

THE WESTERN CAPE ROAD USE CHARGE PILOT PROJECT: PROGRESS AND PRELIMINARY RESULTS

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ABSTRACT

The paper presents ongoing research on a distance-based road user charge pilot project by Stellenbosch University. Several countries, including the USA, Singapore, France, Belgium and Australia, are busy with pilot projects and experiments involving distance-based road use charges (DBRUC). While these projects have different approaches, they share the search for alternative road use charges that are not tied to fuel use in common. All experiments with road use charges are based on distance travelled and vehicle type. The authors are not aware of any work being done in South Africa that considers distance-based road use charges as a means to charge road users for their road use. South Africa relies mainly on the fuel levy as the main mechanism to charge road users for the use of the roads.

An overview of the pilot project is provided (more information can be found at www.wc-ruc.org), and the phased approach to the research is introduced. Some results of the recent surveys are discussed, and respondents' opinions about different road user charges are presented. It is clear that road users do not prefer distance-based road use charges and favour the current fuel levy as a way to recover the cost of road use.

When faced with an increase in fuel costs, road users who can alter their travel behaviour will typically travel outside of the peak, or travel less. Road users prefer variable road user charges over fixed charges, and the charges should vary with the type of vehicle, time of day and type of road used. The tracking experiment is underway, and the data is being analysed to extract a monthly invoice that reflects the road use behaviour.

The work will continue with the focus on expanding the vehicle tracking to a large population (>500 vehicles) and exploring alternative charges and payment options. Participants in the vehicle tracking exercise will be monitored to determine their response to the monthly invoices and obtain feedback on their experience.

Keywords: Western Cape, Road use charge, Distance-based, Public participation, Survey, Fuel levy.

1. INTRODUCTION

Transport infrastructure, and roads in particular, are vital to the economic development of countries and generally the well-being citizenry (Banister and Berechman, 2001). They allow people to reach places of employment and job opportunities; deliver products, services and labour to markets and places of production, and bring consumers to the marketplace. The importance, and indeed the quality of roads, has been well documented in the literature (Queiroz and Gautam, 1992; Bousquet and Queiroz, 1996; Fedderke, Perkins and Luiz, 2006).

Not surprisingly, road funding also has received significant attention in various international policy documents and research studies. Much of the focus of these studies is on how to secure a stable and sustainable revenue stream from the road user to maintain and upgrade the roads to an acceptable level. Most countries, including South Africa, levy taxes and charges on fuel used as a measure to recover the cost of road use from road users and/or generate revenue for the national purse (Floor, 1984; van Rensburg and Krygsman, 2019)¹.

Increasing fuel economy, alternative fuels and electric vehicles and even changing travel patterns have put pressure on the effectiveness of the fuel levy. Raising the levy is often a sensitive political taboo. Technological, social and economic trends have encouraged governments and road authorities to explore alternative road user charges and options to ensure road users are charged a fair tariff and which generate revenue for the fiscus (de Palma and Lindsey, 2011; Jones and Bock, 2017).

South Africa is following many other countries in looking for alternative options in recouping the costs from road users and financing its road and transport infrastructure. Several options are available, such as tolls, vehicle licence taxes, parking charges and a tax on new vehicles and a distance-based road use charge (RDW, 2024). This research discusses progress with a distance-based road use charge pilot that is being undertaken in the Western Cape, South Africa (Van Rensburg & Krygsman, 2016). The pilot project involves tracking road users' road use with positioning technology and generating a road use cost based on the distance travelled.

2. LITERATURE REVIEW: INTERNATIONAL APPROACHES

From a purely theoretical economic perspective, road users should pay the full cost of their road use (Newbery, 1987)². The costs associated with road use include pavement damage, accident costs, cost of congestion and environmental costs, i.e. the marginal social costs (MSC). Vehicle type, type of road, time of day, location, and driving behaviour are some of the factors that influence road use costs. In theory, individual vehicles should be charged a *different* amount based on these factors. The practicality of implementing this theoretical principle for road users has hindered the implementation of a differentiated road use charge.

Most countries have relied on a tax or charge levied on fuel to approximate the road use cost, with road users paying the tax when they purchase fuel. Over the years, these *pay-at-the-pump* type charges and levies have proved adequate as (1) it was easy to collect, (2) was roughly proportional to use, i.e. the more you drive, the more you pay and, (3) it incentivised, albeit limited, fuel efficiency and better driving behaviour.

