holding a university degree and earning well over SEK 800,000 per year.

<u>Insights from the commuters' interviews</u>

Two qualitative interviews have been conducted with male commuters working in the Science Park. For both of them, parking is employer-paid and both are car users. For the case number one, car is chosen as the preferred mode because it is convenient and time-efficient as compared to the bus and the bicycle for instance. Living at around 7-8 kilometres from his workplace in the south of Lund, commuting takes him about 5 to 10 minutes by car. Although he qualifies the public transportation in Lund to be good, this commuter would still have to transfer bus one time, which makes his total trips 45 minutes long. On that point, it should be mentioned that a survey made in 2000 in Helsinki about the effects of parking measures on commuter traffic reports that "car drivers put a great weight on transfers, as a disadvantage of public transport. One transfer is perceived by car drivers as equally important as 14 minutes of actual travelling time (to people travelling with public transport one transfer is equal to 4 to 8 minutes travelling time)" (COST, 2006, 83). Regarding the bicycle mode, the ride is uphill and makes it time consuming when considering to change clothes and take shower. No incentive to commute by alternative modes is given by his employer and parking places can be reached "very" easily. In short, it appears that car is the most attractive mode of transportation in this situation.

The second case lives in Bjärred at around 15 kilometres from his working place. He alternates modes of transportation between car, public transit and bicycle. For him, it will be encouraging if the bicycle paths could be improved and be more straightforward. For instance, he underlines that half of the time spent between Gunnesbo and Idéon is riding back and forth behind the lanes and the roads. Thus, safety was an issue mentioned in cycling in Lund, saying that cyclists are hidden from the cars making them to be continuously aware of the automobile traffic. Regarding the car parking facilities, they are located close to the entrance, employer-paid and are rather crowded making the demand difficult to supply.

4.5 Conclusion

The main conclusion that can be drawn from the present chapter is the relationship between the different parking conditions and the modal split. For the case study number one (the Centre) parking-fares are high and the minimum standards low, which provides a restricted parking context. The portion of car-users reaches about one quarter of the commuters and the rest (near 75%) is travelling by alternative modes of transportation. Case number two (LUH) supplies predominantly charged-parking and access to free parking is limited. Share for car modes attain 45% of the employees while the majority of them commute by alternative modes. Regarding the Science Park, the minimum standards are higher, and the great majority of the parking is employer-paid. Here, near half of the commuters use their car (49%). After analysing the results from the survey, it is believed that there are two main factors influencing the commuting in the area: the parking accesses (being underpriced) and the public transport quality.

Even if it can appear as a simplistic way to observe the relationship and that many external factors can influence the modal split, it remains that there is constancy between the parking access and the modal split. Although it is difficult to trace the line between the direct effects and the indirect effects of parking access, employer-paid parking leads to an increase in car use. The supply feeds the demand and makes car options more attractive.

So far, all the factors analysed relating to parking access in the Science Park seem to affect this location. Despite good infrastructures for bicycle and 59% of the commuters coming from Lund Municipality, the Science Park holds the greatest share of car-users, of solo-drivers, the fourth fifth of the parking are employers-paid, and it is the place where parking are the closest to the working place. In short, parking accessibility in this area does not seem to hold any major obstacles. Furthermore, because parking is free of charge in the area it appears as the most sensitive to parking fares when we look at the difference between the fares and the mode-split. However, it is hard to conclude any causal relationship when the smaller lots are compared within each other. In general, the sample is too small. On the other hand, it gives an interesting indicator about the transport behaviour and the parking conditions in this part of the city. There is one area where the sample is more important and where all the results correlate between parking access and modal split: being SP5 (Pålsjö South).

Regarding the location factors among the areas, it can be mentioned that the Science Park is located in the periphery of Lund, being more accessible by car from the highway, which makes it more attractive for automobile users. However, the Centre is less easy to access by car with its pedestrian areas and car-free streets. It also comprises the central station, making the location even more appealing for transit commuters. These access factors other than parking might influence considerably when it comes to commuting decision. Consequently, the comparison between the three cases in terms of parking conditions give a good indicator, but the external factors should not be underestimated. The comparison provides useful hints on the transport behaviour, but the causal relationship appears to be greatly influenced by these external factors as well. Nevertheless, this should not justify a parking policy oriented on the 'predict and provide" approach.

5 Analysis and discussion

This chapter explores the avenues offered for Lund from diverse angles, in terms of parking strategies and measures to prioritise. The first section browses the possibilities for the Science Park to achieve sustainable transportation. It highlights the diverse characteristics and components present in the area that places it as a central driver to enhance the sustainability for Lund in the transport sector. It observes the current and future parking strategies and the role of the municipality, developers and employers in the Science Park. The last section describes in which contexts the present findings could be generalized and to what degree this research is useful for other municipalities.

5.1 The Science Park: an opportunity to promote sustainable commuting?

After having observed the different factors influencing transport behaviours in Chapter 4, it can be stated that there are many options offered for the Science Park to act as a key player in decreasing the environmental impacts of Lund with minimal efforts. First, the fact that there are little or no parking fees for the parking-users creates the possibility to reach a part of the population that are highly cost sensitive to shift their behaviour. Second, it has been demonstrated from the literature that the shorter the distance from the residence to the working place, the more cost-sensitive are commuters and the easier it is to shift their travel behaviours. As it was shown earlier, around 60% of the commuters in the Science Park are coming from Lund Municipality, of which one quarter is solo-drivers. This situation creates optimal conditions and makes it easier to shift the transport habits. If a change from car use to alternative modes would occur for local commuters, it would liberate parking places and improve the traffic situation in the area. Finally, although some improvements still need to be done in terms of public transportation and cycling infrastructure[34], the services are ready to receive an increase in capacity and are considered good enough to justify lower minimum parking standards in some parts of the area[35].

5.1.1 What strategy to undertake?

The transport situation in the Science Park now calls the diverse actors to question their position regarding which parking strategy to adopt and how to undertake future transport planning. While the planning and the parking policy traditions have been based on a 'predict and provides' approach[36], the upcoming strategy needs to approach the transport system from new angles. The approach used regarding the transport management for the developers and real estate companies rest on the requirements based on the local plan from the municipality. However, the demand from the employer's side was, and remains higher regarding the overall capacity network. In that respect, the representatives of IKANO (one of the main real estate company in the Science Park) mentioned that further collaboration needs to be undertaken with the municipality and the actors operating in the area (Åkesson, 2008). The Gateway Project is a good example illustrating this issue and remains a great challenge. The number of parking spaces is expected to be smaller and the developing companies would be able to

[34] Based on the commuters' interviews and the results from the poll.

[35] The minimum norms is fixed at 21 ppl/ 1,000 sqm in peripheral areas, but can be lowered down to 20% if the public transport is good.

[36] With higher minimum norms, abundant employer-subsidised parking places, and parking development following the demand.

provide the amount mentioned by the local plan (the minimum standards), but not the amount from the demand side (employers). While the City of Lund and the real-estate companies implicitly agreed on the importance of tackling the traffic through parking strategies, the role of the employers remains unclear.

In short, two main strategies are to be undertaken by the municipality and the developers. The former is introducing a new policy proposal in that part of the city and the latter is to implement parking fees and bring modifications in the contract lease so that parking issues are treated separately.

Implementing maximum standards: Lund's Policy Proposal

During the course of this research, parking regulations for the City of Lund only concern the minimum standards. The Technical Service Administration recently suggested a new proposal (Spring 2008) to lower this standard in some part of the city (Brunnshög) and to set a maximum norm for office buildings. Presently, the main requirement is set at 21 parking places (ppl)/ 1,000 m^2 for office area. At a location where the public transport is easily accessible, then the standards can be reduced by 20%, bring it down to 16.8 ppl/ 1,000 m^2. The new proposal would lower the standards down to 12 ppl/ 1,000 m^2, and put a maximum up to 15 ppl/ 1,000 m^2. In a case where a company would like to have more parking spots, a common garage could provide the need up to 12 extra ppl/ 1,000 m^2, putting the overall limit to 27 ppl/ 1,000 m^2.

The advantage with this type of proposal is that it can avoid a situation where an employer constructs too many parking spaces, and then lead to an oversupply or over attractive option to use car. Additionally, by having a common parking garage, a market price would occur so the users, or the employers, would be able to know the value of the price it costs to enjoy the service. Therefore, if the parking is paid by the employer, the value of the parking would be known and could be introduced as a fringe benefit to the employees. For instance, if the amount to lease a parking lot is estimated to be between SEK 180 and SEK 600 per month it could be comparable with a monthly public transit card. By that proposal, the city planners at the Municipality hope to decrease the pressure for parking needs (Rydén and Rube, 2008).

This project is still at an evaluation stage and needs to be approved at the political level. It also remains on a pilot level. However, in a case where it would be implemented, the city planners could consider transposing this type of proposal to another part of the city. This measure is also in line with many authors suggesting the option of public parking in-lieu of private parking (Shoup, 2005 for instance).

Implementing parking levies and improving the contract leases: the role of the developers

The role of the developers operating in the Science Park now needs to be empowered when it comes to parking restrictions. According to IKANOs' representatives, one of the main motivations that pushed the real estate company to be more active in this respect is due to the inability of the road infrastructures to supply the traffic demand. This appears to be an important aspect, see drivers, to mention. Indeed, it demonstrates the importance of road planning at the upper levels of government and its influence on the local development. For instance, we could question what effect a national strategy oriented on a demand approach would have on developers, such as extensive road construction to support car use. Of course, the environmental awareness was mentioned as an important aspect to consider during the interview, but the fact that the road infrastructures become overloaded appears to be the essential point influencing active measures.

One way for the developers to intervene and help redistribute the modal split is through the contract lease and the parking levies. In the previous contracts arranged with their clients, IKANO had to provide a precise number of parking spaces to their clients. The distribution was 1 ppl / 60 sqm, which corresponds to 16.6 ppl/ 1,000 sqm[37]. On the other hand, the developing company had more parking places then this standard, so the distribution could fulfill the demand from the client side (Åkesson, 2008). According to IKANOs' representatives, the new contract lease and those that have to be renegotiated do not include the obligation to provide parking place for the last two years and the parking issue is taken separately. In the case where the company (the clients) would like to provide parking for their employees, they could do so by paying directly for the service, so tax regulation could be applied for this single aspect. Thus, it would represent a fringe benefit for the employees. In the case where the clients do not want to provide parking places to their employees, the employees can access the parking sites by themselves and pay the market price.

This introduction by IKANO of parking fees through the contract leases is done in collaboration with Wihlborgs Property, the other developing company of Idéon. The actual price proposed to lease a parking place is around SEK 400 per month and the goal is to reduce the traffic by 10-20% for the area. The future parking development would include differentiated fees to encourage shorter stay. Besides, projects' incentives like starting up packages to use alternative transportation modes are to be elaborated with the municipality. This is yet at the project stages, but ideas like providing transit bus passes, contests to win a bicycle, helmets or bicycle lamps distribution are suggested.

