

A kilometre-based road-user charge system: proof-of-concept study

THE FUEL LEVY

The South African fuel levy is used to fund government's general expenditure programmes, including the construction and maintenance of roads and the support of public transport. Yet, the continuing reliance on the fuel levy to generate sufficient income is questioned, due to a decrease in the average amount of fuel sold per vehicle per annum. This in turn is due to technological trends which include more fuel-efficient vehicles, the introduction of electric and hybrid vehicles and alternative fuels, as well as societal trends which include working from home and Internet shopping. These problems around the fuel levy are not unique to South Africa. Various countries (America, the European nations, New Zealand and Australia) are also experiencing a decline in the amount of funds that the road-user charge can generate. However, these countries are actively engaged in looking at alternative means of road financing.

The full research paper presented at the Southern African Transport Conference in July this year aimed to identify, explore and test a viable and

operationally feasible alternative that addresses many of the problems associated with the current South African fuel levy.

It was found, through a qualitative analysis of alternative transportation financing sources, that governments around the world use a combination of traditional methods to collect funds for the construction and maintenance of transportation infrastructure. These include, but are not limited to, fuel taxes, vehicle registration fees, tolls, bonds and general fund expenditure through income taxes. Furthermore, over the past couple of years many governments have been experimenting with non-traditional methods which include debt financing instruments, credit assistance, public-private-partnerships, emissions fees, and congestion and cordon pricing. Except for congestion pricing, the problem with the above-mentioned methods is that they stimulate bad travel habits, and do not address the problems associated with the fuel levy. They only deliver small contributions to revenue funds, and as a tax they are not really a good notion, as the purpose of a tax is to change bad behaviour to good behaviour.

Johann van Rensburg

Lecturer: Department of Logistics
Faculty of Economics and
Management Sciences
Stellenbosch University
javrens@sun.ac.za



The SAICE Transportation Engineering Division recognised the full version of this article as the best in the *Under 35 Young Professional* category at the Southern African Transport Conference held in Pretoria earlier this year. The original paper was co-authored by Prof Stephan Krygsman, who is also acting as the author's PhD supervisor.

A PROPOSED NEW APPROACH

The research on which this article is based subsequently identified a new, innovative approach, named Kilometre-Based Road User Charges (KBRUC), as a potentially viable alternative in South Africa. The system, which is being piloted in America and Europe, charges vehicles directly for each kilometre driven. This method is deemed to be the best solution to the problems associated with the fuel levy, as it will not be influenced by technological and societal trends, is not dependent on fuel sales, can be a progressive tax, can generate more income to keep up with road construction and maintenance cost, and taxes for actual road use. Furthermore, it can supplement and even in the future replace the fuel levy to provide sufficient income. It is a policy-sensitive alternative whereby, if the tax is changed, it impacts on road users' behaviour. It is, in theory at least, relatively easy to implement, and can inform road users of costs through an itemised road-user-charge monthly bill.

The concept of the KBRUC system was explored through a review of international research and pilot projects, and it was found that this financing mechanism can have many configurations, but must incorporate at least the following 11 key technical components:

1. The purpose of the implementation
2. Which vehicles and users to be charged
3. Technological devices for measuring kilometres travelled
4. Communication of the vehicle travel data