In December 2023, South African road users were paying a levy of R3.94 per litre of petrol and R3.80 per litre of diesel. The Road Accident Fund (RAF) levy was set at R2.18 per litre. Typically, the more fuel you use, the more fuel levy charges you will pay. Fuel-efficient vehicles pay less, whereas hybrid and electric vehicles pay lower or no charges for the use of the same roads. As cars become more fuel-efficient and electric vehicles (EV's) become common, the revenue earned from fuel levies will decrease. South Africa has seen a decrease of approximately 1% per year in the fuel levy revenue. Fuel

¹ Most countries do not earmark road use charges and the revenue from fuel charges are allocated to a general budget from where the National Government allocates the funding to roads and other economic sectors. It is therefore possible to allocate more funding to roads without considering the fuel levy.

² This theoretical principle is commonly referred to by the umbrella term of the 'user-pay principle' and implies that road users should pay the full cost caused by their use of the road.

levies face long-term sustainability problems (Figure 1) as do all levies and taxes imposed on fuel. The trusted fuel-based levy may not be feasible over the longer term and may even be a regressive tax on low-income road users.

Increasing the fuel levy every year is also not a solution. With fewer road users buying fuel, the levy will deliver less and less revenue and will increase the burden on the poorer road users even more (Mankiw, 1999). Often, modern technology such improved vehicle fuel efficiency, EV's and alternative fuel engines, are expensive and out of reach of most citizens³.

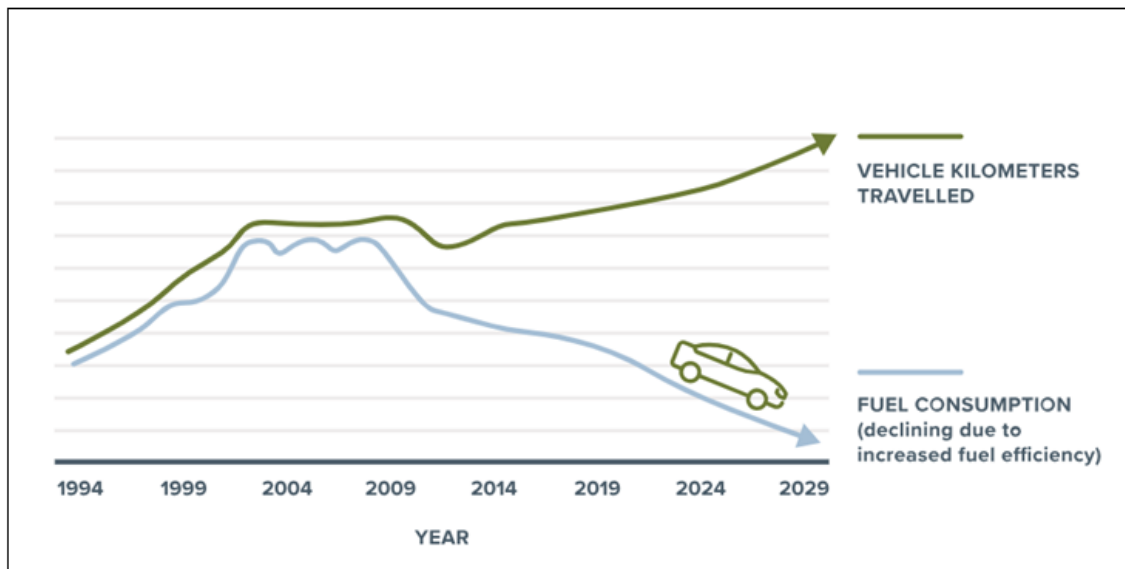


Figure 1: Fuel consumption and vehicle kilometre trends (source www.wc-ruc.org)

Fuel levies make up roughly 5% of South Africa's overall tax revenue and contribute more than 50% of all the *direct revenue obtained from road users*. Other road revenue sources include vehicle license fees, tolls on selected roads, parking fees, heavy vehicle permits, and other sources tied to vehicle ownership and vehicle use (Krygsman and Van Rensburg, 2017). None of these other charges and levies, however, can replicate the magnitude of fuel charges at a national level. As vehicle fuel efficiency improve, alternative energy sources become more prevalent, and road construction inflation pushes for an increase in the fuel levy, policy makers have been looking at other options to recover the cost of road use from road users. Distance charges, or mileage charges, do not suffer from the same shortcomings as fuel-based various and can deliver a stable revenue stream⁴. It is also potentially a much more accurate means to recover road costs compared to the fuel levy (Sorensen, 2013).

