



Study on Road Pricing

Summary, 14 March 2016

Summary

The Helsinki Region Transport System Plan (HLJ) is a quadrennial strategic transport system plan covering 14 municipalities. The HLJ 2015 plan approved in spring 2015 takes an overall view on the transport system and aims to ensure the flow of traffic also in the future. The studies on road pricing were conducted as part of a follow-up to HLJ 2015.

This summary report presents the results of the technical-functional and administrative-legislative sub-studies. The reports of the sub-studies are available at www.hsl.fi/tiemaksut (in Finnish).

One of the key policies of the HLJ 2015 strategy is effective utilization of information and policy tools. During the HLJ process road pricing was identified as one of the key economic policy tools. In addition, road pricing acts as a source of funding for the region's transport system. The introduction of pricing must not decrease State or municipal funding in the region and the revenue generated must be returned into the region's transport system.

The technical-functional sub-study shows that road pricing can positively affect traffic and the urban structure helping to achieve the goals set out in the region. The level and amount of the impacts partly depend on the established profit target as well as on the pricing model studied. More extensive impact assessments suggest that road charges improve the performance of the vehicular traffic network, decrease adverse environmental impacts and increase the modal share of sustainable modes of transport.

On the basis of the administrative study it can be said that area-based road charges could be implemented based on the current administrative model. However, the introduction of road charges requires new legislation. When considering the legislative changes needed, special attention must be paid to whether the charge is a fee or a tax. However, above all, road charges call for a shared commitment across the region, both in terms of administration and legislation.

The study results suggest that road pricing is an effective tool in the development of the region's transport system. It contributes to the achievement of the region's MAL (Land use, housing and transport)/HLJ goals and strengthens the funding base of the region's transport system. While it helps to develop the transport system of the commuting area as a whole, its effects vary from area to area. In addition, pricing will affect commuting, in particular.

The impact assessment shows that the benefits from pricing will be greater in central Helsinki and the centers of the KUUMA municipalities. The decrease in the relative attractiveness of the employment hubs in the Ring Road II-III zone and the commercial and service hubs in the Ring Road I-III zone will be a particular challenge. This issue must be solved during the potential preparation phase.

The current state and future of the transport system

Current state

At present, congestion in the Helsinki region mainly occurs in the metropolitan area. There are several sections of road where traffic slows down and that have a high-risk of congestion. If the definition of congestion is a decrease in speed to 60 per cent compared to free-flow conditions, major congestion occurs around central Helsinki, on radial roads and Ring Road I.



Fig. 1. Bottlenecks in the Helsinki region in the morning peak in 2012. Sections of road where the speed is less than 60% of the free-flow conditions. In the picture, the colors depict the sections of road as follows: orange = prone to congestion, red = congested, black = highly prone to congestion

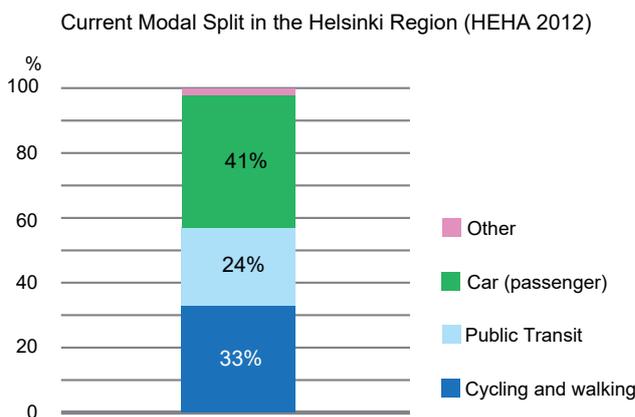


Fig. 2. Modal split at present. The share of sustainable modes of transport (cycling, walking and public transport) is in total 57%.

Future

Population of the Helsinki region is expected to grow significantly in the coming decades. According to the forecast used in the Helsinki region land use plan (MASU) and HLJ 2015, the population will grow by about 200,000 people by 2025, translating into a 15% increase in the population. By 2050, the Helsinki region is expected to be home to 2 million people.

In the HLJ 2015 base alternative, which does not involve pricing, the overload on the vehicular traffic network increases due to increased demand in comparison to the present situation. The study found that even a major investment program cannot meet the growth pressure on the region and stop the resulting traffic network congestion. Problems will occur, in particular, on the radial access roads, inner city access roads as well as Ring Road I between Tuusulanväylä and Valtatie 3 (Finnish national road 3).



