
**TOPIC 1**
TRANSPORT AND
LAND USE (SIG)

# METROPOLITAN PARKING POLICIES: POTENTIAL EFFECTS ON CAR USE AND IMPLEMENTATION STRATEGIES

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## Abstract

One promising strategy to reduce car travel in metropolitan areas is the coordination of land use and infrastructure planning. The scale of urban areas as well as traffic problems is increasing. Therefore an integrated regional planning approach is needed. Within such a (location) planning strategy, parking policies can be an effective instrument.

## INTRODUCTION

One promising strategy to reduce car travel in metropolitan areas is the coordination of land use and infrastructure planning. The scale of urban areas as well as traffic problems is increasing. Therefore an integrated regional planning approach is needed. Within such a (location) planning strategy, parking policies can be an effective instrument. However, decision making with respect to regional parking policies is complex (different actors involved, different perceptions on problems—goals and solutions). So, as a consequence, the central policy issue is not only effectiveness but also political feasibility.

The paper presents the results of some empirical research in the Netherlands on these two topics. It starts with an outline of the Dutch policy context. The second part focuses on the effects of parking supply and pricing measures on shifts in mode share (disaggregated mode choice model, forecasting results of possible effects within different land use planning strategies). The third part describes the differences in perception on problems and policy measures among actors involved in the development of parking policies in the metropolitan area of the Hague (multi dimensional scaling, decision net approach). The paper concludes with some remarks on the potential effects and political constraints of parking strategies, aimed at the reduction of car traffic in urban areas.

## DUTCH POLICY CONTEXT

Two objectives play a vital role in current Dutch Transportation Planning Policies:

- guaranteeing the accessibility of the economical centres and
- reducing the negative impacts of mobility on the environment.

An important strategy to achieve this objectives is the reduction of the growth in car traffic. This strategy is worked out in the Second Transportation Structure Plan of the Dutch government from 1990. This plan presents a comprehensive package of policy measures, such as pricing measures, the improvement of public transport, extending parking restrictions in central urban areas and land use planning.

This paper especially deals with the last two measures, whom are both trying to encourage the use of public transport and slow modes through a better coordination between the planning of transportation facilities and land-use, in particular of employment. Industrial plants, public facilities, offices for business or government, they all generate mobility of persons and goods. The amount of mobility generated and the use of different transport modes depends heavily on the characteristics of these companies and their locations. It is well-known that by locating employment on locations with limited parking facilities near railway stations and other public transport facilities, public transport use is enhanced. Many examples can be found that demonstrate the influence of the location of a company on the mode choice of commuters.

However, stimulating the development of these types of locations requires a balanced policy: a promising and innovative land use strategy exploits the differences between companies as to the mobility they generate. Therefore, attention should be paid to the large variation between companies with respect to their potential use of public transport and the role of the car in business travel and freight transport. Some companies depend heavily on road facilities, central locations with excellent public transport facilities should be reserved mainly for companies with high public transport potentials. Companies with low public transport potential which are heavily dependent on road transport and business travel by car can better be located near motor way exits.

To implement this location policy in urban regions, a key instrument for regional planning has been developed in the Netherlands (see for a general overview van Huut 1991). The so called ABC planning instrument is based on two classifications: one of locations with respect to their multimodal accessibility characteristics (the *accessibility profile*) and another one of companies

according to their mobility characteristics (the *mobility profile*). In order to establish optimal locations for each type of company, three basic types of locations are distinguished:

- *A-locations:* locations with severe parking restrictions which are highly accessible by public transport and slow modes. Examples of A-locations are major public transport nodes such as central stations in the larger urban areas.
- *B-locations*: locations with some parking restrictions which are reasonably accessible both by public transport and by slow modes on the one hand and by car on the other hand.
- *C-locations*: which are defined as typical car-oriented locations. Examples can be found near motor way exits in fringe areas having poor public transport access.

## DEFINITION OF MOBILITY AND ACCESSIBILITY PROFILES

### Mobility profiles

A mobility profile describes the mobility generated by a company. Both the characteristics of commuting travel, visitors travel and freight transport are taken into account. Research in the past has shown that these indicators depend heavily on the characteristics of the companies and their activities. Key factors are:

a. The business activities at the particular establishment of the company, such as goods handling, type and amount of visitors, business travel by staff etc
b. The socio-economic characteristics of the workers (age, sex, income, level of education, working hours), which are also related to the type of company.

