What do we mean by low carbon transport?

UNDERSTANDING HOW PEOPLE MOVE IN CAPE TOWN
Open Streets Briefing Paper:

What do we mean by low carbon transport? Understanding how people move in Cape Town

Author: Lisa Kane

Reviewed by: Zanie Cilliers, Adrian Stone & Megan-Euston Brown from Sustainable Energy Africa (SEA); Philip van Ryneveld, Marco Geretto & Marcela Guerrero Casas from Open Streets Cape Town.

Data Analysis and Modelling Contributions: HJ Nel & Zanie Cilliers.

Infographics: Concept by Lisa Kane and Open Streets Cape Town.
Design: prettysim.pl

September 2016
Background

Transport is a significant, rapidly-increasing and stubborn-to-change system contributing to climate change through the burning of mainly petrol and diesel. It is a particularly significant emitter of carbon, one of the greenhouse gases. The ideas of “low carbon”, “sustainable” or “green transport” are reactions to the knowledge that without changes to our worldwide transport systems, growth in transport emissions, and therefore climate change impacts, is almost inevitable. Experts report that there is no single solution to the transport emissions challenge and that technology advances in fuel efficiency cannot resolve the problem. A basket of measures will be needed. Africa currently accounts for less than 5% of worldwide carbon emissions from transport, but it is expected to be a growing share.

A brief history of low carbon transport in South Africa

Prior to the World Summit on Sustainable Development in Johannesburg 2002, little attention was paid to the impacts of transport on the climate in South Africa. The focus of energy and climate change policy-making was largely on electricity production and industry. The focus of traditional transport planning at the time was on reducing congestion, with some road safety improvements in mind. More recently there have been efforts to improve public transport (although climate change mitigation has not been a major motivation for this. A major reason for public transport improvements has been to enhance mobility). The push for public transport can be seen across the country with initiatives such as Gautrain, Rea Vaya Bus Rapid Transit and MyCiTi Bus Rapid Transit coming on-stream since 2010.

In more recent years, awareness of the role of the transport sector in addressing climate challenges has increased although national frameworks which consider carbon emissions specifically are still relatively limited. At a national level the Public Transport Strategy and Action Plan and the National Transport Master Plan call for a consideration of carbon emissions. The South African transport-climate change commitments are outlined in the National Climate Change Response Policy. The City of Johannesburg has probably been the city with the most substantial set of programmes to address transport energy and emissions challenges. These have included better public transport, attention on eco mobility (pedestrian and cycle infrastructure and visible community campaigns) and a big push towards spatial development that prioritises public transport networks. Some of these initiatives have filtered down to the mid-sized cities and towns, but there is still a capacity gap in bringing energy and emissions awareness into spatial development and transport planning. The City of Cape Town has recently increased attention on pressing transport energy and emissions problems.

There is also an emerging non-governmental sector paying attention to transport, climate change and related concerns with urban form and access, as demonstrated by WWF’s Low Carbon Transport Programme and Sustainable Energy Africa’s work in several local municipalities across Africa, many with a low carbon transport element. The last five years has seen the emergence of practical responses to climate change from transport activists. This has been particularly strong in the cycle advocacy space.

In terms of policy discussions, ideas of Transit Oriented Development (TOD) appear to be gathering traction at local level. Travel Demand Management (TDM) strategies for the central city aimed at curbing the growth in single occupancy vehicles have been discussed and can support emissions reductions, but as 85% of all Cape Town trips take place outside the central city boundaries the Travel Demand Strategies will need to reach beyond the central city in order to be effective for substantial emissions reductions. Furthermore, any policy moves are somewhat countered by ongoing calls for traffic congestion relief and the reality of year-on-year increases in car ownership.

In reality, despite academic work, policy and activist pushes, carbon emissions from transport have not yet reduced or even stabilised in South Africa. The policy levers that will be needed to contain or reduce transport emissions are well understood. How hard government will need to invest resources in these, and exactly which levers will yield most results in order to reach energy and emissions policy goals, is only now beginning to be explored. Going forward, even more specific and detailed visions are needed.

This briefing paper starts to fill some of the knowledge gaps, using detailed household travel and trip diary surveys from the City of Cape Town.


Urban transport in any city is a complex and multi-faceted phenomenon. Trying to understand the climate impacts of such a complex and rapidly changing system can be challenging. Despite this, some things are reasonably well understood and established (the relative energy efficiencies and emissions of vehicles in use, for example).