Fig. 3. Bottlenecks in the morning peak in the Helsinki region in 2025 in the HLJ 2015 base alternative (VE0). Sections of road with speed less than 60% of free-flow conditions. In the picture, the colors depict the sections of road as follows: orange = prone to congestion, red = congested, black = highly prone to congestion

In addition, sensitivity analyses show that the socio-economic profitability and necessity of road pricing for ensuring the performance of the road network significantly increase if, for example, road traffic increases faster than assumed in the forecast underlying the calculations. This is the case also if the funding of the transport system development does not go as planned, public transport fares are increased, or the economic growth accelerates, increasing travel demand. The target funding levels of HLJ 2015 and the base alternative VE0 are rather high compared to the investments decided to be implemented at present in the 0+ scenario. On the other hand, the need for pricing decreases if the price of using a car goes up, or if car use decreases for some other reason.

	Alternatives		Additional analyses	
	VE1	VE0	VE1 / half price / VE3	0+ alternative
Functional alternative	Gate technology	No pricing	Gate technology / half price	No pricing
Revenue from pricing	Target net income €165m/year	No revenue from pricing	Target net income €165m/year	No revenue from pricing
Infrastructure investments	€375m / year	€280m / year	€375m / year	Only the projects decided to be undertaken.
Integrated public transport area	14 municipalities	7 municipalities	14 municipalities	14 municipalities
Major projects	Projects outlined in HLJ 2015. Includes the base alternative as well as Jokeri Light Rail, Espoo city rail link and medium-sized road packages.	The first 10 projects from HLJ 2015	Projects outlined in HLJ 2015. Includes the base alternative as well as Jokeri Light Rail, Espoo city rail link and medium-sized road packages.	Only the ones underway and the ones with guaranteed funding. HELRA and the extension of the West Metro

Introduction to road pricing and its theory

Road pricing refers to a system in which road users pay for road use within a limited area. The charges are often time-based and their aim is to control traffic flow both in terms of space and time. Usually the aim is to affect traffic volumes at peak times, in particular.

Often, the aim of road charges is to minimize the negative externalities of traffic. Externalities refer to the costs of road use that are born directly by individual road users but not experienced by them. Such as externalities could be road network congestion and adverse environmental impacts.

When a new user enters a road network operating at near its maximum capacity, the road network gets overloaded. The new road user slows down other road users and average speeds fall. This incurs costs in the form of time lost for all road users, increasing the overall cost to society and resulting in the difference between the cost to an individual road user and the cost to society.

Road charges are aimed to affect the demand on the road network. The effectiveness of the charges is based on the theory on marginal costs and on managing the road network demand. Marginal costs are the costs incurred by each new unit of road network use. The aim of the charges is to affect the critical group of potential road users whose use of the road network would cause the road network capacity to be exceeded. The charges impose an additional cost on the users, increasing the costs they face to the same level as the cost to society, and helping to adjust their behavior towards the social optimum.

International experiences

Country / City	Technical solution	Impacts	Administration	Experiences
Sweden / Stockholm	Toll gate. Microwave technology and register plate recognition.	18-22% decrease in vehicular traffic volumes. Part of the transport system funding base in the Stockholm package.	Interpreted as a tax. Central-city-driven. Legislation covers the whole of Sweden	A referendum after the trial, then made permanent.
Sweden / Gothenburg	Automatic register plate recognition.	11% decrease in vehicular traffic volumes. A significant source of funding in the "West Sweden package".	Interpreted as a tax. The surrounding municipalities extensively involved.	Political challenges after the introduction.
Norway / Oslo	Microwave technology and register plate recognition.	Reduced vehicular traffic volumes. Steering effect as a by-product, main goal is funding.	Interpreted as a fee. Long traditions and established practices of road tolls.	Key role in funding. Simple and inexpensive systems.

Administrative and legislative aspects

At the moment, there are no pricing schemes corresponding to area-based road charges in Finland but it is possible to implement one based on the existing administrative structure. The introduction of road charges requires new legislation, such as taking account of the

forthcoming EETS regulation, and calls for an understanding of the necessity of road charges and the elements of a good solution. It is important that the jointly developed MAL plans and agreements concluded on the basis of them create the basis on which the various parties can together examine the funding and determine the amount and use of road charges.

The study looked into three different administrative models from the point of view of acceptability and the regional goals set out in HLJ 2015. The models are State tax, municipal tax and municipal fee.

As the amount of the road charge depends on the continuation of other funding, the agreement concluded between the parties must be made more binding and the time period of State funding must be lengthened, for example, to cover each Government term. From the point of view of acceptability, it is necessary to make clear the basis for the amount of the charge as well as its purpose of use. A negotiation body convening annually and a consultation process would promote transparency. The proposed development measures do not depend on whether the road charge is interpreted as a fee or a tax.