In principal, the mobility profile of a company does not depend on its location. The mobility profile refers to the average values. The mobility profile is also independent from the size of a company. The aspect of space consumption is elaborated only in relative terms with the indicator for employment density (in square meters per employee).

Mobility profiles have been determined for different homogeneous classes of companies in the Netherlands (Verroen et al. 1990) with comparable mobility characteristics. These classes were clustered into a typology of 11 main company types. Table 1 gives an overview of these company types and the estimated values of the main indicators of their mobility profile.

### Accessibility profiles

The accessibility profile describes the accessibility of the location for personnel, visitors and goods with different travel modes. In view of the policy goals of the ABC location planning instrument it is preferable to describe both the accessibility by public transport, by slow modes and by car, using indicators such as travel times and travel costs per mode. These indicators are feasible to describe mode choice behaviour. Another advantage is that these indicators are sensitive to various policy measures.

Reducing car use requires competitive alternative modes. It is well known, that a railway station by itself cannot guarantee a low car use. As long as congestion and parking restrictions are limited, public transport can still be less attractive than the car. It is also important that the bicycle, in Holland far more used in commuting travel than public transport, is taken into account as an alternative mode for the car. Differences in commute distances are the determine factor here. They are not only important for the potential use of the bicycle, but they also influence the amount of car-*kilometres* driven in commuting travel.

The classification of A-, B- and C-locations is elaborated as follows: as policy goal for *reducing car use* in commute travel a maximum car use of 20% at A-locations and 35% at B-locations are formulated as policy targets. From our point of view that means that the remaining 80% or 65% of the employees should at least have one realistic alternative for private car. Bicycle is considered to be a realistic alternative for distances up to 5 kilometres. Public transport is considered to be a

realistic alternative when the travel time is not more than 50% longer as by car. The prediction of the percentage of employees with/ without these alternatives for car use is based on one version of the so called actual accessibility indicators, developed by INRO-TNO (Hilbers and Verroen 1993).

**Table 1 Characteristics of the mobility profiles of the 11 main company types**

| | Main company type | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Indicator:** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| Employment Dens. ($m^2$ per empl.) | 200 | 500 | 30 | 200 | 30 | 30 | 30 | 30 | 30 | 60 | 60 |
| Public transport share (perc) | 15 | 15 | 15 | 15 | 17 | 19 | 19 | 17 | 19 | 19 | 21 |
| Car Share (perc) | 65 | 60 | 65 | 60 | 65 | 55 | 60 | 60 | 50 | 60 | 55 |
| Car Dependency Workers (perc) | 15 | 15 | 15 | 50 | 50 | 15 | 15 | 5 | 5 | 5 | 15 |
| Share Slow Modes (perc) | 24 | 24 | 24 | 32 | 24 | 28 | 24 | 24 | 36 | 28 | 32 |
| Average Commuting Dist. (km) | 19 | 17 | 19 | 19 | 19 | 17 | 19 | 19 | 13 | 15 | 15 |
| Visitors intens. ($m^2$ per vis.) | 450 | 900 | 150 | 450 | 150 | 450 | 50 | 50 | 150 | 15 | 50 |
| Car Share Visitors (perc) | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 70 | 90 | 50 | 70 |
| Importance Road Freight Transp. | + | + | o | + | o | + | - | - | o | o | - |

*Notes:*

1. Industrial plants with low density
2. Agricultural firms
3. Trade companies
4. Transport companies
5. Business off. with high car dependency
6. Industrial plants with high density
7. Business off. with low car dependency
8. Governmental offices
9. Social services
10. Public facilities
11. Medical facilities

*Some definitions:*

- The share of a mode is defined as the percentage of commuting trips made with this mode.
- The car dependency of workers is defined as the percentage of the workers of a company which need the car during their working time for business trips.

*Source:* Verroen et al. (1990)

To describe the locational *accessibility for business travel/goods transport*, an indicator based on the network position is used. This means that the average travel time by car to 60 important centres of employment in the western part of Holland is calculated. The distinction between well and poor accessible is made at an average travel time of 30 minutes from a location towards these centres of employment.

