

The Need for Changes in Travel Behaviour towards a Low Carbon Society

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Abstract

Travel behaviour studies were the key issues of analysis in transportation sector in the 1950s and 1960s, especially regarding on travel behaviour and spatial interaction. Travel behaviour trend has increased drastically all over the world. With the present reality of climate change, the transportation studies are becoming increasingly important, in regards of travel behaviour changes. It is important to understand the need to change travel behaviour as one of the initiative to achieve sustainable transportation. In achieving transportation sustainability, understanding on travel behaviour and need can be more functional and useful for transportation planners to encourage people to use public transportations. In recent years, Low Carbon Society (LCS) concept has taken place to change the people's lifestyles, especially to increase the use of public transportations. Undeniably, the only solution to a more sustainable transportation leading to a low carbon society is through a higher adoption rate of public transportation. However, it is still far to achieve as far as transportation planners are concerned because of the lack of understanding of the social needs to complement with public transportations. The planning of the fast developing region of Iskandar Malaysia, which is one of the major economic growth conurbation located in southern part of Peninsular Malaysia, provides a good opportunity for transportation planners or engineers to incorporate the ideas of low carbon society into designing a sustainable transportation systems. Thus, this paper aims to discuss the issues and potential implementation of the ideas to change the travel behaviour of people. This paper also provides current findings of transportation studies on the ongoing research to achieve a low carbon society in Iskandar Malaysia.

Keywords: Travel behaviour, transportation and low carbon society

1.0 Introduction

Climate change has emerged in the past decade as urgent policy mandates. Based on Johansson (2009), climate change has evolved as perhaps the most challenging environmental problem during recent decades.

Serious consideration of greenhouse gases (GHG) in the atmosphere expected to lead significant changes in temperature and precipitation patterns. Many studies failed to conclude the exact factors between GHG and temperature change. According to Johansson (2009), there are still many uncertain factors regarding the exact correlation between GHG concentrations and temperature change. However, many industrial countries are expected to commit in emission reduction of 70-97% by the year 2050.

Transportation energy usage is growing rapidly and expected to reach 175 EJ/yr by 2050. This is supported by research carried out by Paravantis and Georgakelios (2007) which shows that transport sector was responsible for 21% of total energy use and becomes the fastest growing energy consuming sector worldwide. The research also states that the main cause of this increase in energy usage is the growth in road transportation. In recent years, there has been dramatic shift towards road transport, whereby the car increased its share of passenger transport from 65% to 74% worldwide (Paravantis & Georgakelios, 2007).

According to Japan Automobile Manufacture Association (2008), expanding motorization across the globe has caused a steady increase in CO₂ emissions in the transport sector, which accounted for about 23 percent of total worldwide CO₂ emissions in 2005, of which roughly 73 percent was generated by road transport. Road transport is currently the dominant modal sector in contributing to CO₂ emissions, with road passenger modes accounting for close to two-third of emissions in 2030, with the road freight sector growing at a faster rate (Brannlund & Nordstrom, 2004).

Given the current scenarios of increase in energy demand and rapidly changes in modal split, a low carbon society concept has taken place to assist the policy makers, particularly the government to look into certain elements to compliment between carbon reduction and also improvement in transportation sector. Based on Ho et al., (2012) research on low carbon urban development, planning of low carbon cities contribute low carbon emission by using sustainable development principles. To achieve that, a high level of energy efficiency and use low carbon energy sources and production technologies and also adopting patterns of consumptions and behavior that are consistent with low levels of greenhouse gas emissions in the urban areas.

Thus, this paper focuses on the need for changes in travel behavior by using low carbon society ideas to achieve a low carbon travel behavior. It also aims to examine the concept of low carbon society and its relation to transportation planning. This research also prepares review and findings from previous studies for Iskandar Malaysia towards low carbon society.

