
Summary:

Which kinds of P&R can contribute to reduced greenhouse gas emissions?

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We have studied how various properties of Park & Ride (P&R) facilities affect their effects on traffic volumes and greenhouse gas (GHG) emissions. If a P&R is located in an area where it stimulates urban sprawl, regional enlargement or induced traffic, it will not reduce vehicle kilometres travelled. If the P&R intercepts journeys by car close to its starting point and transfer travellers to a relatively long public transport ride, it contributes to reduced GHG emissions. This may be counteracted by increased traffic volumes if the P&R occupy a site which has an alternative use that contribute to less transport demand and traffic, or if the P&R site stimulates to car journeys replacing travelling by foot, bicycling or public transport to the station. The report provides planners and decision-makers with guidelines for analysing traffic-reducing effects of P&R in the planning and decision processes. This also includes discussions on which measures can be applied instead of constructing new or expanding existing P&R facilities in different contexts.

Introduction

Parking close to stations or terminals served by public transport facilitates transfer from car to public transit for the last part of the trip. The concept - P&R - is common in urban regions in many countries. There are several reasons for investing in P&R. It provides easier and more attractive access to a city or it may increase the attractiveness of public transit. It has also been argued that P&R contributes to reducing vehicle kilometres travelled, because it allows people to travel by public transport rather than by car. Thereby, it may reduce a number of negative effects related to increasing traffic volumes, such as local pollution, greenhouse gas emissions, noise, accidents, congestions and the need for investments in new road capacity.

However, the research literature has questioned whether P&R results in reduced vehicle kilometres travelled. Researchers argue that P&R may cause travellers start using their private car on the journey to terminals, stations and bus stops rather than to walk, bicycle or use public transport. It may also encourage urban sprawl and regional enlargement, since P&R improves accessibility to housing in car-based locations. Further, parking sites may displace activities and urban developments in town centres and close to public transport nodal points. Finally, regions with high degree of congestion on the road traffic system have high potentials for induced traffic. This means that traffic reductions caused by P&R will be replaced with new or induced traffic when capacity is released.

In this project, we include all these aspects and analyse which kinds of P&R's can be considered a measure contributing to reduced car usage, traffic volumes and GHG emissions in cities.

We have defined two main research questions:

- What kinds of P&R (location, size/capacity, etc.) can result in reduced vehicle kilometers travelled and reduced GHG emissions? What properties, conditions and regulations affect such effects?
- How can planning and decision-making processes be organized to ensure that traffic- and GHG- reducing effects are assessed?

Our aim has been to improve the understanding of what affect the traffic-reducing effects of P&R, and by that provide a platform for more knowledge-based analyses, plans and decisions concerning expansion of existing facilities or establishing of new facilities.

Approach and methods

We have worked together with authorities in four Norwegian urban areas: Oslo, Bergen, Trondheim and Kristiansand. At 75 selected P&R sites in these regions, we noted plate-numbers of all parked cars, received home addresses for the owners from the Norwegian National Road Authorities, and plotted the home addresses of the car owners on maps. This allowed us to analyse what area each site served¹. We have recorded the distance between home and the P&R site measured both by “as the crow flies” and by real distance along road. We also made note of how early the sites filled up. At 23 of the P&R sites, we asked the users whether they were willing to respond to a questionnaire. We sent a questionnaire to those who provided us with their e-mail addresses. They could respond while travelling with public transport or later, if that was more convenient. We present the empirical data from these investigations in a separate report, while we use these data for analyses here.

We have also selected three P&R projects for detailed study of the planning processes. We have also studied which analyses were undertaken. All three projects have recently been through planning and decision-making processes. Construction is completed.

The main approach in this report, which is the main report of the project, is comparative case studies of 12 P&R sites. We start with a theoretical discussion concerning through which mechanisms a new or expanded P&R-site can influence vehicle kilometres travelled in an urban region. Then we make internal analyses of each case, and comparative analyses of the sites.

In the survey, we asked the users about the destinations for their journeys, and calculated average distances travelled by public transport instead of by car for each P&R site. Likewise, we calculated average distance travelled by car to the P&R. Further, we asked how they would have travelled if the P&R site did not exist, and which alternatives they had to using their car on the journeys to and from the station. We used this information for analyses of car traffic saved by each P&R.

¹ Because it is often argued that people have to use the car in order to transport children to kindergarten or school, we also registered whether there was a child's seat in the cars.

Especially in central parts of towns and cities, sites occupied by P&R often have an alternative use. Such alternative uses may then be located outside the densely developed area and generate more traffic than would be the case in a central location. We estimated whether such effects could be expected in each case. We also analysed whether the P&R facilities were located in areas and regions with high potentials for urban sprawl, regional enlargement or induced traffic. In such cases increased traffic volumes could counteract the traffic-reducing effects of the P&R.

Based on the research described above, we developed guidelines for analysing traffic- and GHG-reducing effects of P&Rs. These guidelines can be used in planning and decision-making processes. We have also discussed alternative measures, which can be implemented instead of P&Rs in various contexts.