If the road charges are interpreted as a tax, the amount of the charges will be decided by the parliament within the limits of law. Who gets the tax revenue and its purpose of use will be specified by law. The tax could be collected by the Finnish Transport Safety Agency, like other traffic taxes. The tax revenue could go to the State or municipalities that can recycle the revenue as subsidies and municipal contributions.

With regard to a State tax, the greatest challenge is the application of the principle of equality of legislation, which emphasizes the need to define the necessity of road charges in the area and the conditions under which road charges could be introduced in the region and other areas.

From a legislative point of view, it would be simpler to interpret the charge as a municipal tax. The Constitution gives municipalities even wider powers to decide the amount of tax than the State. In principle, all municipalities could be given the right to collect taxes, provided certain traffic-related or other such conditions are met.

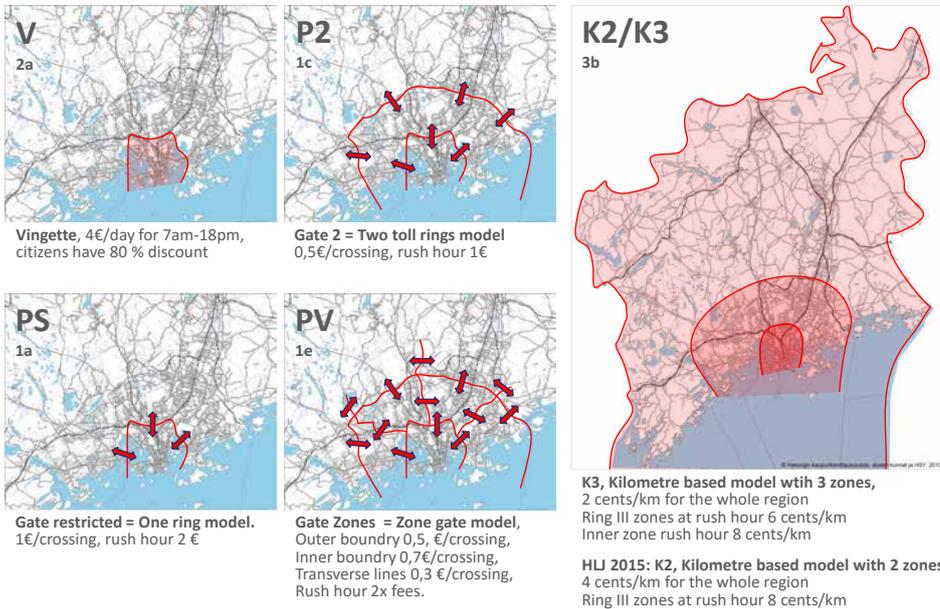
The advantage of interpreting the charge as a municipal fee is that it is administratively simple and the use of the revenue to fund the region's transport system can be ensured. A fee would be easier to accept than a tax, but the risk is that the purpose of use of the revenue cannot be linked to the added value obtained unambiguously enough. In this case, it is possible that the Committee for Constitutional Law ends up interpreting the road charge as a tax.

Regional acceptability requires that the revenue from the road charges is earmarked by law for the development of the region's transport system. Even though earmarking is not widely used, there is no legal obstacle for it. An example of this is the public broadcasting tax whose revenue is directed into a fund financing the activities of the Finnish Broadcasting Company.

If the Helsinki region municipalities and the State decide to start the preparations, a good alternative would be to sign a separate Letter of Intent on the preparation setting out issues such as guidelines for the preparation, as well as the progress of the preparations along with schedules and responsibilities. In this context it would be advisable to decide whether to aim for permanent legislation or progress through experimental legislation.

Implementation alternatives

Implementation alternatives



At the early stage of the technical-functional sub-study, six different technical-functional solutions for the implementation of road charges were studied. All systems are automatic, i.e. drivers do not have to stop at the zone boundary.

In the vignette option, all motorists driving within the central city area pay a fixed daily fee. In the 'Gate, restricted' option, there are toll gates at which motorist must pay to cross. In the 'Gate 2' option, another charging zone is added in the area of Ring Road III. In the "Gate zone" option, transverse charging cordons are added on the ring roads. In the 'Kilometer' option, there are two (HLJ) or three charging zones based on the distance traveled.

