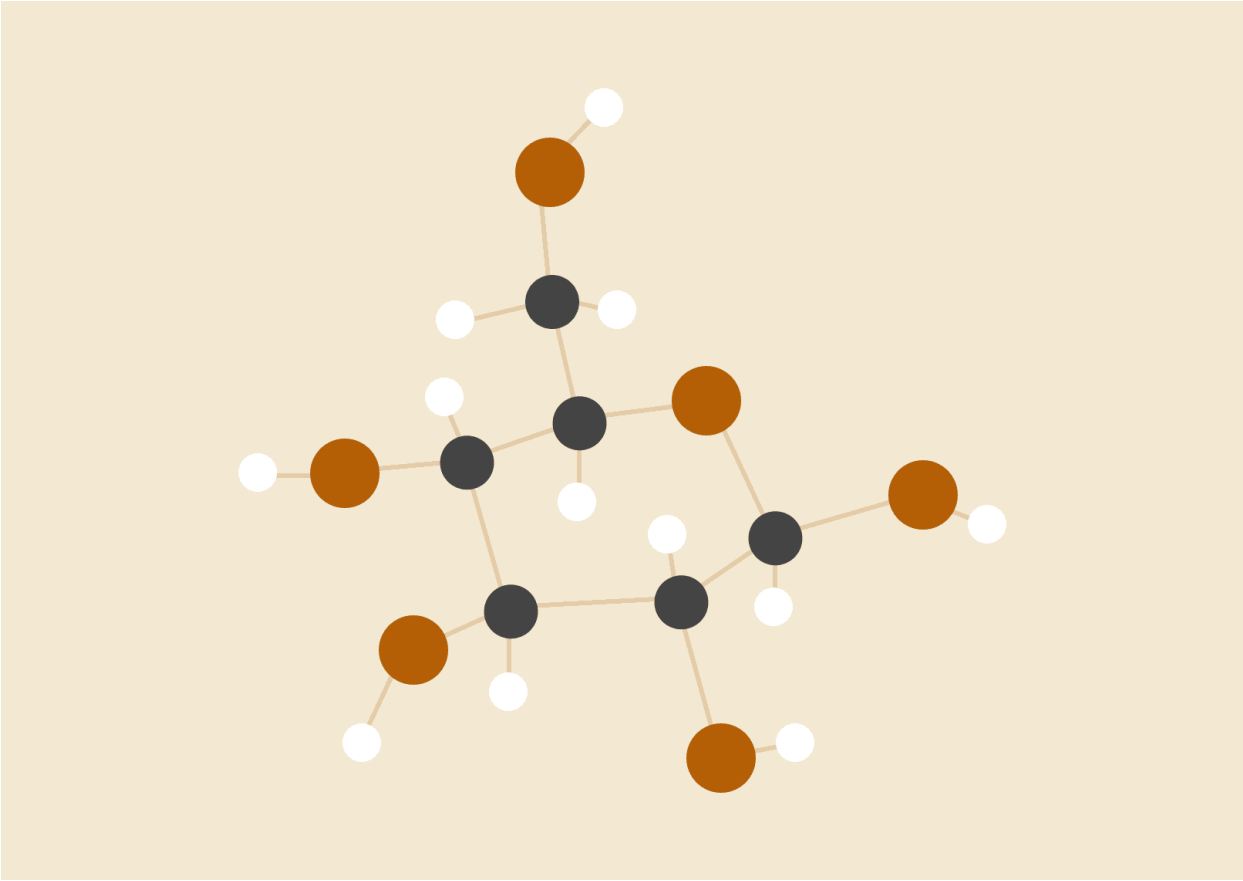
# GROUP PROJECT REPORT

*Policy instruments for short distance trips*



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TRA105: Emissions from Transportation

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# Introduction

The increasing number of cars has become a threat to the environment, air quality, safety and much more. In Sweden, the number of private owned cars has increased 1.1% from 2019 to approximately 5 million in 2020 [1]. Cars have become a vital component in the urban individual's daily life and as a result contributing to a series of societal challenges. This is evident as it is clearly shown that national and international authorities/organizations prioritize the topic of sustainability by implementing and discussing measures to reduce the negative impact it has on quality of life.

There is a general consensus of the need to set negative goals [2] to reduce the number of car trips, in particular short distance trips in order to reduce the negative impact it has on quality of life. Studies have shown that 50% of car trips in Sweden are less than 5 km [2]. Short car trips require more fuel and contribute to many harmful emissions such as CO, NOx, HC etc. due to cold starting engines. Unlike long car trips, most short car trips can be replaced by walking or cycling [3]. Both walking and cycling enhances quality of life as it has a positive impact on the health, the environment as it does not contribute to pollution in terms of fumes and noises [4], the safety as the numbers of accidents are more likely to reduce with the number of cars etc. It also has a positive impact on the costs for public health, individual's driving costs and results in a low-carbon society [3].

Thus, in this report the societal challenge that will be dealt with is – the utilization of private, in particular fossil-fueled cars for short distances. The aim of this report is to analyze the societal challenge and suggest policy instruments to tackle the problem. I.e., focusing on changing the travel habits of the individual to a more sustainable way in order to have a positive impact on quality of life.