From the interviews conducted with the employers, this initiative appears to have direct effects on the way parking is dealt with. Indeed, some companies that are renting offices there now have to think if they will offer it to their employees or if they will let their employees choose what they want to do. It is actually the case of Ericsson that has some offices in the area. According to the site manager, Ericsson is in the process to decide whether they will offer the parking to their employees or not. In case they do, this will be accounted as a taxable fringe benefit. In short, it demonstrates how effective this instrument is in terms of rethinking parking management and transport system at the corporate level.

The role of employers

Although the employers can intervene and have a role in the transport decisions made by their employees, it appears that there is no real incentives given related with parking access in the Science Park. The actual strategy regarding parking access is rather oriented on a 'business as usual' approach. As it was mentioned earlier, parking policy and commuter incentives are seldom considered as a priority at the agenda of the employers. If environmental concerns are integrated in the corporate practices, it will usually relate to the direct environmental impacts of the company (production for example). Thus, it makes it more challenging to discuss about the effectiveness of voluntary instruments concerning parking policies.

For instance, the interviews showed that although they are willing to offer a certain support to the municipality, some of the employers do not see their role in sustainable commuting. The responsibility according to one of them devolves upon the municipality and public authorities. It appears that they do not see where they can intervene and contribute on a simple way.

[37] For example, an office with 200 sqm would receive around three parking permits.

Indeed, from what was observed out of the site visits and interview, it appears that there are several problems related to the parking management for employers. Most of these problems relate to the site design, which is conceived to support car-users. In general, the locations of the car parking are situated near to the entrance[38], whereas bicycle parking is further away and overcrowded. In some cases, there is no facility to support the bicycle users, like changing rooms, showers, and repair tools. These are all examples where the employers can intervene in a simple way, optimizing the site design for alternative mode of transportation.

For instance, the current figure for parking at Ericsson is 0.6 ppl per employees (Jönsson, 2008), which make parking capacity available for 60% of the commuters. Yet, the findings obtained in chapter 4 demonstrated that 46% of the commuters are solo-drivers and the total car user represents about half of the commuters in the area. This means that there is presence of an over supply, that the parking management is not optimal and that it represents additional cost that has be covered by the company and are then internalized in the price of their products and services. Taking the parking demand as it is for now according to the data from the poll (without any incentives to use alternative modes), there is already a potential to reduce supply by at least 10%, without hurting anybody. Considering a more proactive approach and taking the average figure for Lund as a baseline, being around 40% of car commuters, the figure could be lowered down to 0.4 ppl/ employee.

According to the interview conducted with Astra Zeneca, there are 958 parking places with around 1,000 permanent employees and 1,200 employees including contractual in total (Persson, 2008). Applying the same recipe above will bring an average of 0.8ppl/ employees (958 ppl/ 1,200 employees[39]). This represents a potential to cut down by the half the total parking capacity (to reach the average demand of 0.4 ppl/ employee), which would release a considerable amount of space that could be use for other purpose and be made profitable. Overall, there is an oversupply of about 30% for this employer if we consider 50% of car-use in the Science Park as the reference figure. It should be noted that the share of solo-drivers in Pålsjö (lot SP5) was found to be 66% with a total portion of car user established at 73%, which is the highest figure among all its counterparts. In other words, it means that a reduction of 10% could occur without any harm.

Another issue coming out of the interviews and underlying the role of the employers in sustainable transport relates to the travel policy. Indeed, many of large employers located in the area, are global companies with corporate transport policies. Obviously, these policies will relate with the business travels but not with work commuting. Generally, parking management is treated site by site and locally. In that sense, priority will be given to virtual mobility or other measures where important benefits can be seen. An example demonstrating the case of virtual mobility is illustrated by Astra Zeneca (being located in Pålsjö). As a part of a global policy, this employer has reached 50% of all the meetings in a virtual form instead of face-to-face (Persson, 2008). Even if no financial figures are provided, it can be expected that this investment has been profitable to have shifted 50% of the meeting virtually. In that way, it would be interesting to know where this savings have been reinvested from a business perspective. Consequently, it can be asked if a portion of the funds recovered from virtual meetings could be re-injected in promoting sustainable personal commuting. It would represent a transfer from business travel costs to fringe benefits related costs that could be used to promote the employer on the job market. Therefore, further researches could be

[38] This is also confirmed by the data collected in chapter 4, where the mean is 73 meters from the parking place to the entrance.

[39] It should be noted that the parking place for the visitors are not included. However, this should be compensated by the 200 part-times employees.

investigated further: on how work commuting and parking policies be integrated with business travel in corporate transport policies; and how the interaction within the company's managers could be done to support better travelling system (environmental manager, travel manager, site manager and personal manager). These questions would be useful to answer in order to have a comprehensive parking policy. So far, what was found from the interviews is that corporate parking policies are isolated from each other, because it is generally treated site specifics. In that way, overarching corporate guidelines could be used in order to reduce the impact caused by work commuting due to economic activities making both of them more optimal. On the other hand, bringing such overarching guidelines could intervene with the field of public policies. Nevertheless, it can be worth to investigate further this matter. Remembering the case of Switzerland that provides a legal framework for corporate parking policy.

Indeed, the drivers for the employers seem hard to find in surface and many myths seem to subsist regarding parking practices. For instance, employer-paid parking is sometime used as a way to attract new job seekers and to compete with concurrent employers. Nonetheless, it is less obvious to know how other fringe benefits related to sustainable commuting, like paid transit pass, are used as a competitive advantages to the future working force. It would be interesting to know how different commuting incentives, as fringe benefits, influence the choice of job seekers and what are their comparative effects. As it was mentioned in section 2.2.1, the cost of un-priced parking is bore by the employers, who ultimately pass it to their customers. Furthermore, free-of-charge parking for the employees reduces the supply for the visitors.

Then, the location is also seen as an influential factor, where unrestricted parking norms appear advantageous for the economic development of the companies. However, an optimal location would be much more profitable on the long-term perspective. Providing large and generous parking spaces also prevent the company to expend its building. Several studies show that priced parking have limited influence on the economic growth of the business activities (Martens, 2006; LLREI, 2000). On the contrary, locations where there are parking-fares often show a larger economic expansion according to some of them. In short, charging for parking in the Science Park will not automatically harm the economic development, since the area is already attractive and accessible in many other ways. The interviews conducted with the employers pointed out that although parking is a factor to consider in the choice of the location to a minor extent, the access to the University is the main reason why they are located on that site. It confirms the outcomes coming from literatures, saying that parking does play a role, but only a limited one and that factors related with proximity to clients, potential employees, and status and image are much more determinant (Martens, 2005; Mardsen, 2006).

5.1.2 Estimating the potential reduction of carbon dioxide and gasoline saving

The section below presents an estimation of the potential reduction in CO_2 and fuel consumption if parking fees were introduced in the Science Park. According to the SRA, it is better to focus on fewer pollutants in order to facilitate the comparison between projects. In that way, "a report should include [carbon dioxide] at the very least" (Hyllenius et al, 2004). Although the approach taken was tried to be as conservatory as possible, it is also greatly experimental comprising several limitations and assumptions.

The CO_2 reductions can be calculated by generalising the results of the sample to the total working population of the Science Park (estimated at 7,400 employees). Then, we can multiply the reductions in vehicle trips (VTR) and vehicle kilometre travelled (VKT) by the emissions created per trip (CO_2 emissions in the present case) (Shoup, 1997, 206).

In order to do that, we need first to know the number of vehicles users for the areas according to the following formula:

$$SD = (WF)S(sd)\% \quad (1)$$

$$CP = (WF)S(cp)\% \quad (2)$$

Where WF is the total workforce (number of employees), S is the share in modal split, cp is the car-poolers and sd the solo-drivers. Thus, the number of solo-drivers driving to the Science Park is estimated at 3,396.6 and the number of car-poolers at 259. For the details of the calculations see appendix 4.

Second, we need to know the rate of vehicle trips rate (VTR). To calculate it, each solo driver is counted as one vehicle trip and each car-pooler as one-half of a vehicle trip (assuming that the average number of passengers for car-pooler is two). This approach may overestimate the number of VTR, since the number of passenger in one car maybe be higher than two. The transit-riders, cyclists, and pedestrian are excluded of the VTR.

$$VTR = SD(1)+CP(0,5) \quad (3)$$

Therefore, 3,526 vehicles are estimated to travel to the Science Park for working purpose. From this total, it is thus possible to apply the reduction in car trip after accessing parking fees (VTRr). It was demonstrated earlier that the average reduction in car use for the three areas was 30%[40]. Thus, the potential reduction in vehicle trip from work commuting in the Science Park reaches 1,058 vehicles[41].

Then, the calculation of the reduction in CO_2 and fuel consumption can be found. Remembering that the average distance travelled for the Science Park is 27.9 km for car users (see section 4.4.5). Multiplying the VTRr by the average one-way distance travelled can provide the reduction of daily vehicle-kilometres travelled (dVKTr):

$$dVKTr = 2(VTRr)km \quad (4)$$

Where *d* account for "daily" and *r* for "reduction". Therefore, the VKT that could be avoided every day reaches 59,026.9 km travelled to the Science Park. However, it should be noted that the change in behaviour might come from local commuters and the vehicle kilometres could be lower and the result above may be overestimated[42].

From this figure, it is possible to multiply the mean of CO_2 emission calculated from fossil fuel. This figure is established at 181g/km, which might be underestimate, since it applies for

[40] It was preferred to take the average reduction (including the three areas) rather than the single Science Park (established at 37%), since this figure is more realistic and provide a more conservative approach.

[41] 1,057.8 vehicles (3,526.1 VTR * 30%)

[42] Studies suggest that the average distance for commuting one-way is 23.8 to 26.6 km. In addition, the Science Park presents the highest figure for the distance traveled by car when compared with the LUH (22.1 km) and the Centre (14 km). (SRA, 2008, 10).

2007 vehicles, which emit less CO_2 and consume less gasoline (SRA, 2008, 10)[43]. In other words, it is assuming that all vehicles driven in the Science Park are from 2007 and the potential reduction in CO_2 is taken from that. The following formula would apply:

$$CO_2r = (dVKTr)(CO_2g/km) \quad (5)$$

In which CO_2r corresponds to the reduction in CO_2. Thus, the calculation brings a result of 10,683.9 kg of CO_2 reduction per day. Assuming that the commuters work an average of four days a week (to include part-time employments) and 47 weeks per year, it means an average of CO_2 reduction of 2,008.6 tonnes of CO_2 per year.

Regarding the fuel saving, the Swedish Road Administration estimates the average fuel consumption for the car fleet as a whole (old and new cars) being 8.3 litres/km per vehicle (SRA, 2008, 2). Thus, the average reduction of fuel consumption assuming a reduction of 30% in car users would be 489,923.4 litres/ day. However, it should be noted that a portion of this gasoline saved on one side, might lead to an increase in public transportation, which on its turn may increase fuel consumption to some extent.

One of the targets of LundaMaTs II is to decrease the emission from transport per resident by 10% for 2013. The total decrease in CO_2 aimed for 2013 is 12,680 CO_2 tonnes (Lund Municipality, 2007, 4). Therefore, there is a potential to attain 15.8 % of this goal through parking levies in the Science Park. This adds up to the overall potential for the Science Park in increasing the sustainability of Lund and in reaching the environmental goals.

