

Does Non-Motorised Transport and electric vehicle cultures help reduce carbon footprint related to commuting and does the provision of Non-Motorised Transport and electric vehicle infrastructure ensure an increase in use of these alternative mode of transport?

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Abstract

This review aims to answer the question whether Non-Motorised Transport and electric vehicle cultures help reduce carbon footprint related to commuting and whether the provision of infrastructure encourage the culture of walking, running, cycling and the adoption of electric vehicles.

An investigation into the Effects of Non-Motorised Transport Facility Implementations and Upgrades in Urban South Africa was reviewed and revealed that South Africa is facing both safety and infrastructural challenges, which makes the NMT culture to be perceived as unattractive due to the lack of adequate and integrated infrastructure, with a fragmented network that is characterized by broken links or routes, therefore unable to meet the needs of users. The review was carried out in the South African context, evaluating the impact that the NMT infrastructure has had on trips generated due to upgraded pedestrian and cycling infrastructure.

The impact of electric vehicle infrastructure was also reviewed and barriers to full adoption of the electric vehicle culture were addressed. Automotive marketplace, Autotrader's survey on electric car buyer was reviewed to get an understanding of how well electric vehicles are being received in South Africa and what is hindering its success. A number of things came out which included the initial cost of purchase and the lack of charging infrastructure.

The review went on to evaluate factors influencing the choice of the mode of travel and affordability, availability, distance and safety were on top of the list. This went on to show that the purpose of travel also influences the mode of travel. While other may perceive walking and cycling as just leisure activities, some are subject to those activities due to lack of monetary means to pay for public transport or even purchase a private car.

The review also continued to evaluate some of the municipal interventions for working towards reducing carbon footprint related to commuting and aiming for net zero buildings in the year 2030. With the continuing trends and concerns about the impacts of climate change, it is crucial to develop ways to prevent air pollution and environmental degradation through sustainable and green practices.

This paper reveals the need to encourage the transition to the Non-Motorised Transport (NMT) culture which allows people to walk, run and cycle, adopt electric vehicles (EV) over conventional vehicles, and introduce telecommuting policies in the workplace where the nature of business allows in order to reduce carbon footprint.

It recommends how buildings should be designed to support the transportation sector to decarbonize commuting emissions and encourage the NMT culture. The uptake is however based on user experience and what is convenient to them.

It was however revealed that a well-designed NMT infrastructure with inter-connected routes, connecting to social and economic activities may be able to address the needs of users. Successful adoption of electric vehicle is however a high-level issue which needs government intervention - introduction of incentives such as subsidies on the retail prices and import duties which seems to be the current and main barrier to a successful electric vehicle centric country.

Keywords: commuting footprint; climate change; electric vehicle; low-carbon; adoption barriers.

1. Introduction

South Africa is experiencing significant effects of climate change, observed through extreme and changed weather patterns, and increased average annual temperatures, with the weather becoming hotter, less predictable, and with a marked reduction in the annual rainfall. The South African National Department of Environmental Affairs (DEA) reports that the rate of warming of more than 4-6°C is projected for South Africa in the next coming years.¹

The rate of warming and the foreseeable effects of climate change require urgent actions to refocus environmental sustainability and adapt to projected future conditions, while implementing a change in behaviour, to protect the human health and prevent the degradation of the environment.²

Human activities have been identified as the main cause of global warming and climate change due to excessive emission of greenhouse gases into the atmosphere. The dependency on burning of fossil fuels to generate electricity and run cars, deforestation, agricultural activities, industrial processes and poor waste management are some of the human practices that have contributed to climate change.³⁻⁵

C40 Cities is a global network of large cities working to address the effects of climate change through the development and implementation of policies and programmes that ensures high-efficiency energy performance for all new buildings. Since the construction and operation of buildings is a contributor to greenhouse gas emissions, one of the C40's initiatives is to reduce the carbon footprint of buildings. The work of the C40 Cities Network supports the intentions in the National Development Plan (NDP), which aims to achieve zero emission building standards by 2030.⁶

Four South African cities are a part of this initiative: City of Tshwane, City of Johannesburg, City of Cape Town and City of Ekurhuleni. These four cities signed the Net Zero Carbon Buildings declaration, committing to net-zero carbon by 2030 for all new buildings and all municipal buildings; and by 2050 for all existing buildings.

In the same space of developing net-zero carbon buildings policies and standards, municipalities have identified building design as a potential way of addressing emissions reductions in other sectors, particularly the transportation sector. While roads and transport is an aspect beyond the bounds of a building, it has been identified that buildings can play a contributing role in the reduction of commuting emissions by providing facilities that support alternative transport.