The remaining part of the report is structured as follows:
*Policy instruments*: The second section of this report will reflect upon 5 existing policy instruments to deal with the societal challenge.
*Non-chosen policy instruments*: This section will contain the reasons why some policy instruments were not preferred over the chosen ones.
*Analysis and discussion*: An MAMCA will be conducted to choose the most suitable policy instrument. Relevant discussion on the policy instruments will also be presented in this section.
*Conclusion*: The final section of this report will contain the report's conclusions.

# Policy instruments

Policy instruments are methods that are used by governments or governing bodies to implement certain policies and achieve target goals [5]. They are the linkage between policy formulation and policy implementation. They can be categorized into four main categories;

- Legal and Regulatory instruments
- Rights-based instruments and Customary Norms
- Economic and Financial instruments
- Social and Cultural instruments[6]

## Zero Emission Zones (ZEZs)

*Technical system*

Zero emission zones are for cities which have ambitious goals for reducing emissions and have enough resources to implement complementary measures. It mainly focuses on the local emissions. Imposing restrictions on certain types of vehicles can lead to high inconvenience to many people in terms of transportation. It is relevant for the cities which already have a high proportion of zero-emission vehicles, developed public transport systems and good cycle path networks. A ZEZ doesn't have to be a large area but can be a few streets depending upon the area that needs to be monitored for pollution [7]. The introduction, rules and regulations for ZEZ should be made well in advance to allow all the actors; municipalities, companies and households to have enough time to prepare and adapt for it. [7]

*Description of the policy instrument*

Zero emission zone is a type of legal instrument as it includes monitoring and imposition of some mechanisms to ensure the rules are followed. It leads to behavioral change. It is an area which can be as big as a city (Amsterdam is planning to become a zero-emission city by 2030) or can be an extension of car-free streets (Aarhus, Denmark) to be able to influence the area [7]. In this zone, combustion engines vehicles are not allowed to enter and only electric vehicles which includes Battery operated vehicles and Fuel-cell vehicles are allowed. This is a very strict regulation since not allowing other categories of vehicles limits the activities that can be carried out in that area.

*Expected outcomes*

Introduction of ZEZ can lead to significant reduction in the local pollution caused by fossil-fuel powered vehicles. This can also lead to vehicle owners shifting to buy electric vehicles to be able to access the urban area that is a zero-emission zone and hence increasing the number of electric vehicles in the city.

*i. Climate and Nature (environment)*

ZEZ will positively impact the climate, especially the local climate. Reduction in major pollutants like particulate matter and NOx can be expected which will result in cleaner air. Introduction of ZEZ will also allow more space for pedestrians, bikers and public transport systems, making them accessible.

*ii. Human health*

Reduction in pollutants and noise pollution will positively affect human health. It will give access to cleaner air and low noise levels and thus increase the quality of life.

*iii. Consequences for individuals*

As far as individuals are concerned, imposing ZEZ in city center areas will increase the accessibility for pedestrians and bikers since more space will be available for them instead of cars and parking spaces. As mentioned above, imposing ZEZ will also lead to individuals buying electric cars which will lead to expenditure.

*Monitoring*

A ZEZ can be monitored similarly to Low emission zone (LEZ) with cameras and tolls to regulate and track the vehicles entering the zone. If not followed, heavy fines can be imposed or severe punishment can be charged. Exceptions can be made for emergency service vehicles like ambulances, fire trucks and police services.

# High parking fees

*Technical system*

The differentiation in parking pricing for non-environmentally friendly vehicles (e.g., fossil-fuel vehicles) and zero-emission vehicles encourages the driver to make a conscious decision in the selection of travel mode. A significant relationship between commutation by car and parking costs was shown [7]. The study revealed that when parking is expensive, the commuters by car vary by less than ~ 20% compared to more than ~ 60% when parking is cheap and available. Thus, indicating the great influence this policy has on the selection of vehicles and as a result, mainly how much CO2, CO, CH4 etc. emissions are being emitted.

*Description of the policy instrument*

The suggested policy is an economical instrument. When entering the vehicle's registration plate in the parking app/automated pay machines, information whether the vehicle is zero-emission or not will show and the subsidization can be made. According to [7], it is recommended that the policy be implemented in cities where there are not many zero-emission vehicles. This is to encourage the interest in these kinds of vehicles.

*Expected outcomes*

*i. Climate and nature*

Both global-and local emissions are expected to decrease. The reduction of CO2 due to less vehicles traveling on the road. Other emissions such as CO, CH4, noise pollutants. etc. are also expected to decrease. I.e., a reduction in parking vehicles also indicates a reduction in those emissions being formed (cold start). Thus, a positive impact is expected on the environment. However, it is not certain how great the impact will be as it is dependent on how efficient the policy is, which is dependent on many factors.

*ii. Human health*

The overall health of citizens is expected to improve in terms of better air quality but also less stress and related diseases due to noise pollutants. The policy might also result in less accidents and more safety.

*iii. Consequences for individuals*

The policy might solely benefit individuals from high-income groups which may cause some difficulties in social acceptance [8].

*iv. Other impacts*

It is recommended that the policy solely be implemented for a limited period and in cities where there are not a lot of zero-emission vehicles [7]. This is because the policy might result in an increase in car ownership which can have negative outcomes such as traffic congestion, the need for infrastructure investments (e.g., electric charging) etc.