Distance-Based Road Use Charges (DBRUC) have been piloted in several countries with positive outcomes regarding technical feasibility, policy acceptance, and user feedback. In the USA, several states have implemented pilot projects for distance-based road use charges. These projects typically invite road users to participate in the pilot vehicle tracking initiative. Examples include Oregon (www.oregon.gov/odot/orego), Hawaii (<https://hiruc.org/>), Washington (waroadusagecharge.org), and Utah (www.road-usage-chargeutah.org). Vehicle owners join the project and receive a tracking device by post. In

³ It is one of the jobs of Government to shield its citizenry of the negative implications of new technological advances.

⁴ Distance-based Road Charges are often referred to as a kilometre-based user fee (KBUF), vehicle kilometres travelled (VKT) tax, or distance-based fee (DBF).

all these projects, participants pay a flat fee (between 0,8 and 2,4 cents per mile) without any variation.

Road user charging is widely implemented in the European Union following the introduction of Directive 1999/62/EC, also known as the Eurovignette Directive. This directive was established to create a road charging regime across the EU that enables heavy goods vehicles to operate across borders. However, the charging schemes vary considerably between EU member states, with only a few countries having adopted a distance-based charge. Examples include Belgium (<https://www.satellic.be/belgian-kilometre-charging-system>), Toll Collect in Germany (https://www.toll-collect-de/en/toll_collect), Slovakia (<https://www.emyto.sk/>), and several other countries. More recently, Iceland has become the first country in the world to completely transition from a fuel-based charge to a distance-based charge (www.island.is/en/kilometer-fee). Similarly, Singapore is in the process of moving from Electronic Tolling to Global Navigation Satellite Systems (GNSS) tolling. Worldwide, news campaigns and pilot projects have been undertaken to test a distance-based road user charge and demonstrate the benefits to the government and, importantly, the general public (de Palma and Lindsey, 2011).

A DBRUC would be fair to all South Africans. Whereas the fuel levy disproportionately affects those who cannot afford more fuel-efficient vehicles, under the DBRUC system, everyone would pay a per-kilometre charge for how much they use the road, regardless of whether they use an EV, hybrid or internal combustion engine vehicle. Because a DBRUC is tied to actual use of the road, it would be transparent and it would also overcome many of the problems associated with a fuel levy, making it sustainable (National Surface Transportation Infrastructure Financing Commission, 2009; Coyle *et al.*, 2011; Van Rensburg and Krygsman, 2018).

The literature and current pilot projects identified 3 key factors that contribute to the success of these charges, including (1) public participation, (2) technical and financial feasibility, and (3) testing and refining of the programmes well before final consideration.

Firstly, citizen participation is vital. Those who will be required to pay must be involved in the process. They should be made aware of the problem and possible solutions. Secondly, people should trust the technology and the system. This implies that the system should be tamper-proof and that the technology used delivers accurate results and is thoroughly tested. Thirdly, projects have a much greater chance of success if they are piloted over an extended period. This allows people, politicians, and implementation problems time to be addressed. Roads are public infrastructure, and road users should, after all, have insight into what they should pay, how much they should pay and how they should pay. The following section discusses the Western Cape pilot project.

3. PILOT PROJECT

The *Western Cape Road Use Charge* (www.wc-ruc.org) pilot project is a collaborative research project between Stellenbosch University, the Western Cape Provincial Government, SABITA and SARF. The pilot focuses on creating public awareness, assessing technical feasibility and gaining experience with distance-based road user charges in South Africa. While the main purpose of the pilot is to trial a road use charge based on road use (and differentiate the charge based on distance, location and time of day), an important objective is to understand the opinion of road users and inform the public of the importance of our roads. The pilot project involves three components:

- It shares information: A website conveys and explains the road funding debate in clear terms. The public is provided with information on the state of the network and the need to fund the network. Problems with the fuel levy are discussed, and the distance-based road use charge is introduced as one suitable alternative.
- It collects information: The public is asked to provide input and comments on the road use charge and present their opinion. General comments are also requested, and the responses are analysed.
- It evaluates the policy, methodology and technology with the public involved: Road users are asked to join a vehicle tracking pilot project, which involves the tracking of their vehicles with a small non-intrusive GPS device⁵. Respondents receive a monthly road use invoice that reflects their road use behaviour and are asked to share their opinion of this approach.

Since its launch, the website has received a lot of attention and has also been visited by people from roughly 90 countries. Only South Africans, however, can complete the survey, and only respondents living in the Western Cape can take part in the pilot. The following section briefly discusses the elements of the website.