The graph below compares energy usage across vehicles. We know from this that on a vehicle-for-vehicle comparison, electric cars are more energy efficient than minibus taxis. But thinking only about vehicles is highly misleading. We are concerned about the energy-efficiency of moving people. Some vehicles, such as public transport vehicles, typically carry many occupants and so we get a very different picture of energy efficiency of transport when we compare the energy efficiency of passenger movement instead of vehicle movement. The graph also shows how cars, even hybrid cars, are currently inefficient energy users due in part to the low occupancies of use. While hybrid vehicles are manufactured for optimum energy efficiency, the way cars are used in our current society (that is, driving around with most seats empty most of the time) makes a hybrid car an inefficient way of moving people around. The various bus and taxi options are half as energy intensive in moving people compared to cars. Rail is the least energy intense mode (that is, it needs the least energy to travel a passenger-km). This is thanks in part to the technology and partly to the typically high occupancy of trains in South Africa. Walking and cycling, though, are the most energy efficient modes of transport. They use no fossil fuels directly (although some energy is, of course, used in food production). Walking or moving by bicycle uses no or only very light vehicles and so they are the least energy intensive modes of movement.

**Energy efficiency and emissions – the important vehicles-people-occupancy link**

Data: City of Cape Town, 2013 and Sustainable Energy Africa (SEA). Analysis: Zanie Cilliers, SEA
Looking at the climate impacts of transport modes weakens any argument for electric cars in South Africa, at least in the short term. In terms of emissions intensity, electric cars perform poorly in this comparison, largely thanks to the relatively dirty South African electricity production which is largely based on emissions-intensive coal sources. Low car occupancies exacerbate the problem (this picture changes, though, if we assume sufficient nuclear-generated or renewable energy sources are built).

MyCiTi buses fare well on climate and energy indicators given the relatively new, energy-efficient and low carbon-emitting fleet. Minibus taxis, though, also fare well on this comparison. Although many of the minibus taxi vehicles may not be as modern as MyCiTi buses, they are relatively light vehicles which are well occupied for much of their operating day.
By who, when, where and why are transport emissions generated?

Who is using the transport system, where, when and why is less well-understood than vehicle energy intensity and emissions factors. This leads to the problem of knowing precisely where and how to make changes to the system. Below we unpack the rich picture of passenger transport in Cape Town, using the latest available comprehensive data from 2013.

The data used for this briefing paper captured all ‘modes’ of moving around the city, including walking, and gave most detail for the first trip of the day to either work or education. A smaller, more detailed survey looked at trips across the whole day. From that all-day survey we know that “going to work” accounts for less than a quarter of all trips across the day (although going to and from work is the main reason people travel). We also know that in Cape Town, for every two morning trips to work, there is one trip to a place of education.

In Cape Town, ‘car drivers and their passengers going to work’ account for 24% of all morning trips. ‘Walking to education’ accounts for 16% of all morning trips. Thinking instead about the distance travelled in the morning, ‘car drivers and their passengers going to work’ account for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people. Although walking to school and places of education accounts for 30% of the distance covered by people.

Thinking about transport beyond the congested morning peak

Although morning peak travel analysis is useful it can paint a distorted picture. Approximately 30% of trips take place in the morning peak period, but that leaves 70% which take place outside those peak morning hours. For an energy and emissions analysis, these trips are as important as morning peak studies.

Thinking ‘beyond the peaks’ also challenges us to think about the social role that transport plays, in giving people access to things other than work and schools: to shopping, health and other services, and to each other.
Travel by minibus taxi (including employer buses), regular bus and train users going to work, account for 55% of the distance covered by people in the city in the morning. MyCiTi (which in 2013 was at an early stage of roll-out) accounted for less than 0.5% of the passenger-kms travelled in the morning.

For morning trips to education, the proportions of passenger-kms from the various modes are fairly evenly distributed at around 2-3% each. Bus and train use dominate the longer education trips. Walking and car passengers dominate the shorter education trips. Cycling and motorcycling account for small proportions of education passenger-kms (<0.5% in total).

Driving to work dominates the passenger-km profile of morning trips (25%), followed by bus (18%), minibus taxi (14%) and train (13%). It’s unclear, however, how many of the ‘work’ trips also involve dropping children at school. Employer transport accounts for a surprisingly significant amount of passenger-kms to work (5%).

Looking at trip speeds and the travel distances in the morning across the City, a fairly consistent picture emerges. Residents from Mitchells Plain/Khayelitsha face both the longest and the slowest work trips. This data highlights the ongoing legacy of apartheid and the travel barriers daily faced by residents in the South East of the city.

