

# Tran:SIT E-bike Report



**Compiled by: Sustainable Energy Africa**

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## **1. Introduction**

In the context of rising fuel costs and increased awareness around more sustainable forms of transport, new forms of transport are being introduced to the South African market. One such product is the e-bike – a battery driven mountain bike which promises to be a viable alternative to the scooter/small motorbike market.

The e-bike can be effectively used for errands and trips where not much storage space is required, and is ideal for daily trips to work. The range of the bike is approximately 20km before the battery runs low and needs to be recharged. Pedalling is not required on the flat, downhill or gentle uphill (unless you wish to go faster), but is required to go up steeper hills comfortably.

The degree of exercise required to ride the bike can be determined by the rider. It is possible to have anything from a totally relaxing trip to a really good exercise session, depending on the effort the rider puts in.

## **2. Technical Assessment**

### **a. Overview**

The e-Bike is the mini version of the electric car. It is powered by a rechargeable battery which drives an electric motor positioned on the front wheel. The motor is brushless and virtually maintenance free.

The motor is engaged with the use of a twist grip throttle on the right hand handle- much like a motorbike throttle. Gears can be changed from a selector on the right hand handle.

The bike travels at a steady 27km/h on the flat without any additional pedalling assistance. With comfortable pedalling the speed can increase to 30km/h and with aggressive pedalling can reach 35km/h. On an uphill one can expect to travel around 16km/h without pedalling (depending on the steepness) but this can be radically improved to 23km/h with comfortable pedalling. Aggressive uphill pedalling will see the bike reach 27km/h. On a downhill, the motor is not required, and the bike can reach upward of 40km/h with pedalling. Through its period of testing the e-bike delivered an average speed of 25km/h with comfortable pedalling.

The initial expectation from the bike was that it would recharge on downhill sections of the ride when the motor is not being used. This however is not the case. Recharging is done exclusively through a charger which plugs into the electricity mains. Recharging time is approximately 3-4 hours depending on how depleted the battery is.

The economy rate of the e-bike is typically 80c/100km. When compared to an economical scooter of R15/100km, the financial savings are immediately apparent. When compared to an average car of

R60/100km, the prospect of using an e-Bike instead of driving a car wherever possible is even more attractive.

#### **b. Specifications**

- Standard 6 speed 26" mountain bike with mudguards and safety reflectors
- 400W Silent Hub motor
- 3x12V 12A.h Lead Acid Battery (430Wh)
- Off road tyres
- Bike stand

#### **c. Performance**

Average Energy required/km	20wH
Maximum Range:	21km
Overall Average speed:	25km/h (comfortable pedalling)
Cost/100km:	80c (based on current electricity rate of 40c/kWh)
Recharging time:	2-4 hrs

#### **d. Practical considerations**

##### **i. Weight**

The e-bike is cumbersome, with a heavy battery at the back and a heavy motor on the front wheel. It should not be compared to a standard bicycle but rather to a scooter or a small motorbike. Weight is an important consideration on several counts.

- Firstly, it is inevitable that in order to store the e-bike safely, or to access a power point to recharge the bike, a certain amount of steps will need to be negotiated at some point. Lifting the e-bike up or down stairs will prove to be difficult, particularly for women and children.
- Secondly, the weight of the e-bike makes pedalling it without assistance from the motor very difficult and tiring. This is problematic should the battery run flat, a connector lose contact or the motor malfunction while on a journey.
- Thirdly, if the e-bike gets a puncture and cannot be ridden, pushing it to a place of safety or repair (particularly up a hill) will require great effort.
- Fourthly, it is very difficult to transport the e-bike in a standard car. The battery is not secure when placed on its side, it is unlikely to fit into most car boots, and if it does, will require at least two people to lift it in and out.

##### **ii. Maintenance**

The e-bike has standard mountain bike fittings, so maintenance of these parts will be in line with maintaining a standard mountain bike. However, due the weight of the bike, wear and tear on the parts will be greater than on a standard bike. This is particularly true for the braking system. The hub motor is very low to no maintenance as there are no moving

parts in it. Batteries do deteriorate over time-no information is available on how many charging cycles the e-bike's battery can go through before failing. A good ball park figure though would be around two years of regular use.

**iii. Charging time and distance limitations**

It is important to realize that the e-bike can only be used for up to 20km in total before it needs to be recharged. A full recharge will require 3-4 hours of non use. Careful planning around use of the bike is therefore necessary. If a trip to work is 15km for example, the charger needs to come along, and the batteries need to be recharged over the working day. Long charging time and limited range are disadvantages of the e-bike over a petrol or diesel driven vehicle.