*Monitoring*

The policy solely requires a new integrating function in already existing forms to differentiate between zero-emission vehicles and non-environmentally friendly vehicles when taking the parking fee.

# Enhancing bicycle culture

Improve the attractiveness to use the bike by enhancing the safety and overall availability of high quality bicycling infrastructure.

*Technical background*

The technical background of this policy instrument regards mainly the individual transport that is conducted within the city. People using cars or other kinds of vehicles based on fossil fuels or in electric manner, to commute from A to B. This kind of transport has both an impact on global level when CO2 is emitted during the ride, but also contributes to a local level, when considering emissions like NOx or PM. Not only do normal bicycles have the possibility to reduce these emissions, but also electrical bicycles are getting more important as a good alternative to individual transport by car also for people with a decreased stamina.

*Description of the policy instrument*

The policy instrument is described on different strategic decisions based on the transport plan for Brisbane in Australia. The instrument is located in infrastructure and traffic planning [9]. It can be seen as a source that promotes desirable behaviors or compicate behavior that is undesirable [9]. As described in Styrmedel [9], policy instruments rarely exist on a stand-alone basis. They rather come together in packages or work parallel. The best effect will be made by having policy instruments placed in an integrated way together.

The strategic report for transport in Brisbane addresses the cycling network in an extraordinary way. People should have the possibility to use bikeways that are safe and connect big employment and activity centers in a direct manner. For that cycle lanes should not be together with pedestrians and vehicles, they should rather be separate [10]. A different approach that can be connected with the complication of undesired behavior while parallel promoting desired behavior, described in Styrmedel, is the identification of opportunities to provide increased pedestrian and cycling priority on local roads. This measure would lead to cars having less priority and therefore for example longer waiting times, and on the other hand would speed up the traffic for cyclists and pedestrians.

*Expected outcomes*

As described in the transport plan, improving the "connectivity, safety and quality" of the bicycle infrastructure will probably lead to a substantially higher number of people using the bike instead of other individual transport like cars [10]. This also leads to less local emissions, including noise, gas and particulate emissions [10], that affect the human health system. Additionally, the shift from individual transport with a vehicle on fossil fuels to riding with the bike is also much better when considering the cost factors. People would save the costs that are connected with a car. The investment and maintenance costs for a bike are much lower, compared to a car.

*Monitoring*

Monitoring the success and other factors of this policy instrument can be reached with many different methods. The first example would be the measurement of local emissions (gases, noise and PM) in areas, where cars forfeit priority over bicycles and pedestrians. Additionally it should be thought about the counting of bicycle users taking specific roads. For that the counting should start already before the policy instrument comes into effect, to be able to compute the difference. In this way bottlenecks can be identified and adjustments can be implemented based on the utilization on the roads. There are many different solutions to count bicycles that are implemented in several cities. One example can be observed directly in front of the technical university of Berlin. Here induction loops are the key technological aspect of counting [11].


Figure 1: Bicycle counter in front of TU Berlin[1]

[1] https://www.berlin.de/sen/uvk/verkehr/verkehrsplanung/radverkehr/weitere-radinfrastruktur/zaehlstellen-und-fahrradbarometer/

# Enhance public transportation

A topic such as improving public transportation is broad and can be interpreted in many ways. It can be interpreted as improving technology to lower their emissions, or improving public transport to make it more appealing to most people. All of them can help to reduce global and local emissions as a whole. Therefore, it is important to understand that it is necessary to have more than one policy instrument to improve this broad topic. All policies in the report can positively impact public transport. Another perspective that can make the public transport system more appealing is the factor of travelling time. If travel time can be faster or equivalent to driving your car at a lower cost, it can drastically increase the use of public transport in urban cities. A more technical policy can be about the quality of public transport both to the user experience and emission wise.

*Technical system*

Public transport is an important part of the infrastructure in urban areas. It is essential for larger cities to help people, both the inhabitants and travellers, to travel within the city. The public transport system also has a vital impact of reducing traffic within urban areas and lowering emissions [12]. To fully benefit the system, it needs safer and more environmentally friendly heavy vehicles within the public transport sector. In public transport, trams, subway, or other railway transportation systems are often powered by electricity. This means that the public transportation systems using roads are still the primary user of fossil fuel or biofuels. These can be changed to a zero-emission vehicle, focusing on zero-emission buses (ZEB). This requires a more advanced infrastructure in charging stations and a change in strategic management of the system. However, it is said that the technology to make this possible exists and is developed even more in the near future [14][16].

*Description of the policy instrument*

This policy increases the developing speed to use zero-emission buses in public transport uses by setting a date of when this plan should be executed. In NSW (New South Wales) in Australia, they want to improve the net emission in the public transport sector. They want to transition the bus fleet to zero-emission buses to the commitment to achieve net-zero emissions by 2050 (NSV.gov) [14] [16]. It is a policy instrument that can be included in the infrastructure or planning strategy for city transportation [9, p25]. This is because making a more efficient and environmental public transport system within urban areas will need technological changes within the infrastructure to make it possible.