The criteria for the different location types are summarised in Table 2. An example of a classification based on this criteria is given in Figure 1 for the urban region of The Hague. It shows that A and B type locations can especially be found near the central urban areas of the region, whereas C and R type locations can be found mainly in the periphery of the region, in suburbs and near motor ways.

*Actual accessibility* can give an accurate indication of accessibility and the competitiveness of different modes. This is illustrated in Table 3. The table indicates to what extent the method is able to come to the same sequence of locations for car share and car kilometres driven as the one we have based on forecasts with our travel demand model. A correlation coefficient of 1 means that the method of actual accessibility gives the exact same ordering. A correlation of 0 means that there is no relation between the results of the accessibility indicator and the forecasted car use.

**Table 2 Criteria for accessibility profiles based on actual accessibility and position in network**

| Percentage with alternative for using car: | Average travel time for business travel to 60 important centres of employment | |
|---|---|---|
| | long (> 30 minutes) | short (< 30 minutes) |
| > 80% | A | A |
| 65% - 80% | AL(ocal) | B |
| < 65% | R(est) | C |


**Figure 1 ABC-locations based on actual accessibility and position in network**

**Table 3 Correlation between accessibility measurement and expected car use/car kilometres**

| | With expected share of car-use | | With expected car-kilometres | |
|---|---|---|---|---|
| **Method: actual accessibility** | The Hague | Eindhoven | The Hague | Eindhoven |
| % employees > 5km and with travel time PT/car > 2 | 0.89 | 0.83 | 0.43 | 0.67 |
| kilometres by employees > 5km and with travel time PT/car > 2 | 0.93 | 0.83 | 0.74 | 0.78 |

The table shows high correlations, especially on mode share. The accessibility indicators appear to be adequate. Besides this, the criteria can be linked with the formulated targets. The method can give a comprehensive indication of the number of commuting trips without an alternative for the private car. The effects of policy measures as parking restrictions, improved public transport etc, can be implemented by adjustments of the travel times.

## EFFECTS OF PARKING RESTRICTIONS ON CAR ACCESSIBILITY AND USE

The importance of parking restrictions in location planning strategies can be illustrated with the results of simulation study in the urban region of Eindhoven, carried out by INRO-TNO in 1993. In this study different scenarios for social-economic developments, spatial developments, public

transport improvement and parking regulation are worked out for the period 1990-2010. Some results are summarised in Table 4. The table proves that especially the combined implementation of parking measures and public transport improvement can lead to a substantial decrease in car use. The measures tend to reinforce each other. This underlines the important role of parking strategies in urban transportation and land use planning. However, experiences in the Netherlands also indicate that the implementation of parking measures in practice is a rather complex political problem, where many stake-holders are involved.

**Table 4 Expected car use in the year 2010 in the region of Eindhoven under different scenarios**

| Indicator: | Base scenario | Base scenario with improved PT | Base scenario with improved PT and intensified parking restrictions |
|---|---|---|---|
| Expected car share | 63% | 61% | 50% |
| Expected car kilometres per employee per day | 18 km | 17 km | 15 km |

## REGIONAL PARKING POLICY

Regulation and pricing of parking within metropolitan areas can be considered as an effective approach to limit car use in these areas. In the past, in the Netherlands these parking policies were developed and implemented by local governments (municipality level), who were strongly focused on the problems within the area of the municipality. Due to the increased scale of traffic problems, however, coordinating the parking policies of adjacent municipalities becomes increasingly important. The national government therefore tends to emphasise the need for policy development at a regional level. The following allocation of tasks will be pursued:

*local:* policy design and implementation (regulation of supply and price of parking facilities);

*regional:* regional parking policy (coordinating parking policies of adjacent municipalities, stimulation of cooperation between local governments, coordinating land-use strategies);

*national:* policy conditions (law), support (financial) and evaluation on major issues.

