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WC-DRiVE: Western Cape *Distance-based Road* user charge *Voluntary* *Experiment*

ROAD USE DISTANCE CHARGE MODEL - Progress

April 2021

SUNTrackAnalytics © The content of this presentation is confidential.

Purpose of the research

- The project is about:
 1. Research an equitable road user charge based on road use, vehicle type and location
 2. Explore user feedback, opinion, feelings about the road user charge, user behaviour
 3. Insight in technology, institutions and trends.

And

- Establish capacity in South Africa, Southern Africa and Developing Countries in road user charging
- Avoid digital colonisers of public data



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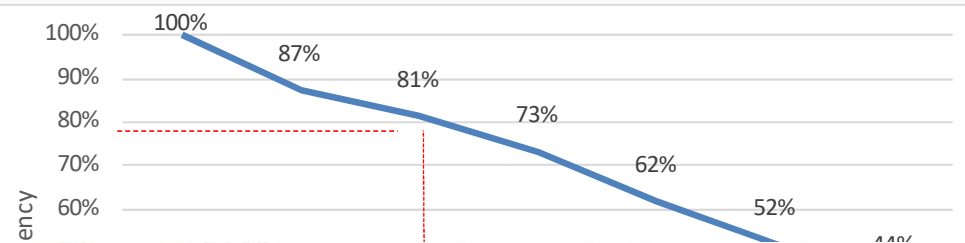
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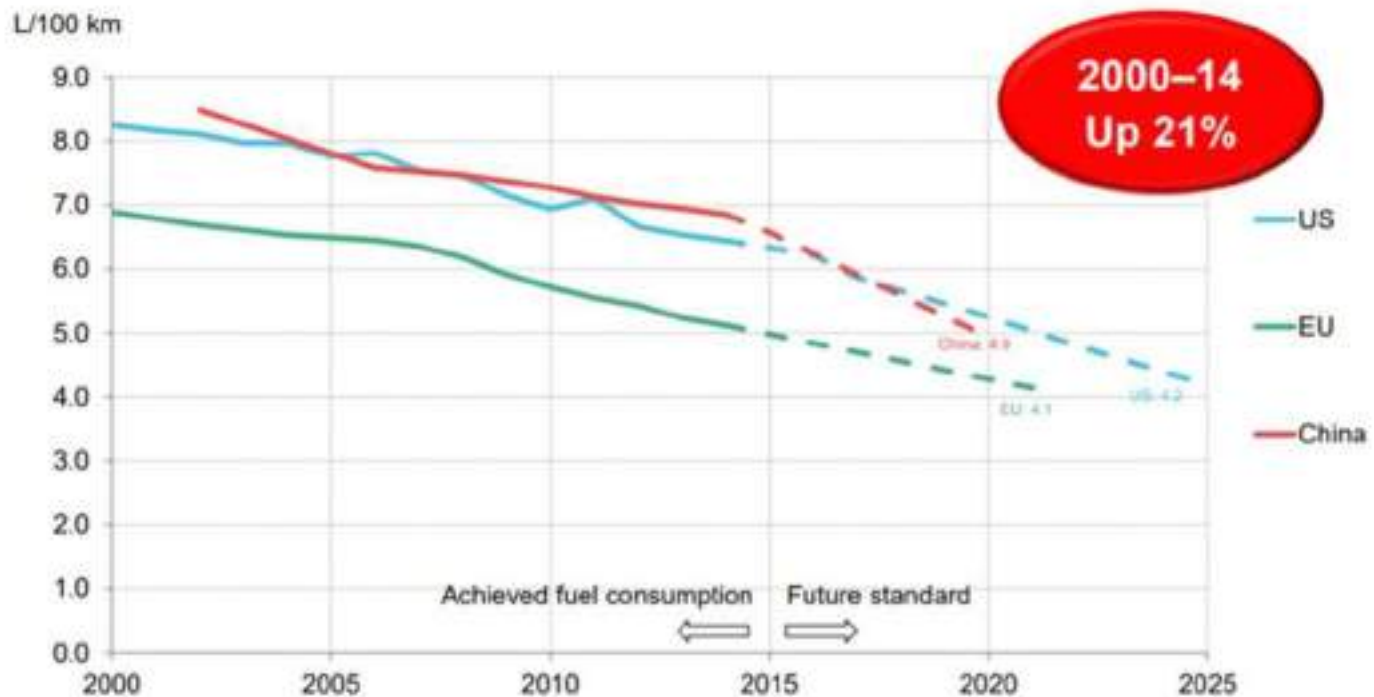
Why

Efficacy of our fuel-based levies...



Is the inefficiency

Fuel economy regulations for China, US and Europe, 2000-25 (litres/100km)



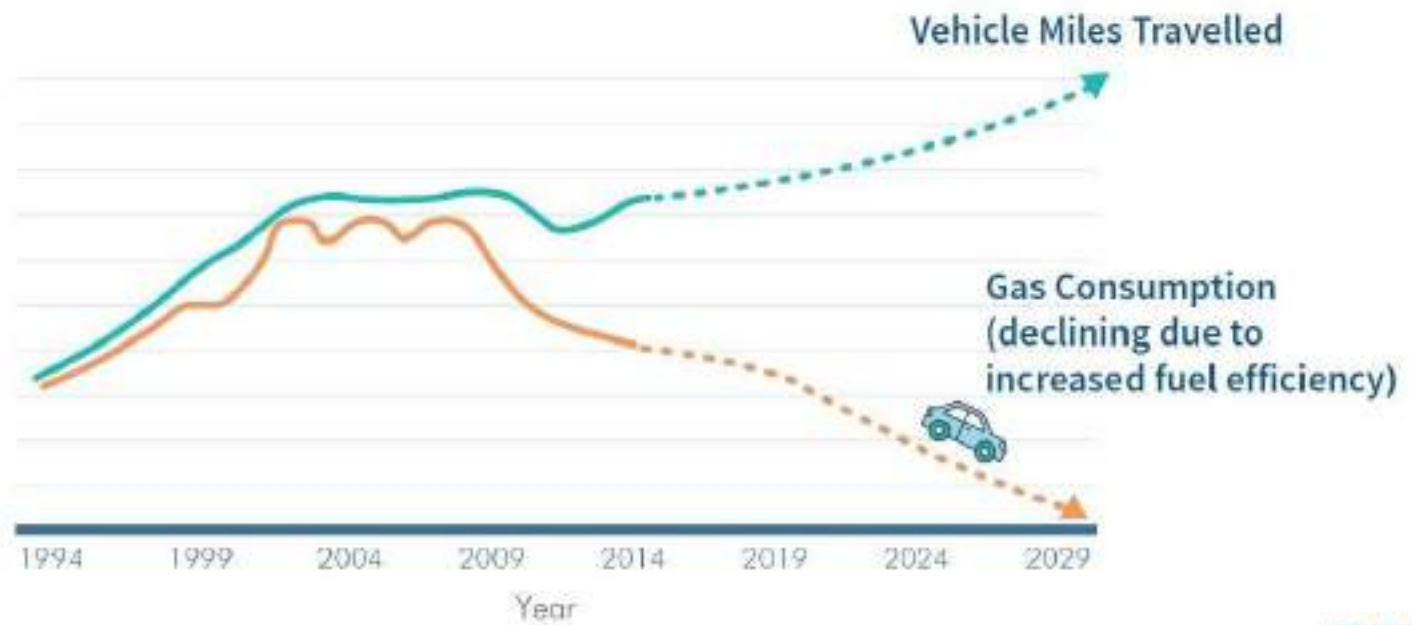
Note: The fuel economy targets have been normalised to the CAFE testing procedure. US targets are for passenger cars only.