5.1.3 In a broader perspective: some reflections about the ecological economics principles

The explanations given above suggest that parking fees present several advantages for the Science Park, both from an environmental perspective (reduction of the environmental impacts), and economic perspective (financial benefits). However, should 'command and control' measures (such as maximum parking norms) be prioritised over market-based instruments, or vice-versa? The strategies undertaken by the municipality of Lund (implementation of maximum norms), and the developer's side (introduction of parking fees), appear to be a proper mix of instruments.

Nevertheless, many elements need to be considered when analysing parking instruments if sustainable urban development is to be achieved. One can think about the polluter-pays principle, the user-pays principle or issues of fairness and equity for instance. How do the current parking policies fit into them? In fact, one paradigm covering these questions can act as a useful guide in providing an analytical framework: ecological economics.

This multidisciplinary field of research provides policy tools that integrate economic principles within environmental protection and social welfare. The foundation of ecological economics is to address policymaking based on fair distribution of resources among present and future generations through allocation of economically efficient resources to protect the stock of natural capital (Costanza et al, 1997, 3). According to some authors in the field, there are three policy recommendations to achieve sustainability (Costanza et al. 1997, 207; Bednar, 2003, 43):

[43] This figure is taken from the SRA and applied for 2007 vehicles: « All values are based on the figures which are reported by the vehicle manufacturers themselves and which have to be stated in advertising, in car showrooms and in the instruction manuals of cars. »

1. *Natural Capital Depletion (NCD) tax.*[44]

2. Application of the *Polluter Pays Principle*[45].

3. The ecological tariffs[46].

Although there are generally referring to large corporations and national policies rather than private individuals and local policies, charging the users for parking supports to some extent the principles of polluter pays (PPP) and user pays. In environmental policies, these concepts are defended and recognized[47]. Polluter-pays refers to the principle that the polluter must bear the costs occurred by the pollution generated. The aim is to internalize the environmental externalities caused by the activities through regulatory or economic instruments, so that the full cost is included in the price (De Lucia et al., 2008). The user-pay principle (UPP) is a "variation of the polluter-pays principle that calls upon the user of natural resource to bear the cost of running down the natural capital" (UN, 1997, 75). Consequently, it is probably more appropriate to address the user pays principle when talking about charging directly to the parking-users. One important aspect linked to the application of the PPP (or UPP) is the elimination of subsidies. In that sense, employers-subsidized parking is supporting the externalities produced by car and should thus be removed according to this principle. TDMs' studies highlight an interesting aspect about the impact of subsidized parking on fairness issue:

> "Policies to provide generous, free or inexpensive parking often result in cross subsidies from households that drive less than average to households that drive more than average. This violates the principle of horizontal equity. Policy changes that result in more direct payment of parking costs, reduce total parking costs, reduce total parking costs, or provide comparable benefits to non-drivers tend to support equity objectives. User charges are usually the most equitable way to fund parking facilities and transportation services, unless a subsidy is specifically justified for a disadvantaged group." (TDM, 2008c, 11).

Therefore, their researches support the user pay principle. Besides, taking into consideration these principles on the local scale bring us to land-use planning decisions and its integration within the local ecosystem. It implies that decisions made related to land-use do not impair the local carrying capacity through the market processes. According to Bednar, the current land use policies and regulations are reflected by the lobbying of developers, focusing on private costs and private benefits rather than the full environmental and social costs and benefits. He points out that "many local governments compete with one another to attract developers, in the process of lowering standards which developers must meet" (Bednar, 2003, 45). Parking policies perfectly apply to this situation, where localities want to attract the developers according to their unrestricted parking policies. However, conventional cost and benefits analyses (CBA) usually hold on intra-generational perspective (rather than inter-generational including future generation). In that way, calculation of future costs and benefits

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[44] A tax to assure that resource inputs into the society are sustainable, so that strong incentives to develop new technologies are promoted.

[45] Some authors will refer to the 4P (Precautionary Polluter Pays Principles) to ensure that the total "costs of outputs from the economy to the environment are charged to the polluter" (Costanza et al. 1997, 207).

[46] A tariff to make trade sustainable in order to facilitate countries in the implementation of the two first proposals.

[47] By the European organization and the OECD for instance.

of protecting the environment are not considered[48]. For instance, it does not integrate the benefits of protecting the lands or make it profitable for other purposes like crops cultivation that can then be of use for food or biofuel, instead of developing surface parking that will seal the soil.

Apart from the general policy instruments mentioned above, there are four criterions applying on land use planning at the local level in ecological economics (Bednar, 2003, 45; Costanza et al., 1997, 225-226):

1. Assigning priority to social welfare benefits over net private benefits;

2. Providing scientific evaluation, protection and management of local ecological resources to promote sustainable use of resources;

3. Allowing open and equitable participation in land-use decision processes by all parties affected;

4. "Oversight and review at higher level of governments to prevent interregional competition for growth from degenerating into competitive sacrifice of natural capital and of critical areas".

Elaboration of future land-use planning and parking policies could be inspired by these criterions. Presently, although there are processes following these criterions in land-use in Lund, the situation appears unclear regarding parking policies. Taking into granted that parking policies firmly affect land use, it could be interesting to know what is happening in terms of scientific evaluation (if any) to protect the local ecosystems; public participation; and overarching regulation when it comes to parking norms elaboration. In that way, an evaluation of the costs and benefits relating to the impacts of parking surfaces on land use and the local ecosystem, or environmental impact assessments for instance, could represent some avenues to explore when designing parking policies and related norms. It should be reminded here the case of Switzerland, with the obligation of conducting Environmental Impact Assessment for parking comprising more than 300 places[49]. From the interviews conducted with the professionals at the municipality of Lund, although there are unofficial consultation steps towards the concerned parties, there are no formal and open participation related to parking decision because of lack of financial resources and times. Regarding legislation at higher level of governances, this appears to be one of the most interesting avenues to explore. Several authors and organizations studying parking management and policies defend regional harmonisation (but flexible) of parking standards on regional and national level (COST, Shoup, Litman, Evanas & Petersson).

The stages in which the regulations (norms) intervene in the transport development occur much more in up-stream of the planning process than the parking fares. It supports a preventative approach by avoiding that too many parking places would be built and feed the demand for further parking and car use. On the other side, the parking fares arrive rather downstream of the process, where parking problems and traffic already occurs. Although it appears as a necessary measures, the actual way the parking fares would be introduced in the Science Park seem to take place somewhat after the damage is done. Consequently,

[48] Discounting future impacts can be responded as an intra-generational valuation not from a sustainable development perspective.

[49] Should also be noted the inclusion of the polluter pays principle (Art. 73) and economical land-use (art. 75) in the Swiss Constitution (Neuenschwander et al., 2000).

introduction of parking fees at the beginning of the business development and planning process could be an interesting avenue to undertake. However, care needs to be taken when charging for parking in an area that is under priced, since it can leads to unwanted spill-over effects due to inefficient pricing in other places, like moving the car to a low-cost/free parking places. In that sense, even if the minimum price to charge should be at least twice as a price for one transit ticket (for both ways) to be competitive and optimal, many factors need to be consider when starting to charge in an area.

The new area currently in development in the North-East of Lund will provide a strong opportunity to introduce parking fees immediately if the new proposal on maximum standards is adopted. By having a maximum norm, it will promote the use of shared parking garages. The issue is however to know which property the parking site will be: a private parking company or public parking company, where the fund returns in the municipality. In the latter case, it will be interesting to implement a new pilot project, where the revenues would be used in a revolving fund, serving at financing an efficient sustainable transport system in the area for instance. It is stated in one of the proposed detailed plans that the goal is to develop Brunnshög with a high environmental profile, promoting sustainable urban development and mix land use (Lund Municipality, 2008c). Such project could be a good opportunity to encourage these goals.

Moreover, there are two practical instruments present in ecological economics to help at fulfilling these objectives: *Land Purchasing and Conservation Easement* as well as *Full-Cost pricing* (FCP). The first instrument aims at achieving the criterion number two (scientific evaluation). Conservation easement relates to evaluating the land before allowing future developments according to various scientific criteria (soil type, hydrology, and habitat for example). The objective is also to strengthen the local land use according to sustainable measures supported by transdisciplinary sciences (Costanza et al., 1997, 226)[50]. The second instrument (FCP) consists of local taxes and utility fees that "reflect the full cost to society of additional residential, commercial and industrial growth" (Ibid). It explicitly targets unpriced social costs that could be further taxed for their environmental impacts, like the loss of open spaces (Ibid). On the other hand, applying local taxes remain difficult due to the share of competencies with the other levels of government. Nevertheless, these costs could be considered when selling new lands for parking development. In that way, offering the developers to pay cash in-lieu of fulfilling the standards could be applicable (Shoup, 2003)[51].

While the scope of this thesis is limited to parking policies, looking at land-use planning on a long-term perspective is an inevitable step. For instance, a scenario where a decrease in car use would occurs will automatically leads a reduction of parking demands, as parking is a complementary good to cars. Planning in a long-terms perspective, taking into account a decrease in individual vehicles uses because of fuel prices and an increase in public transportation, would lead to a decrease in parking demand. This context has to be considered when planning for parking regulations and its development.

The whole development project happening in the Science Park has not been studied within this thesis as well as the land prices and related issues to development projects. Perhaps the City of Lund already characterized and priced the lands according to these criterions. However, according to the interviews and the literature, the area presents a fertile soil and the

[50] Costanza et al. interprets FCP differently than the conventional interpretation. The OECD definition, as most other definitions, is related to a company (firm) level, not from a society perspective.

[51] However, cash-in lieu mostly apply for location situated in the centre part of the city, since the outer parts yet require a minimum parking standards.

exploitation of the lands appears to be a delicate issue. Therefore, estimating the social costs of the location could be an interesting avenue to investigate if not already completed. Economically efficient instruments of this type can assist in limiting eventual parking problems. In that way, it can support the market to make decisions according to the full costs and benefits and avoid that resources are overexploited.

5.2 Generalization of the results

Although Lund presents specific characteristics that influence transport behaviour (LundaMaTs, medieval city centre with several car-free areas), it is assumed that some results could be applicable to other medium size Swedish cities dealing with large economic actors in the periphery, and where the parking situation is controlled in the centre but presents problems in the outskirt. Although the sample is small, it still gives an indicator of the commuter's behaviour and information about the characteristics of the population. It should be noted that the later (characteristics of the population) could be hardly generalised though, since the employers located in the outskirt attract a precise type of workforce (high-technology sector and highly educated workers) that is specific to Lund and its University.

On the other hand, it is believed that the commuter's behaviour in peripheral areas and the difference in modal split between commuters having access to free parking and parking fees could serve as a gross indicator for other municipalities. Indeed, a situation where public transits are under-used, free of charge parking generally spread in the whole area and solo-drivers representing the main type of commuters might not been uncommon. Thus, it is assumed that in a Swedish context, shifting modes in the peripheral areas might not be as difficult as expected. Improving parking pricing and management as well as the public transportation could help at reducing the environmental impacts caused by the transportation sector.