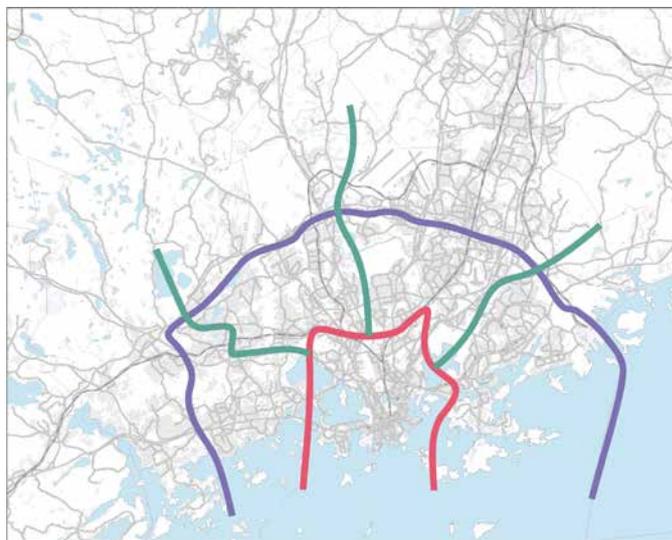
Fig. 4. Implementation alternatives..

Pricing model	Cost-effectiveness	Impacts on traffic	Challenges	To be noted
Vignette	Annual cost €15.1m. Annual net income €67.9m.	Effectively decreases traffic volumes in the central city area. No effects on the ring roads or access roads.	Distributing traffic over different times of day is challenging. Setting a discount percentage for people living within the charging zone is challenging.	Efficient mainly for reducing traffic volumes in the central city area. Not practical from the perspective of achieving regional goals.
Gate S (restricted)	Annual cost €20m. Annual net income €59m.	Reduced traffic in the central city area.	Effects restricted due to the size of the charging zone. A strong barrier effect at the charging zone boundary.	Good for improving traffic flow in the central city area. Effects on traffic less pronounced than in the more extensive options.
Gate 2 (2 toll rings)	Annual cost €21.6m. Annual net income €87.4m	Reduces bottlenecks in the central city area and on the access roads.	Congestion on ring roads. Charging zones form boundary zones.	More extensive than the more restricted models, meets regional goals better. Congestion on crosstown routes remains a challenge.
Gate V (zone) / VE1	Annual cost €23.1m. Annual net income €130m. There are no big differences in the costs of the gate models.	Effectively eliminates bottlenecks. Positive environmental impacts.	Charging zones form boundary zones but not as strong as in the more restricted options.	Supports regional goals. Internationally speaking an advanced solution, no corresponding system in use elsewhere in terms of scale.
Kilometer HLJ / Kilometer 3 zones	Annual cost €68.1m. Annual net income €94.9m. The annual costs are primarily due to initial investments.	The most even effects across the region. Positive environmental impacts.	High investment costs. Charges target also journeys outside the congestion zone.	A solution for the future due to the high investment costs Suitable for national level.

Versatile impacts were assessed using the gate zone model (VE1/VE3)

The model selected for a more extensive impact assessment was the gate zone model (VE1) because:

1. Its impacts correspond to the goals set out in the HLJ 2015:
 - More predictable journey times and congestion in control
 - Adverse environmental impacts and the environmental load of transport are reduced
 - The transport system is developed cost-effectively
2. It is cost-effective:
 - Basic investment close to that of the other gate options but revenue significantly higher
 - An annual revenue of €150m was used in the assessment
3. It is feasible with existing technology
 - Microwave technology, automatic register plate recognition or satellite positioning



Cordon	Peak times	Other times
Central city boundary	1,6 € / 0,8 €	0,8 € / 0,4 €
Ring Road III	1,2 € / 0,6 €	0,6 € / 0,3 €
Transverse cordons	0,8 € / 0,4 €	0,4 € / 0,2 €

Charges: Peak times / Day time

Morning peak 6am-9am

Evening peak 3pm-6pm

Daytime 9am-3pm

- No charges in the evening after 6pm and on weekends

- No charges for freight traffic

- Studies to be conducted on other professional transport in potential follow ups

Fig. 5. A more extensive impact assessment was conducted using the gate zone model (VE1). The model includes three radial cordons in addition to the cordons within ring roads I and III. The impact assessment was made in the 2025 situation with investments outlined in HLJ 2015..

Alternatives for road pricing (VE2)

Alternative measures	Additional infrastructure investments	Regional parking policy	Cutting the price	Promotion of walking and cycling	Incident management, mobility management services and intelligent transport
Possibilities	Removing bottlenecks.	Steering effect similar to that of road charges.	Impacts in line with goals.	Effective on short journeys.	Improves the performance of the transport system.
Challenges	High costs relative to benefits. Do not ensure the performance of the entire road network.	Affecting in particular the roads prone to congestion more challenging than with road charges.	An expensive measure. Would require substantially higher public transport subsidies.	Requires a major change in the modal split. Changes in the mileage would occur mainly on very short journeys.	A solution for the future whose effectiveness is not yet known.