Source: EPA, NHTSA, EU, ICCT

3) Social consciousness - alternative fuels /less travel

- Policy: 1) Government under pressure to only charge for use

Revenue Loss Due to Increased Fuel Efficiency





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Solution

Road funding reform



**NATIONAL SURFACE TRANSPORTATION
INFRASTRUCTURE FINANCING COMMISSION**



AUTHORIZING LEGISLATION **COMMISSIONERS** **MEETINGS & HEARINGS** **BACKGROUND DOCUMENTS**

Final Report

On Thursday, February 26, 2009, the National Surface Transportation Infrastructure Financing Commission released its Final Report. A copy of the full report can be downloaded by [clicking here](#). The Press Release can be downloaded by [clicking here](#), and the Executive Summary, which summarizes the report's conclusions and recommendations, can be downloaded by [clicking here](#). Printed bound copies of the Final Report can be ordered by e-mailing financecommissionreport@dot.gov. A copy of the Commission's Options Evaluation Tool, which they used to evaluate the different funding and financing options, is available at the [link below](#).

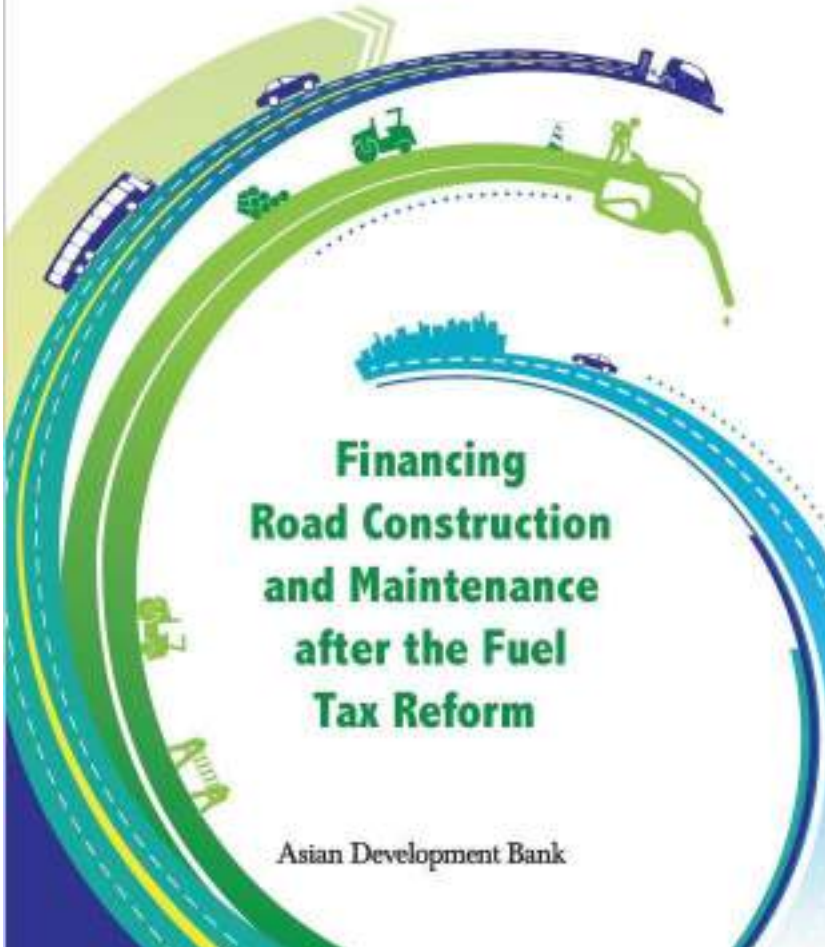
The Financing Commission offers a roadmap for sweeping reform of the nation's transportation infrastructure funding and finance framework. The Commission offers specific recommendations for increasing investment in transportation infrastructure while at the same time reducing the burden on taxpayers by shifting motor fuel taxes toward more direct fees charged to transportation users.

The Financing Commission's report addresses the challenges of a transportation infrastructure funding and financing system with staggering shortfalls in federal and state funds. President Obama calls "the roads and bridges...necessary to n

**GOVERNMENT
POLICY STATEMENT
ON LAND TRANSPORT FUNDING**
2012/13-2023/22
400 pp.

www.dot.gov


ADB



**Financing
Road Construction
and Maintenance
after the Fuel
Tax Reform**

Asian Development Bank

Public information



Who Pays for Roads?
How the "Users Pay" Myth Gets in the Way
of Solving America's Transportation Problems


U.S. PIRG
Education Fund

FRONTIER GROUP

Report of the National Surface Transportation Infrastructure Financing Commission

PAYING OUR WAY

Why It Doesn't Work
and How to Fix It



EXECUTIVE SUMMARY

Who Pays for Roads?
How the "Users Pay" Myth Gets in the Way
of Solving America's Transportation Problems

Frontier Group
U.S. PIRG Education Fund

Jay Dutzik and Gideon Weissman,
Frontier Group
Phyllis Broadbill, Ph.D.,
U.S. PIRG Education Fund

Spring 2015



The Economist

Home » Politics » More »

Difference Engine

End of the road

Getting Americans to pay by the mile could help resolve America's jamming infrastructure





9 News Perth
24 Nov at 11:05

PAY BY TRAVEL
Drivers could eventually pay for e...
they travel. Fuel excise and regis...
be scrapped, and replaced with a...
drivers for how much they use th...
are your thoughts?



South Africa Road Funding Policy



ROADS POLICY FOR SOUTH AFRICA

JANUARY 2020



8.3. EXISTING AND POSSIBLE ADDITIONAL ROAD FUNDING SOURCES IN SOUTH AFRICA

8.3.1. In the current South African context, all taxes collected reverts to the National Revenue Fund and National Treasury allocates budgets to national departments, provinces, municipalities and State Owned Entities as outlined in the Division of Revenue Act (DoRA).