It is important to establish whether the provision of infrastructure for alternative transport means actually stimulate the uptake of use of Non-Motorised Transport (NMT) and Electric Vehicle (EV).

2. Objective and Methodology

This paper seeks to investigate the impacts that Non-Motorised Transport and Electric vehicles have on the society. It also seeks to investigate how well both cultures are being received in South Africa. It answers whether NMT and EV cultures help reduce carbon footprint related to commuting and whether the provision of NMT and electric vehicle infrastructure ensure an increase in use of the alternative mode of transport (i.e walking, running, cycling and EV adoption).

To answer the research question, the paper investigates the following:

1. Transportation sector emissions landscape and the need to transition to green systems.
2. The role of NMT and electric vehicles and opportunities or benefits of both.
3. Municipal involvement in reducing carbon footprint and opportunities from its involvement.
4. Challenges and barriers to full adoption.
5. Factors influencing the choice of the mode of travel.

The above are answered through various sources; previous investigations into the NMT trends, municipal interventions to acquire net-zero buildings by 2030, South Africa's automotive marketplace electric car buyer survey, The South African National Department of Environmental Affairs (DEA) reports on climate change and conference papers.

3. Discussions

3.1 Transportation sector emissions landscape and the need to transition to green systems

Transportation sector is responsible for 10.8% of South Africa's green house gas emissions and it is highlighted that if these trends persist in the absence of policies and relevant measures, it might emit an even higher percentage.⁷ This would mean that the environment would further be degraded and as water scarce country, we are vulnerable to the risks of the increased temperature, drought and rainfall variability. It is for these impacts that there needs to be a change in behaviour from the way we build, mobilize people, the way we utilize both water and energy in order to protect our environment.

The Green Transport Strategy for South Africa is committed to reducing the country's green house gas emissions by 5% in the transport sector by 2050. Some of the objectives of the strategy includes; to promote the manufacturing and assembly of vehicles locally to mitigate carbon emissions of imported vehicles, to promote non-motorised transport and develop legislative frameworks and smart incentives aimed at promoting an uptake of sustainable modes of transport and its infrastructure

3.2 The role of NMT and electric vehicles and opportunities or benefits of both.

Both NMT and electric vehicles have a role to play towards the reduction of carbon emissions, they are both beneficial to the environment and the human health. NMT is known for its cost-effectiveness. While the cost of initial purchase of an Electric vehicle is high, the cost to maintain it is however low which makes it attractive.

South Africa is comprised of learners and workers that walk to school and their places of work, mostly in the peri-urban and rural areas. Non-motorised transport planning is of less priority in these regions and reasons are often associated with the lack of awareness of NMT roles and their benefits.⁸ Other reasons leading to NMT being perceived as unattractive is the fear fatalities and injuries. Pedestrian accidents rates continue to rise due to the lack of prioritization and provision of infrastructure which then compromises the safety of both pedestrians and cyclists.

NMT should not be associated with poverty but should be seen as a way to address the inefficient public transport systems or networks, by enabling low income communities the access to public facilities and connecting them to the public transportation network, social and economic activities. Electric vehicles should also not be viewed as a rich person's form of mobility, communities need to be educated of the need to transition which is mostly to address the issues of climate change by reducing the carbon emissions which would then lead the country's improved air quality.

3.3 Cities' involvement in reducing carbon footprint (green building concept) and opportunities

The construction and operation of buildings is responsible for 36% global energy use and accounts for 39% energy-related carbon dioxide emissions with power generation included.⁹ It is for this reason that cities in collaboration with C40 South Africa Buildings Programme are in the process of developing high-efficiency energy performance requirements for all new and existing buildings.

Like previously highlighted, cities are in the process of developing net-zero carbon buildings policies and standards and have identified building design as a potential way of addressing emissions reductions in the transportation sector. The city of Tshwane can be referenced in this regard, although at the time of writing, this is still in progress.

C40 South Africa Buildings Programme supports the transitioning to green buildings. The World Green Building Council defines a green building as "a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment".¹⁰ Green Building Council South Africa (GBCSA), recognizes the role of transport in green building design. It offers a certification rating tool, the Green Star, which aims to evaluate the environmental impacts of the building and its surroundings, rewarding the reduction in motorized transport and encouraging alternative transport use.¹¹

While roads and transport is an aspect beyond the bounds of a building, it has been identified that buildings can play a contributing role in the reduction of commuting emissions by providing facilities that supports alternative transport, because for developments with internal roads, on-site transportation is a contributing factor in the development's overall carbon footprint.