Impact assessment

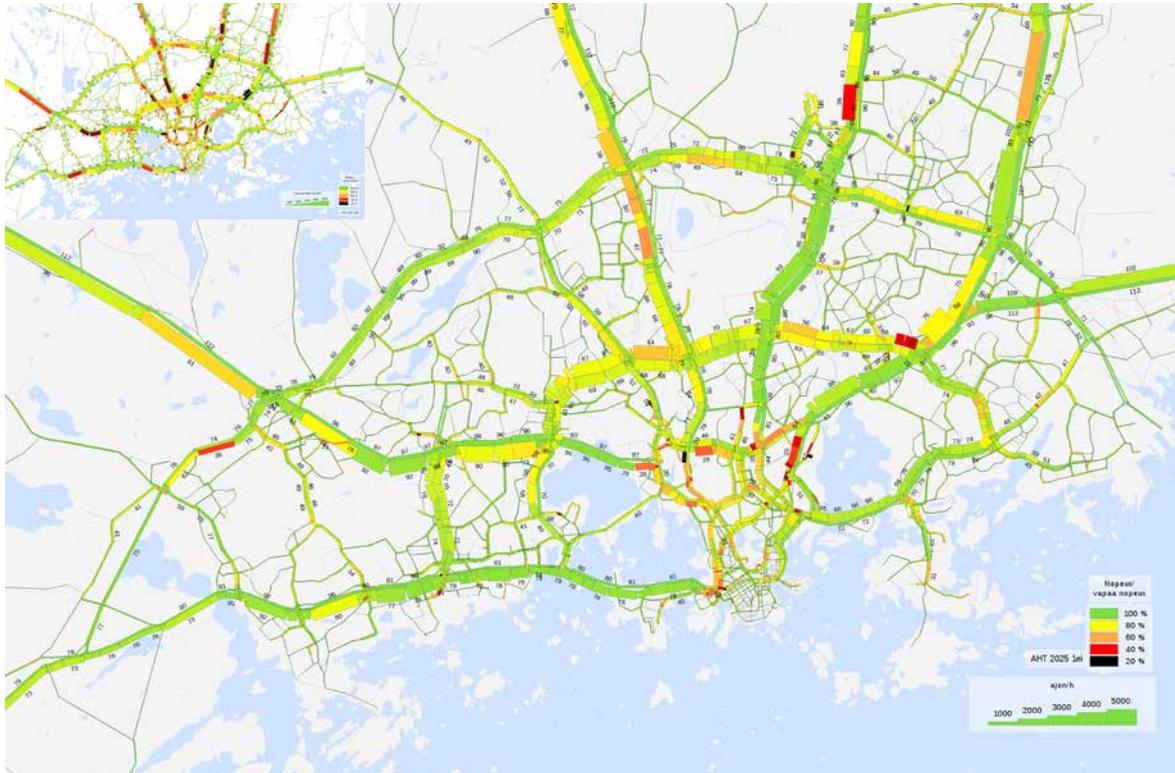


Fig. 6. Bottlenecks in the Helsinki region in the morning peak in 2025 have been depicted using the HLJ 2015 gate zone pricing model (VE1). Sections of road where the speed is less than 60% of the free-flow conditions. In the picture, the colors depict the sections of road as follows:

Orange = prone to congestion, red = congested, black = highly prone to congestion

Impacts on traffic

According to analyses, road charges are a tool that would significantly improve the performance of the region's transport system. Figure 6 shows that road charges (VE1 Gate zones) together with the investments outlined in HLJ 2015 contribute to the optimal use of the vehicular traffic network. The profitability of road pricing increases if investments are implemented at a slower pace than in the HLJ 2015 plan.

All in all, it can be said that road charges could positively affect the goals set out in the region in terms of traffic. Road charges shift the modal split towards more sustainable modes of transport, reduce the load on the environment and assist the effective use of the vehicular traffic network. The impacts on traffic are not essentially different at a lower level of annual net revenue of 80 million but the socio-economic impacts are significant. These impacts are depicted in Figure 9.

However, as the impacts of pricing are the greatest in areas with high risk of congestion, the impacts vary from area to area. The positive impacts of the charges are not as pronounced on already well-performing roads, such as the ones located in the metro catchment area. Road charges affect less than 20% of all morning peak journeys, when all modes of transport are taken into account. The charges affect journeys made in the metropolitan area municipalities the most.