8.3.2. To ensure the realisation or implementation of this policy, various sources of revenue will need to be pursued by Road Authorities (including the three spheres of government).

8.3.2.1. At national level, the potential sources of revenue include:

- For road infrastructure: general tax (equitable share), toll, specific taxes (carbon, fuel), loans and bonds, the road reserve portfolio, business opportunities, weigh bridges, and weight distance charges.
- For regulation and law enforcement: general tax, business opportunities, specific taxes, cross border charges, weighbridges, traffic fines and donor funding.
- For road safety: general tax, specific taxes (carbon, fuel), traffic fines and donor funding.
- For victims of road crashes: general and specific taxes and fuel levies.

8.3.2.2. At provincial level, the potential sources of revenue include:

- For road infrastructure: general tax (equitable share and grants), toll, the road reserve portfolio, business opportunities, weight distance charges, driver licence fees, vehicle licence fees, developer contributions, weigh bridges, provincial airport levies/duties and business opportunities.
- For regulation and law enforcement: general tax, permit fees, traffic fines, business opportunities, driver licence fees, vehicle licence fees, traffic fines and donor funding.
- For road safety: general tax, traffic fines and donor funding.



Elements of road funding

- Important and common elements of such a road funding framework:
 1. Long term planning by National Government for new road funding framework
 2. Distance based road user charges, congestion charges and environmental charges based on use
 3. Public opinion and understanding / acceptance



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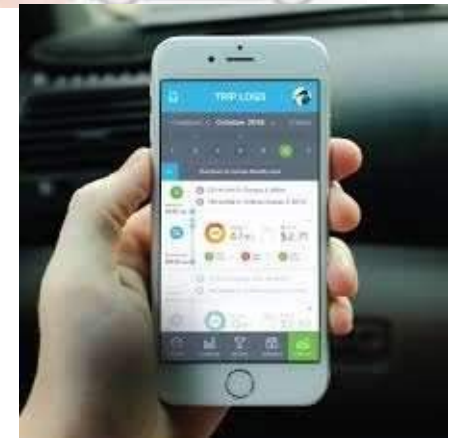
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What are we doing?

Distance-based road user charge

The concept is really very simple ...

- Use new technology (GPS and smartphones)
 - to track different vehicle types
 - in order to charge for actual road use
 - based on distance travelled, vehicle type, weight of vehicle, time of day, location.
- *Create road user invoices:*
 1. To illustrate your road use
 - Time of day,
 - Location
 - Vehicle type
 - Use variable fares
 - per vehicle / road / time of day
- 2. Accident Charge that consider additional
 - Driving behaviour



How do we determine the charge?

- ☐ Road user charge is a function of:
 - Weight of vehicle
 - Type of Road - classification
 - Time of day
 - Location: Metro – Urban – Rural: Congestion



- Formula:

- **Charge (cents per km) =**

- Base fee +
 - Weight fee
 - Time of day
 - Road type
 - Location

HDM will be used to determine this cost (Pavement, Congestion, Environment, Accident)



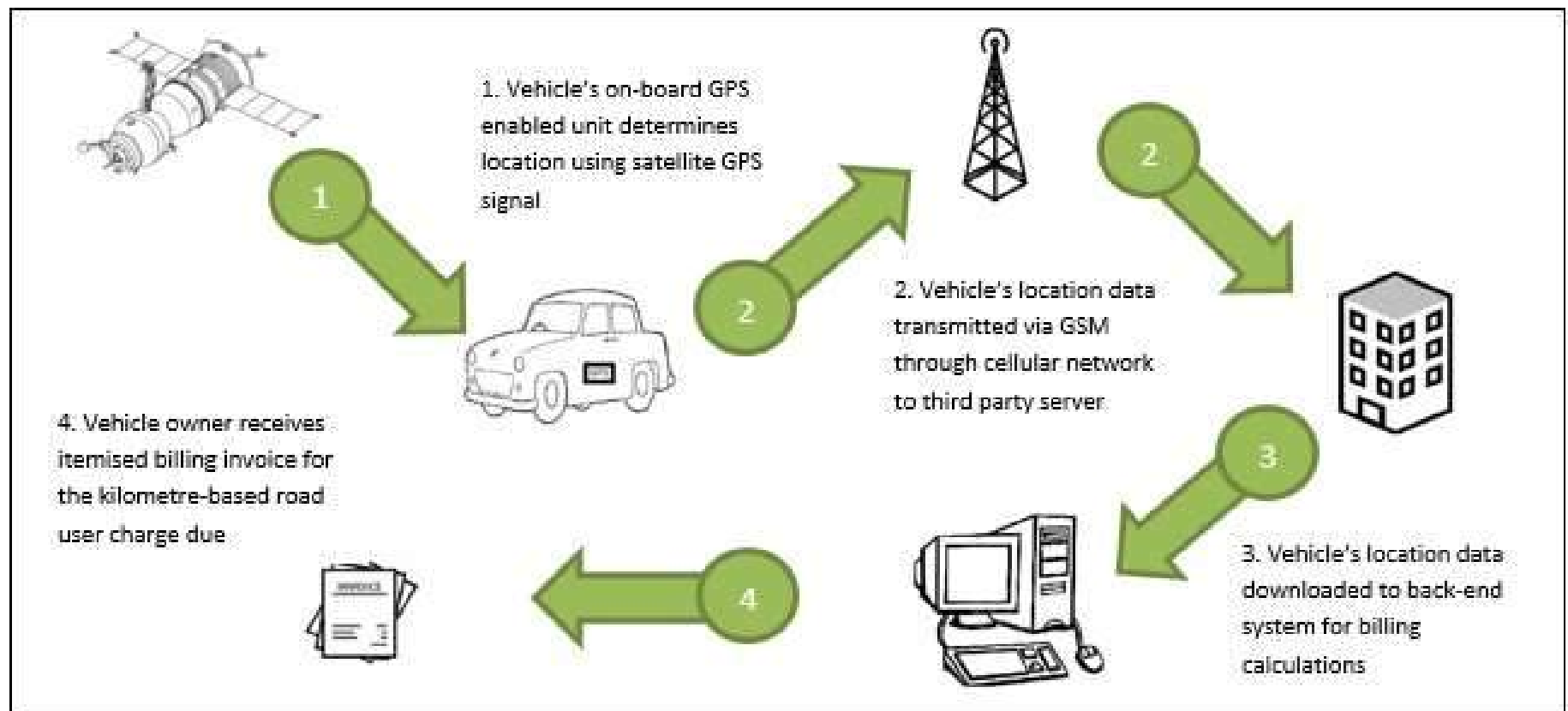
- Monthly invoice =

- **Base fee + Charge (c / km) x distance (km's)**



Significant hard and software issues ...

- We need to combine the infrastructure with additional data





How does it work?