*Expected outcomes*

*i. Global/local emissions*

This is expected to decrease global and local emissions due to the high emission rate from urban areas. It will reduce the global scale of CO2 emission and the extensive effects of local emissions on other particles. Because of the primary use of diesel engines in heavy vehicles, in this case buses, using ZEB can contribute to a reduction of direct emissions like NOx, SO2, CO, etc [14] [19]. However, the product life cycle is not the same with a ZEB compared to a bus with a combustion engine. Therefore, this has other emission effects in its production or recycling process, e.g., the batteries and other heavy metals.

*ii. Human health*

With the emission as mentioned above decreasing, it will greatly improve air quality and noise reduction

in the heavily populated urban areas, improving human health. Implementing new technologies in transportation systems will increase the efficiency on our roads, but it will also enhance traffic safety [20].

*iii. Consequences for individuals*

Economically it is hard to tell the outcome; the consequences for individuals could increase because of the heavy investment in new technology. However, the prediction is that it will become more cost-effective in the long-life cycle cost and, therefore, it might decrease ticket cost.

# Information Campaign - "Nudging"

*Technical system*

- *Prompting* — Using anonymous data to encourage or raise awareness about a specific behavior. The information indicated for inducing pro-environmental behavior are knowledge-based information (e.g., environmental conservation knowledge, up-to-date environmental information, and actual environmental issues) and social norm-based information [21].
- *Priming* - Incorporating clues into the environment in order to sway subconscious decisions. Cues are proposed to be placed in on-site locations to help people access their subconscious and trigger subconscious responses that result in pro-environmental behavior [21].
- *Labeling* - Accompanying an object or option with endorsed information or special specifics. The pro-environmental facts or details that have been supported might be labeled on the pro-environmental product to enlighten consumers [21].
- *Presentation* - Changing the object's visual design or presentation. It is advised that the presentation of pro-environmental goods or instruments be altered or redesigned in order to pique people's interest in adopting or consuming them [21].

*Description of the policy instrument*

Information campaign, or "Nudging", has the purpose to educate the people and make them choose certain options, that in this case is more sustainable and environmentally friendly, above using fossil driven vehicles for short distances.

*Expected outcomes*

*i. Global/local emissions*

It can have a positive impact on both local and global emissions.

*ii. Climate/nature*

Positive impact on climate and nature.

*iii. Human health*

Positive impact on human health.

*iv. Consequences for individuals*

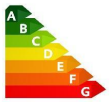
Better knowledge of more sustainable and environmentally friendly options.

*v. Economy*

Worse economic growth in sectors where non-sustainable practices are used. Better economic growth in sectors where sustainable practices are used.

*Monitoring*
Surveys and research among consumers and companies on their lifestyle and practices. How much of each type of transportation is used.

## New PI: Road tolls based on vehicle energy efficiency class




*Technical system*
As there is an already established system of classifying a vehicle based on how "green" it is, this grading system can be used as a measure when applying a new policy instrument regarding emissions. This energy efficiency scale is a measure for how much energy the vehicle consumes or how efficient the vehicle is, which is a direct measure of how much carbon dioxide ($CO_2$) the vehicle is producing given in g/km as they will be burning more fuel to travel the same distance [22]. An 'A-class' efficient vehicle will also produce other associated emissions less compared to a 'G-class' labeled vehicle in g/km. Vehicles such as plug-in hybrids are near the A or B zone, and vehicles such as internal combustion engine supercars are in the red G zone.

*Description of the policy instrument*
This proposed new policy instrument is a mode of economic instrument. As the vehicles enter and exit or move around cities, town centers, or different roads, they pay automatic congestion tolls/charges which vary according to time (for example, high price of 22kr during peak hours here in Göteborg). This new proposed policy instrument suggests a rate based on the energy efficiency class/label of the vehicles passing through. As a result, the larger and less efficient vehicles passing are paying extra for driving vehicles which emit more $CO_2$ (and other emissions of course). So basically, the toll rate is based on the energy efficiency scale, the less energy efficient the vehicle is, the higher the cost of running the vehicle becomes inside cities/towns. This new policy uses an already built infrastructure for collecting tolls and uses it to make consumers pay according to the vehicle energy class they are driving. Cost can be reduced to zero for electric vehicles if other EV market boosting strategies/instruments are to be applied (EVs can move around cities/towns at lower costs).

*Expected outcomes*
*i. Global/local emissions*
The global emissions are expected to decrease through the implementation of this new policy as this will clearly discourage the public to use gas-guzzling personal vehicles and encourage more efficient personal vehicles. Local emissions are expected to reduce around cities/towns because energy efficient vehicles will have much less emissions and also better after-treatment systems, no tailpipe emissions at all when the vehicle is electric.

*ii. Climate/nature*
Reducing $CO_2$ emissions will have a positive impact on global warming as it is a main greenhouse gas. With tailpipe emissions discouraged/omitted from city centers, the surroundings are expected to be cleaner as well.

*iii. Human health*
This new policy will have a positive impact on human health. Less air and sound pollution, better local air quality is all expected outcome of reduced emissions altogether.

*iv. Consequences for individuals and governing party*
One downside to this policy will be faced by people who are using old vehicles as most of them are not very efficient and produce quite a bit of $CO_2$. Economically, it will not be feasible for an individual to drive larger cars or cars with large engines but the government on the other hand, will benefit from this. Fees can go to funds supporting green climate for example.

*v. Other impacts at large*
Societal impact can be a bit uncertain upon implementing such policy. Often there are groups of people that new policies will work against.