As it was mentioned, Lund has its specific policy characteristics that made the public transport system of this city competitive in relation to private cars. This should be taken into account when considering possible generalization. Furthermore, this research has been conducted in 2008, where the gasoline price ranges between SEK 13 and 14 per litre. Needless to say, a change in gasoline prices will greatly influence in modal split, corporate parking policy, and public policy making[52]. Furthermore, Lund holds a policy tradition promoting sustainable transportation and several projects have been implemented which has a certain influence on the behaviour of the population (keeping in mind transposition of the results in another policy context with different discourses, traditions and structures). Thus, it could be possible to find different figures in modal split (higher share of car use for instance) for a city centre located in a different place. In addition, the collaboration between the municipality and external stakeholders is generally good, which adds up to the specificity of the city and makes the policy context easier to implement instruments that could be more difficult operate elsewhere. Bearing in mind that Lund is one of the rare cities that stabilized its traffic flow. Moreover, from the researches reviewed in the literatures and the modal split presented, Lund holds in the lowest share of car-use. In brief, it is believed that the results could be useful to other Swedish city regarding the potential in achieving sustainable transportation system in the periphery. However, generalization of the modal split and parking access should be taken with care, especially for other country, where the policy context and transport traditions are different.

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[52] On that point, it should be noted that the recent raise in gasoline prices in the USA had some effects towards the corporate practices, where many employers now start to offer their employees teleworking as an alternative to reduce the travel-related costs (Hill, 2008).

6 Conclusion and Recommendations

As it was demonstrated in this thesis, the effects of parking accessibility on work commuting tend to be closely related with the transportation mode choice. To answer the first set of research questions, it appears that the greater the accessibility is to parking, the greater is the share of car-drivers, especially solo-drivers.

It is demonstrated through the literature and the case studies that factors like *parking distance* very close to the destination increases the attractiveness of the parking sites and therefore increases the share of car drivers. The findings regarding the *parking pricing* demonstrate a clear relationship with the modal split, both in the literature and the empirical analysis. It was found that shifting from free parking to cost-based parking can reduce car-commuting by 10-30%. This correlates also with the findings from the case studies, showing that there is an average shift of 30% between car-use towards other transport means from free parking to parking fees (Section 4.4 and 4.4.2). In each case studied, there is a reduction in car use when parking levies are compared with free parking. The *parking supply* is also a central factor.

Focus was mainly set on case number three (Science Park), which comprises 83% of commuters accessing employer-subsidized parking. Although this area presented differences in modal split when divided in smaller lots (see Section 4.4.1), it remains that about half of the commuters opt for private vehicles according to the sample analysis. Still the share of non-motorized vehicles is considerable, standing at 41%. On the other hand, the ratio for public transportation was found to be surprisingly low, reaching a thin 9%. This situation suggests that the quality of public transit in the area is not able to respond to the needs of the commuters. Overall, it was in the Science Park that the connection between parking access and modal split was the strongest.

As brought up in the literature review, parking policies can act as a very important tool in mobility management. Study after study has pointed out the different effects of diverse measures in dealing with urban mobility. Research groups like COST and TDM Encyclopedia consider them a fundamental, if not the most important, instrument when developing mobility strategies. It appeared that work commuters are the most responsive target group regarding parking policy measures and their related travel behaviours when compared with residents and visitors for instance.

The findings revealed that market based instruments, i.e. parking pricing, act as the most effective measures in reducing the number of car-trips and changing the modal split. On the other hand, time-restrictions appeared less effective when compared with paid parking. Besides, norms and standards, being regulatory instruments, were mentioned as crucial tools in terms of urban planning and traffic management. Furthermore, parking standards affect the overall parking supply and the attractiveness of the parking site. Thus, future problems can be prevented in terms of parking management, traffic conditions, and environmental impacts through urban planning and regulatory measures. It is believed that although pricing appears as a very effective tool, dealing with parking norms by intervening early in the process makes it more powerful in preventing car-dependency.

Regarding the corporate parking policies, the literature shows that some practices can affect work commuting considerably. On the other hand, the different corporate policies applied demonstrate mitigated measures in some cases, depending on how they are implemented. For the case of Lund, it was found that the developer companies hold a central position through their parking strategies in affecting the transport planning and future travel behaviours.

Consequently, it appeared that the influence of the roads' infrastructure conditions on the local transport planning is essential to shape the forthcoming orientations. On the employer's side, no concrete sustainable parking strategy has been found, although collaboration is undertaken with the City of Lund to elaborate greener commuting conditions. From the interviews conducted, it was brought up that if transport policy will be followed by the employers, this will only relate with business travels, rather than the personal related travel. Therefore, an important aspect observed was the inefficiency in the parking management for private companies and presence of oversupply.

After having reviewed the literature and evaluating the three case studies, it can be concluded that parking pricing makes a difference in commuting mode-choice as compared to free of charge parking, although many external factors can have influence (gas price, access to driving license, reliability and quality of public transit, location residence of the worker; road access). It can be stated that the effects of parking accessibility on travel behaviours largely depend of these external factors. From what has been observed, the more the location presents wide access to free parking, the larger the gap between the different modes of transportation (modal split rate) with private motorized vehicles representing the favourite mode of commuters. An area where the quality of public transits and their accesses are high will have more influence on the modal split than the parking access. On the opposite, parking factors will tend to have more influence on a location where the access to public transit is reduced and the location less accessible.

Before going further, it is important to mention that the time in which this thesis is written is the same period where decisions will be taken by policy-makers regarding parking policy in Lund. One of the objectives of this research was to provide empirical data and further information to decision-makers in order to support effective policy tools promoting mobility management. The other objectives were to evaluate different practices of parking management and learn from these experiences as well as understanding how parking policies can support mobility management. It is believed that these aims have been fulfilled through this research. Contributions have been made through analysis of key areas regarding work commuting in Lund, as well as providing empirical data concerning the effects parking accessibility.

6.1 Recommendations

The literature, the results from the survey on transport behaviours and the discussion pointed out that there are plenty of opportunities offered for improving the transport system in Lund, and the Science Park in particular. This section suggests recommendations[53] related to the main findings and the possible ways forward. The recommendations are divided by stakeholders.

6.1.1 City of Lund

1. Collaborate with neighbouring municipalities on standard settlements

As a part of *LundaMaTs II*, a new parking management strategy could include starting collaboration with other municipalities, like the City of Malmö, on standards setting to prevent

[53] These recommendations are based on how effective various measures are on modal split. Recommendations based on economic efficiency need to consider all costs and benefits to society.

competition on future investments based on parking norms[54]. There are many examples where regional collaboration has been undertaken regarding parking management and standards setting. In most of the cases, the common agreements relate to maximum standards. The city of Portland and the Metro's region in USA experienced it (Shoup, 1997, 93). On the European side, France, Netherlands and Germany have started regional coordination on both levels: parking standards settlement and parking fees. Moreover, the European Technical Committee on Transport (COST Action 342) recommends that application of maximum parking standards should be applied in land-use planning (COST, 2006, 11). One of the greatest advantages of common maximum norms is that it secures the investments and it avoids cities competing with each other for parking standards.

Currently, the parking norms in Malmö are stricter than in Lund. Harmonisation of parking standards in peripheral areas among certain municipalities in Skåne could be an interesting avenue to investigate. Table 6-1 illustrates the difference in standards.

Table 6-1 Comparison of Parking Standards between Lund and Malmö for offices and industries

	Offices (ppl /1,000 sqm)		**Industries (ppl /1,000 sqm)**	
Zones	Malmö	Lund	Malmö	Lund
Centre	8 ppl	12,5 ppl	3 ppl	--
Half-centre	12 ppl	18 ppl	4,5 ppl	12 ppl
Periphery	16 ppl	21 ppl	6 ppl	14 ppl

Source: Malmö 2003; Lund Municipality, 2008 (2).

2. Improve public transit in areas of the Science Park (through public parking revenue)

The results presented in chapter 4 demonstrated that around half of the commuters are using their car to go to work, against 9 percent opting for public transit. This is also a small figure when compared with other studies in general. It illustrates that public transport system does not respond to the needs of the commuter in this area. Furthermore, the interviews conducted with the commuters and the employers also confirm this situation. A way to make the public transit more competitive could be to implement a pilot project which would use the revenues from public parking sites in a revolving fund system to finance public transportation or non-motorized modes.

3. Target policies towards Lund's commuters and enhance collaboration with companies located in Pålsjö (site SP5) to promote sustainable commuting.

The results found in this thesis demonstrate that a high percentage of commuters travelling to the Science Park are car drivers and that this portion is even more important for the site SP5, being Pålsjö. It is believed that information campaign targeted towards specific working group could be an appropriate way to influence the travelling behaviour in the Science Park.[55]

6.1.2 Developers

1. Monitor and evaluate the effects of the parking levies on the modal split

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[54] "LundaMaTs II accentuates the possibilities of increased regional cooperation" (Lund Municipality, 2007)

[55] The System Evaluation for Mobility Projects (SUMO), strongly recommend policy designed with target groups, in order to respond to their needs and be as effective as possible in the policymaking.

An evaluation after (ex-post evaluation) parking levies are introduced would provide empirical figures on the direct effects of the pricing system on modal split. It would also give an indicator on how the diverse actors can contribute in supporting sustainable transport system. Furthermore, this thesis could serve as a base for the evaluation (ex-ante evaluation). This recommendation could also be appropriate for the municipality.

2. Implement a car-pool system and/or car sharing station

In order to increase the share of car-poolers in the Science Park, a car-pool system could be implemented by the developers. This could be done within the new contract policy framework. By having the developers operating such systems, it would create opportunities to increase the contacts and exchanges among the different company' employees and could also help to promote business development. For the future developments, like Idéon Gateway, facilities offering car sharing stations could be considered.

3. Designing sites to support alternative mode of transportation

Future parking design should include some criteria to promote the use of carpool, public transit and non-motorized modes of transport. For example, this can pass directly through reserved parking place for car-pooler, or environmental car. Reduced parking fare for these types of commuters could also be an opportunity to consider.

6.1.3 Employers

1. Improving the site design for environmentally friendly commuting

    1.1. Regulate and redesign car parking facilities

    It was found that the management of the parking site could be improved considerably. This can either pass through fares implementation or supply reduction. Soft instruments that can be also used and considered as positive incentives, providing bicycles or financial incitement on transit pass; implementing reserved parking for car-poolers, or environmental cars, and enhancing shared parking sites. Redesign sites so that the walking distance for car parking is the same as the distance to public transit stops to help promote use of buses. Another way to reduce the supply is to promote bicycle use instead of car use can be to specifically replace some of the closer parking lots used for cars with bicycles parking.

    1.2. Enhancing bicycle facilities

The share of cyclist travellers makes up 29% of the commuters going to the Science Park. Thus, sites have to be designed to support this need. Employers can promote commuting by bicycle by improving the infrastructures on their sites. Providing further bicycle parking that are closer to the entrance than car parking, changing room facilities and showers, and offering maintenance services on-site, like air pump and repair tools are examples of improvements that can be done to encourage the commuters to bike.