Step 1: Register

It only takes a few minutes to register. Click the Sign Up button on the top right hand corner. You'll be notified on the status of your DRIVE application within 5 business days.



Step 2: Install

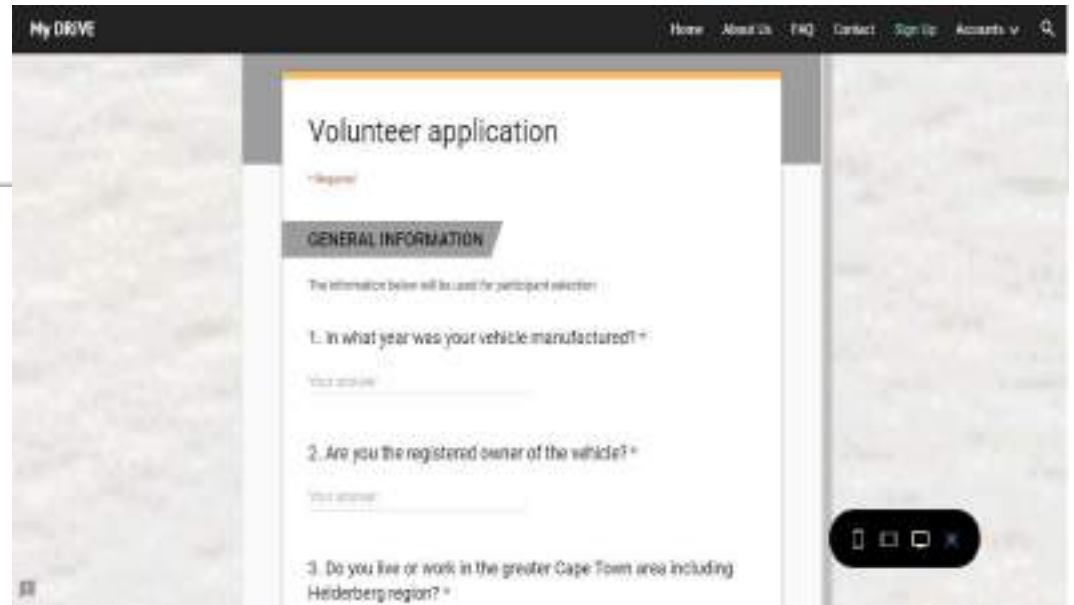
The device is very easy to install. It will be delivered to you within 5 business days upon registration approval. You just need to plug it into the diagnostic port of your vehicle.



Step 3: DRIVE

No further action required, just DRIVE and watch your account! You can follow your kilometres and fuel consumption online. A summary of your road charge and your fuel levy rebate will be visible every week. If there is a balance due at year end, we'll send an invoice with "payment" instructions.

Your active participation is only required every few months to complete a short survey.



Distance-based road user charging

Results so far:

- We can get technology working
 - Testing various devices
- We can extract accurate data:
 - Data from GPS is very accurate (*depend on service provider*)
- We can calculate a road user invoice based
 - Even differentiate per time of day
 - Level of congestion
 - Toll roads



| Time | Location | Speed | Altitude | Heading | Accuracy | Source |
|-------|------------|-------|----------|---------|----------|--------|
| 08:00 | 1000000000 | 100 | 1000 | 0 | 10 | GPS |
| 08:01 | 1000000000 | 100 | 1000 | 0 | 10 | GPS |
| 08:02 | 1000000000 | 100 | 1000 | 0 | 10 | GPS |



Individual University
 (Private Reg'd)
 (Institution)
 (NU)

Account number: 000001
 Reference number: 000001

Bill/Invoice Charge Period:
 From: 2015-08-01
 To: 2015-08-31

Participant A
 Address: N/A
 Gender: N/A
 Overweight: N/A

Account summary as of: 2015-08-31
 Previous account balance: 0.00

Current account due (X): 11.00
 Total due (X): 11.00

Account balance: 0.00

Account total: 11.00

Please note:

- Billed for use of National, Provincial and Municipal Parks
- Billed according to vehicle travelled
- Billed according to time of day travelled
- Vehicle will be charged on all routes (i.e. Outhanking after fuel sale)
- You may not avoid payment, even if you have contacted a query concerning this payment

Pay points: Stellenbosch University Cash Office or the vendors below

| Pay point | PayCode | DropOff | DropOff |
|--------------|----------|-------------|---------|
| Stellenbosch | WOODMONT | Park 9 gate | PostNet |

Account details as of: 2015-08-31

| Charge | Period | 2015-08-01 to: | 2015-08-31 | 20 |
|-------------|--------|----------------|------------|-------|
| 05143565 km | X | | | 11.00 |
| 12457007 km | X | | | 11.00 |

Total account total due: 11.00

| Segment | Start/End | Time | Speed | Altitude | Heading | Accuracy |
|--------------|-----------|------|-------|----------|---------|----------|
| Stellenbosch | 08:00 | 100 | 1000 | 0 | 10 | GPS |
| Stellenbosch | 08:01 | 100 | 1000 | 0 | 10 | GPS |
| Stellenbosch | 08:02 | 100 | 1000 | 0 | 10 | GPS |

| Segment | Start/End | Time | Speed | Altitude | Heading | Accuracy |
|--------------|-----------|------|-------|----------|---------|----------|
| Stellenbosch | 08:00 | 100 | 1000 | 0 | 10 | GPS |
| Stellenbosch | 08:01 | 100 | 1000 | 0 | 10 | GPS |
| Stellenbosch | 08:02 | 100 | 1000 | 0 | 10 | GPS |



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Some of our results

2. Testing Data: Findings (1)

1. Testing data

- Two service providers:
 - AFSOL
 - Cartrack
- Results:
 - CarTrack
 - Good Quality – Road name attribute helps a lot
 - Very good Map Functionality
 - Benefit is we have separate trips
 - They have user interface that we can use – user will be able to see their own trips
 - Afsol:
 - Data can be matched
 - Need separate trips
 - Still exploring Map Functionality
 - Big benefit is that already have a good source of data – we can get going



2. Testing Data: Examples (1)

CarTrack data

Page 1 of 1 Created: 2020-11-09 1 By: CARTR00375

Detailed Trip Report

Report shows all data recorded from "Ignition on" to "Ignition off" daily
 Date: 2020-10-27 00:30:00+0200 - 2020-10-27 23:59:00+0200

Working Hours: 00:24 - 23:33

Legend: Ignition On (Green), Ignition Off (Yellow), General Alert (Red), Excessive Speeding (Orange), Idle Hours (Pink)

| # Trip | Driver | License No. | Registration | PC55/0/GP-10/RAA | Duration | Start | End | Start Location | End Location |
|--------|--------|-------------|------------------|------------------|----------|-------|-----|--|---|
| 1 | | NA | FC55/0/GP-10/RAA | Taxi Auto | 0:08:53 | Start | End | Close to Du Noon, Vindian Street, Western Cape, South Africa | South Main House Park, Western Cape, South Africa |
| | | | | | Stop | | | | NA |