*Monitoring*
This new policy uses an already built infrastructure for collecting tolls (for example, the automatic congestion toll collecting infrastructure here in Göteborg). Therefore, no new infrastructure or physical systems are needed to charge and collect these emission-based tolls for moving about in cities/towns. It can be monitored the same way as the tolling system for congestion charges. Also, current air quality monitoring systems are to be used for comparison before and after situations.

## Non-chosen policy instruments

One of the not chosen instruments was to make public transport free of charge. Following different arguments that were considered within the lectures, making public transport free would probably not have a high impact on reducing emissions when considering our societal challenge [23], which is to get people away using their own car. It could be assumed that for some routes maybe public transport would be preferred, but overall the problem would remain. Additionally the cost efficiency of this policy instrument or measure would be very low, meaning having very high costs while having low impact. Less money would then also mean it would be harder to improve public transport. We therefore decided to look at it the other way around and utilize the policy instrument of enhancing public transport.

Another policy instrument that regards the economical side is to have cheap parking spaces outside of urban areas in order to get people to use public transport to enter the city. This is an instrument which could be helpful to have less cars in city areas. It was not chosen as this cannot work isolated. The instrument would only have an effect, when considering very high parking fees within the city and a very good public transport connection from the outside parking areas into the city. As the impact of higher parking fees in cities and a better public transportation infrastructure will have a higher impact, the decision was against low parking fees on outer parking spaces.

The last instrument that was considered is allowing only EVs within city areas. This legal instrument would bring a high release when referring to local emissions within the city. Other than that people would still be able to use the car, which is not in line with our societal challenge to get people to stop using individual transport on short distances within cities. Congestion would still remain a problem in that case.

## Conflicts between policy instruments

How the different policies instruments interfere with each other are mentioned a bit in the chapter enhancing public transport, though it is mainly discussed how the different PI is enhancing the public transport system. However, some conflicts still occur between some of the policies and the main is between enhancing public transport and enhancing bicycle culture regarding land use and safety. Both policies require more space for their needs, whereas urban areas are already struggling with limited space. For the enhancement of bicycle culture, paths or roads are needed to make it more convenient and a smoother experience for the user, which is also needed for public transport to achieve increased efficiency in heavy traffic. This may lead to a safety risk if paths are mixed or crossed with more heavy-duty vehicles, in this case, buses, with the increased traffic of bike cycles. Especially with the heavy vehicle, which has more blind spots with a limited view of their vehicle's surroundings, compared to a standard car, where it can be difficult to realise if a smaller object has been hit. This added up with a more common use of electric bicycles, which move much faster, making them harder to spot and expect their speed than non-electric bikes. Although enhancing public transport policy, in this case, is about transforming fossil fuel buses to ZEB, it is indirectly part of improving and enhancing the public transport system.

## Analysis

We conducted a Multi Actor Multi Criteria Analysis [24] for the selected policy instruments to determine which is the most effective at working towards the objective but also reducing the two main aspects, i.e., reducing emissions and reducing travel time.

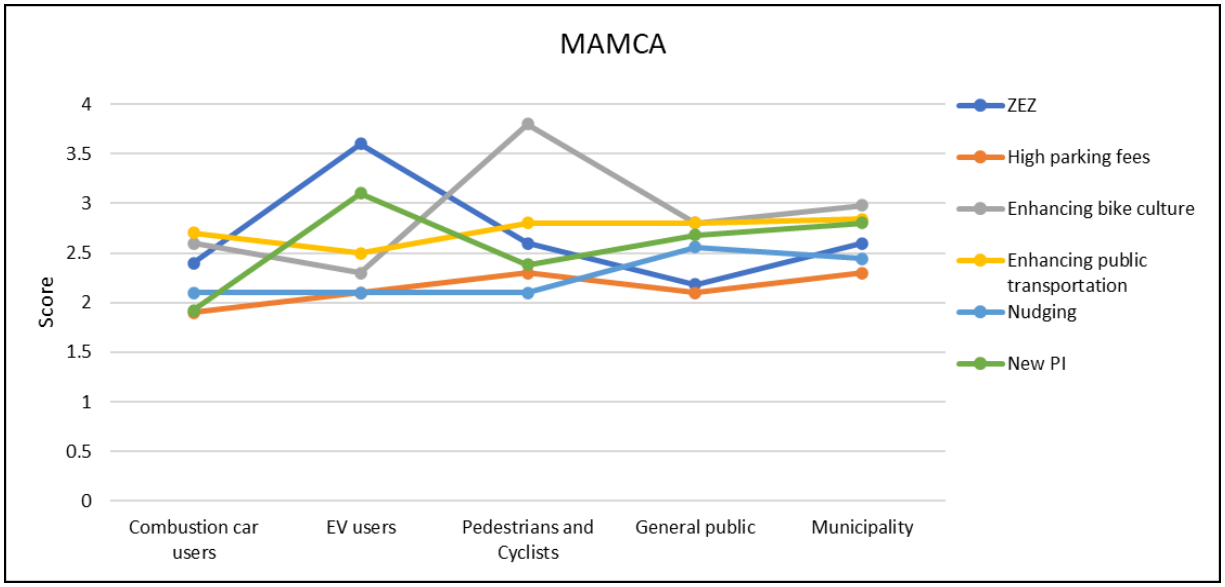



Figure 2 : MAMCA for the selected policy instruments

As can be seen in Figure 2, there is not one policy instrument that is the best for all the stakeholders. Although, it can be seen that Enhancing bike culture scores good for most of the stakeholders and the highest for pedestrians and cyclists, the general public and the municipality when it comes to reducing emissions, reducing the travel time and reducing congestion in the city areas.