6.2 Suggestion for future researches

In the light of these findings, the following topic can be further researched:

1. Assessing the current situation regarding environmental impact assessment used when designing public parking policy.

2. Evaluating the effects of different national transport policies on urban planning and see how national transport policies can shape parking policies.

3. Analysing costs and benefits of different corporate parking policies.

4. Identifying drivers and barriers in supporting better corporate parking policy.

5. Exploring the interaction between corporate managers and how is the integration of parking policy in corporate transport policies

6. Researching the level of influence of different commuting incentives (as fringe benefits) on the job market.

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Abbreviations

COST: European Cooperation in the Field of Scientific and Technical Research

CPO: City Planning Office

EPA: European Parking Association

EPOMM: European Platform on Mobility Management

GHG: Greenhouse gases

ICT: Information and Communication Technologies

LUH: Lund University Hospital

LTH: Faculty of Engineering of Lund University

MOST: Mobility Strategies for the Next Decades

Ppl: Parking place

PPP: Polluter Pays Principle

SEPA: Swedish Environmental Protection Agency

SPA: Swedish Parking Association

SRA: Swedish Road Administration

SUMO: System for Evaluation of Mobility Projects

TCRP: Transport Cooperative Research Program

TDM: Transport Demand Management

TSA: Technical Service Administration

UPP: User Pay Principle

VKT: Vehicle Kilometres Travelled

Appendix (1) Information on RVU 07

The RVU 07 is a survey project launched in collaboration with different municipalities[56] in Skåne and diverse stakeholders operating in the field of transportation: Trivector Traffic, Skånetrafiken, Vägverket (Swedish Road Administration), Banverket (Swedish Rail Administration), Region Skåne, Länsstyrelsen i Skåne län (Skåne County Administrative Board). It aims to provide a better understanding of the different travels made in the region of Skåne. The main goals are to have a picture of the current travel situation and find the parameters that influence transport planning, including its population, its traffic system, the building settlement, etc. It should serve as a tool for city planners and decision-makers. The Survey consists of a small questionnaire and a travel book submitted to the population during the year 2007. It results in an extensive travel database. The sample size for Lund is 4,147 survey respondents, and 28,870 survey respondents for Skåne (Trivector Traffic, 2008).

The main reasons why RVU was launched rest on the changes in travel behaviour observed in Skåne during the past few years. The connection of the region with the Danish coast through the Öresund Bridge explains in part this phenomenon. RVU 07 signs in the continuity of a first survey on transport behaviour made by Skånetrafiken in 2006 (Ibid).

[56] Bjuv, Malmö, Helsingborg, Lund, Kristianstad, Landskrona, Eslöv, Höör, Kävlinge, Vellinge, Lomma, Staffanstorp, Osby, Perstorp, Höganäs, Hörby, Ystad, Östra Göinge, Sjöbo, Hässleholm, Klippan, Trelleborg, Båstad and Örkelljunga

ID

Resdagbok för

Från kl 04.00 på morgonen till kl 03.59 påföljande dag

Först några allmänna frågor

Har du gjort några förflyttningar under mätdagen?

- ☐ Ja.
- ☐ Nej. Jag var hemma hela dagen.

Om du inte gjort några förflyttningar, vad var orsaken?

- ☐ Jag hade inga speciella ärenden
- ☐ Sjukdom
- ☐ Vård av sjukt barn / föräldraledig
- ☐ Funktionshinder
- ☐ Arbetade hemma
- ☐ Annan orsak, nämligen:

När du fyller i resdagboken kan du ta hjälp av de instruktioner som finns på nästa sida.

Har du frågor om hur du fyller i enkäten och resdagboken, så ring 046-38 67 91. Telefontid: måndag till fredag 15–21 samt lördag och söndag 9–12. Du kan även nå oss via e-post, rvu07@trivector.se.

På nästa sida börjar själva resdagboken. Du ska fylla i en kolumn för varje förflyttning du gör under mätdagen, dvs den dag som står angiven i rubriken på denna sida. Gör du exempelvis fem förflyttningar fyller du alltså i fem kolumner.

Med *förflyttning* menas att du tagit dig från en plats till en annan för att göra ett ärende vid målet.

Om du t ex tar dig till arbetet räknas detta som *en* förflyttning. Om du uträttar något ärende på vägen (t ex lämnar barn på dagis) blir det sammanlagt *två* förflyttningar (en mellan bostaden och dagis samt en mellan dagis och arbetet). Dessa två förflyttningar redovisar du i var sin kolumn.

Hemresan räknas som ytterligare en förflyttning.

Även förflyttningar till fots eller med cykel räknas om du har uträttat något ärende. Motionsrundor eller promenader för att t ex rasta hunden ska du dock inte redovisa.

Du ska inte ta upp förflyttningar som du gjort som chaufför i yrkesmässig trafik, t ex om du kört buss eller taxi.

Du behöver inte ta upp resor som i sin helhet genomförts utanför Skåne, t ex om du befann dig på annan ort under hela undersökningsdagen.

Byte av färdsätt redovisas *inte* som olika förflyttningar. Om du till exempel byter från cykel till buss när du tar dig till jobbet, så noterar du cykel som "1:a färdsätt" och buss som "2:a färdsätt" när du beskriver en sådan förflyttning.

Fyll i dina resor/förflyttningar för mätdagen

Din mätdag finns angiven överst på sidan 1.

Ange platsen så noga du kan. Rör det sig om en annan plats än din egen bostad, så anger du gata och nummer samt ort/kommun. Är platsen allmänt känd (som t ex MAS, LTH, Stortorget eller Center Syd) räcker det med att skriva platsens namn. Men glöm inte att ange ort/kommun.

Alla färdsätt räknas, även förflyttningar till fots och med cykel. Ange alltså samtliga färdsätt du använt för denna förflyttning, i den ordning du använde dem.

Exempel: Om du gick till busshållplatsen för att sedan ta bussen, så markerar du "till fots" som 1:a färdsätt och "buss" som 2:a färdsätt. Byter du sedan till en annan buss, så anger du "buss" även som 3:e färdsätt.

Har du gjort fler förflyttningar denna dag, så kryssar du i ja-rutan och fortsätter i nästa kolumn.

Förflyttning 1

Var började dagens första förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Hur dags startade du? (kl): ____ : ____

Vilket var ditt ärende?

- ☐1 Till bostaden
- ☐2 Till arbetsplatsen
- ☐3 Resa/ärende i tjänsten
- ☐4 Till skola/utbildning
- ☐5 Hämta/lämna barn
- ☐6 Inköp av livsmedel
- ☐7 Annat inköp
- ☐8 Besöka vårdcentral/sjukhus/tandvård
- ☐9 Besöka post/bank/myndighet
- ☐10 Motion/friluftsliv
- ☐11 Föreningsaktivitet (t ex idrott, kultur)
- ☐12 Nöje (t ex bio, dans, restaurang)
- ☐13 Besöka släkt och vänner
- ☐14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ____ : ____

Hur lång var denna förflyttning?

____ , ____ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt upptill i nästa kolumn

Förflyttning 2

(startar där förflyttning 1 slutade)

Hur dags startade du? (kl): ____ : ____

Vilket var ditt ärende?

- ☐1 Till bostaden
- ☐2 Till arbetsplatsen
- ☐3 Resa/ärende i tjänsten
- ☐4 Till skola/utbildning
- ☐5 Hämta/lämna barn
- ☐6 Inköp av livsmedel
- ☐7 Annat inköp
- ☐8 Besöka vårdcentral/sjukhus/tandvård
- ☐9 Besöka post/bank/myndighet
- ☐10 Motion/friluftsliv
- ☐11 Föreningsaktivitet (t ex idrott, kultur)
- ☐12 Nöje (t ex bio, dans, restaurang)
- ☐13 Besöka släkt och vänner
- ☐14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ____ : ____

Hur lång var denna förflyttning?

____ , ____ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt upptill i nästa kolumn

Förflyttning 3

(startar där förflyttning 2 slutade)

Hur dags startade du? (kl): ______ : ______

Vilket var ditt ärende?

- ☐ 1 Till bostaden
- ☐ 2 Till arbetsplatsen
- ☐ 3 Resa/ärende i tjänsten
- ☐ 4 Till skola/utbildning
- ☐ 5 Hämta/lämna barn
- ☐ 6 Inköp av livsmedel
- ☐ 7 Annat inköp
- ☐ 8 Besöka vårdcentral/sjukhus/tandvård
- ☐ 9 Besöka post/bank/myndighet
- ☐ 10 Motion/friluftsliv
- ☐ 11 Föreningsaktivitet (t ex idrott, kultur)
- ☐ 12 Nöje (t ex bio, dans, restaurang)
- ☐ 13 Besöka släkt och vänner
- ☐ 14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ______ : ______

Hur lång var denna förflyttning?

______ , ______ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt upptill i nästa kolumn

Förflyttning 4

(startar där förflyttning 3 slutade)

Hur dags startade du? (kl): ______ : ______

Vilket var ditt ärende?

- ☐ 1 Till bostaden
- ☐ 2 Till arbetsplatsen
- ☐ 3 Resa/ärende i tjänsten
- ☐ 4 Till skola/utbildning
- ☐ 5 Hämta/lämna barn
- ☐ 6 Inköp av livsmedel
- ☐ 7 Annat inköp
- ☐ 8 Besöka vårdcentral/sjukhus/tandvård
- ☐ 9 Besöka post/bank/myndighet
- ☐ 10 Motion/friluftsliv
- ☐ 11 Föreningsaktivitet (t ex idrott, kultur)
- ☐ 12 Nöje (t ex bio, dans, restaurang)
- ☐ 13 Besöka släkt och vänner
- ☐ 14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ______ : ______

Hur lång var denna förflyttning?

______ , ______ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt upptill i nästa kolumn

Förflyttning 5

(startar där förflyttning 4 slutade)

Hur dags startade du? (kl): ______ : ______

Vilket var ditt ärende?

- ☐ 1 Till bostaden
- ☐ 2 Till arbetsplatsen
- ☐ 3 Resa/ärende i tjänsten
- ☐ 4 Till skola/utbildning
- ☐ 5 Hämta/lämna barn
- ☐ 6 Inköp av livsmedel
- ☐ 7 Annat inköp
- ☐ 8 Besöka vårdcentral/sjukhus/tandvård
- ☐ 9 Besöka post/bank/myndighet
- ☐ 10 Motion/friluftsliv
- ☐ 11 Föreningsaktivitet (t ex idrott, kultur)
- ☐ 12 Nöje (t ex bio, dans, restaurang)
- ☐ 13 Besöka släkt och vänner
- ☐ 14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ______ : ______

Hur lång var denna förflyttning?

______ , ______ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt upptill i nästa kolumn

Förflyttning 6

(startar där förflyttning 5 slutade)

Hur dags startade du? (kl): ______ : ______

Vilket var ditt ärende?