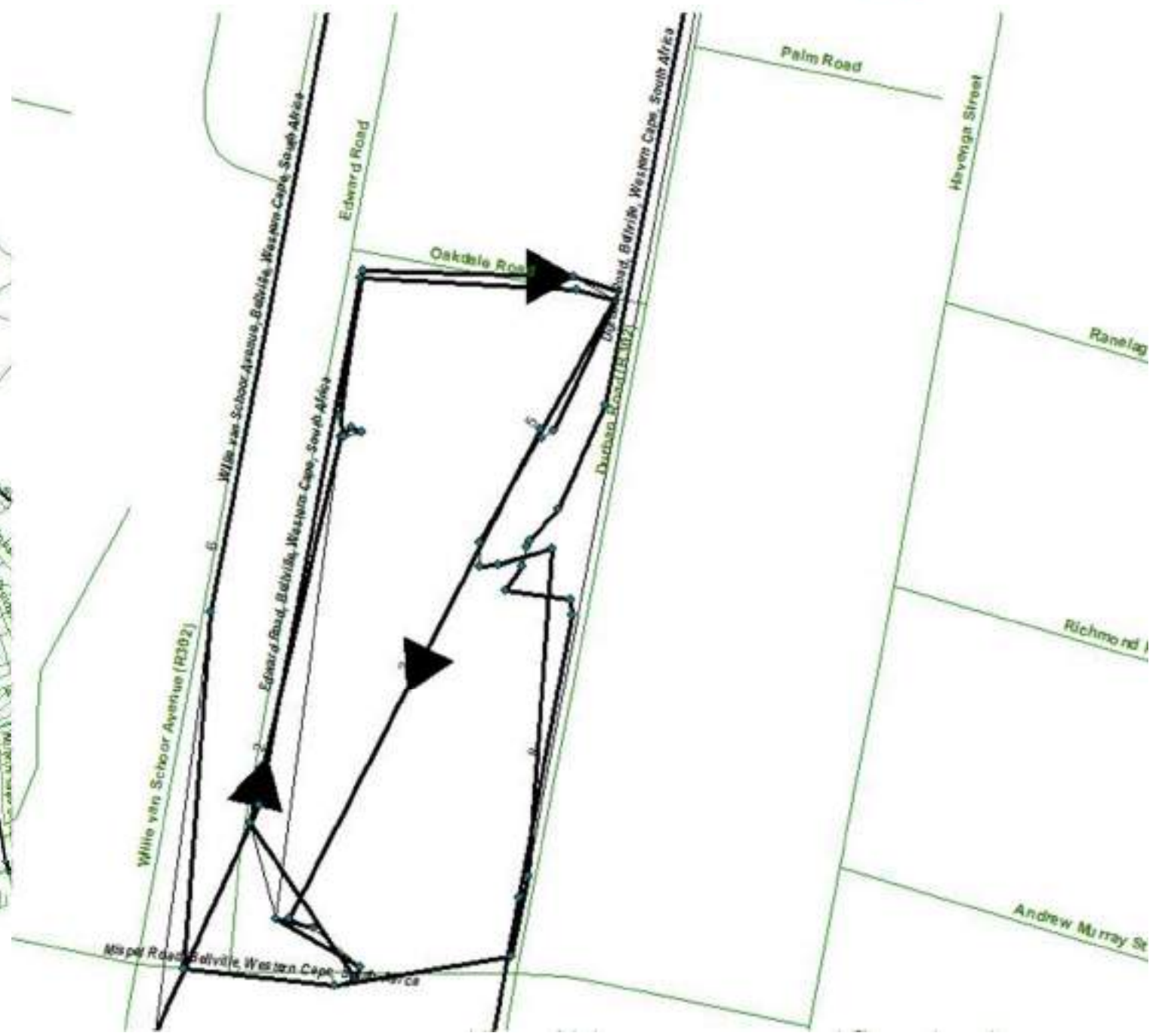
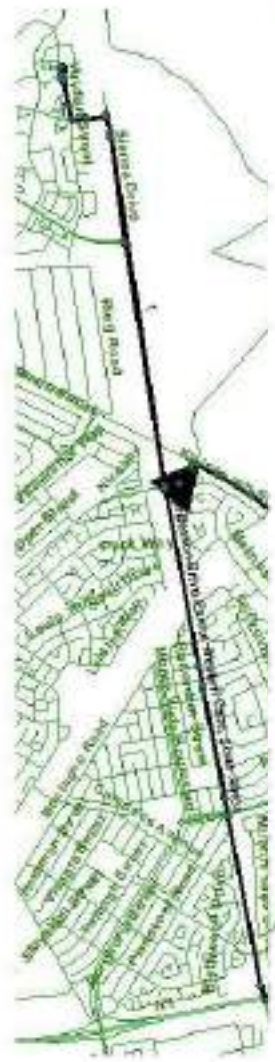
| Case | Date | Long | Lat | Location | Speed | Odometer | RPM | TPS |
|-------------|---------------------|-----------|------------|--|-------|----------|-----|-----|
| Ignition On | 2020/10/27 05:58:05 | 18.551884 | -33.895557 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 0 | 01468.0 | 0.0 | 0 |
| | 2020/10/27 05:58:02 | 18.551886 | -33.895552 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 0 | 01468.0 | 0.0 | 0 |
| | 2020/10/27 05:58:19 | 18.551886 | -33.895552 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 0 | 01468.0 | 0.0 | 0 |
| | 2020/10/27 05:58:45 | 18.551888 | -33.895427 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 0 | 01468.0 | 0.0 | 0 |
| | 2020/10/27 05:58:50 | 18.551890 | -33.895342 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 5 | 01468.0 | 0.0 | 0 |
| | 2020/10/27 05:58:34 | 18.550021 | -33.895793 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 15 | 01468.2 | 0.0 | 0 |
| | 2020/10/27 05:58:40 | 18.550008 | -33.895770 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 38 | 01468.25 | 0.0 | 0 |
| | 2020/10/27 05:58:50 | 18.550423 | -33.895487 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 58 | 01468.39 | 0.0 | 0 |
| | 2020/10/27 05:57:00 | 18.550408 | -33.895390 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 25 | 01468.49 | 0.0 | 0 |
| | 2020/10/27 05:57:10 | 18.552556 | -33.895273 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 42 | 01468.59 | 0.0 | 0 |
| | 2020/10/27 05:57:27 | 18.553999 | -33.895162 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 15 | 01468.71 | 0.0 | 0 |
| | 2020/10/27 05:57:37 | 18.554288 | -33.895990 | Close to Du Noon, Vindian Street, Western Cape, South Africa | 52 | 01468.90 | 0.0 | 0 |
| | 2020/10/27 05:59:16 | 18.557054 | -33.893022 | Grid Baseen Drive, Parow, Western Cape, South Africa | 27 | 01471.03 | 0.0 | 0 |
| | 2020/10/27 05:58:36 | 18.559099 | -33.892775 | BevanvandenRood Road, Parow, Western Cape, South Africa | 46 | 01471.12 | 0.0 | 0 |
| | 2020/10/27 05:58:36 | 18.559096 | -33.892870 | BevanvandenRood Road, Parow, Western Cape, South Africa | 21 | 01471.24 | 0.0 | 0 |
| | 2020/10/27 06:04:06 | 18.559793 | -33.893095 | BevanvandenRood Road, Parow, Western Cape, South Africa | 23 | 01471.28 | 0.0 | 0 |
| Turning | 2020/10/27 06:00:10 | 18.559301 | -33.893670 | Plotekhof Road, Parow, Western Cape, South Africa | 35 | 01471.28 | 0.0 | 0 |
| | 2020/10/27 06:04:20 | 18.559471 | -33.893387 | Plotekhof Road, Parow, Western Cape, South Africa | 67 | 01471.44 | 0.0 | 0 |
| | 2020/10/27 06:04:32 | 18.559363 | -33.893490 | Plotekhof Road, Parow, Western Cape, South Africa | 64 | 01471.68 | 0.0 | 0 |
| | 2020/10/27 06:01:03 | 18.559306 | -33.893922 | Plotekhof Road, Parow, Western Cape, South Africa | 58 | 01471.68 | 0.0 | 0 |
| | 2020/10/27 06:04:17 | 18.559454 | -33.893513 | Plotekhof Road, Parow, Western Cape, South Africa | 76 | 01472.22 | 0.0 | 0 |
| | 2020/10/27 06:01:30 | 18.579276 | -33.895395 | Plotekhof Road, Parow, Western Cape, South Africa | 71 | 01472.49 | 0.0 | 0 |