As far as our objective is concerned, this analysis shows that enhancing the use of bikes is the best way to reduce short distance travel by vehicles. Enhancing bike culture will help reduce the local emissions caused due to short distance travel. Vehicles are usually used for short distance travel to reduce the travel time. This objective can also be fulfilled by enhancing bike culture. It doesn't have to be privately owned bicycles. Rental bikes, e-bikes are a great option to make this possible. They are cheap, widely available and fulfill the objective of reducing emissions and travel time and avoid health issues from local emissions. The possibilities are just the other way around. Improving the attractiveness of bicycling could lead to a more active and healthy mode of transportation and therefore affect the resident's health in an extraordinary way. Other selected policy instruments also work towards achieving the objective. Zero emission zone eliminates the use of combustion vehicles in a particular area which forces behavioral change. High parking fees essentially do the same. Imposing high parking fees discourages people from taking out cars in certain areas which can be at a shorter distance. Enhancing public transport enables the availability of transport in areas which may have the above policies imposed. This encourages people to use public transport instead of personal vehicles, thus reducing emissions and congestion. This in combination with the new policy "road tolls based on vehicle energy efficiency class" all work towards achieving the objective. This new policy instrument in turn will be a realistic and applicable new policy because of the above-mentioned reasons, and can be easily implemented with minimal cost for cities like Gothenburg but an infrastructure needs to be built for cities/towns without the automated toll collection system. Nudging is an important policy instrument that helps make people aware of the emissions caused due to short distance travels and bring a behavioral change.

# Conclusion

To address the described societal challenge of utilization of private transport especially with fossil fueled vehicles on short distances, various policy instruments have been described. The types of instruments were chosen to be very diverse as not only one PI or one type of instrument can solve this challenge. They rather have to interlock with each other, to be able to have some kind of impact on the current situation. Additionally it is key how these instruments will be operationalized. All affected stakeholders have to be included into the decision-making process. This can work with many different multi-stakeholder participation techniques. The multi actor multi criteria analysis showed that on short term enhancing bicycle infrastructure has the highest impact among the most of the stakeholders. To reach a long term shift in this context, many different PI have to be implemented on different levels (legal, economic, informative etc.).

The described instruments have a good potential to reduce individual transport by fossil fueled vehicles on short distances mostly within city areas and therefore bring positive impacts such as cleaner air, reduction of noise pollution and faster flowing traffic due to less congestion. Everything considered, the key element is the individuum. Only if people are willing to change personal views and overcome individual obstacles, these PI will change how society will live their mobility on short distances in the future.

# References


1. Trafikanalys. Fordon 2020 [Internet]. Trafa.se. 2021 [cited 2022 Jan 7]. Available from: https://www.trafa.se/globalassets/statistik/vagtrafik/fordon/2021/fordon_2020.pdf

2. Hallberg A, Tovatt L. Mål om minskad biltrafik [Internet]. Riksdagen.se. 2021 [cited 2022 Jan 7]. Available from: https://www.riksdagen.se/sv/dokument-lagar/dokument/motion/mal-om-minskad-biltrafik_H9024207

3. He M, Fei Y, He M. Exploring the factors associated with car use for short trips: Evidence from Kunming, China. J Adv Transp [Internet]. 2020 [cited 2022 Jan 7];2020:1–10. Available from: https://www.hindawi.com/journals/jat/2020/3654130/

4. Chaloupka F, Ohg R, Gnavi F, Bonanni C. How to enhance WALking and CYcliNG instead of shorter car trips and to make these modes safer Public [Internet]. Dot.gov. [cited 2022 Jan 7]. Available from: https://safety.fhwa.dot.gov/ped_bike/docs/walcyng.pdf

5. Hettiarachchi H, Kshourad C. Promoting waste-to-energy. In: Kumar S, Kumar R, Pandey A, editors. Current Developments in Biotechnology and Bioengineering. Elsevier; 2019. p. 163–84.

6. secretariat. Policy instruments [Internet]. IPBES secretariat. 2017 [cited 2022 Jan 27]. Available from: https://ipbes.net/policy-instruments

7. Trafikanalys. ABC om styrmedel [Internet]. Trafa.se. 2018 [cited 2022 Jan 7]. Available from: https://www.trafa.se/globalassets/pm/2018/pm-2018_2-abc-om-styrmedel.pdf

8. Trafikverket. Trängselselskattens effekter på mäns och kvinnors resande i Göteborg -en kvalitativ studie Publikationsnummer: 2011:041 ISBN: 978-91-7467-108-7 Utgivningsdatum: Mars 2011 Utgivare: Trafikverket Kontaktperson: Alice Dahlstrand Upphovsman: Jenny Källström, WSP:s projektledare Dokumentansvarig: Susanne Planath Layout: Trafikverket, Grafisk form Tryck: Trafikverket Distributör: Trafikverket [Internet]. Ineko.se. 2011 [cited 2022 Jan 7]. Available from: https://trafikverket.ineko.se/Files/sv-SE/11413/RelatedFiles/2011_041_trangselskattens_effekter_pa_mans_och_kvinnors_resande_i_goteborg_en_kvalitativ_studie.pdf