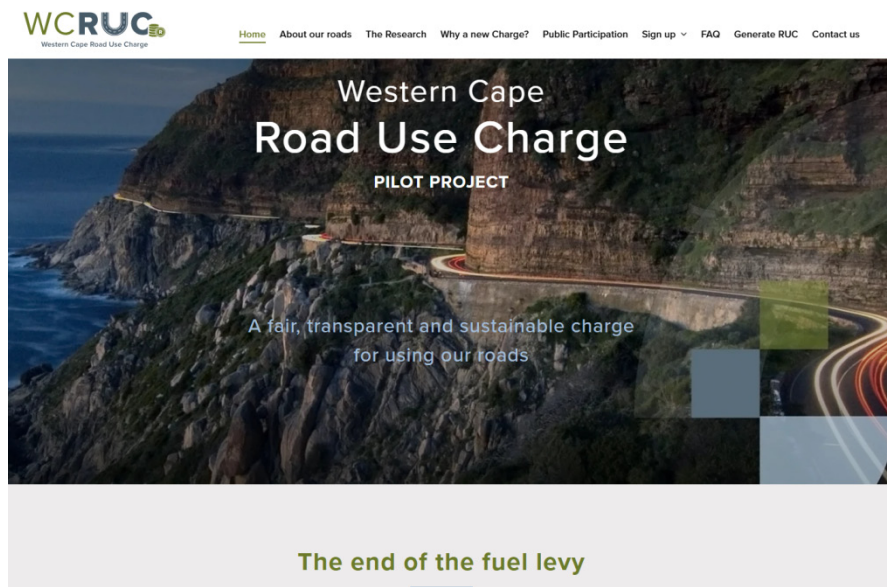


Figure 2: Western Cape road use charge project (www.wc-ruc.org)

3.1 Informing Users of the Benefit of the Road Network

South Africans have seen their fair share of upheaval about road funding and the financial difficulties faced by local authorities in maintaining the road network. The failed E-toll project, the financial difficulties faced by the Road Accident Fund, urban congestion and the poor condition rural road network have contributed to the general scepticism about the road funding. Calls are made for a larger allocation to roads, an increase in the number of toll roads and increasing fuel-based charges. An increasingly sceptical populace has rejected most of these options. A first step to redress public trust is to achieve a general acceptance of the problem and the need for change. Public awareness campaigns about the importance of South Africa's road network and the problems the network faces may address the current distrust between the government and road users.

⁵ Respondents on the survey are asked if they are willing to be tracked with a GPS device and take part in the pilot.

South Africa has the largest road network in Africa and the 12th largest road network in the World. The *wc-ruc.org* website is populated with information about South Africa's road network, the trends impacting the road network and vehicle technology and the subsequent impact on the revenue from fuel-based road user charges. The public is informed about the value of the road network and the implications of insufficient funding, such as rapid pavement deterioration, increased accidents and ultimately poor accessibility.

Emphasis is placed on the case for sustainable funding, and that planning for funding needs to happen earlier and that the public should be involved in this process. Road users are made aware of the need for a fair, transparent and sustainable charge for using the roads. Importantly, the public is placed central in the road funding discussion, i.e. it is their road network.

Visitors to the website are introduced to the phased research approach, the first phase reviews international policy and examples, the second phase focuses on public opinion surveys, and the third phase is the pilot tracking exercise. This phased approach aims to promote public participation in a new policy, reduce risk and limit possible errors in designing a road funding policy.

The public is made aware that all countries have similar road funding problems, and that South Africa is not unique. Most countries are actively engaged in finding solutions to the road funding debate. South Africa is also experiencing the same trends as most countries with road funding. Improved vehicle fuel efficiency, electric vehicles, changing travel patterns, etc, are even more noticeable in developed countries. All countries face a decrease in the effectiveness of the fuel-based taxes. Most countries, however, are actively considering alternatives to fuel-based charges.

Visual aids and data visualisation are used to illustrate the problem and the need for a solution to the problem. The public is made aware of the need for a new road use charge, and the case for a distance-based road use charge is stated:

"A road use charge (RUC) would collect adequate revenues from all road users – including the owners of highly fuel-efficient vehicles – based on their actual road use. Everyone who drives on our roads would be paying their fair share of the costs".

Using unambiguous statements, users are informed what they should pay for, i.e.:

- *We should pay for the pavements and road infrastructure we use.*
- *We should pay for the pollution and other environmental costs that our travel causes.*
- *We should pay for road accidents and traffic safety.*
- *We should pay for the congestion on the roads.*

The purpose is to share information, inform the public and build trust in the process. In South Africa, participation in policy may trump trust in government.