**iv. Braking**

Due to the weight of the e-bike, its momentum is greater that of a standard bike. This means that the brake system has to work much harder to slow the bike down to a stop. The brakes, while not unsafe, do respond slower than those of a standard bike.

**v. Battery Charge Indicator**

There is an indication panel next to the throttle on the left handlebars with three indicators

- Red indicator -burns if the battery has been connected to the motor (power),
- Green indicator-burns if the battery charge status is high
- Orange indicator-burns if the battery charge status is low

This is not a satisfactory design, as the battery runs out very shortly after the orange battery low indicator comes on. There is therefore insufficient warning available for the e-biker that the battery will go flat on the ride. Changing the battery charge indicators to a 4 step system would be substantially more useful and improve user confidence when using the e-bike.

**vi. Throttle design**

The throttle has a spring action. The more you twist it, the more the motor engages and the faster the bike goes. On releasing the throttle it springs back to its resting place and the motor is not engaged. Although this system is fine for short distances, it does require some effort to keep the throttle engaged for longer trips. Wrist fatigue is a factor here, and does count against this particular design. A push button throttle is also available, and may be a better choice when purchasing an e-bike.

**vii. Licensing**

The e-bike does not require a license to drive it on the road. In this respect it is considered a bicycle by the Department of Transport.

**viii. Recharging**

Each e-bike user will need to learn how to recharge the e-bike safely. Although the process is relatively simple, some instruction will be required initially.

### 3. Safety of use in Cape Town

The e-bike does not go fast enough to allow the rider to ride in the road like a motorbike or scooter would. In this respect, it is to be ridden as one would ride a bicycle- on the left hand verge of the road or on pavements or bike paths. The e-bike is not allowed on the freeway. A benefit of the e-bike's mountain bike frame and wheels is that it can be used on dirt verges with very little chance of damaging the bike or getting a puncture. It is compulsory to wear a bicycle helmet in South Africa.

Bicycle safety is a big issue when considering Cape Town roads. Many of Cape Town's busy suburban roads are narrow with no verges. This makes any form of bicycle riding unsafe in these areas, as the bike occupies a section of the vehicle lane required for normal driving. The e-bike should be ridden on wider roads where there is comfortable room for a bicycle to the left of the vehicle lane, on a dirt verge running next to the road, or on a bicycle path or pavement where available. Routes should be planned carefully around these considerations, as safety on the road when riding is of primary importance.

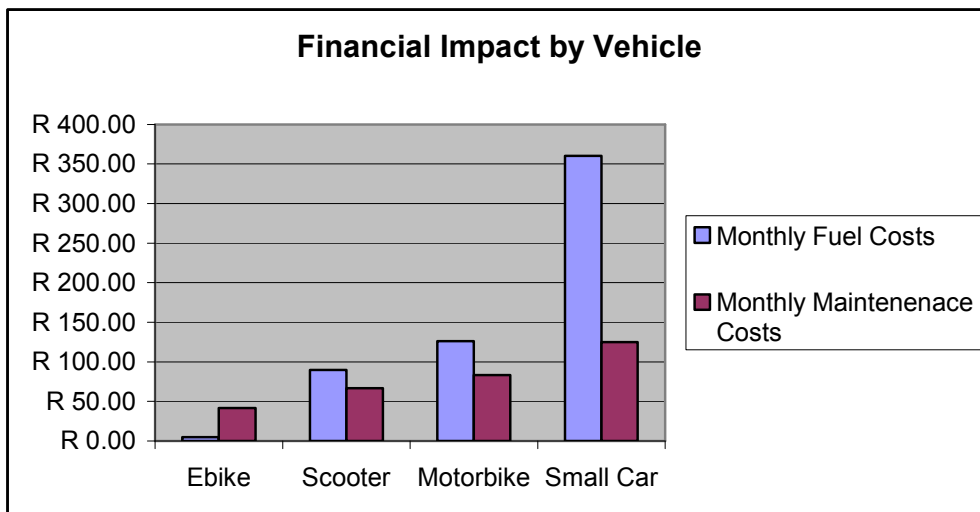
### 4. Comparison with other forms of transport