New procedures will be developed to stimulate and facilitate this coordination. However, procedures do not solve the substantial problems of policy development due to the fact that cities within a region are not identical. Moreover, decision makers have diverging perceptions of problems, goals and solutions. One of the challenges for coordinating parking policies is therefore to identify such potential conflicts and transfer them into manageable pieces of information for the support of policy development and decision making. Three central issues will be highlighted:

1 Which parking obstacles mainly cause the regional parking problem?

2 Which main-criteria make a parking policy more preferable then another?

3 Should the development of a new regional parking policy starts from zero or on the base of local policies?

The answers to these questions will be illustrated with the results of a perception-study in the transportation region of The Hague, carried out by Delft University of Technology in 1993-1994. In the transportation region The Hague the adjacent municipalities have based their regional transportation policy on land-use and economical developments: an increase in the distance between employment and living leads in most cases to an increase in car travel. Therefore the main goal for the transportation region is to ensure accessibility for social economical activities and mobility for the people, both on condition of improvement of environment and traffic-safety. To meet this goal one tries to improve car-alternatives and to limit car-travel. A (regional) parking policy will play an important role in this strategy.

For the benefit of a Regional Traffic and Transportation Plan in the region of The Hague the adjacent municipalities have been questioned for their opinion about the best approach to develop

a regional parking policy (Parking study 1992). This research made clear the big differences in particular interests between municipalities and the doubt of some local governments about the effectiveness of parking policies as an instrument to reduce car-travel and stimulate public transport. With respect to regional cooperation three main conclusions can be drawn from the outcomes of the research:

- There is a willingness to debate on a regional level;
- There is not yet any willingness to turn over responsibilities to the regional level, attend to the different interests;
- The ABC planning instrument offers better opportunities for new locations of employment and less opportunities for existing employment-locations in inner cities.

With a so called bottom up approach the adjacent municipalities try to develop a parking policy for The Hague region. This approach includes consideration, information transfer and coordination of local parking policies and evaluation by means of weight-factors. In that way the transportation region The Hague thinks that local policies will come together in a regional parking policy.

## REGIONAL PARKING ISSUES

In the perception-study different actors within the policy-process have been questioned for their perception about the policy problems, goals and solutions in this region. These actors play an important and identifiable role in the process and work at the three governmental levels and within the three most significant policy-themes.

### Which parking obstacles mainly cause the regional parking problem?

This part of the study was called "problem perception". 44 actors (out of 100) returned a questionnaire of 51 items, divided in three categories: actual situation, policy evaluation and future situation. A priori, the 44 respondents can be grouped into the three functional characteristics (see Table 5).

**Table 5 Functional characteristics of the respondents**

| Role | # | % | Level | # | % | Theme | # | % |
|---|---|---|---|---|---|---|---|---|
| policy dev. | 27 | 61 | local | 32 | 72 | transport | 23 | 52 |
| politics | 7 | 16 | regional | 6 | 14 | land use | 8 | 18 |
| interest.party | 10 | 23 | national | 6 | 14 | economics | 13 | 30 |

Just like Termeer (1993) every question has three or four multiple choice answers. The "answer" closest to one's perception must be marked. The sequence of the answers is very important in this kind of questionnaires and must be based on an ordinal scale, so the first and last answer can be seen as extreme-perceptions. An example:

*Question 4 Land Use*

[1] in the actual situation *too much* space is available for parking,

[2] in the actual situation *enough* space is available for parking,

[3] in the actual situation *too little* space is available for parking.

The ordinal scale of the answers allows the researcher to conclude that a [1]- and a [2]-respondent have a closer perception then a [1]- and a [3]-respondent, on the understanding that [1] and [2] still have a different perception in the light of this question only.

Within the regional parking problem several issues play a role, however not equally important. Therefore it's good to know which issue dominates another. To answer this question a frequency analysis on the data material can help. A frequency analysis gives the distribution of the number of

respondents over the possible answers. A priori 5 distribution clusters were made (A-E, see Table 6).

The group B- and D-questions are more or less the most important "perception problems" to solve in the regional decision process. The variables which lie behind these questions are representative for the regional parking problem, because there is no (mental) consensus on these five issues. At the same time it is not possible to cluster the different perceptions on base of the functional characteristics "role", "level" or "theme". So, the (mental) disagreement about these issues don't have any "functional background" and for this reason in-depth-research of these issues must be a major part of the regional policy development process.