Impacts on traffic and the environment

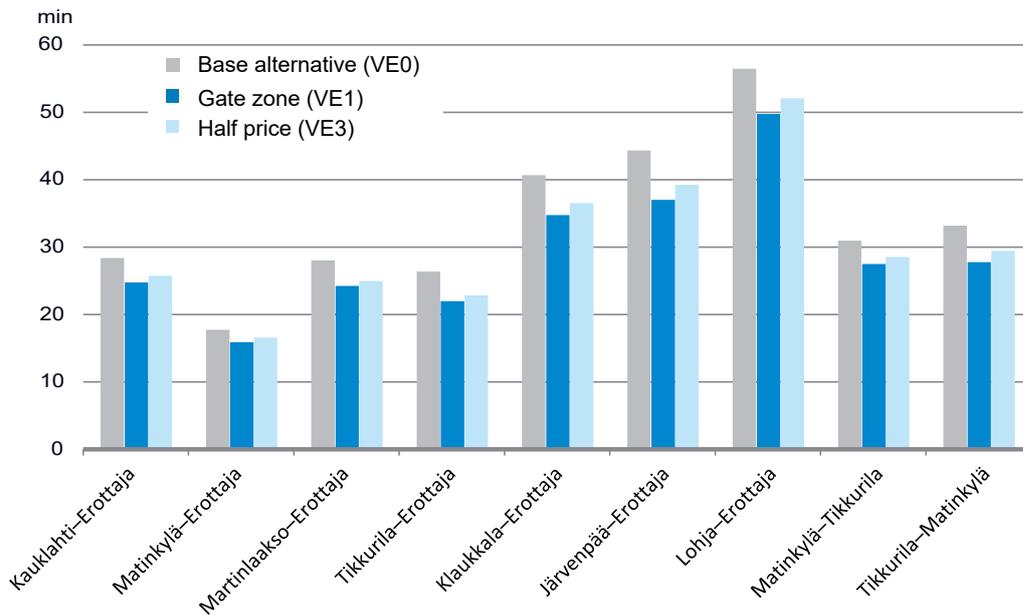
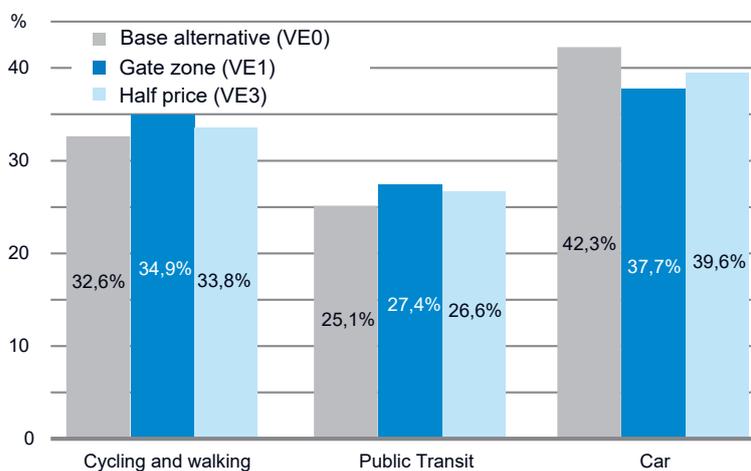


Fig. 7. Car journey times in the morning peak (min).

Road charges reduce travel times by car by alleviating congestion on the road network. Travel times on the sections of road are about 10 per cent shorter in the gate zone alternatives (VE1/VE3) than in the base alternative (VE0). It is worth noting that the greatest change occurs on roads where the charges have the greatest impact on congestion.

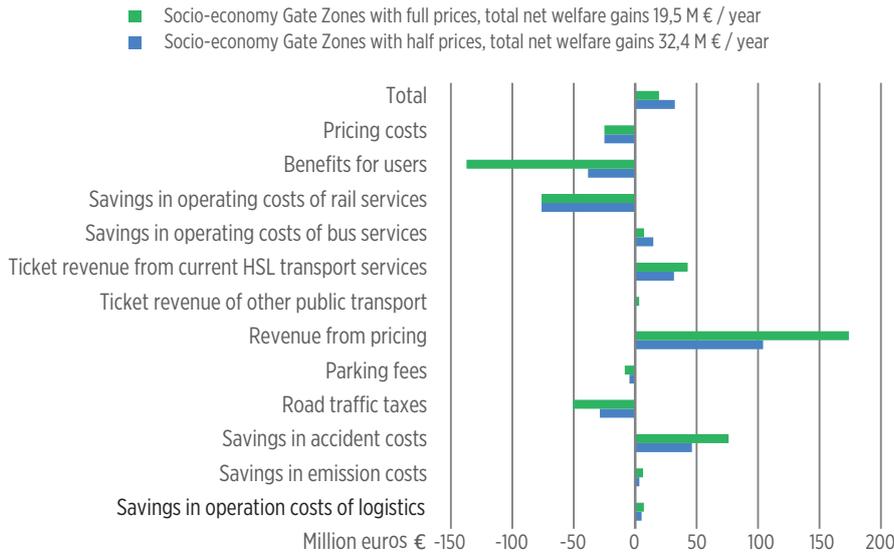


Road pricing changes the modal split in the region.