9. Roth A, Bahr J, Henrik K, Wisell T. Zero-emission vehicles and zones in Nordic cities - Promotion, instruments and effects [Internet]. Ivl.se. 2021 [cited 2022 Jan 7]. Available from: https://www.ivl.se/english/ivl/publications/publications/zero-emission-vehicles-and-zones-in-nordic-cities----------promotion-instruments-and-effects.html

10. Brisbane City Council. Transport Plan for Brisbane -Strategic Directions [Internet]. Gov.au. 2018 [cited 2022 Jan 7]. Available from: https://www.brisbane.qld.gov.au/traffic-and-transport/transport-plan-for-brisbane/transport-plan-for-brisbane-strategic-directions

11. Berlin DE. Zählstellen und Fahrradbarometer: Fahrradverkehr in Zahlen [Internet]. Berlin.de. 2020 [cited 2022 Jan 7]. Available from: https://www.berlin.de/sen/uvk/verkehr/verkehrsplanung/radverkehr/weitere-radinfrastruktur/zaehlstellen-und-fahrradbarometer/

12. Kansas City Area Transportation Authority. Environmental benefits of public transit [Internet]. Kcata.org. 2017 [cited 2022 Jan 7]. Available from: https://www.kcata.org/about_kcata/entries/environmental_benefits_of_public_transit

13. NSW Government. Zero Emission Buses [Internet]. Gov.au. 2021 [cited 2022 Jan 7]. Available from: https://www.transport.nsw.gov.au/projects/current-projects/zero-emission-buses

14. Trafikverket. Styrmedel för ett effektivare transportsystem Underlagsrapport [Internet]. Ineko.se. 2012 [cited 2022 Jan 7]. Available from: https://trafikverket.ineko.se/Files/sv-SE/10765/RelatedFiles/2012_106_Styrmedel_for_ett_effektivare_transportsystem_2.pdf

15. Star 8. NSW pledges zero emissions from buses by 2050 [Internet]. star8green.com. 2020 [cited 2022 Jan 7]. Available from: https://www.star8green.com.au/nsw-electric-buses-2050/

16. Hill JS. NSW outlines strategy for 8,000 zero emissions buses by 2030 [Internet]. The Driven. 2021 [cited 2022 Jan 7]. Available from: https://thedriven.io/2021/08/26/nsw-outlines-strategy-for-8000-zero-emissions-buses-by-2030/

17. Centers for Disease Control and Prevention. Public transportation system: Introduction or expansion [Internet]. Cdc.gov. 2021 [cited 2022 Jan 7]. Available from: https://www.cdc.gov/policy/hst/hi5/publictransportation/index.html

18. Nix J. Denmark, Luxembourg, Netherlands lead the way on emissions-free buses [Internet]. Campaigning for cleaner transport in Europe | Transport & Environment. 2021 [cited 2022 Jan 7]. Available from: https://www.transportenvironment.org/discover/denmark-luxembourg-netherlands-lead-way-emissions-free-buses/

19. Koopmans L. Lecture 3a: “Emissions from combustion” [Internet]. Instructure.com. 2021 [cited 2022 Jan 24]. Available from: https://chalmers.instructure.com/courses/17874/files/1784270?wrap=1

20. Stockfelt L. Lecture 5a: “Health effects of air pollution” [Internet]. Instructure.com. 2021 [cited 2022 Jan 7]. Available from: https://chalmers.instructure.com/courses/17874/files/1810520?wrap=1

21. Wee S-C, Choong W-W, Low S-T. Can “nudging” play a role to promote pro-environmental behaviour? Environmental Challenges. 2021 [Internet]. 2021;5(100364):100364. Available from: https://www.sciencedirect.com/science/article/pii/S2667010021003383

22. European Commission. Car labelling [Internet]. Climate Action. 2021 [cited 2022 Jan 7]. Available from: https://ec.europa.eu/clima/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/car-labelling_en

23. Deutsche Welle (www.dw.com). Can free public transport really reduce pollution? 2018 [Internet]. DW.COM. Deutsche Welle (www.dw.com); [cited 2022 Jan 27]. Available from: https://www.dw.com/en/can-free-public-transport-really-reduce-pollution/a-42584328

24. Macharis C. The importance of stakeholder analysis in freight transport [Internet]. Researchgate.net. 2005 [cited 2022 Jan 24]. Available from: https://www.researchgate.net/publication/227580136_The_importance_of_stakeholder_analysis_in_freight_transport

# **APPENDIX A** (Tables for Analysis)

We decided to perform the analysis for 5 main stakeholders for the policies

- Combustion car users
- EV users
- Pedestrians/Cyclists
- General Public
- Municipality