- ☐ 1 Till bostaden
- ☐ 2 Till arbetsplatsen
- ☐ 3 Resa/ärende i tjänsten
- ☐ 4 Till skola/utbildning
- ☐ 5 Hämta/lämna barn
- ☐ 6 Inköp av livsmedel
- ☐ 7 Annat inköp
- ☐ 8 Besöka vårdcentral/sjukhus/tandvård
- ☐ 9 Besöka post/bank/myndighet
- ☐ 10 Motion/friluftsliv
- ☐ 11 Föreningsaktivitet (t ex idrott, kultur)
- ☐ 12 Nöje (t ex bio, dans, restaurang)
- ☐ 13 Besöka släkt och vänner
- ☐ 14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ______ : ______

Hur lång var denna förflyttning?

______ , ______ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt upptill i nästa kolumn

Förflyttning 7

(startar där förflyttning 6 slutade)

Hur dags startade du? (kl): ______ : ______

Vilket var ditt ärende?

- ☐ 1 Till bostaden
- ☐ 2 Till arbetsplatsen
- ☐ 3 Resa/ärende i tjänsten
- ☐ 4 Till skola/utbildning
- ☐ 5 Hämta/lämna barn
- ☐ 6 Inköp av livsmedel
- ☐ 7 Annat inköp
- ☐ 8 Besöka vårdcentral/sjukhus/tandvård
- ☐ 9 Besöka post/bank/myndighet
- ☐ 10 Motion/friluftsliv
- ☐ 11 Föreningsaktivitet (t ex idrott, kultur)
- ☐ 12 Nöje (t ex bio, dans, restaurang)
- ☐ 13 Besöka släkt och vänner
- ☐ 14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ______ : ______

Hur lång var denna förflyttning?

______ , ______ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt upptill i nästa kolumn

Förflyttning 8

(startar där förflyttning 7 slutade)

Hur dags startade du? (kl): ______ : ______

Vilket var ditt ärende?

- ☐ 1 Till bostaden
- ☐ 2 Till arbetsplatsen
- ☐ 3 Resa/ärende i tjänsten
- ☐ 4 Till skola/utbildning
- ☐ 5 Hämta/lämna barn
- ☐ 6 Inköp av livsmedel
- ☐ 7 Annat inköp
- ☐ 8 Besöka vårdcentral/sjukhus/tandvård
- ☐ 9 Besöka post/bank/myndighet
- ☐ 10 Motion/friluftsliv
- ☐ 11 Föreningsaktivitet (t ex idrott, kultur)
- ☐ 12 Nöje (t ex bio, dans, restaurang)
- ☐ 13 Besöka släkt och vänner
- ☐ 14 Annat, nämligen:

Var avslutade du denna förflyttning?

- ☐ Egna bostaden
- ☐ Annan plats, nämligen …

… gata och nummer (eller platsens namn):

… i ort/kommun:

Ange färdsätt i den ordning de användes

	1:a	2:a	3:e	4:e
Bil som förare	☐	☐	☐	☐
Bil som passagerare	☐	☐	☐	☐
Buss	☐	☐	☐	☐
Tåg	☐	☐	☐	☐
Moped/MC	☐	☐	☐	☐
Cykel	☐	☐	☐	☐
Till fots	☐	☐	☐	☐
Flyg	☐	☐	☐	☐
Taxi (ej färdtjänst)	☐	☐	☐	☐
Färdtjänst	☐	☐	☐	☐
Annat, nämligen:	☐	☐	☐	☐

Hur dags kom du fram? (kl) ______ : ______

Hur lång var denna förflyttning?

______ , ______ km

Gjorde du fler förflyttningar under dagen?

☐ Nej ☐ Ja, fortsätt på ett blankt papper

Frågeformulär

Undersökningen består av två olika delar:

- **Detta frågeformulär** om dig och din familj (del A-C)
- **Resdagbok** där du beskriver dina resor <u>under en dag</u>

A Först några frågor om dig själv

A1 **Är du...?** ☐$_1$ kvinna ☐$_2$ man

A2 **Din ålder?** ________ år

A3 **Hur många personer är ni i ditt hushåll?** *(Räkna även med dig själv)*

☐st 0-6 år ☐st 7-10 år ☐st 11-15 år ☐st 16-18 år ☐st 19-64 år ☐st 65-74 år ☐st 75- år

A4 **Vilken är din huvudsakliga sysselsättning?** *(Kryssa för ett alternativ)*

- ☐$_1$ förvärvsarbetar
- ☐$_2$ studerar
- ☐$_3$ sjukskriven
- ☐$_4$ föräldraledig
- ☐$_5$ arbetssökande
- ☐$_6$ pensionär
- ☐$_7$ annat:______________________________

A5 **Vilken är din högsta avslutade utbildning?** *(Kryssa för ett alternativ)*

- ☐$_1$ grundskola/folkskola
- ☐$_2$ gymnasium/realskola
- ☐$_3$ eftergymnasial utbildning, annan än högskola/universitet
- ☐$_4$ utbildning på högskola/universitet

A6 **Ange den sammanlagda årsinkomsten för samtliga personer i ditt hushåll före skatt** (pension och studiemedel ska räknas in men inte bidrag som t ex bostadsbidrag och barnbidrag). *Du kan multiplicera månadsinkomsten med 12.*

- ☐$_1$ 100 000 eller mindre
- ☐$_2$ 100 001 – 200 000
- ☐$_3$ 200 001 – 300 000
- ☐$_4$ 300 001 – 400 000
- ☐$_5$ 400 001 – 500 000
- ☐$_6$ 500 001 – 600 000
- ☐$_7$ 600 001 – 700 000
- ☐$_8$ 700 001 – 800 000
- ☐$_9$ mer än 800 000

A7 **Bor du i enfamiljshus eller flerfamiljshus?**

- ☐$_1$ flerfamiljshus (lägenhet)
- ☐$_2$ fristående en- eller tvåfamiljshus (villa)
- ☐$_3$ radhus/kedjehus
- ☐$_4$ Annat, nämligen________________________________

A8 **Har du körkort för bil?** ☐$_1$ ja ☐$_2$ nej

A9 **Hur många personer i hushållet har körkort?** *(Räkna även med dig själv)*

☐$_1$ 0 st ☐$_2$ 1 st ☐$_3$ 2 st ☐$_4$ 3 st eller fler

A10 **Hur många bilar har hushållet tillgång till? Räkna även med eventuella leasingbilar och förmånsbilar.** *(Kryssa för ett alternativ)*

☐$_1$ 0 st ☐$_2$ 1 st ☐$_3$ 2 st ☐$_4$ 3 st eller fler

A11 **Kan du i allmänhet använda dig av bil när du behöver?** *(Kryssa för ett alternativ)*

☐$_1$ ja, alltid ☐$_2$ ja, för det mesta ☐$_3$ ja, ibland ☐$_4$ nej, sällan ☐$_5$ nej, aldrig

A12 **Har du tillgång till cykel?** *(Kryssa för ett alternativ)*

☐$_1$ ja, alltid ☐$_2$ ja, för det mesta ☐$_3$ ja, ibland ☐$_4$ nej, sällan ☐$_5$ nej, aldrig

A13 **Har du något kort du kan använda för resor med kollektivtrafiken eller färdtjänst?** *(Kryssa för ett alternativ)*

☐$_1$ ja, alltid ☐$_2$ ja, för det mesta ☐$_3$ ja, ibland ☐$_4$ ja, men sällan ☐$_5$ nej, aldrig

Om JA: Vilken typ av kort? *(Kryssa för ett eller flera alternativ)*

- ☐$_1$ Skånekort - hela länet (890 kr)
- ☐$_2$ Skånekort - 9 zoner (740 kr)
- ☐$_3$ Skånekort – 6 zoner (580 kr)
- ☐$_4$ Skånekort – 3 zoner (450 kr)
- ☐$_5$ Skånekort – 1 zon (270 kr)
- ☐$_6$ Öresundskort
- ☐$_7$ SJ-kort
- ☐$_8$ Abonnemangskort (Lund och Helsingborg)
- ☐$_9$ Rabattkort
- ☐$_{10}$ Värdekort
- ☐$_{11}$ Serviceresekort
- ☐$_{12}$ Skolkort
- ☐$_{13}$ Frikort
- ☐$_{14}$ Tillstånd för färdtjänst
- ☐$_{15}$ Övrigt kort, nämligen_____________ ________________________________

A14 **Hur långt har du <u>från hemmet</u> till närmsta busshållplats?**____________**meter**

Hur långt har du <u>från hemmet</u> till närmsta järnvägsstation?_____________**meter**

Hur långt har du <u>från hemmet</u> till närmsta bilparkering?_____________**meter**

B Frågor till dig som förvärvsarbetar eller studerar

Du som <u>inte</u> förvärvsarbetar eller studerar, gå vidare till fråga C1.

B1 **Hur långt har du <u>från arbete/studieplats</u> till närmsta busshållplats?**____________**meter**

Hur långt har du <u>från arbete/studieplats</u> till närmsta järnvägsstation?__________**meter**

Hur långt har du <u>från arbete/studieplats</u> till närmsta bilparkering?____________**meter**

B2 **Har du tillgång till något av följande på arbetsplatsen/studieplatsen?** *(Kryssa för ett eller flera alternativ)*

- ☐$_1$ fri parkering
- ☐$_2$ parkering med avgift
- ☐$_3$ förmånsbeskattad parkering
- ☐$_4$ företagsbil/bilpoolsbil
- ☐$_5$ förmånsbil
- ☐$_6$ ersättning för egen bil i tjänsten
- ☐$_7$ subventionerat kort för kollektivtrafiken
- ☐$_8$ tjänstecykel
- ☐$_9$ inte något av ovanstående alternativ
- ☐$_{10}$ annat;_____________________________

C Övriga frågor

C1 **Frivillig uppgift: Ange gärna ditt namn och telefonnummer** så att vi kan komplettera enkäten via telefon om något verkar oklart. ____

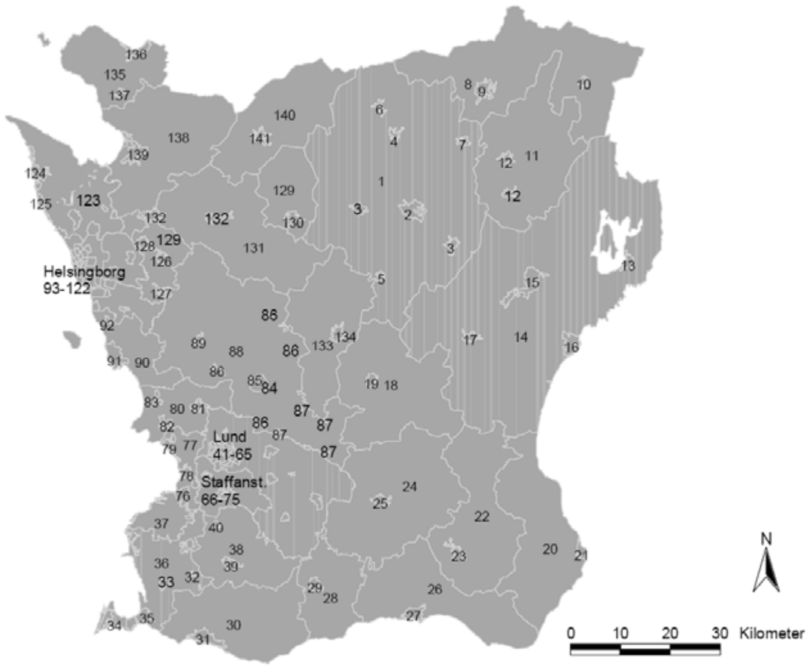
C2 **Synpunkter/Förslag:**____
____
____