Compared to the base alternative, the shift from car journeys in the Helsinki region to sustainable modes of transport by 2025 is two (VE3) or four (VE1) percentage points. The change is in line with HLJ/MAL goals.

Fig 8. Modal splits in 2025.

Road charges affect the environment. They reduce both emissions and noise from traffic. In the 2025 situation, carbon emissions from traffic decrease in the Helsinki region by 3% (VE3) or 5% (VE1) compared to the base alternative. In addition, they have a positive impact on traffic safety as the number of personal injury accidents in the region decreases by 4% (VE3) or 8% (VE1) compared to the base alternative.



In the socio-economic calculations, the impacts of the gate zone model (VE1) have been compared to the 0+ alternative in the 2025 situation. This describes the impacts of pricing and other HLJ 2015 measures on the currently known transport system development measures. The calculations are based on the general project assessment guidelines of the Finnish Transport Agency.

The most significant items consist of user benefits, which are depicted as net benefits including the costs incurred by road charges, as well as benefits from time savings. In addition, significant items include accident cost savings and pricing revenue, which can be interpreted as net income to society.

Fig. 9. Socio-economic calculations

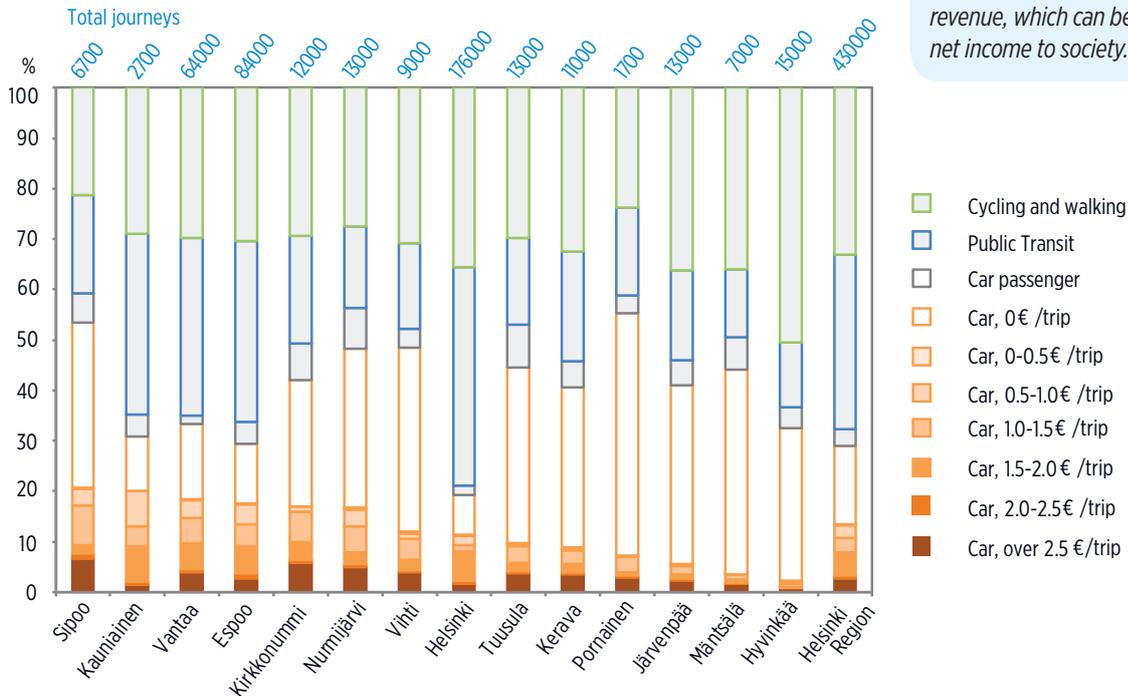


Fig. 10. Road charges by municipality in the morning peak hour in 2025 (VE1).

Road charges affect less than 20% of all morning peak journeys. With regard to car traffic, the corresponding figure is 40%. In terms of relative distribution of the charges, distribution by area is rather uneven. The greatest effect is in the Helsinki metropolitan area municipalities where the charges affect over 50% of passenger car journeys in the morning peak. Further away from the Helsinki city center, the corresponding percentage is under 30. In total 68% of road charges are collected in the metropolitan area, 18% in other municipalities in the region and 14% outside the region.

In the calculated socio-economic optimum, (net revenue €80m/year) the average annual cost for a car commuter (200 round trips a year) is 340 euros. Relative to the median income of households in the region (€35.000/year, source: Statistics Finland), this corresponds to a tax burden of 0.9%.