Every stakeholder has 2 criterias in which the total weight of 10 is split. Each criteria is scored on the scale of 5 and the weighted score for each is calculated. The sum of weighted scores for each policy is the score for the particular stakeholder. The table for each stakeholder is mentioned below

| Criteria | Criteria Weights | Base Case | | ZEZ | | High Parking Fees | | Enhancing bike culture | | Enhancing public transport | | Information Campaigns - Nudging | | New PI | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Score | Weighted score | Score | Weighted Score | Score | Weighted Score | Score | Weighted Score | Score | Weighted Score | Score | Weighted Score | Score | Weighted Score | |
| **Combustion car users** | | | | | | | | | | | | | | | | |
| Reduction in emissions | 6 | 2.8 | 1.68 | 3 | 1.8 | 2.5 | 1.5 | 3 | 1.8 | 2.5 | 1.5 | 2.5 | 1.5 | 2 | 1.2 | 1.57 |
| Reduction in travel time | 4 | 2 | 0.8 | 1.5 | 0.6 | 1 | 0.4 | 2 | 0.8 | 3 | 1.2 | 1.5 | 0.6 | 1.8 | 0.72 | 0.73 |
| **Total** | 10 | 4.8 | **2.48** | 4.5 | **2.4** | 3.5 | **1.9** | 5 | **2.6** | 5.5 | **2.7** | 4 | **2.1** | 3.8 | **1.92** | 2.30 |
| **EV Users** | | | | | | | | | | | | | | | | |
| Reduction in emissions | 6 | 1.5 | 0.9 | 4 | 2.4 | 2.5 | 1.5 | 2.5 | 1.5 | 2.5 | 1.5 | 2.5 | 1.5 | 3.5 | 2.1 | 1.63 |
| Reduction in travel time | 4 | 2 | 0.8 | 3 | 1.2 | 1.5 | 0.6 | 2 | 0.8 | 2.5 | 1 | 1.5 | 0.6 | 2.5 | 1 | 0.86 |
| **Total** | 10 | 3.5 | **1.7** | 7 | **3.6** | 4 | **2.1** | 4.5 | **2.3** | 5 | **2.5** | 4 | **2.1** | 6 | **3.1** | 2.49 |
| **Pedestrians & Cyclists** | | | | | | | | | | | | | | | | |
| Increase in paths and | 6 | 1.4 | 0.84 | 3 | 1.8 | 2.5 | 1.5 | 4 | 2.4 | 3 | 1.8 | 2.5 | 1.5 | 2.5 | 1.5 | 1.62 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| space | | | | | | | | | | | | | | | | |
| Reduction in travel time | 4 | 1.7 | 0.68 | 2 | 0.8 | 2 | 0.8 | 3.5 | 1.4 | 2.5 | 1 | 1.5 | 0.6 | 2.2 | 0.88 | 0.88 |
| **Total** | 10 | 3.1 | **1.52** | 5 | **2.6** | 4.5 | **2.3** | 7.5 | **3.8** | 5.5 | **2.8** | 4 | **2.1** | 4.7 | **2.38** | 2.5 |
| **General Public** | | | | | | | | | | | | | | | | |
| Reduction in emissions | 6 | 1.4 | 0.84 | 2.5 | 1.5 | 2.5 | 1.5 | 3 | 1.8 | 3 | 1.8 | 2.8 | 1.68 | 3 | 1.8 | 1.56 |
| Reduction in travel time | 4 | 1.7 | 0.68 | 1.7 | 0.68 | 1.5 | 0.6 | 2.5 | 1 | 2.5 | 1 | 2.2 | 0.88 | 2.2 | 0.88 | 0.82 |
| **Total** | 10 | 3.1 | **1.52** | 4.2 | **2.18** | 4 | **2.1** | 5.5 | **2.8** | 5.5 | **2.8** | 5 | **2.56** | 5.2 | **2.68** | 2.38 |
| **Municipality** | | | | | | | | | | | | | | | | |
| Reduction in emissions | 6 | 1.8 | 1.08 | 3 | 1.8 | 2.5 | 1.5 | 3.5 | 2.1 | 3.2 | 1.92 | 2.8 | 1.68 | 3 | 1.8 | 1.70 |
| Reduction in congestion | 4 | 2.2 | 0.88 | 2 | 0.8 | 2 | 0.8 | 2.2 | 0.88 | 2.3 | 0.92 | 1.9 | 0.76 | 2.5 | 1 | 0.86 |
| **Total** | 10 | 4 | **1.96** | 5 | **2.6** | 4.5 | **2.3** | 5.7 | **2.98** | 5.5 | **2.84** | 4.7 | **2.44** | 5.5 | **2.8** | 2.56 |

Table 1: Scoring for different criterias for different stakeholders

| **MAMCA** | **Base Case** | **ZEZ** | **High parking fees** | **Enhancing bike culture** | **Enhancing public transportation** | **Nudging** | **New PI** |
|---|---|---|---|---|---|---|---|
| **Combustion car users** | 2.5 | 2.4 | 1.9 | 2.6 | 2.7 | 2.1 | 1.92 |
| **EV users** | 1.7 | 3.6 | 2.1 | 2.3 | 2.5 | 2.1 | 3.1 |
| **Pedestrians and Cyclists** | 1.5 | 2.6 | 2.3 | 3.8 | 2.8 | 2.1 | 2.38 |
| **General public** | 1.5 | 2.18 | 2.1 | 2.8 | 2.8 | 2.56 | 2.68 |
| **Municipality** | 2 | 2.6 | 2.3 | 2.98 | 2.84 | 2.44 | 2.8 |

Table 2: Summary of scores for different stakeholders