**Table 6 Outcomes of the frequency analysis**

| Group | Outcome |
|---|---|
| Group A | *4 questions show no distribution (consensus of perception)*<br>the area-dependent parking approach is useful in order to the general approach,<br>the company-dependent parking approach is useful in order to the general approach,<br>the "Local Parking Tax Law" has a positive impact on parking regulations, and<br>the actual parking strategy contains both general as custom-made rules. |
| Group B | *3 questions show a large distribution (no consensus of perception)*<br>the key-issue in a rightful use of parking space (varying from the amount of parking space, the site, the parking time and the price),<br>the key-issue in the problem solving approach (varying from the reduce of parking supply, regulation, price mechanism and governmental co-ordination), and<br>the starting point of the problem solving approach (environment versus economics). |
| Group C | *14 questions show a down- or upward trend* |
| Group D | *2 questions show an extreme-distribution (both extreme answers scored equally)*<br>the kind of car travel that causes the increase in car mobility (no alternative versus economical necessary), and<br>the main bottleneck within accessibility (parking space capacity versus flow on main roads). |
| Group E | *28 questions show a distribution around the mean answer* |

## Which main-criteria make a parking policy more preferable then another?

This part of the study was called "policy perception". 24 actors, with emphasis on the local level and the transportation-theme, were asked for their perception of preferable parking policies by means of a structural interview. The 24 participants can be grouped into the three functional characteristics (see Table 7).

**Table 7 Functional characteristics participants**

| Role | # | % | Level | # | % | Theme | # | % |
|---|---|---|---|---|---|---|---|---|
| policy dev. | 8 | 33 | local | 15 | 63 | transport | 14 | 59 |
| politics | 8 | 33 | regional | 5 | 21 | land use | 4 | 17 |
| interest.party | 8 | 33 | national | 4 | 17 | economics | 6 | 25 |

The main goal is to trace the individual (mental) evaluation-mechanism that judges suggested parking policies by means of the decision net approach (see Timmermans et al. 1987). This approach is hardly been used in this kind of research. First each participant was asked to name the criteria in order of importance which he/she would consider when judging a parking policy. These criteria were entered on a sheet and then the participants were invited to specify the boundaries and conditions associated with these criteria under which they would consider the corresponding

policy satisfactory. For each less important criteria participants were told to assume that previous criteria were at a satisfactory level. This process continued until participants indicated that all main criteria influencing their evaluation had been mentioned. In the second step participants were asked what they would do when a policy would not be satisfactory on a specific criterion. Participants could either reject the policy (rejection inducing dimension, see Park et al. 1981) or still consider it:

- if all remaining criteria are satisfactory (relative preference dimension);
- if some of the remaining criteria (or other features) are satisfactory, in which case participants were asked to name those criteria/features (trade off dimension).

This procedure was repeated for each criterion in turn until all were considered.

For the answering of the question mentioned above, the results were analysed on base of the rejection inducing dimension. Criteria in this dimension were clustered into 4 groups, see Table 8. The analysis shows the vital role in policy feasibility of "accessibility for economic necessary car-travel" in the policy making process, besides others. There are no criteria specific for one particular level, role or theme, so maybe the "functional background" will be dominated by a more "personal opinion".

**Table 8 Criteria (#>2) in the rejection inducing dimension**

| | | |
|---|---|---|
| I: | **Traffic and Transportation** | |
| | guarantee accessibility for economic necessary car-travel | #12 |
| | meet local goals | #8 |
| | reduce car mobility | #3 |
| | reduce non-economic necessary car-travel (stimulate public transport) | #3 |
| II: | **Policy process** | |
| | stimulate regional coordination | #6 |
| | possibilities for social acceptance (of policies) | #5 |
| | possibilities for financial realisation | #4 |
| | stimulate custom-made solutions | #4 |
| III: | **Economics** | |
| | stimulate attraction of economical activities | #4 |
| IV: | **Environment and Land Use** | |
| | meet goals ABC planning instrument | #6 |
| | stimulate quality of public space | #6 |

## Should a new regional parking policy starts from zero or on base of local policies?

The "The Hague-approach" to develop a new regional parking policy can be marked as "on base of local policies". The first results of this perception study don't support this approach, because it is not possible to cluster peoples perception from the functional characteristic "level". Also "role" don't give any clustering. Only "theme" shows a slight movement towards a couple of clusters (see Multi-Dimensional Scaling plot Figure 2). The big cluster of "traffic and transportation" can't be subdivided into smaller clusters.