3.2 Public Participation

Experience with road use charge experiments and road charges in general reveals that public participation is the most important factor influencing the success and acceptability of the system (Ortúzar et al., 2021; Hsieh, 2022). As road pricing is a government policy directly impacting citizens' daily life and their expenditure patterns, public acceptance of such a policy must involve a collaborative relationship between the government and the public to achieve buy-in (Knipe and Krygsman, 2024). The pilot project was preceded by

three rounds of surveys canvassing people’s opinions. First round survey adverts were published in local newspapers, distributed via social media and sent by email to professionals working in road transport, see Figure 3.



Figure 3: Social media and newspaper adverts

Two additional rounds of surveys have been distributed similarly, with a fourth round ongoing. The four rounds yielded approximately 1200 responses to date. These responses are not necessarily statistically representative of the Western Cape population, but the large sample does provide some indication of the public’s perception of road funding⁶.

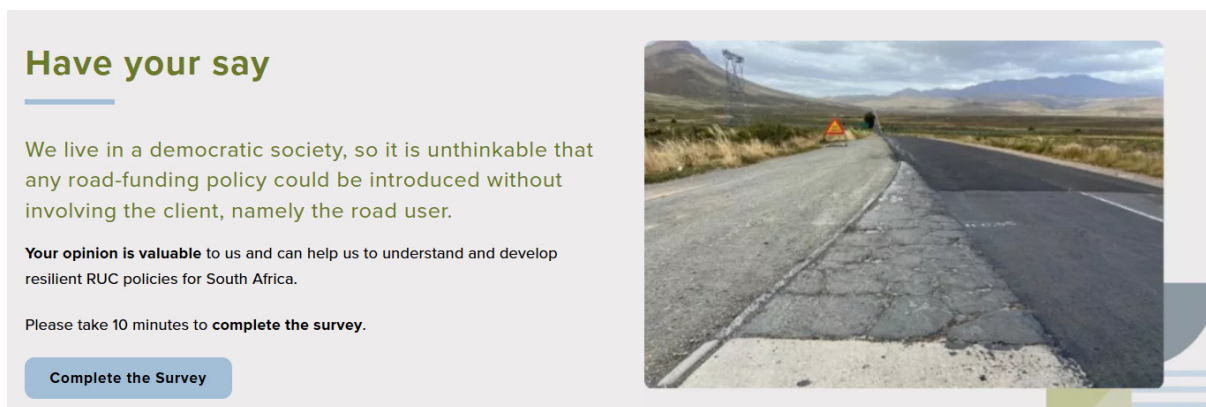


Figure 4: Public input required

In addition to these surveys, the public can provide general comments and raise any issues (Figure 4). Frequently asked questions raised by participants are added to the FAQ section and continuously updated.

3.3 Survey Results

The survey results are reported in detail in a related paper, and only summary results for the third round (n = 426) are reported in this paper. Road users are asked several questions relating to their opinion on how much they pay and how they prefer to pay for roads, whether they understand the purpose of the fuel levy, etc. Road users are also asked their opinion about road funding in general and how they would prefer to pay for roads.

Seventy per cent of the respondents claimed that they know the fuel levy is delivering less revenue due to improvements in vehicle fuel efficiency and new EVs. This bodes well for suggesting alternatives, as the road users are aware of the problem. Despite the fuel levy being a commonly discussed topic and political hot potato, very few people know the exact amount of the levy, i.e. only 16% could state the correct charge of 394 cents per litre (in

⁶ The surveys is discussed in a related paper (van Rensburg and Krygsman, 2019) and administered via newspapers adverts, social media and emails.

2023). When asked to state the charge per kilometre, only 7% of the respondents attempted to answer the question, and virtually no one was able to estimate the price correctly (which is the average fuel consumption per km multiplied by the fuel levy per litre).

When confronted with an increase in the price of fuel, 65% of respondents indicated that they would change their travel behaviour. The remaining 35% indicated they are not able to change their behaviour as they have no other option to travel and must accept the higher fuel cost. Figure 5 shows how individuals, from Survey 3, will change their travel behaviour if confronted with higher fuel costs.