2.0 Low Carbon Society and Transportation Concerns

In simple terms, low carbon society (LCS) is a society that consumes sustainable and relatively low-carbon energy as compared to our present day practice to avoid adverse climate change. Hence, conscious efforts need to be taken by community, industry, institution and government to change their behavior towards energy consumption and supply. The working definition for policy research and action of low-carbon society should have the following attributes (National Institute for Environmental Studies, 2006):

- i) Take actions that are compatible with the principles of sustainable development, ensuring the development needs of all groups within society are met.
- ii) Make an equitable contribution towards the global effort to stabilize the atmospheric concentration of CO₂ and other greenhouse gases at a level that will avoid dangerous climate change, through deep cuts in global emissions.
- iii) Demonstrate a high level of energy efficiency using low-carbon energy sources and production technologies.
- iv) Adopt patterns of consumption and behavior that are consistent with low levels of greenhouse gas emissions.

Under the initiatives of UK-Japan Low Carbon Society movement and Bali meeting in February 2008, the world needs to cooperate to make concerted efforts to establish a low-carbon society by reducing global emissions by half from the current level by 2050. Under the principle of common but differentiated responsibility, developed nations will take the lead on climate change mitigation. Developing countries will adopt the necessary technology and expertise to reduce the often inefficient and carbon intensive development path of the pasts. Figure 1.0 below describes the movement and trends in developing a low carbon society at conceptual level.

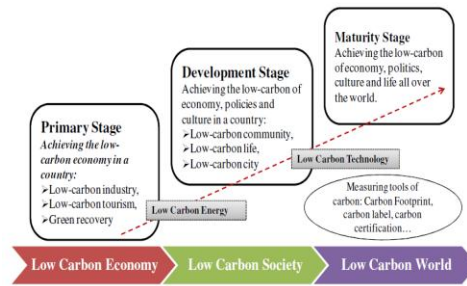


Figure 1.0 The Phases Of Low Carbon Development (Janice, 2012)

The diagram above explains the importance of adopting LCS concept in the world. Most significant stage is to promote low carbon lifestyle and consumption patterns. This is also the stage when there are introduction of various low carbon technologies, including for transportation sector. This also involves the changes in travel behaviour to have more balanced modal split in the countries. As such, the research conducted by Ho, et.al (2012) has come out with the example of the LCS policy package.

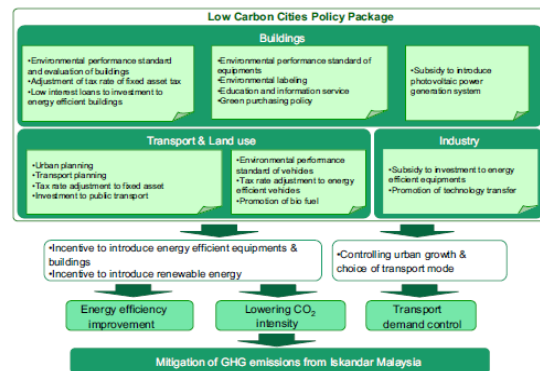


Figure 2.0 Examples of LCS Policy Package (Ho et al., 2012)

In that example of LCS policy package, the researcher highlighted transportation as one of the base studies to be conducted in achieving LCS. This mainly due to interactions or integration between transportation and land use planning. This is supported by Nicholas, R. *et. al* (2008) that mentioned on successful compact cities rely on transportation linkages, mix land uses and high quality urban services. The researcher also highlighted that urban spatial and strategic planning shape the built environment over the long term, including travel distances and development in vulnerable areas, they provide a key entry point for low-carbon development and adaptation planning.

The same ideas implemented in Shiga Prefecture. The study conducted in Shiga Prefecture towards Sustainable Shiga 2030 also emphasize on integrating land use or urban planning with transportation sector. By forming compact city concept, it can rejuvenate the local economy by spreading the use of land to be incorporated with transportation linkages or lines. Besides that, Susilo *et.al* (2012) also discussed on the influence of urban form on specific indices of the activities and behaviour of travellers. The researcher indicates that the less dense the urban structure, particularly when locating a mix of uses in close proximity to each other, the less dependence there is on the car. Such urban form results in densities that are high enough to support public transport services and encourages greater levels of walking and cycling.