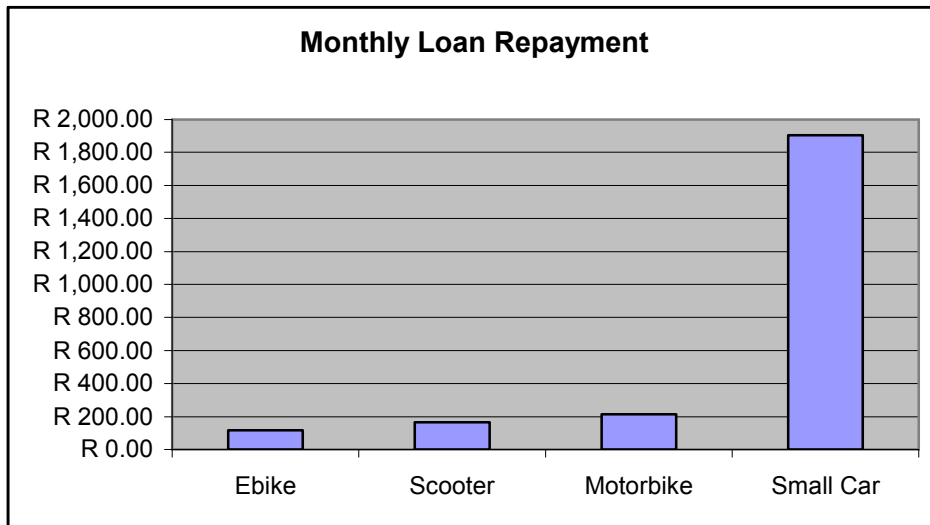
#### Financial Impact

	<b>Ebike</b>	<b>Scooter</b>	<b>Motorbike</b>	<b>Small Car</b>	<b>Taxi</b>
<b>Capital Cost</b>	R 5,000.00	R 7,000.00	R 9,000.00	R 80,000.00	
<b>Monthly Repayment (at 15%pa, 5yrs)</b>	R 118.25	R 166.53	R 214.11	R 1,903.19	
<b>Running cost/100km</b>	R 0.80	R 15.00	R 21.00	R 60.00	
<b>Average distance used/day (km)</b>	30	30	30	30	30
<b>Fuel cost to run/day</b>	R 0.24	R 4.50	R 6.30	R 18.00	
<b>Fuel cost to run/month</b>	R 4.80	R 90.00	R 126.00	R 360.00	
<b>Monthly Maintenance (parts,servicing etc)</b>	R 41.67	R 66.67	R 83.33	R 125.00	
<b>Total monthly costs</b>	R 159.92	R 233.20	R 297.44	R 2,028.19	R 360.00

#### **Assumptions:**

Fuel economy of Scooter (l/100km)	2
Fuel economy of Motorbike (l/100km)	3
Fuel economy of Small Car (l/100km)	8.5



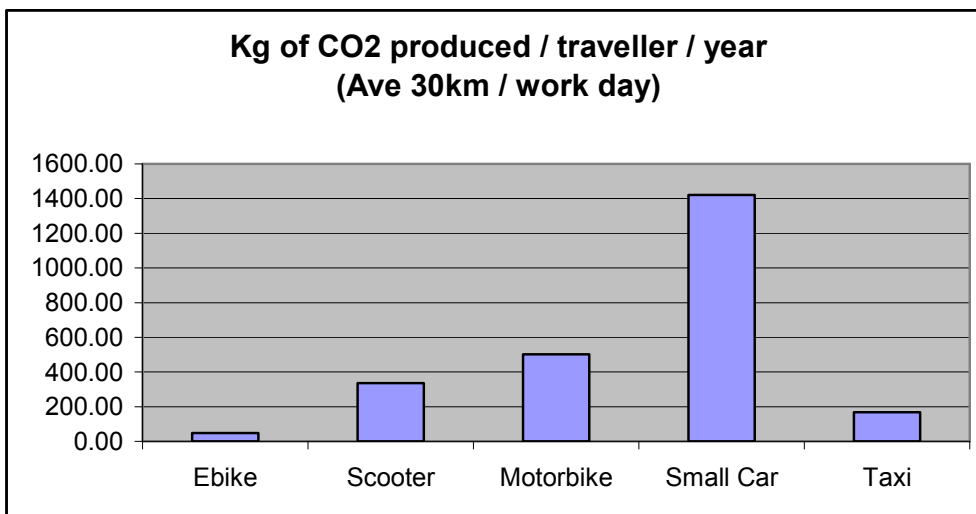


### Environmental Impact of traveller

	<b>Ebike</b>	<b>Scooter</b>	<b>Motorbike</b>	<b>Small Car</b>	<b>Taxi</b>
<b>kg CO2/km</b>	0.00677	0.04645	0.06968	0.19742	R 0.02
<b>Average distance used/day (km)</b>	30	30	30	30	30
<b>kg CO2/day</b>	0.20	1.39	2.09	5.92	0.70
<b>kg CO2/month</b>	4.06	27.87	41.81	118.45	13.94
<b>kg CO2/year</b>	48.73	334.45	501.68	1421.42	167.23