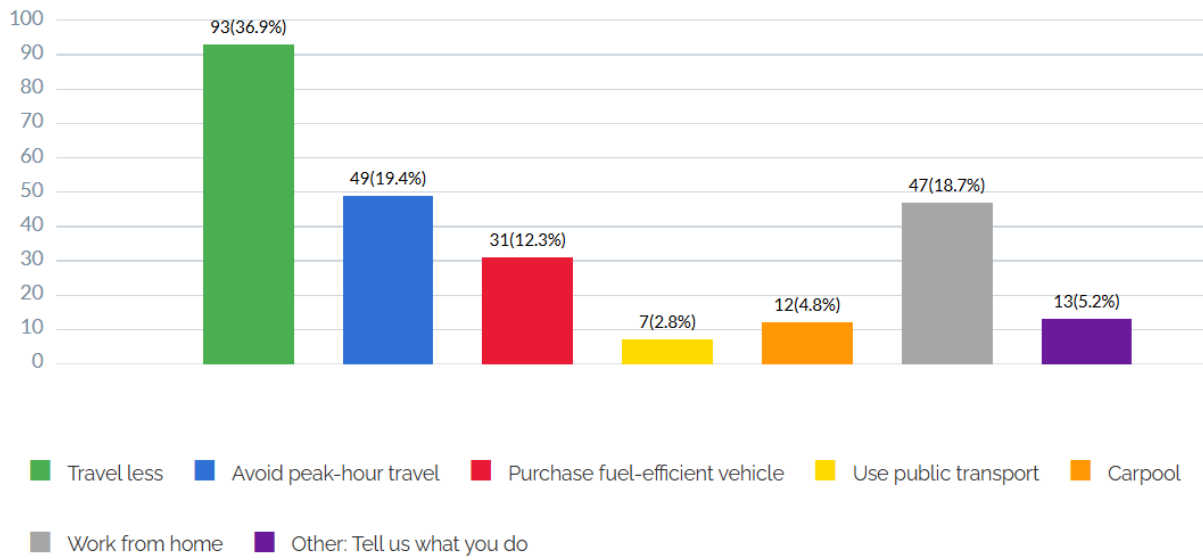


Figure 5: How would they react to a change in travel cost

Respondents were also asked to rank their opinions on various aspects of the road funding and charging. Using a scale of 1 to 5, where 5 means completely acceptable and 1 means completely unacceptable, the respondents answered as follows:

1. South Africa needs to ensure that adequate funding is available to keep our transport infrastructure safe, effective and properly maintained = 4.72.
2. How do you rate the current system of a levy on every litre of fuel purchased as a method of charging road users? = 3.22.
3. The Government needs to find an alternative to the fuel levy to adequately fund our transport infrastructure = 3.29.
4. A distance-based road user charge would make for a suitable alternative to the fuel levy = 2.47.

Survey participants were also asked whether, if a distance-based road-user charge is considered, the cost per kilometre should be fixed or should it vary with time of the day, location and/or vehicle type. A total of 67% indicated that the charge should vary. Figure 6 shows how the respondents believed the charge should vary. Most respondents believe that the charge should vary by type of vehicle, followed by time of day. Comparing Figures 5 and 6, it seems that road users will switch to various times of the day to travel and will alter their travel patterns, such as travelling less. These outcomes are, in fact, some of the main objectives of road pricing, and the initial findings suggest that carefully designed road

use charges may impact travel behaviour and achieve the desired results, i.e. less peak hour travelling and less travelling.