As far as transportation study is concerned, by providing and upgrading transportation infrastructures and systems does not guarantee success in achieving LCS. It should incorporate with the social needs of people to change their behaviour and lifestyle as one of the criteria to achieve LCS. Every country are more concern to introduce more environmental friendly vehicles such as green transportation and so on but there are no comprehensive studies to highlight the willingness of people to adopt the suggestions. For example, Shiga Prefectures are putting actions to increase the convenience of public transport and to promote more usage of bicycles. However, it depends on the willingness of people to adopt the ideas. If people fail to practice the new strategies, LCS is far from reach.

Besides that, the importance to adopt LCS as one of a new way to reduce carbon emissions should be promoted all over the world. As mentioned by Ho, et al., (2012), the increase of CO₂ concentration are due primarily to fossil fuel use, rapid urbanization and affluence life style and land use change. Low carbon society study plays a vital role in reducing carbon emissions from transportation sector by providing green transportation, changes in modal split, modes share, reduce trip making by people and promote walking in cities or walkable and cycling cities.

3.0 Needs for a Low Carbon Travel Behaviour in Malaysia

Many researchers failed to discuss the importance to change the travel behaviour to achieve a low carbon society. This is supported by Susilo et al., (2012) findings that most of the studies contributed to solve at very physical based level, particularly in urban form and structures. For example, the study conducted by Williams et al., (2000) highlighted on urban forms which are multi-centered or corridor developments have significant sustainable transport benefits. At the policy level, the LCS has been initiated to incorporate urban planning with transportation sector to have better modal split (Ho et al., 2012). However, we still need to understand people preferences on regards of social needs to be incorporated with urban planning. Susilo et al., (2012) explained the importance of understanding the cultural, attitudinal and individual socio-demographic factors to be included in transportation study. These ‘soft’ elements of social aspects should put into considerations as new paradigm or shift-paradigm in transportation studies as these are given less concentration.

Research by Susilo and Dijst (2009) and Susilo and Waygood (2012) and many more for examples, have found although land use characteristics have some significance in explaining travel behaviour, individual’s attitude are often more strongly associated with travel behaviour than land use policies that promote higher densities. It is proven that urban form policies may not have a material effect on travel demand unless individual’s attitude also changes.

Prillwitz and Barr (2011) discussed about the importance of behavioural change as main domain to attain sustainable behaviour. Attitude is an important determinant for environmental friendly behaviour for daily mobility. Susilo et al., (2012) strengthened these findings and concluded that attitude towards the environmental behaviour will determine future sustainable behaviour.

Table 1 and 2 presents energy consumer and CO₂ in Malaysia, generally accounting for more than 40% during the period of 2000-2005 (Ho et al., 2012). Besides that, it is also expected to be the second largest of energy demand by 2020 with 2.74% of growth rate. This is due to 2 factors which are increase in number of vehicles per capita and rapidity of the public utilization of road transport (Saqr & Musa, 2011).

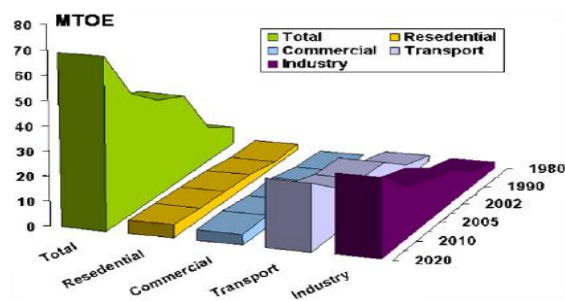
Table 1: Energy demand by sector

Final commercial energy demand by sector in Malaysia 2000–2010.