Municipality codes

Kommun-kod	Kommun	Tätortsnummer	Landsbygdsnummer
1214	Svalöv	89	88 (tillsammans med Eslöv)
1230	Staffanstorp	66-74	75
1231	Burlöv	76	77 (tillsammans med Lomma)
1233	Vellinge	32-35	36 (tillsammans med Malmö)
1256	Östra Göinge	12	11
1257	Örkelljunga	141	140
1260	Bjuv	126-128	129 (tillsammans med Perstorp)
1261	Kävlinge	81-83	80
1262	Lomma	78-79	77 (tillsammans Burlöv)
1263	Svedala	39-40	38
1264	Skurup	29	28
1265	Sjöbo	25	24
1266	Hörby	19	18
1267	Höör	134	133
1270	Tomelilla	23	22
1272	Bromölla	13	14 (tillsammans med Kristianstad)
1273	Osby	9-10	8
1275	Perstorp	130	129 (tillsammans med Bjuv)
1276	Klippan	132 (tillsammans med Åstorp)	131 (tillsammans med Åstorp)
1277	Åstorp	132 (tillsammans med Klippan)	131 (tillsammans med Klippan)
1278	Båstad	136-137	135
1280	Malmö	37	36 (tillsammans med Vellinge)
1281	Lund	0, 41-58, 60-65	59
1282	Landskrona	91-92	90
1283	Helsingborg	93-120	121-123 (123 tillsammans med Höganäs)
1284	Höganäs	124-125	123 (tillsammans med Helsingborg)
1285	Eslöv	84-87	88 (tillsammans med Svalöv)
1286	Ystad	27	26
1287	Trelleborg	31	30
1290	Kristianstad	15-17	14 (tillsammans med Bromölla)
1291	Simrishamn	21	20
1292	Ängelholm	139	138
1293	Hässleholm	2	1

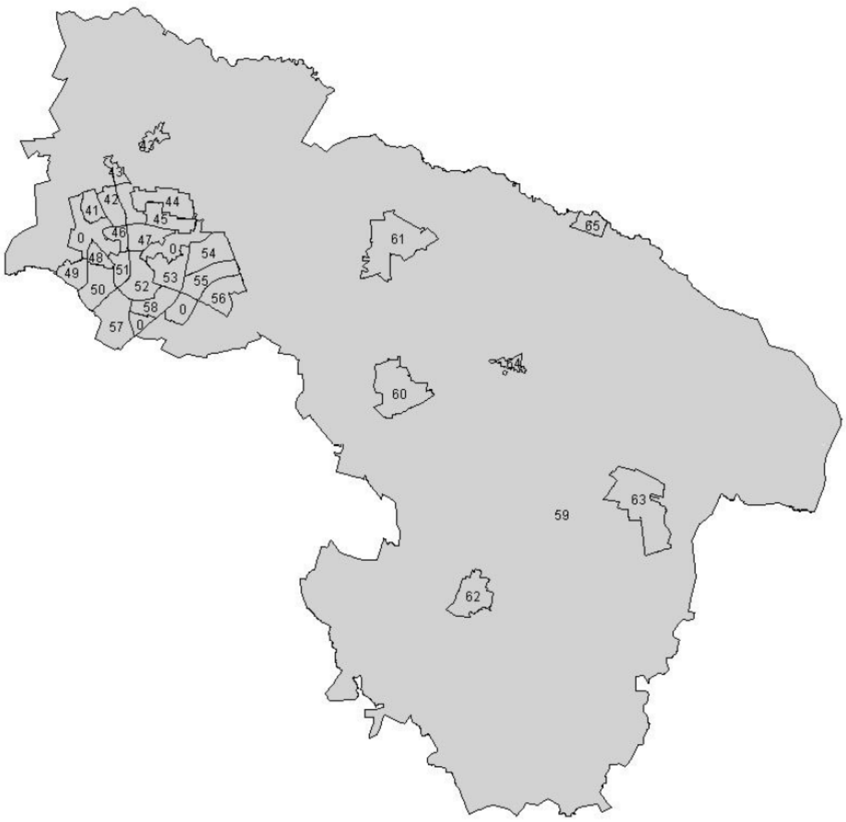
Source: Trivector Traffic, 2008, Table 2.1, p. 3.

<u>Map of Skåne – « Division of the areas » (Områdesindelning av Skåne).</u>



Source: Trivector Traffic, 2008, Figure 2.1, p. 4

<u>Area covered for Lund.</u>



Source: Trivector Traffic, 2008b, Figure 6.3, p. 45.

Appendix (2) LUH - Parking Map

Source: Skåne Region, 2004.

Appendix (3) Survey - Requests details

Parking access

Centre

UP: Har du tillgång till fri parkering på arbetsplatsen/studieplatsen?					
Centre		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	markerat alternativ	7	16,3	100,0	100,0
Missing	System	34	83,7		
Total		41	100,0		

UP: Har du tillgång till parkering med avgift på arbetsplatsen/studieplatsen?					
Centre		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	markerat alternativ	11	26,9	100,0	100,0
Missing	System	30	73,1		
Total		41	100,0		

Lund University Hospital

UP: Har du tillgång till fri parkering på arbetsplatsen/studieplatsen?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	markerat alternativ	9	5,0	100,0	100,0
Missing	System	179	95,0		
Total		189	100,0		

UP: Har du tillgång till parkering med avgift på arbetsplatsen/studieplatsen?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	markerat alternativ	161	85,5	100,0	100,0
Missing	System	27	14,5		
Total		189	100,0		

Science Park

UP: Har du tillgång till fri parkering på arbetsplatsen/studieplatsen?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	markerat alternativ	107	82,9	100,0	100,0
Missing	System	22	17,1		
Total		129	100,0		

UP: Har du tillgång till parkering med avgift på arbetsplatsen/studieplatsen?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	markerat alternativ	10	7,4	100,0	100,0
Missing	System	119	92,6		
Total		129	100,0		

Modal Split

(Data Referring to Figure 4-5 and Figure 4-6)

Centre							
	Valid						
	cykel	tåg	bil som förare	till fots	buss	bil som passagerare	Total
Frequency	8,53334	8,464669	7,64463	7,238412	5,897349	3,214426	40,99283
Percent	20,81667	20,64915	18,6487	17,65775	14,3863	7,841435	100
Valid Percent	20,81667	20,64915	18,6487	17,65775	14,3863	7,841435	100
Cumulative Percent	20,81667	41,46581	60,11452	77,77227	92,15856	100	

Hospital									
	Valid							Missing	Total
	bil som förare	cykel	buss	tåg	bil som passagerare	till fots	moped /MC	Total	System	
Frequency	72,51	39,31	29,73	25,52	10,65	7,59	0,21	185,51	3,09	188,60
Percent	38,45	20,84	15,76	13,53	5,65	4,02	0,11	98,36	1,64	100,00
Valid Percent	39,09	21,19	16,03	13,76	5,74	4,09	0,11	100,00		
Cumulative Percent	39,09	60,28	76,30	90,06	95,80	99,89	100,00			

Science Park										
	Valid								Missing	Total
	bil som förare	bil som passagerare	buss	tåg	moped /MC	cykel	till fots	Total	System	
Frequency	58,85	4,46	6,05	5,85	0,57	37,08	15,38	128,24	0,40	128,64
Percent	45,75	3,47	4,70	4,55	0,45	28,83	11,95	99,69	0,31	100,00
Valid Percent	45,89	3,48	4,72	4,56	0,45	28,92	11,99	100,00		
Cumulative Percent	45,89	49,37	54,08	58,65	59,09	88,01	100,00			

Modal split for the individual lots in the Science Park

(Referring to Figure 4-7)

Nyko mål			Frequency	Percent	Valid	Cumulativ
SP5 (Palsjö)	Valid	bil som förare	16,1	64,7	65,8	65,8
		cykel	5,0	20,2	20,5	86,3
		bil som passagerare	1,9	7,6	7,7	94,0
		moped/MC	0,6	2,3	2,3	96,3
		buss	0,3	1,3	1,3	97,6
		tåg	0,3	1,2	1,2	98,9
		till fots	0,3	1,1	1,1	100,0
		Total	24,4	98,4	100,0	
	Missing	System	0,4	1,6		
	Total		24,8	100,0		
SP1 (Idéon)	Valid	bil som förare	13,1	45,5	45,5	45,5
		cykel	12,4	43,2	43,2	88,7
		till fots	2,3	7,8	7,8	96,5
		buss	1,0	3,5	3,5	100,0
		Total	28,8	100,0	100,0	
SP2(Idéon/ LTH)	Valid	bil som förare	16,8	39,2	39,2	39,2
		cykel	12,9	29,9	29,9	69,1
		till fots	7,1	16,5	16,5	85,6
		buss	2,5	5,9	5,9	91,5
		bil som passagerare	2,2	5,1	5,1	96,6
		tåg	1,4	3,4	3,4	100,0
		Total	42,9	100,0	100,0	
SP3 (Idéon)	Valid	cykel	2,4	37,1	37,1	37,1
		till fots	2,2	34,3	34,3	71,4
		bil som förare	1,2	19,1	19,1	90,5
		tåg	0,6	9,5	9,5	100,0
		Total	6,5	100,0	100,0	
SP4 (Palsjö)	Valid	bil som förare	7,9	47,9	47,9	47,9
		cykel	3,8	22,8	22,8	70,7
		till fots	2,3	13,7	13,7	84,4
		buss	2,2	13,3	13,3	97,7
		bil som passagerare	0,4	2,3	2,3	100,0
		Total	16,5	100,0	100,0	
SP9 (Brunnshög)	Valid	bil som förare	1,8	63,0	63,0	63,0
		tåg	1,0	37,0	37,0	100,0
		Total	2,8	100,0	100,0	
SP6 (Brunnshög)	Valid	tåg	2,5	39,2	39,2	39,2
		bil som förare	1,9	31,1	31,1	70,3
		till fots	1,3	20,0	20,0	90,3
		cykel	0,6	9,7	9,7	100,0
		Total	6,3	100,0	100,0	

Modal splits between different parking accesses (Free Parking vs Parking Fees)

Referring to Table 4-3 Change in modal split from access to free parking to access to parking fares, Table 4-4 Change in solo-share from access to free parking to access to parking-fees, and Figure 4-8Shift in modal split between commuters having access to free parking and parking-fare