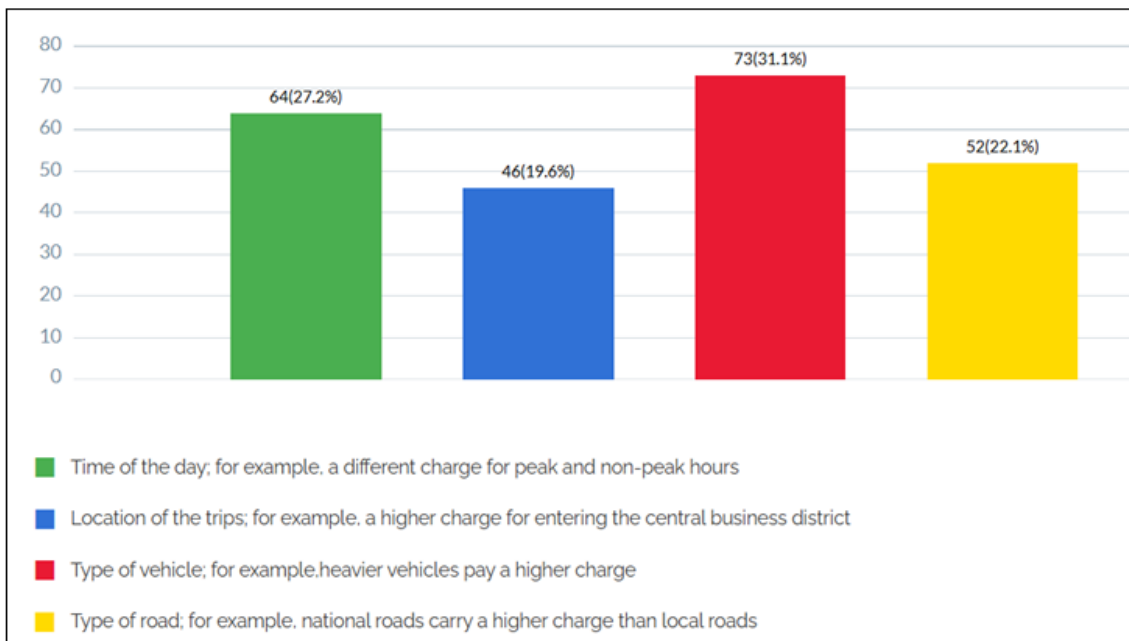


Figure 6: If the charge per kilometre is variable, it should vary by....

Respondents were also asked about their preferred alternative to fund roads and charge road users. Distance-based and congestion charges are the least favourite alternatives, as shown in Figure 7. This is very much supported by similar international findings, which also show distance-based charges as the least favourable option. To be fair, road users in general do not prefer any charge. Most respondents prefer a combination of charges. This is somewhat contradictory to the user pay principle of only paying for road use, as a combination of taxes may include charges that are not related to actual road use.

	Rank your choice with 1 indicating the least preferred alternative and 6 indicating the most preferred alternative.						Average Rating
	Least preferred (1)	2	3	4	5	Most preferred (6)	
Fuel levy	26 (20.97%)	18 (14.52%)	11 (8.87%)	17 (13.71%)	17 (13.71%)	35 (28.23%)	3.69
Vehicle license and registration fee	38 (30.40%)	19 (15.20%)	14 (11.20%)	18 (14.40%)	18 (14.40%)	18 (14.40%)	3.10
Toll roads on national roads	25 (20.00%)	18 (14.40%)	24 (19.20%)	29 (23.20%)	15 (12.00%)	14 (11.20%)	3.26
Congestion charge for cities	29 (23.20%)	24 (19.20%)	28 (22.40%)	23 (18.40%)	13 (10.40%)	8 (6.40%)	2.93
A distance-based road-user charge	41 (32.80%)	13 (10.40%)	22 (17.60%)	13 (10.40%)	24 (19.20%)	12 (9.60%)	3.02
A combination of various options	23 (18.40%)	17 (13.60%)	13 (10.40%)	10 (8.00%)	19 (15.20%)	43 (34.40%)	3.91

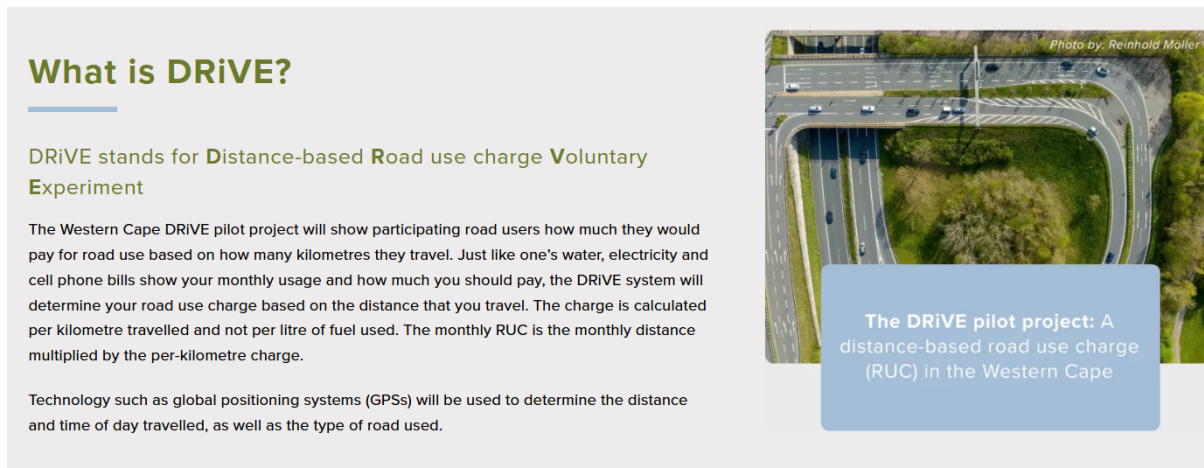
Figure 7: Public opinion on preferred road use charge

Generally, feedback from the survey made it clear that the respondents are very much aware of the road funding debate, but that their knowledge of solving the issue is inadequate. It seems the public is concerned about trust and prefers the traditional means to collect revenue from road users, which is the fuel levy (fix what we have before a new charge). These findings are comparable to international experience. Most international

surveys reveal that distance-based charges and congestion taxes are not favoured options. In fact, any alternative road use charges are not well-received by the public.