Breaking down the data into roughly equal income class groups (where class 1 is low-income and class 5 is high-income) shows a fairly consistent picture for ‘travel time budgets’ across income groups, with education trips on average of around 30 minutes, regardless of class. Work trips are between 50 and 60 minutes.

Interrogating further, we see that morning trips for the poorest are largely walking or on public transport, with very few energy-intensive car trips made in this income group.
For the middle class, almost a third walk to school or work and over 45% move by public transport. The emissions-intensive car accounts for a fifth of all trips in this group.

For the highest class, the emissions-intensive car trip dominates and walking accounts for less than 10% of morning trips. We can see then, how the extent of walking and individual car usage in a person’s daily life is defined by class.

Thinking across gender lines reveals interesting differences in how men and women are moving to work. The graph below shows how men dominate energy-intensive car driving, while women are more likely than men to be car passengers. Women use the less energy-intensive bus and minibus taxi modes in greater numbers than men. This finding compares well with analyses of the Nelson Mandela Municipality, where men were found to use cars more. There, 28% of all trips by men were made by car compared with 22% by women

**Income, energy and emissions**

This data shows that high income groups in Cape Town are predominantly car users and thus are energy- and emissions-intensive in transport terms.

This confirms work from Nelson Mandela Municipality where it was found that the highest income 20% of the people consume about 80% of the transport energy.

Analysis of Gauteng transport data found that the 20% highest income group was responsible for almost 60% of passenger transport emissions.

---

Thinking beyond work and education trips in the morning peaks shows the full complexity of why people move. Shopping, in particular, accounts for almost 10% of all day trips during the Monday-Friday week. Visiting and picking up or dropping off others, recreation and medical trips collectively account for almost as much activity as shopping. These, and the poorly understood weekend trips, are all important to consider in targeting emissions reductions.

Data: City of Cape Town, 2013, Table 12. Analysis: HJ Nel and Lisa Kane
Putting all of this information together (vehicle energy intensity, vehicle occupancy, and patterns of travel) helps us to arrive at a fairly complete picture of Cape Town’s movement patterns, and how much carbon is emitted by passenger transport.

Although car use accounts for less than two thirds of the total passenger kilometres in the City, it accounts for over 85% of the emissions. This is particularly alarming, given the tendency for car ownership to increase as GDP per capita increases. Despite significant investment in public transport systems such as the MyCiTi, and other public transport investment during the last 20 years, these are not yet carrying enough passengers to significantly have an impact on carbon emissions from transport in the city. Much, much more will need to be done, and on several fronts, to have an impact on transport emissions.
Possible carbon emission scenarios

To test what would be needed to reduce transport emissions, Sustainable Energy Africa analysed a number of different transport scenarios for Cape Town using an energy and emissions model. The model was asked: “what change would be needed to reduce 2013 baseline emissions from passenger transport by 10%?” Two types of policy were tested: (1) Shifting from cars to less energy-intensive modes such as public transport, walking or cycling and (2) Improving existing cars by increasing occupancy or increasing the proportion of hybrid cars. Avoiding trips altogether through, for example, remote working or land-use changes was not tested.

1. Improve the energy intensity of the car

<table>
<thead>
<tr>
<th>Change.....</th>
<th>of....</th>
<th>Reduces emissions by....</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car occupancy increases</td>
<td>13%</td>
<td>10%</td>
</tr>
<tr>
<td>(An increase in all cars from 1.4 average occupants per vehicle to 1.58)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid car use increases at expense of conventional petrol cars</td>
<td>38%</td>
<td>10%</td>
</tr>
<tr>
<td>(Hybrid cars, currently negligible in terms of market share, increase to over 38% of all cars driven)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Shifting to more energy-efficient modes of travel

<table>
<thead>
<tr>
<th>Change.....</th>
<th>From (% share of passenger-kms)</th>
<th>To (% share of passenger-kms)</th>
<th>Reduces emissions by....</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buses and minibuses gain users from cars</td>
<td>Cars: 59%  Buses: 8%  Minibuses: 18%  Other: 15%</td>
<td>Cars: 49%  Buses: 11%  Minibuses: 25%  Other: 15%</td>
<td>10%</td>
</tr>
<tr>
<td>Walking instead of driving by car</td>
<td>Cars: 59%  Walking: 6%  Other: 35%</td>
<td>Cars: 52%  Walking: 12%  Other: 35%</td>
<td>10%</td>
</tr>
<tr>
<td>Cycling instead of driving by car</td>
<td>Cars: 59%  Cycling: 0.1%  Other: 41%</td>
<td>Cars: 52%  Cycling: 7%  Other: 41%</td>
<td>10%</td>
</tr>
</tbody>
</table>
To Reduce Emissions by 10%