Resans huvudfärdmedel - access to free parking - Centre

Centre	bil som förare	cykel	buss	till fots	tåg	Total
Frequency	2,6903843	2,008574	0,754042126	0,621183	0,616444	6,690627
Percent	40,211245	30,02071	11,27012713	9,284375	9,213541	100
Valid Percent	40,211245	30,02071	11,27012713	9,284375	9,213541	100
Cumulative Percent	40,211245	70,23196	81,50208415	90,78646	100	

	Resans huvudfärdmedel - access to parking fares – Centre					
Centre	tåg	bil som förare	cykel	buss	till fots	Total
Frequency	4,595285	2,021362	1,962244	1,681812	0,775788	11,03649
Percent	41,63719	18,31526	17,7796	15,23865	7,029296	100
Valid Percent	41,63719	18,31526	17,7796	15,23865	7,029296	100
Cumulative Percent	41,63719	59,95245	77,73205	92,9707	100	

Resans huvudfärdmedel - access free parking – Hospital						
	bil som förare	bil som passagerare	buss	cykel	till fots	Total
Frequency	4,410953	3,002589	1,40777	0,261786	0,325907	9,409005
Percent	46,88012	31,91187	14,96194	2,782296	3,463774	100
Valid Percent	46,88012	31,91187	14,96194	2,782296	3,463774	100
Cumulative Percent	46,88012	78,79199	93,75393	96,53623	100	

Resans huvudfärdmedel - access parking fares - Hospital										
	Valid								Missing	T
	bil som förare	bil som passagerare	buss	Tåg	moped/ MC	cykel	till fots	Total	System	
Frequency	67,49476	6,929317	23,00586	23,31023	0,207388	32,65249	4,629674	158,2297	3,08808	1
Percent	41,83962	4,295445	14,26121	14,44988	0,128559	20,24109	2,869909	98,08572	1,914283	
Valid Percent	42,65618	4,379277	14,53953	14,73189	0,131068	20,63613	2,92592	100		
Cumulative Percent	42,65618	47,03546	61,57499	76,30689	76,43795	97,07408	100			

Resans huvudfärdmedel - access to free parking – Science Park										
	Valid								Missing	Total
	bil som förare	bil som passagerare	buss	tåg	moped/ MC	cykel	till fots	Total	System	
Frequency	50,45	4,46	5,37	5,85	0,57	28,27	11,27	106,25	0,40	106,64
Percent	47,31	4,18	5,04	5,49	0,54	26,51	10,57	99,63	0,37	100,00
Valid Percent	47,48	4,20	5,05	5,51	0,54	26,61	10,61	100,00		
Cumulative Percent	47,48	51,68	56,73	62,24	62,78	89,39	100,00			

Resans huvudfärdmedel - Access to parking fees – Science Park				
	Valid			
Science Park	bil som förare	cykel	till fots	Total
Frequency	1,41003	6,2276489	1,90751141	9,54519
Percent	14,772152	65,243842	19,98400604	100
Valid Percent	14,772152	65,243842	19,98400604	100
Cumulative Percent	14,772152	80,015994	100	

Table referring to Table 4-5 Science Park, individual lots: type of pricing access and preferred mode of transportation

UP: Har du tillgång till fri parkering på arbetsplatsen/studieplatsen?						
Nyko mål			Frequency	Percent		Cumulative Percent
SP5 (Palsjö)	Valid	markerat alternativ	22,07656	88,86247	100	100
	Missing	System	2,766954	11,13753		
	Total		24,84351	100		
SP1 (Idéon)	Valid	markerat alternativ	20,92643	72,73039	100	100
	Missing	System	7,846178	27,26961		
	Total		28,77261	100		
SP2 (Idéon/ LTH)	Valid	markerat alternativ	35,40756	82,43977	100	100
	Missing	System	7,542053	17,56023		
	Total		42,94962	100		
SP3 (Idéon)	Valid	markerat alternativ	6,525295	100	100	100
SP4 (Palsjö)	Valid	markerat alternativ	16,09733	97,5987	100	100
	Missing	System	0,396057	2,401305		
	Total		16,49339	100		
SP9 (Brunnshög)	Valid	markerat alternativ	1,702781	60,92641	100	100
	Missing	System	1,092035	39,07359		
	Total		2,794816	100		
SP6 (Brunnshög)	Valid	markerat alternativ	3,905508	62,41934	100	100
	Missing	System	2,35138	37,58066		
	Total		6,256888	100		

UP: Har du tillgång till parkering med avgift på arbetsplatsen/studieplatsen?						
Nyko mål			Frequency	Percent	Valid Percent	
SP5 (Palsjö)	Missing	System	24,84351	100		
SP1 (Idéon)	Valid	markerat alternativ	4,788134	16,64129	100	100
	Missing	System	23,98448	83,35871		
	Total		28,77261	100		
SP2 (Idéon/ LTH)	Valid	markerat alternativ	3,992021	9,294659	100	100
	Missing	System	38,9576	90,70534		
	Total		42,94962	100		
SP3 (Idéon)	Missing	System	6,525295	100		
SP4 (Palsjö)	Missing	System	16,49339	100		
SP9 (Brunnshög)	Missing	System	2,794816	100		
SP6 (Brunnshög)	Valid	markerat alternativ	0,765036	12,2271	100	100
	Missing	System	5,491852	87,7729		
	Total		6,256888	100		

<u>Distance from residence to the nearest parking</u>

UP: Hur långt har du från hemmet till närmsta bilparkering i meter?							
Centre				Hospital			Science Park
Valid	34,37634		Valid	175,4914		Valid	121,6477
Missing	6,61649		Missing	13,11083		Missing	6,988435
Mean	405,2431		Mean	365,8905		Mean	349,2122

<u>Origin of commuters</u>

Centre

Kommunkod startpunkt					
Centre	Municipality Code	Frequency	Percent	Valid Percent	Cumulative Percent
	1230	2,22001	5,415605	5,415605	81,28781
	1231	0,798521	1,947953	1,947953	96,38055
	1261	2,853742	6,961565	6,961565	69,88846
	1262	1,372165	3,34733	3,34733	92,21981
	1264	1,456498	3,553056	3,553056	88,87248
	1265	0,907085	2,212789	2,212789	94,43259
	1266	0,767244	1,871653	1,871653	98,2522
	1267	1,652671	4,031611	4,031611	85,31942
	1280	3,332958	8,130588	8,130588	62,92689
Valid	1281	22,46255	54,7963	54,7963	54,7963
	1282	2,452907	5,983746	5,983746	75,8722
	1283	0,716472	1,747799	1,747799	100
	Total	40,99283	100	100	

LUH

Kommunkod startpunkt					
Hospital	Municipality Code	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1214	0,815728	0,432512	0,437995	0,437995
	1230	9,515723	5,045394	5,109347	5,547341
	1231	2,163726	1,147244	1,161785	6,709127
	1233	2,126828	1,12768	1,141974	7,8511
	1261	9,646765	5,114874	5,179708	13,03081
	1262	5,143539	2,72719	2,761758	15,79257
	1263	1,275066	0,676061	0,68463	16,4772
	1265	2,765102	1,466103	1,484686	17,96188
	1266	4,396424	2,331057	2,360604	20,32249
	1267	9,957217	5,279481	5,346401	25,66889
	1277	1,934508	1,025708	1,038709	26,7076
	1278	1,142215	0,605621	0,613298	27,3209
	1280	34,41987	18,24999	18,48131	45,80221
	1281	78,42354	41,58146	42,10853	87,91073
	1282	5,314973	2,818086	2,853807	90,76454
	1283	2,532941	1,343007	1,36003	92,12457
	1284	0,492674	0,261224	0,264535	92,38911
	1285	9,121134	4,836177	4,897477	97,28658
	1286	0,932997	0,49469	0,500961	97,78754
	1287	1,131281	0,599824	0,607427	98,39497
	1290	0,533209	0,282716	0,2863	98,68127
	9930	2,456021	1,302223	1,318729	100
	Total	186,2415	98,74832	100	
Missing	System	2,360696	1,25168		
Total		188,6022	100		

Science Park

Kommunkod startpunkt					
	Municipality Code	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1230	3,878898	3,015404	3,030746	3,030746218
	1231	0,406248	0,315812	0,317419	3,348165106
	1233	5,237772	4,071774	4,092491	7,440656297
	1256	1,033965	0,80379	0,80788	8,24853628
	1261	5,981087	4,649617	4,673275	12,92181094
	1262	5,6191	4,368213	4,390439	17,31225013
	1263	1,275406	0,991483	0,996528	18,30877828

	1264	0,900946	0,700384	0,703947	19,01272554
	1266	1,676492	1,303282	1,309913	20,32263903
	1267	0,759289	0,590261	0,593264	20,91590337
	1273	0,836116	0,649985	0,653292	21,56919577
	1275	0,36923	0,287035	0,288495	21,85769107
	1280	4,158163	3,232501	3,248948	25,10663889
	1281	75,84143	58,95811	59,25809	84,36473082
	1282	4,363938	3,392467	3,409728	87,77445896
	1283	4,106406	3,192265	3,208508	90,98296647
	1284	1,56898	1,219704	1,22591	92,20887644
	1285	5,446755	4,234235	4,255779	96,46465533
	1286	2,593438	2,016104	2,026362	98,49101743
	9910	1,368413	1,063786	1,069199	99,56021614
	9930	0,562857	0,437558	0,439784	100
	Total	127,9849	99,49376	100	
Missing	System	0,651201	0,506235		
Total		128,6361	100		

Appendix (4) CO_2 Calculation

SD = wf*S(sd)% = 7,400*45.9% = 3,396.6 solo-drivers for the Science Park

CP = wf*S(cp)% = 7,400*3.5% = 259 carpoolers for the Science Park

CP = Carpoolers

SD = Solo drivers

wf = workforce

S = share in modal split

VTR = sd(1)+cp(0,5) = 3,396.6 + 259*0.5 = 3,526.1

The potential reduction in vehicle trip from work commuting in the Science Park reaches 1,057.8 vehicles (3,526.1 VTR * 30%).

dVKTr = 1,057.8 vehicles *27.9km *2 times a day = 59,026.9 km per day.

CO_2r = dr(km)(CO_2g/km) = 59,026.9 km * 181 g CO_2/km = 10,683,871.4 g CO_2 = 10,683.9 kg of CO_2 reduction per day.

yCO_2r = 10,683.9 CO_2 kg per day *4 days *47 weeks = 2,008.6 tonnes of CO_2 per year

Fuel saving: 489,923.4 litres/ day (8.3 l/km * 59,026.9 km).

One of the targets of LundaMaTs II is to decrease the emission from transport per resident by 10% for 2013 and by 40% for 2030 (Lunds Municipality, 2007, 4). The CO_2 emissions were estimated to be 155,000 tonnes in 2004 (Ibid, 7). Taking that as a baseline, introducing parking fees in the Science Park could thus help at reducing the emission by 1.3% (2,008.6 CO_2t/155,000 CO_2t) which can be significant to reach the 10% objective fixed by LundaMaTs. Taken alternatively, the total decrease in CO_2 aimed for 2013 is 12,680 tonnes. In that respect, there is a potential to attain 15.8 % of this goal through parking reforms in the Science Park (2,008.6 CO_2t/12,680 CO_2t).