4. TRACKING AND DATA ANALYTICS

The final phase of the research involves canvassing road users to take part in the vehicle tracking and road use charge pilot. Survey participants can opt to join the pilot after basic information is collected about their vehicle and road use behaviour. Users can choose to receive a self-installation tracking device or have a unit installed at one of the tracking providers. Tracking commences once the units start sending information. Users receive an SMS which they accept, and tracking is then activated.



What is DRiVE?

DRiVE stands for **D**istance-based **R**oad use charge **V**oluntary **E**xperiment

The Western Cape DRiVE pilot project will show participating road users how much they would pay for road use based on how many kilometres they travel. Just like one's water, electricity and cell phone bills show your monthly usage and how much you should pay, the DRiVE system will determine your road use charge based on the distance that you travel. The charge is calculated per kilometre travelled and not per litre of fuel used. The monthly RUC is the monthly distance multiplied by the per-kilometre charge.

Technology such as global positioning systems (GPSs) will be used to determine the distance and time of day travelled, as well as the type of road used.

The DRiVE pilot project: A distance-based road use charge (RUC) in the Western Cape

Figure 8: Informing users of the tracking exercise

The GPS devices only send raw location and time information. This information consists of spatial coordinates (x; y) and a time stamp (z).

This raw data is cleaned and classified according to road type, time of the day and location⁷. Once the trips are allocated to the road network, the distance travelled per road type, at the specific time and location, is extracted. This information is used to determine the road charge for the user.

Charges can be differentiated according to vehicle type, time of day and location. Considering five vehicle categories, peak and off-peak, rural and urban, this can ultimately lead to twenty different charges. In the initial stages of the project, however, only a single charge per kilometre is used for each vehicle type with no distinction between time of day or location. All trips over the month are aggregated by road type, and the monthly road use cost is determined. Trips shorter than 500 meters are discarded. The home and work location of the respondents is not recorded.

5. MONTHLY INVOICE

Participants in the pilot tracking receive a monthly road use charge, similar to a household utilities bill. The 'invoice' contains all the qualifying trips, the type of roads and the cost per kilometre. Road users are then provided with an option to pay monthly cost by acknowledging the invoice simply by clicking on the link. The road use charge invoice also allows user to automatically pay their annual license fees.

⁷ A related paper discusses the rules methodology to classify the raw data into trips and extract the total trips per day and per month and prepare the

The invoice also contains additional information. Users are provided with some analytics; this includes the costs of peak-hour travel versus off-peak travel, as well as the costs of fewer monthly trips. Furthermore, road users are provided with their carbon cost, i.e. their carbon footprint of the trips.

6. CONCLUSIONS AND RECOMMENDATIONS

The Western Cape Road Use Charge Pilot Project is a collaborative research effort between the Western Cape Provincial Government, industry and Stellenbosch University to evaluate a distance-based road-user charge for South Africa. Several international pilot initiatives and projects have been implemented, and the project aligns South Africa with these developments.

International experience is clear: the success of these projects, and any new road use charge, is dependent on (a) active public participation and shared learning, (b) technical feasibility and operational viability and (c) long-term consistent testing. The pilot project addresses these three elements.

Road users do have strong *opinions* about road funding. Yet their *knowledge* of the extent of South Africa's road network and the financial demands of the network, what they currently pay, and should pay, is limited. It is the purpose of the government to inform them of the road funding demands.

The distance-based road-user charge is not a favoured option, and road users prefer a combination of taxes as the most preferred option to charge road users. Survey respondents' responses are at least partly rooted in the belief that government overreach and corruption should be addressed before additional funding can be considered. This is similar to international findings where the concept has not received support. Fortunately, none of the road charges options receive much support.

The tracking revealed that it is entirely possible to extract road use, identify the roads and determine a charge based on the type of road use, from the GPS devices. The data is accurate, and all roads can be identified at a sufficient level of accuracy. The charge can be differentiated by time of the day, vehicle type, road type and area. In addition to the standard data, a lot of additional information can be extracted, allowing value-added services to be delivered.

Research should continue to explore the possibility of extending the pilot to a larger sample of 1000 vehicles. Various payment options should be considered, including a monthly invoice or an annual payment. Data integrity, privacy and security should be strengthened. The role of the private sector should be explored as third-party technology providers.

In an environment where the public does not trust the government, participation in policy may just outdo trust in government.

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