The transition to green technologies or systems is also supported by the International Green Construction Codes (IGCC) which assist with effective designing, constructing and the regulation of buildings and structures. It also encourages commuting by means other than conventional cars and trucks, i.e low-emission, hybrid and electric vehicles. It also encourages the provision of accessible walking and cycling routes that connects to transportation stops.¹²

Building design of a particular site which incorporates NMT and EV facilities such as pedestrian and cycle routes, bicycle parking, showers, changing rooms with individual lockers, EV parking and charging bays has been identified as a way to address the infrastructural challenges that South Africa is currently facing.

Building designers can play a part in decarbonizing the transport sector emissions by catering for alternative means of transportation in facility designs. Building developments can be designed with internal roads that accommodate non-motorised transport routes, such as pedestrian walkways and cycle routes with designated parking. Where possible, these can be designed to be connected to the public transport network. Furthermore, buildings can be designed to include showers and change rooms with individual lockers. Buildings can also be designed to facilitate the use of electric vehicles as an alternative low-carbon mode of transport.

This review however did not identify any study which demonstrates that the provision of NMT supporting facilities such as showers and changing rooms with individual lockers increases the uptake in the number of NMT trips generated. According to Awareness Policy 6.5 of the City of Cape Town's NMT Policy and Strategy,¹³ these facilities are promoting factors to the NMT culture. City of Cape Town's NMT Policy and Strategy further highlights that in a workplace setting, people show the desire to use NMT but feel they need a shower and a place to change clothes once they arrive at work, hence these facilities need to be provided.

While these low or zero carbon emissions modes and facilities are acknowledged for their environmental benefits, a question remains: "does the provision of NMT and electric vehicle infrastructure improve uptake from users?". This question is addressed in Baufeldt's review on the effects of NMT facility implementations in urban South Africa.¹⁴

3.4 Challenges and barriers to full adoption.

3.4.1 Challenges and barriers to NMT adoption

Baufeldt's investigation,¹⁴ reveals that South African NMT users are facing safety and infrastructural challenges, resulting in the NMT culture being perceived as unattractive. The investigation reports that NMT trips are not acknowledged as important, hence their planning is deprioritised relative to motorised transport, which could be seen as barriers to the success of the NMT culture. New developments that fail to address the needs of NMT users show a lack of an integrated approach towards reaching NMT goals. Municipalities are however extending significant efforts to promote the NMT culture by drawing in the private sector to cater for NMT within developments. An example is the City of Tshwane, which, at the time of writing, is in the process of updating its Green Building Development Policy and by-law with which the net-zero carbon targets are to be met. Part of the contents include the provision for NMT and electric vehicles facilities in developments.

NMT facilities do not only improve the level of service to the end-user, but also create an enabling environment for public transport trips through the provision of an inter-connected transport network. Despite this, the provision of NMT facilities does not necessarily guarantee an improvement of all aspects of NMT commuting. Baufeldt¹⁴ considers two questions:

1. Whether NMT facilities reduce fatalities and injuries and,
2. Whether the identified study areas had an increase, decrease or same volume of trips, even with NMT facility implementations or upgrades.

It is noted from this investigation that, while one aspect of the NMT might improve, it doesn't guarantee an improvement in the other aspect, i.e an improvement in the safety aspect due to implementation of NMT facilities might not necessarily lead to an improvement in the volume of NMT trips generated. It is therefore important that these questions are answered to see the trends that are impacting the uptake of NMT.

An Equivalent Accident Number (EAN) Analysis was conducted on selected areas of the City of Cape Town, where there were NMT implementation and upgrades. The analysis was done separately for both pedestrians and cyclists from the year 2008 to the year 2013. For pedestrians, areas that had NMT facility upgrades experienced decline of NMT fatalities and injuries, while it was the opposite for areas without NMT facilities upgrades. For cyclists, there was a decrease in Equivalent Accident Number in areas with NMT facilities and upgrades. There was however not much of a difference from areas without NMT facilities and upgrades. It was concluded that the NMT facilities had a low impact on cyclist safety, indicating a need to improve cyclist facilities and the priority that pedestrians receive, being the dominant mode of NMT.

Considering NMT trips at a national level, the National Household Travel Survey (NHTS) between years 2003 and 2013 was used to investigate the changes in NMT trips to establish whether they increased, decreased or remained the same. The study areas used for the for the Equivalent Accident Number Analysis were used to understand how Western Cape as a province was doing compared to other eight South African provinces and to see if NMT facilities are having an impact in the number of trips generated.