2. Testing Data: Examples (2)

AFSOL data

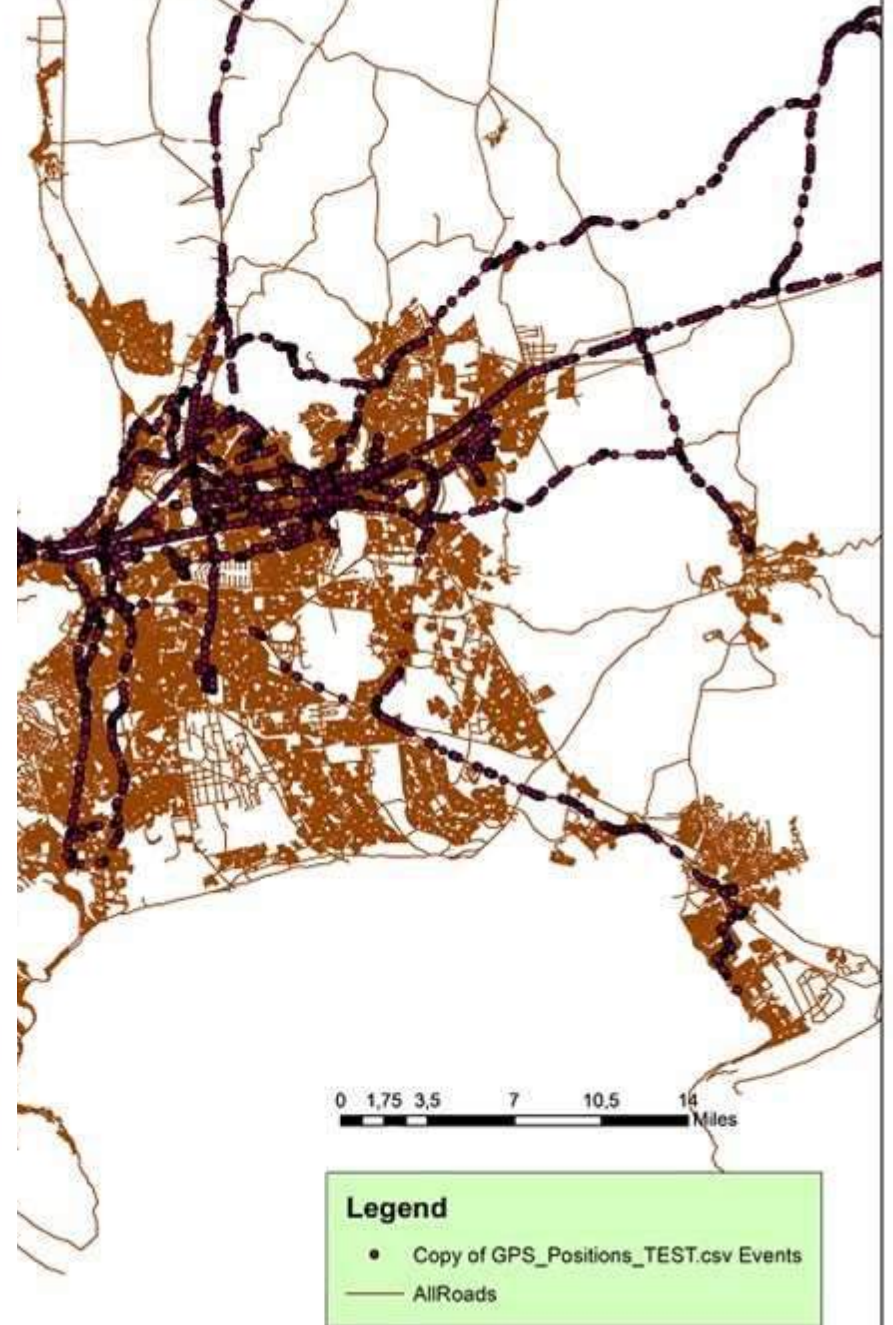
| CPSID | Asset ID | Time of reading (South Africa Standard Time) | Latitude | Longitude | Y-axis (m) | Altitude (m) | Heading | Number of satellites | HDOP | Age of reading | Distance since reading (m) | Driver ID | Reading source | Connected to asset | Has connected asset | Is satellite parked |
|-----------------|----------|--|------------------|-----------------|------------|--------------|---------|----------------------|------|----------------|----------------------------|-----------|-------------------|--------------------|---------------------|---------------------|
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| 728899207325688 | 548 | 20200801 06:03 | -33.02244 | 0.4906 | 8 | 24 | 278 | 5 | 4 | 0.0001 | 0.0001 | 5 | 548 LightningDart | False | False | False |
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| 728899207325688 | 548 | 20200801 06:05 | -33.02242 | 0.49036 | 8 | 23 | 316 | 5 | 1 | 0.0001 | 0.0001 | 7 | 548 LightningDart | False | False | False |
| 728899207325688 | 548 | 20200801 06:06 | -33.02242 | 0.49036 | 2 | 25 | 328 | 6 | 1 | 0.0001 | 0.0001 | 0 | 548 LightningDart | False | False | False |
| 728899207325688 | 548 | 20200801 06:07 | -33.02242 | 0.49036 | 7 | 25 | 332 | 6 | 1 | 0.0001 | 0.0001 | 0 | 548 LightningDart | False | False | False |
| 728899207325688 | 548 | 20200801 06:08 | -33.022418942232 | 0.4907779988128 | 8 | 24 | 196 | 6 | 1 | 0.0001 | 0.0001 | 0 | 548 LightningDart | False | False | False |