- Increase by 13%
  Occupants per vehicle increases from 1.4 people to 1.56 people

- Increase to 38% of the fleet
  Hybrid car use increases at the expense of petrol cars

- Buses & Mini-Buses gain from cars
  % Share of passenger-kms: 59% → 49%

- Walking increases instead of using cars
  % Share of passenger-kms: 59% → 52%

- Cycling instead of driving by car
  % Share of passenger-kms: 59% → 52%
  0.1%

Data: City of Cape Town, 2013 and Sustainable Energy Africa (SEA). Analysis: Zanie Cilliers, SEA
So what to do?

When thinking in terms of short term transport system changes, modest shifts from a large existing user base may be more feasible than large shifts off a low base. Increasing vehicle occupancy, for example, by 13% yields the same emissions benefits as a 68-fold increase in cycle use.

The current privately-owned car vehicle ‘fleet’ on the roads is underutilised, with high numbers of Single Occupancy Vehicles, and so is very energy-intensive. Anything which reduces the energy-intensity of that very large energy-consuming sector will be beneficial in terms of emissions too.

However, such analyses do not take into account the social, health and equity benefits of a well-functioning public and non-motorised (or “own steam”, walking and cycling) transport system which brings benefits to all.

Also, this analysis does not account for costs of interventions. The 68-fold increase in cycle use required to achieve a 10% reduction in emissions may seem substantial, but this could come at relatively low cost when compared to more costly high-end public transport investments.

Recommendations

The analysis sends several messages:

– The transport picture is different, sometimes significantly so, across income, purpose of travel and gender.

– Car use, especially single occupancy car use, is the prime cause of emissions from the passenger transport sector. Cars are disproportionately driven for work trips, by the higher income groups and by men. This sector, then, should be a key target group for reducing carbon emissions.

– When considering emissions, trips for all purposes and at all times of day and week need to be taken into consideration. This is different to the traditional approach which has focused on congestion, during the peaks, of work trips.

– The transport picture is dominated by walking, cars, minibus taxis, rail and buses. Employer transport is also important for work trips. MyCiTi, cycling and motorcycling are currently used in small numbers. However, each of these smaller modes is significantly less energy-intensive than car use.

– The emissions benefits of battery electric cars currently depend heavily on the way in which electricity is produced in the country, and so on energy policy. Future significant rooftop solar PV use, and concurrent uptake of battery electric cars, could improve vehicle emissions substantially, but are not at all guaranteed developments.

– Increasing car occupancy is the change that would deliver the most emissions reduction, for the least change in baseline behaviour. This deserves much more investigation and support. Technologies which enable carpooling offer substantial possibilities for emissions reductions at no cost to the state, and at reduced cost to the consumer.

– Increasing public transport use also offers emissions reduction benefits. In the case of minibus taxis, this is at no direct cost to the state (in terms of subsidies), but to compete effectively against the car, investment in public transport lanes, enforcement of the same, and partnering with public transport operators will be required.

The transport systems of South African cities are (as in all cities) a complex mix of different interests. Reducing emissions from transport needs to compete in political spaces with many, sometimes competing, issues. Technology from large private companies such as Uber and Google look set to disrupt the status quo12. Fair access to opportunities and support; safe and secure movement; speed and congestion; private business profitability; public sector constraints; and land development pressures can all draw attention away from transport emissions concerns. This is a challenge that will need much more action and on many fronts.

Disclaimer: This briefing paper benefitted from reviewer comments but errors remain the author’s own.

Open Streets is a worldwide movement of citizens who are reclaiming their streets as public space. During an ‘Open Streets Day’, streets are closed off to motorized transport to create a platform for community building and healthy recreational activity. Rather than being an event, Open Streets is simply a day to reimagine public life and use our streets differently.

Open Streets Cape Town (OSCT) is a non-profit organisation founded in 2012 by a group of volunteers committed to a more equitable, integrated, safer and vibrant city.

OSCT designs campaigns that raise citizen awareness, foster public debate about public streets and engage everyone in redesigning and re-working streets.

www.openstreets.org.za
info@openstreets.co.za
@OpenStreetsCT
OpenStreetsCapeTown
OpenStreetsCapeTown