The investigation considered two aspects:

1. Changes in the percentage of workers who walked all the way to work
2. Changes in the percentage of learners who walked all the way to their educational institutes

It was noted from the findings that the number of trips for workers who walked all the way to work decreased for all provinces, except Kwazulu-Natal and Gauteng, which showed an increase in the trips. It was further noted that decreasing trends continued for learners who walked all the way to school in all provinces.

Declining percentages in walking trips shows the increasing dependence on motorised transport and continuing priorities to improve the conditions for motorised modes than for NMT users. NMT trips may continue to decline or to be considered less important. The isolation of NMT facilities that were implemented were also seen as a contributing factor as they were unable to meet the needs of the user for an entire NMT trip.

There was however no supporting evidence to measure the impact that implemented NMT facilities had on cyclists from those that didn't have any upgrades. This supports the conclusion made that cyclists are less prioritized as opposed to pedestrians.

3.4.2 Challenges and barriers to Electric Vehicle adoption

Private cars are continuing to dominate the public road spaces. An overview of South Africa's Internal Combustion Engine (ICE) vehicle market shows an continuing increase of ICE units being sold in all vehicle segments (private transport, public transport and industrial transport), with a notable decline in the number of electric vehicles sold between years 2013 and 2018.¹⁵

There are more than 12 million vehicles on the public road of South Africa.¹⁵ The International Energy Agency (IEA) tracking report,¹⁶ reveals that electric cars on the world's roads exceeded 7 million in 2019. State of Electric Vehicles in South Africa report by Uyilo, accounts that 1119 plugin electric vehicles were sold in South Africa by the end of 2019 with only 214 public charging locations.¹⁷ Internationally, 25 cars are allocated per charging station, while South Africa only caters for 6 cars per charging station.¹⁸

When compared to other parts of the world (China, Europe and the United States), South Africa is still behind and unable to catch up with global developments.¹⁹ According to the 2020 South Africa EV car buyer survey by Autotrader¹⁸, the reasons for the slow uptake in electric vehicles include the Initial cost of EV purchase, high import duties, with EVs attracting a 25% Import Tax, compared to 18% for ICE vehicles. Although the running cost for EV is low, the purchase cost is still high that it cannot be offset by low running or maintenance cost.

It is noted from the survey that South Africans desire to own electric vehicles but the lack of incentives; capital subsidies on electric vehicle retail prices and lower import duties are preventing a mass electric uptake. Other barriers include the lack of national charging infrastructure, charging times, range anxiety, impact of load-shedding.¹⁸

While South Africa possesses a strong market in the manufacturing of internal combustion engine (ICE) vehicles, there is however still a lack of local skills in EV manufacturing which is hindering the Electric vehicle market growth.¹⁵

This part of the review shows that there is still a financial barrier to purchase electric vehicles, the import tax is high, which is preventing people from owning electric vehicles. The current infrastructure is unable to meet the needs of users, there is no enough charging stations which raises anxiety upon users of running out range. It can be concluded that to increase the level of service, these infrastructural challenges need to be addressed.

3.5 Factors influencing the choice of the mode of travel

The choice of transportation mode is mainly dependent on user convenience. The following are some of the factors that contribute to the choice of transportation mode:

- Availability and accessibility
- Cost and affordability
- Speed and travel time
- Distance and purpose of travel
- Convenience and comfort
- Safety

According to the investigation on the factors that influence the choice to a transportation mode by the Council for Scientific and Industrial Research (CSIR) for the National Department of Transport, the choice on the transport mode is often associated with the level of income, affordability and accessibility of specific modes of transport.²⁰

The findings of the investigation showed that high income participants felt that walking to public transport access points is inconvenient and they would rather spend more money for public transport or operational

costs of their private cars. The medium income group felt that public transport is costly but prefer it due to its accessibility and efficiency. Although reasons were not given, the medium income group felt that NMT modes are not safe. This might have been associated with the lack of designated or separation of NMT users from motorised vehicle. Low income participants showed a limitation in what is available to them.

The Department of Transport (DoT) has a bicycle programme called the Shova Kalula Bicycle programme. The objective of this programme is to increase non-motorised transport usage while providing communities with access to social and economic activities. It seeks to promote cycling as low-cost mobility solution especially to low-income households, learners, rural women and farm-workers.²¹

Participants in the investigation by the CSIR for the DoT felt that the Shova Kalula Bicycle programme objective was not being met, as some areas hardly knew about it and where there was awareness about the programme, it was indicated that the programme is not sustainable due to high maintenance costs, lack of support services and no clear management of the programmes. Another barrier to awareness was the lack of inter-connected NMT routes which posed a limitation to the uptake of the programme.