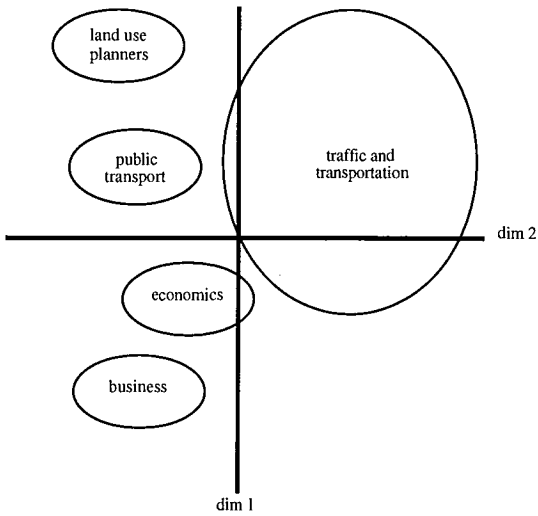


**Figure 2 MDS-plot, based on the functional characteristic "theme"**

Next step was to make cross-tables of all variables (questions). Because the relative small amount of data material many tables were statistically not relevant. Hence the analysis is carried out on base of added tables, which show answering patterns over the total data-matrix. The results of this analysis confirmed the results of the MDS-analysis: answering patterns don't show a different picture over the functional characteristic "level". There are some differences between small municipalities and the regional level, but these differences are marginal. At the same time there is no significant difference between patterns on base of the "role in the policy making process". By the way, politicians judge their own policies much better then other actors. Again, the characteristic "theme" shows different answering patterns. "Traffic & Transportation" has a more medium perception about the actual situation; "Land Use - Environment" and "Economics" a more extreme perception, see Table 9. The same can be seen when we look at the policy evaluation.

**Table 9 Added-cross-table "actual situation" based on "policy theme"**

| | actual situation | | | |
|---|---|---|---|---|
| | ++ | + | - | -- |
| traffic & transportation | 19.6% | **49.5%** | 23.2% | 7.7% |
| land use - environment | 19.4% | 38.2% | 25.7% | **16.7%** |
| economics | **25.6%** | 35.9% | 30.3% | 8.1% |

So, returning to the "The Hague-approach" to develop a new regional parking policy, this study made clear there are yet no reasons to support such an approach, based on local perceptions (functional characteristic "level"). That is, this approach results in a regional policy making process where (local) actors must defend local visions they are not supporting. This causes delay in the process and de-motivation of actors. For certain when we take into account that problems at a regional level have a different order and scale, compared with local problems.

The above has its origin from the fact that a local parking policy is already the result of a consensus-seeking process. So, by definition, local parking policies are sub optimal and therefore there are no logic reasons to base a regional parking policy on these sub optimal policies, trying to get another consensus-situation. One should try to start all over: new (regional) problems and topics, new goals, new solutions etc. Therefore it is necessary that actors working in the same

policy field ("*theme*") sit together and not the actors working at the same policy *level*. In that way regional policy making will become a consensus-seeking process at a regional level, based on (regional) visions and interests of the different policy themes. Of course, this means a complete change of (regional) policy making.

## CONCLUSIONS

Parking strategies play a crucial role in current Dutch Transportation Planning Policy to achieve the two main objectives: guaranteeing the accessibility of the economical centres and reducing the negative impacts of mobility on the environment. On the other hand, the studies mentioned in this paper made clear there are huge contradistinctions within the policy making process. The fundamental issue in "Dutch Transportation Land" between "Environment" and "Economics" is also under discussion on the field of parking policies. Within the regional parking policy, this discussion comes to a head on some "non-consensus-issues": the key-issue in a rightful use of parking space, the key-issue in the problem solving approach, the starting point of the problem solving approach, the kind of car travel that causes the increase in car mobility, and the main bottleneck within accessibility. This political stress is fatal for the development of a regional parking policy and has to be solved before starting the policy making process.

Fortunately, within the regional parking policy, there are also some "consensus-issues": the area-dependent parking approach is useful in order to the general approach, the company-dependent parking approach is useful in order to the general approach, the "Local Parking Tax Law" has a positive impact on parking regulations, and the actual parking strategy contains both general as custom-made rules. These issues must be the starting point for a new regional parking policy, based on (regional) visions and interests of the different policy themes. This means a complete change of (regional) policy making.

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