At the VE1 pricing level, the charges would be on average €670/year for commuters and for about 10% of the payers, over €1,000/year. Relative to the median income of households in the region, this corresponds to a tax burden of 1.9%.

Impacts on land use, housing and economic activity

The impacts on the accessibility of the region from the point of view of land use, housing and business and industry are based on two mechanisms. The flow of traffic improves particularly on sections of road prone to congestion, while the monetary cost of travel by car increases when entering a charging zone. The relative changes between areas result from the net impact of these two factors.

Long-term effect	Impacts on the attractiveness of different areas
Housing and housing market	<ul style="list-style-type: none"> + / - No significant impacts on most of the areas + Helsinki central city + Main line zone in the KUUMA municipalities - Car-dominated areas north of Ring Road III - South Espoo
Office-dominated employment hubs	<ul style="list-style-type: none"> + Helsinki central city + Espoo Ring Road I zone + Centers of the KUUMA municipalities along the main line - Ring Road II - Ring Road III zone - South Espoo
Commercial and service hubs	<ul style="list-style-type: none"> + Helsinki central city + Shopping centers and other service hubs in the center of KUUMA municipalities - Shopping centers and other service hubs in the Ring Road I-III zone
Goods transport and logistics	<ul style="list-style-type: none"> + Urban city logistics + Goods transport from urban ports (in particular the West Harbor) + / - National goods transport

Competitiveness and economy of the Helsinki region

The quality of the transport system and other basis structures is a key competitiveness factor in all international comparisons of competitiveness and wellbeing. Common criteria include public transport service level, quality of the road network, congestion management, international transport and telecommunications links. These criteria mostly recur also in the HLJ/MAL goals. The Nordic capitals of Oslo and Stockholm, which use road pricing generally perform well in the comparisons when measured by these criteria.

In the study, it was noted that pricing improves the flow of traffic and helps to enable the transport investments of HLJ 2015. Consequently, it can be said that in the 2025 situation, the gate zone models (VE1 and VE3) of road pricing result in a better performing transport system than the base alternative (VE0) which does not include pricing. The conclusion is that road pricing can create conditions for maintaining and improving the competitiveness of the region as well as for supporting sustainable growth.

Conclusions and suggested follow up measures

1. Road charges promote the achievement of the transport system goals set out in HLJ: trip and transport chains are smooth, congestion is in control, the competitiveness of public transport improves and the transport system is well accessible by sustainable modes of transport. Road charges together with other HLJ 2015 measures ensure the performance of the transport system as the region grows as a competitive, sustainable metropolis.
2. In the long-term, road charges together with other HLJ 2015 measures contribute to a more compact urban structure of the core area, rail corridors and centers of the KUUMA municipalities.
3. Road charges affect less than 20% of all journeys made in Helsinki region in the morning peak. The charges affect 10-60% of car journeys, with variation by the place of departure and destination. In the calculated socio-economic optimum, (net revenue €80m/year) the average annual cost for a car commuter (200 round trips a year) is 340 euros. In the VE 1 alternative the corresponding annual cost is about €670. The charges affect the working population the most. The burden falls on those users who are causing congestion and other negative externalities, in particular. Alternatively, without road charges there will be congestion, incurring major costs to road users.
4. Impacts on the economic activity vary from area to area. Road charges contribute to a more compact urban structure, strengthening the areas accessible by sustainable modes of transport. In central Helsinki, the operating conditions for city logistics improve and the area's role as a commercial, service and employment hub increases. The role of the service hubs of the KUUMA municipalities increases in importance, with the centers along the main line developing also as employment hubs. The zone between the ring roads will be a challenge, in particular the area outside the rail corridors, as its relative attractiveness as an area for commercial uses and offices decreases. This issue needs to be addressed in the follow up studies.
5. Road charges can be implemented in the Helsinki region with the existing administrative structures but adjustments and new legislation are needed. In order for the region to be able to introduce road charges if it so wishes, legislation enabling road charges must be developed. Fixed-term experimental legislation is one possibility. The decision on a potential proposal for launching the legislative preparations will be made separately.
6. A prerequisite for the introduction of road charges is that the revenue from the charges is returned to the region's transport system and that the revenue does not decrease State or municipal funding for the region's transport system.

Control by pricing allows socio-economically effective optimization of the transport system and urban structure. For some of the region's population and businesses, road charges would mean increased cost of travel and some would need to change their travel habits. This creates pressure on the planning of the system and has to be taken into account in further studies.

Road charges would significantly reshape the range of transport system measures and funding. A well-functioning transport system is vital for the competitiveness of the region and with the increasing number of inhabitants, it should not be jeopardized.

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