Afsol

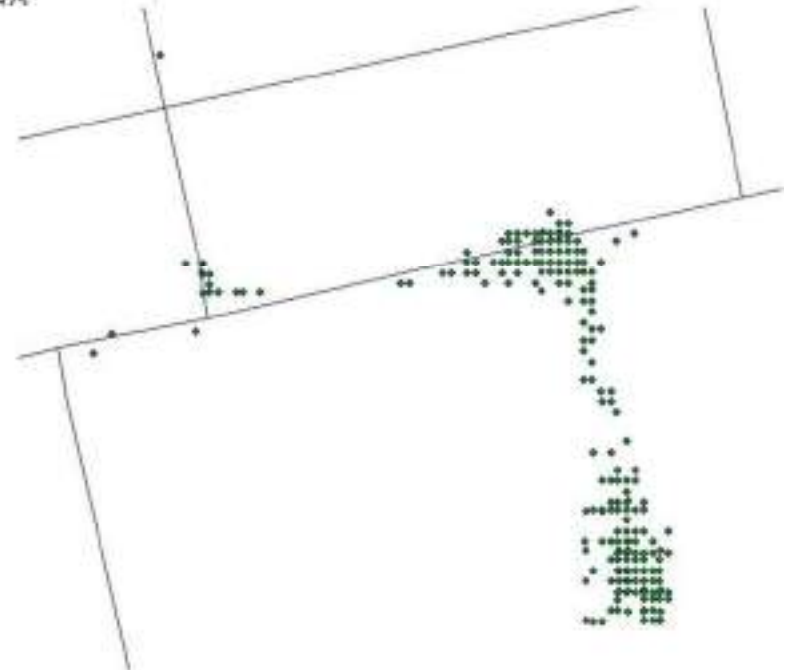
Tracking Data: Western Cape Provincial Government

Tracking Data: Western Cape Provincial Government



Some data issues

| A | B | C | D | E | V |
|---------------------|----------|--|-------------------|------------------|---|
| GPS ID | Asset ID | Time of reading (South Africa Standard Time) | Latitude | Longitude | |
| 2868685787842693104 | 18484 | 2021/03/01 14:45:58 | -33.92261 | 18.49853 | |
| 2868685938340459026 | 18484 | 2021/03/01 14:46:33 | -33.9224433898926 | 18.4983615875244 | |
| 2868685943094817613 | 18484 | 2021/03/01 14:46:34 | -33.92244 | 18.49836 | |
| 2868685961165706309 | 18484 | 2021/03/01 14:46:38 | -33.92247 | 18.49828 | |
| 2868685988986166476 | 18484 | 2021/03/01 14:46:45 | -33.9225 | 18.49808 | |
| 2868685998276356693 | 18484 | 2021/03/01 14:46:47 | -33.9225 | 18.49803 | |
| 2868686007196356610 | 18484 | 2021/03/01 14:46:49 | -33.9225 | 18.498 | |
| 2868686013709161864 | 18484 | 2021/03/01 14:46:51 | -33.9225 | 18.49794 | |
| 2868686018491657400 | 18484 | 2021/03/01 14:46:52 | -33.9225 | 18.49792 | |
| 2868686022981230613 | 18484 | 2021/03/01 14:46:53 | -33.92247 | 18.49789 | |
| 2868686034336790578 | 18484 | 2021/03/01 14:46:55 | -33.92244 | 18.49786 | |
| 2868686042932803964 | 18484 | 2021/03/01 14:46:57 | -33.92239 | 18.49783 | |
| 2868686048437748374 | 18484 | 2021/03/01 14:46:59 | -33.92236 | 18.49783 | |
| 2868686064518509611 | 18484 | 2021/03/01 14:47:02 | -33.92228 | 18.49783 | |
| 2868686149543129960 | 18484 | 2021/03/01 14:47:22 | -33.92161 | 18.49761 | |
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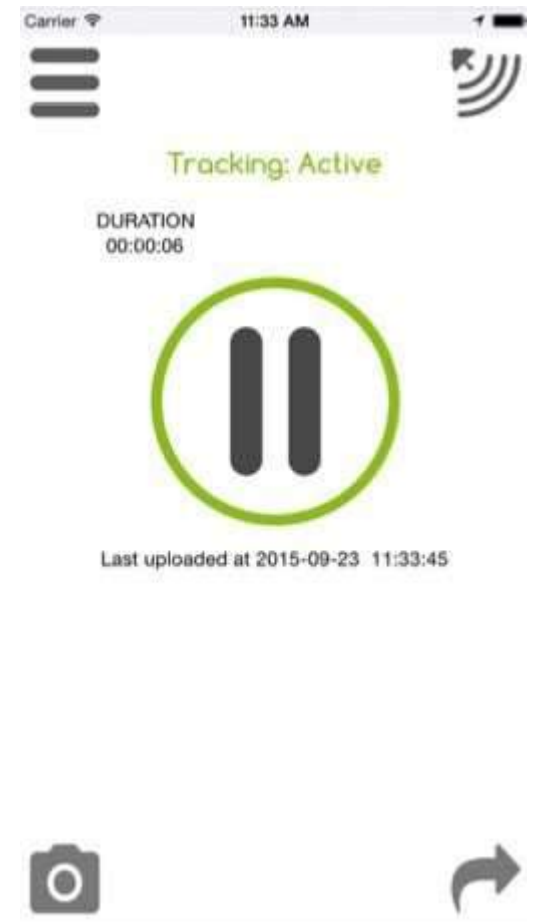
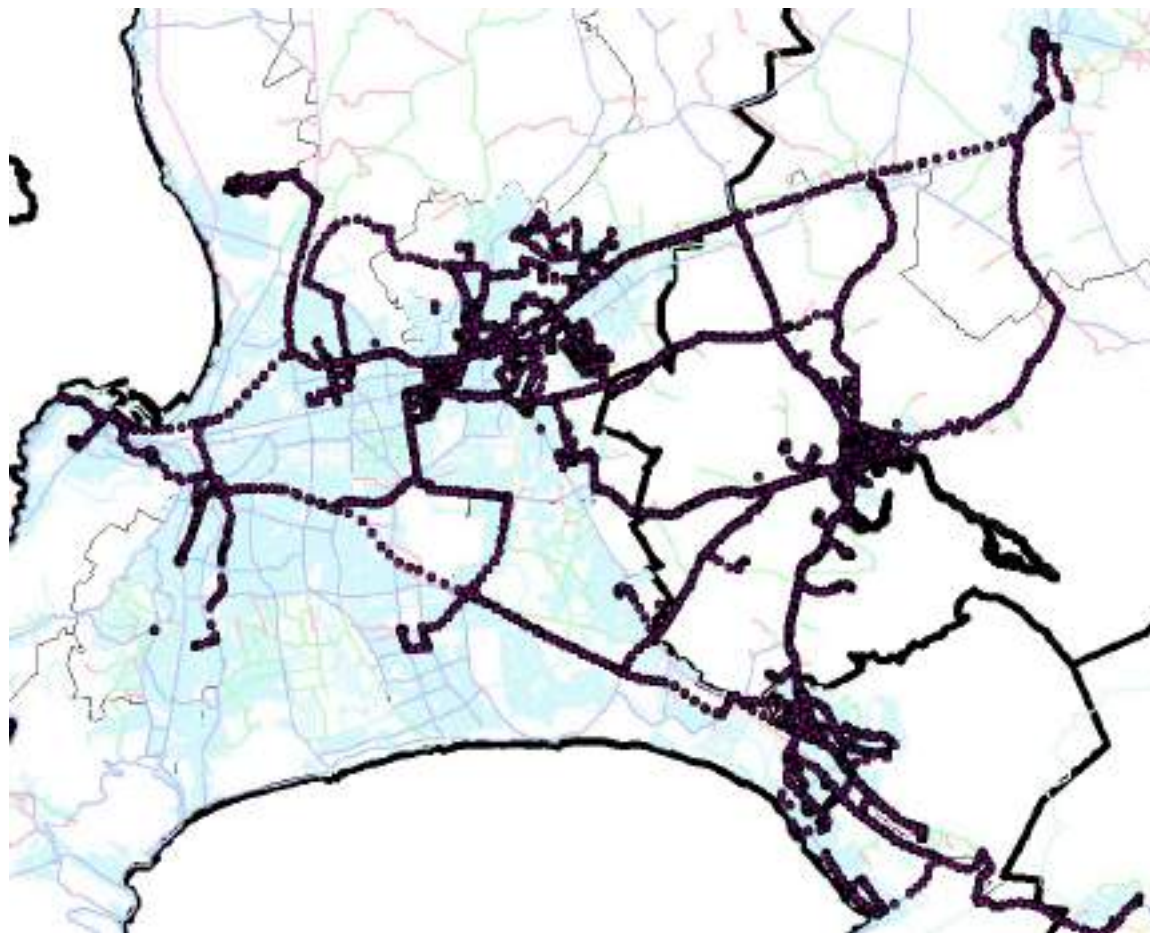