Types of P&R resulting in reduced car use

We are answering the first question asked on three levels:

i) Current use and users of P&R, in isolation

When analysing each site in isolation, and considering current use and users, we found that all 12 P&Rs resulted in reduced vehicle kilometres travelled. The average distance between home and P&R is shorter than the distance travelled by public transport to the final destination. In most cases, relatively low shares of the P&R users lived in walking distance to the station served by the P&R. Hence, the potential for changing car trips to P&R sites into walking trips is rather low. In several cases we found that P&R contributed to the dislocation of developments and activities from central areas well served by public transport. This causes increased traffic.

When asking which kinds of P&Rs contributing the most to traffic reduction, we found that:

- The farther away from the destination the P&R site is located, the larger effect (reduced vehicle kilometers) does each parking space have
- P&Rs that do not encourage to unnecessary car use have larger effects
- Locating P&R outside the central parts of cities and towns reduce traffic created by developments and activities being displaced

ii) Several P&R sites operating as a system

We analysed corridors where P&R sites influence on each other. Car drivers do not always use the P&R nearest to their home. Therefore, the relative length of the journey done by car may increase. Fare structures, toll systems, congestion and the standard of the public transport services (capacity, frequency, travel time, etc.) influence the choices of the car users. We found that:

- Systems of P&R causes less unnecessary car traffic if the attractiveness of the P&Rs in the system is quite similar and users therefore will choose the site nearest home

iii) P&R in a regional and long range horizon

P&R located in cities and regions with potential for urban sprawl, regional enlargement or induced traffic will contribute to increased traffic volumes and GHG emissions. In such areas, P&R provide increased mobility and greater freedom of

choice. This is beneficial in itself, but also contributes to increased traffic volumes and GHG emissions. In such areas, P&R cannot be understood as a means to reduce traffic volumes and GHG emissions. We found that this is especially true for the Oslo region.

Based on interviews with planners and a study of documents related to the expansion of two existing P&R sites and one new P&R site, we concluded that neither environmental impacts nor aggregated car use (vehicle kilometres) were important issues in the processes. The main reason for building the new capacity was that the demand was higher than the supply.

Guidelines

Based on the empirical work and analyses, we have formulated guidelines for analysing traffic-reducing effects of P&Rs, and how these analyses can be used for making planning and decisions more based on knowledge.

Information and data that may be useful as a basis for these analyses:

- The destination for the majority of commuter trips (statistics, information from local planners)
- Where the users of the P&R live (registration and analyses of car license plates, information from local planners)
- More detailed information about the users and the use of the site (surveys, interviews with local planners)
- Information about public transport services, routes for access by walking or bicycling (statistics, operators, interviews with local planners)
- Existing land use, traffic situation and plans for future development near the proposed site (master plan, interviews with local planners)
- Study a larger part of the region in order to evaluate the potential for sprawl (master plans, regional plans, interviews with local planners)
- Information on congestions and delays on main roads and possibility for induced traffic

For the analyses of the traffic reducing potentials of P&Rs, we recommend asking the following questions (Table S1). We have indicated which further actions can be taken, based on whether the answers to the questions are yes or no.

Table S1 Questions used for evaluating whether a P&R project may reduce traffic volumes.

Question	If Yes	If No
Does the location contribute to long car journeys compared to the length travelled by public transport?	Does not result in significant reduction. Consider other measures.	Allow, if no other significant and unwanted effects
Do many of the users live so close to the site that they can walk or bicycle? Do many of the users have a good public transport service feeding to the P&R?	Results in no or limited effect. Consider reducing the number of spaces, pricing or other measures.	Allow, if no other significant and unwanted effects
Do many of the users have public transport service from home (within walking or bicycling distance) to the destination?	Can increase traffic volumes. Consider improvements of the existing public transport service.	Allow, if no other significant and unwanted effects
Are there other and better uses of the site occupied by P&R? Does it displace other activities and create nuisances?	Can displace activities or developments in the centre. Consider relocation, pricing or other measures.	Allow, if no other significant and unwanted effects
Do properties of the P&R site or the system of P&R sites cause people to travel longer by car than necessary?	Contributes to increased traffic to and from the station. Consider parking fees or other approaches in order to regulate the demand.	Allow, if no other significant and unwanted effects
Will this P&R stimulate to urban sprawl or regional enlargement?	Can contribute to increased traffic. Consider other approaches for easy access to the station or bus stop.	Allow, if no other significant and unwanted effects
Is the P&R located in an area with a congested road system? Will the "traffic relief" be replaced by induced traffic?	Does not give significant reduction of traffic volumes. Consider other approaches for access to the station/bus stop.	Allow, if no other significant and unwanted effects

If the answers to all questions are no, the new or expanded P&R will probably contribute to reduced traffic volumes and GHG emissions. If the answers to one or more of the questions is yes alternatives should be considered. Which alternatives are appropriate will vary with the context, but include:

- Improved access for walking or bicycling
- Improved feeder services by bus from residential areas to the station or terminal, and/or construct smaller P&R sites serving the local bus routes
- Improved regional bus services with more direct buses from local bus stops (in some cases also combined with small, local parking lots) to the urban centre
- Charging a fee for parking or regulate the use of P&R in other ways
- Adjusting the fare zones for public transport
- Implementing incentives for carpooling to the P&R site
- Relocating the P&R
- Reducing the capacity (the number of parking spaces) at the P&R site
- Consider multilevel parking structures