#### **Assumptions:**

1 person travelling in car 10 people travelling in taxi
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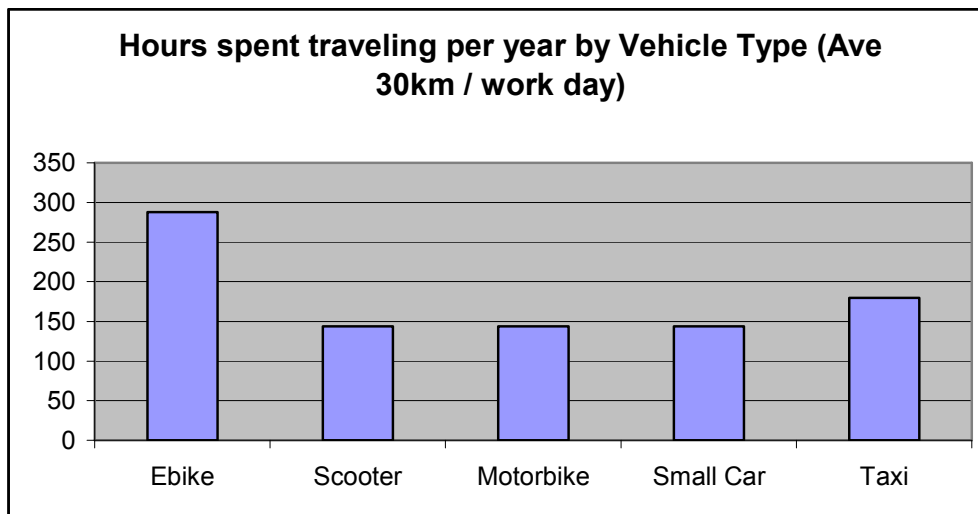


## Social Impact

	<b>Ebike</b>	<b>Scooter</b>	<b>Motorbike</b>	<b>Small Car</b>	<b>Taxi</b>
<b>Average distance used/day (km)</b>	30	30	30	30	30
<b>Time spent travelling/day (hours)</b>	1.2	0.6	0.6	0.6	0.8
<b>Time spent travelling/month (hours)</b>	24	12	12	12	15
<b>Time spent travelling/year (hours)</b>	288	144	144	144	180
<b>Health Impact</b>	Medium/High	None	None	None	None

### **Assumptions:**

Average speed of Scooter (town traffic)	50 km/h
Average speed of Motorbike (town traffic)	50 km/h
Average speed of Small Car (town traffic)	50 km/h
Average speed of Taxi (town traffic)	40 km/h



## **5. Conclusions and recommendations**

The e-bike has several benefits over other forms of transport:

- 20 times cheaper to run than most fuel economical scooter
- Lower capital cost
- Lower maintenance costs
- 7 times less CO<sub>2</sub> produced than most fuel economical scooter
- Less strenuous than bike riding – no need to change clothes or shower when destination is reached
- Healthier alternative to other motor driven transport

Some of the disadvantages of the e-bike over other forms of transport are:

- Cumbersome for storage and recharging
- Longer travelling time
- Limited range
- Long recharging time
- Design problems: Battery status indicator inadequate, throttle system tiring on wrist
- Several unsafe roads in Cape Town for e-biking

From a sustainability perspective, the benefits of the e-bike greatly outweigh the disadvantages, provided the amount of travelling required per day falls within the e-bike's limited range.

It is recommended that:

- The e-bike be used wherever possible as an alternative to liquid fuel driven forms of transport (work, errands) due to the sustainable benefits listed above
- Certain design considerations (weight, battery status indicator, throttle system) be taken into account when purchasing an e-bike
- Safety of route be carefully considered when planning trips on e-bike
- The e-bike is maintained regularly:
  - Brakes be checked for wear and tear
  - Battery tested every 3 months
  - Check that the points of contact between wires are well connected and secured
  - Tyres be maintained at recommended pressure