Some data issues



For road user charging you need close collaboration between local, regional and national road authorities ...

Some results of what is possible... other benefits ...



Distance-based road user charging

□ Pilot results

- We can recover the true road user cost
 - Even from fuel efficient, electric and hybrid vehicles
- *May result in a change in travel behaviour if users know their travel cost*
 - We show them their road usage cost per month
 - Also travelling statistics such as time, speeding, etc.
- People may understand better what they pay for...
- A lot of other benefits
 - Origin and destination data
 - Household surveys
 - Dynamic travel data

| | Kms driven | Average revenue required per km to sustain road network (infrastructure and operations) - 67 R/km | Revenue collected | | | | |
|----------------|---------------|---|-------------------|---|---|------------------------------------|---|
| | | | Current system | Proposed RUC system | | | |
| | | | Approach 1 | Approach 2 | Approach 2 | Approach 4 | Approach 5 |
| | | | Fuel tax | Oregon / California's current fuel tax per average fuel efficiency US ave | Oregon / California's current fuel tax per average fuel efficiency SA ave | Average social marginal cost (SMC) | Freeman's average cost allocation - 58 R/km for vehicle class |
| Participant 1 | 1 019 | R683 | R576 | R485 | R328 | R2 364 | R987 |
| Participant 2 | 1 358 | R775 | R459 | R459 | R572 | R1 064 | R666 |
| Participant 3 | 1 332 | R759 | R452 | R474 | R584 | R502 | R652 |
| Participant 4 | 1 200 | R800 | R367 | R505 | R408 | R2 935 | R695 |
| Participant 5 | 3 014 | R2 019 | R786 | R1 263 | R1 021 | R4 811 | R1 736 |
| Participant 7 | 1 086 | R694 | R337 | R434 | R351 | R2 053 | R597 |
| Participant 8 | 662 | R443 | R374 | R263 | R213 | R394 | R381 |
| Participant 9 | 813 | R545 | R348 | R340 | R276 | R394 | R468 |
| Participant 10 | 918 | R615 | R244 | R384 | R295 | R5 154 | R529 |
| Participant 11 | 787 | R527 | R505 | R312 | R253 | R2 680 | R453 |
| Participant 12 | 1 480 | R1 048 | R705 | R1 030 | R834 | R1 925 | R1 418 |
| Participant 13 | 423 | R284 | R239 | R168 | R136 | R1 123 | R244 |
| Participant 14 | 1 222 | R1 689 | R810 | R930 | R753 | R2 989 | R1 280 |
| Participant 15 | 789 | R529 | R241 | R330 | R267 | R535 | R455 |
| Participant 16 | 1 398 | R801 | R365 | R500 | R405 | R536 | R689 |
| Participant 17 | 1 008 | R674 | R202 | R421 | R341 | R2 431 | R580 |
| Participant 18 | 1 065 | R1 383 | R549 | R864 | R700 | R5 267 | R1 190 |
| Participant 20 | 1 527 | R1 023 | R376 | R639 | R518 | R441 | R880 |
| Total | 28 427 | R15 696 | R7 722 | R9 687 | R7 854 | R35 487 | R13 497 |

Technical

☐ Staff:

- Luciano Marshall – M student
 - Road User Charging Experiment
- Helvi Petrus
 - HDM – Road user cost

- Megan Bruwer (Civil Engineering, University of Stellenbosch)
 - Floating Car data
- Missing:
 - GIS experts
 - Website designer
 - Database experts
 - Stephan Krygsman taking care of the these task

- External advisors
 - Bert van Wee (Delft University of Technology, Road Funding Policy – The Netherlands)
 - Tom De Jong (Utrecht – Spatial Data)



The End