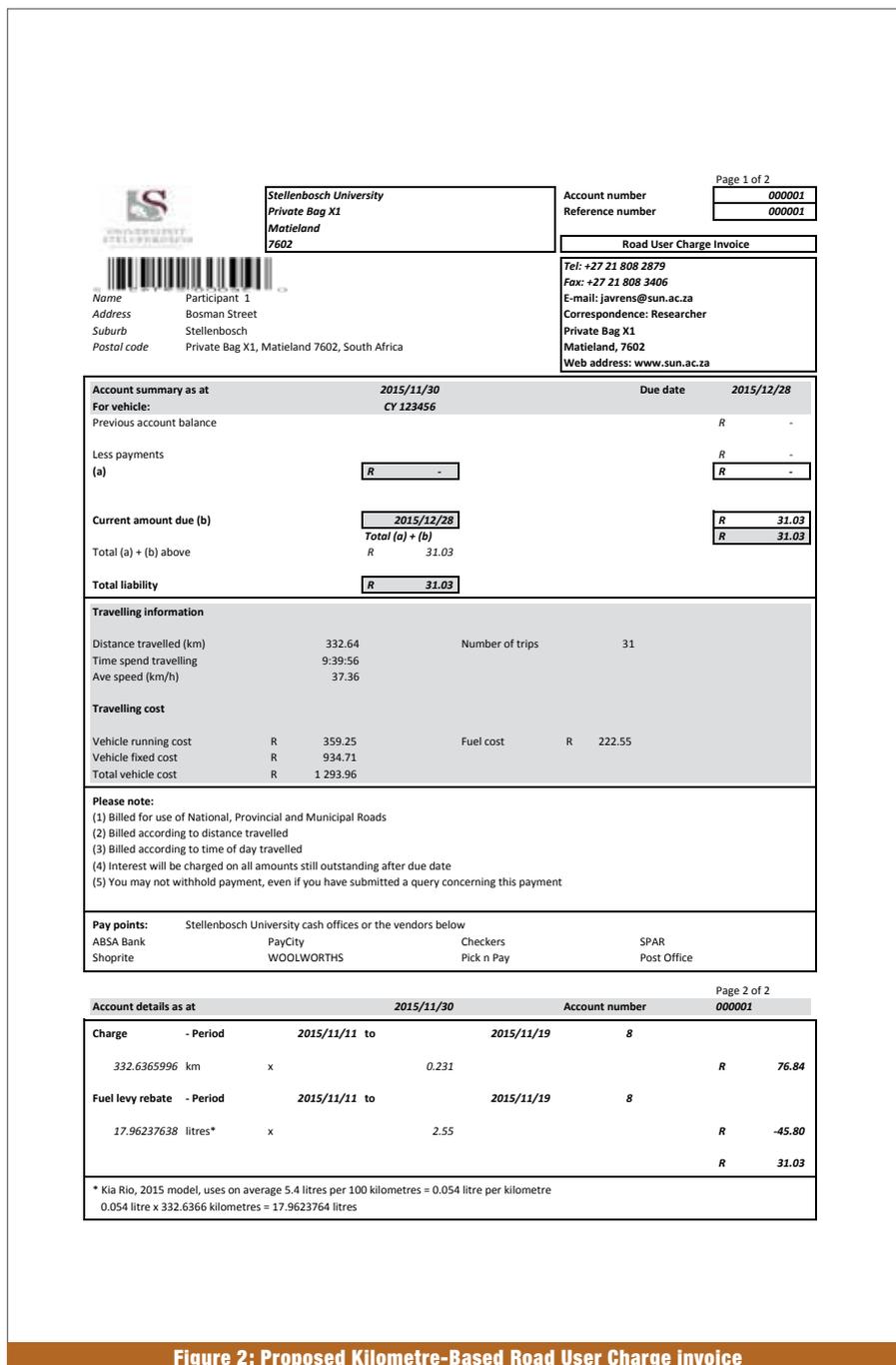


Figure 2: Proposed Kilometre-Based Road User Charge invoice

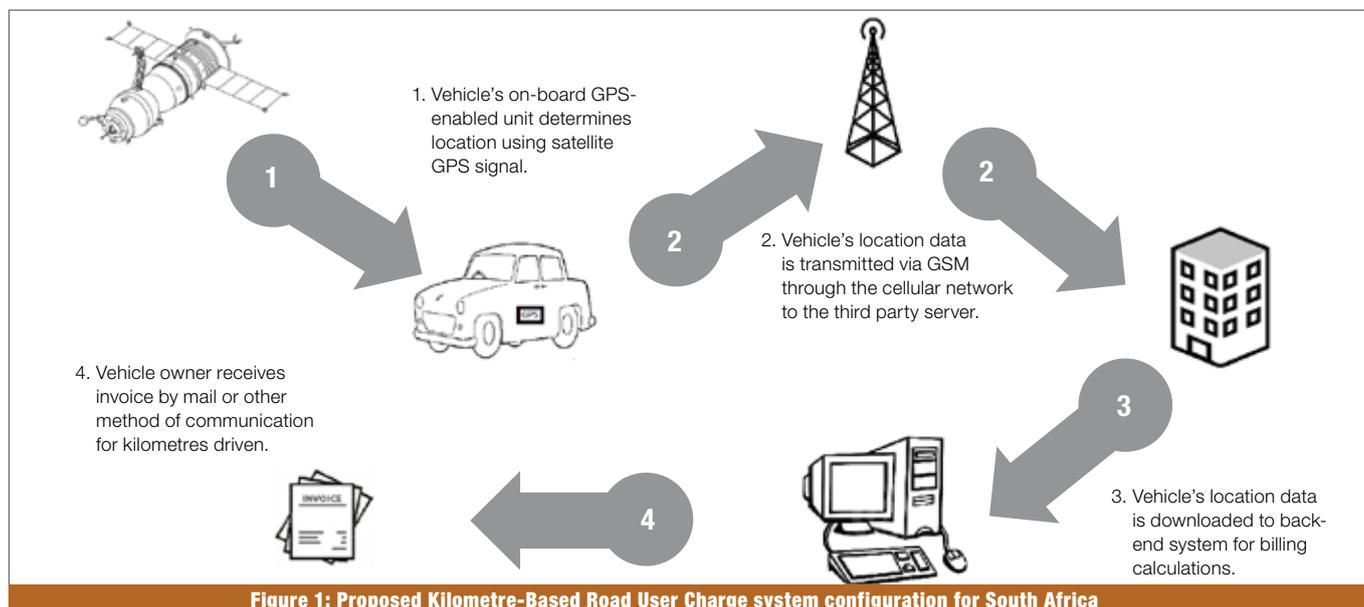


Figure 1: Proposed Kilometre-Based Road User Charge system configuration for South Africa

5. The type of road to be charged
6. The time of day that will be charged
7. How much should be charged
8. Invoice billing
9. Enforcement of the system
10. Protection of privacy
11. Value-added services.

A proposed KBRUC system configuration for South Africa (see Figure 1) was tested using one vehicle, in a small-scale proof-of-concept study in 2015, comprising selected key technical components. The configuration was designed to charge all self-propelled vehicles for the infrastructure cost they incurred on the road system. A removable GPS unit with GSM technology was fitted to the vehicle, and tracking was undertaken for a period of one week, collecting vehicle movement data comprising x- and y-coordinate pairs on all roads every 30 seconds throughout the day. The use of the system was enforced by assessing the vehicle's odometer reading throughout the tracking period. The vehicle movement data was sent to the server of a third party vehicle tracking company, and reported via their secure web-based interface. A back-end system extracted various datasets from the web-based interface in order to compile a billing invoice to be forwarded to the vehicle owner. A value-added service was also provided by showing information related to the vehicle movement which might facilitate a change in travel behaviour.

The road use charge for the tracked vehicle was calculated at 21.45 cents per

kilometre by means of dividing the estimated annual maintenance, administration, street cleaning, street lighting and capital cost incurred by the vehicle class it belongs to, by the vehicle's estimated annual kilometres travelled. The calculation assumed a total infrastructure and maintenance expenditure of R54.6 billion (estimated income generated from road users in 2015) for all vehicle classes and then allocated the cost to each vehicle class in terms of the above-mentioned cost components. Added to this calculated road use charge is an operating cost of 5% for the KBRUC system to be implemented, resulting in a charge of 23.10 cents per kilometre.