The investigation by CSIR for the DoT further reveals that walking is a common mode across all regions, either to access the nearest public transport or because of not having the means to pay for public transport. In the rural areas, safety is the greatest concern, especially for learners who walk long distances along uneven roads with no clear designation or separation, and where fear of personal attack is rife.

This shows that people feel that their safety is compromised when it comes to NMT, hence most prefer to use of public transport and private cars. It was also noted that awareness of the NMT programmes available to communities is lacking or not reaching all spheres of communities in South Africa.

While South Africa possesses a strong market in the manufacturing of internal combustion engine (ICE) vehicles, there is however still a lack of local skills in EV manufacturing which is hindering the Electric vehicle market growth.¹⁵

4. Interpretation of the solution

The research question will be answered in two parts

1. Does Non-motorised transport and electric vehicle cultures help reduce carbon footprint related to commuting?

Yes, both cultures are vital for sustainable living, they are safe and efficient and reduce energy consumption and the environmental pollution. NMT promotes a healthy lifestyle through physical activity.

2. Does the provision of NMT and electric vehicle infrastructure?

While infrastructure might be a barrier to an acknowledged migration to both cultures, it is more of a well-established infrastructure. The studies consulted in this review revealed that infrastructure can be available but if it is not adequate and comprises of broken links, there is a decline in uptake and continuing incline in the use of motorized transport or public transport. Infrastructure should address the safety aspect of users.

The review also revealed that South Africa still lacks adequate charging station causing discomfort in users, but mostly the issue of high retail and import duties of electric cars is the main barrier towards adoption.

5. Telecommuting

Although this section does not form part of the research question, it was identified that it forms part of the review as another way to address the carbon emissions within a building site.

Designers work to ensure that buildings are energy-efficient, but most buildings i.e office buildings are responsible for more energy to mobilize its occupants (employees).²²

It is noted that for a new code-compliant office building in the United States, the energy for commuting using private cars by office workers is 11% more than that of the operation of the building while for an existing building, commuting energy is 16% more than the building operational energy.²²

Telecommuting refers to the situation where employees can work from homes, rather than commuting to the office. It has been noted that it increases productivity, allows for flexibility as employees don't spend time in the traffic, results in reduced carbon footprint as employees work remotely and saves both travel cost and building operational costs and in turn saves the need for construction of office spaces and roads.²³

According to chapter 3 of the sustainability handbook,²⁴ telecommuting is not feasible and applicable for all companies or organization due to their working nature, hence for a purpose where people can work effectively from home, this is recommended. The chapter shows potential carbon emissions savings from telecommuting.

6. Conclusions and recommendations

Walking and cycling are activities that are happening even in the absence of adequate infrastructure and conducive conditions.

Based on the review, it can be concluded that NMT supporting facilities, such as showers and changing rooms with individual lockers can only be used as promoting factors to the NMT culture. No evidence supports that these facilities actually increase the NMT use. It can be concluded that designated NMT routes play a role in decreasing road fatalities and injuries.

It is recommended that the supporting facilities in buildings continue to be promoted and encouraged through building designs. It is also recommended for an NMT network to be improved so that it seeks to efficiently address the needs of users for an entire NMT trip rather than having a fragmented network with broken links that makes it unattractive to users.

In order for South Africa to be able to shift away from a conventional car-centric country, It is recommended that an enabling environment for the mass uptake of electric vehicles is created through government intervention, which may include capital subsidies on electric vehicle retail prices and lowered import duties.

It also recommended that current road upgrades projects also cater for the establishment of even more charging stations.

Private sectors need to be drawn in to supporting the transitions to low-carbon mobility and assist in working towards integrated NMT and public transport networks through implementation of projects which caters for NMT aspects. Private sectors can also introduce telecommuting policies where the nature of business allows, which will not only assist in addressing carbon emissions but also mitigate the need for new office space constructions.

Municipalities are already working to develop policies to fill the infrastructural gaps and these are aggressively promoted. In future, should an open opportunity for mass uptake of electric vehicles arise, the government could look at ways to address non-compliance, where punitive measures may be investigated.

Communities need to be educated about the benefits which NMT, electric vehicles and telecommuting can have on both the human health and the environment in which we thrive.

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