The invoice was compiled with a similar look and feel as the municipal account invoice of the City of Cape Town (see Figure 2). The charge owed was calculated by multiplying the rate per kilometre by the amount of kilometres travelled. The invoice also incorporated a rebate for the fuel levy already paid. The fuel levy rebate was calculated by multiplying the average fuel consumption per kilometre of the vehicle by the amount of kilometres travelled, and the fuel levy rate. The fuel levy rebate amount was then subtracted from the total charge owed by the participant to show the additional road user charge owed. Additional information relating to travel behaviour and vehicle operating cost was included as a value-added service. The vehicle operating cost was calculated by means of the AA rates for vehicle usage.

CONCLUSION

The vehicle tracking experiment has shown that the suggested configuration of the system is operationally feasible on a small scale in South Africa. A removable on-board GPS unit with GSM technology was acquired from a third-party tracking company. Installation was quick and the service was easy to use. Information pertaining to the vehicle's movement was secure and only available to the participant and researcher via a web-based interface. Vehicle travel data was readily available in the correct format for analysis, and a road user invoice could be constructed with ease, charging the vehicle owner for the distance travelled at a set rate per kilometre.

Future research is needed to assess the operational and technical feasibility of a KBRUC system on a larger scale, as scaling issues are critical to the implementation of such a system. Additional policy, social and equity concerns also still need to be investigated and addressed. This includes setting fee levels properly, as well as understanding road users' responses to the acceptability and experience of using such a system. □

The vehicle tracking experiment has shown that the suggested configuration of the system is operationally feasible on a small scale in South Africa.



MULTIDISCIPLINARY CONSULTING ENGINEERS

- Management & Advisory Services
- Urban & Social Development
- Hydropower & Energy
- Water & Environment
- Asset Management
- Resources
- Transport