Sources	Peta Joules (PJ)			Percentage of the total			
	2000	2005	2010	2000	2005	2010	Growth rate (% p.a.)
Industrial ^a	477.6	630.7	859.9	38.4	38.6	38.8	6.4
Transport	505.5	661.3	911.7	40.6	40.5	41.1	6.6
Resident/commercial	162.0	213	284.9	13.0	13.1	12.8	6.0
Non energy ^b	94.2	118.7	144.7	7.6	7.3	6.5	4.0
Agriculture/forestry	4.4	8.0	16.7	0.4	0.5	0.8	15.9
Total	1243.7	1631.7	2217.9	100.0	100.0	100.0	6.3

Source: Ho et al., (2012)

Table 2: CO₂ status with baseline year in 2008



Source: Saqr & Musa (2011)

With the increasing concerns in energy demand of transportation sector in Malaysia, various efforts should be carried out to promote sustainable transportation, where by changes in travel behaviour is essential. Therefore, understanding and realizing the characteristics of social needs by people should be given consideration to plan for future sustainable transportation system. Besides integrating with land use planning, understanding on social needs and demands should be aimed to change the modal split and to have better modal shares in Malaysia.

4.0 Case Study – Iskandar Malaysia Development Region

Iskandar Malaysia lies at the heart of South East Asian at the southern tip of Peninsular Malaysia. Its covers an area of 2216.3 km². The Planning Area falls under the jurisdiction of five local planning authorities, namely Johor Bahru City Council, Johor Bahru Tengah Municipal Council, Pasir Gudang Local Authority, Kulai Municipal Council and Pontian District Council. Subsequently, each flagships were assigned to be major hub for economic activities. Among the economic growth are Johor Bahru City (financial district), Nusajaya (new State administrative centre), Pasir Gudang (port and industrial township) and Senai-Skudai/Kulai (transport and cargo hub). From a regional perspective, the development of Iskandar Malaysia will lend a greater competitive edge to the region and will benefit significantly from air and sea linkages within Asia-Pacific countries.

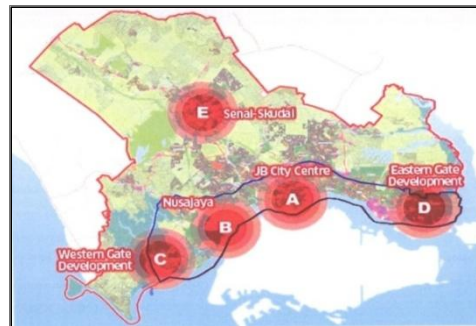


Figure 3.0: Flagship zones within Iskandar Malaysia
 (Source: Iskandar Regional Development Authority, 2010)

Figure 4.0 below shows the CO₂ emissions by sector and energy demand in Iskandar Malaysia. It is identified that freight transport and passenger transport will have significant impact on carbon emissions as well as for energy demand. Freight transport is estimated to produce 1,564 kt-co₂ emissions and passenger transport is estimated to produce 1,246 kt-co₂. With the findings of the studies shown that transportation sector will be among the major contributor carbon emissions in Iskandar Malaysia, urban or transport planner will have to start to think to adopt a low carbon society concept. This concept will have more comprehensive framework to build low carbon travel behaviour by promoting sustainable transportation systems.

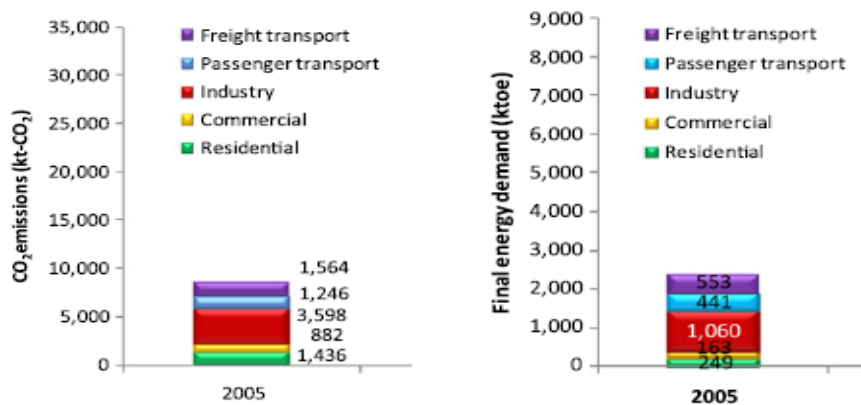


Figure 4.0 CO₂ emissions and Energy Demand in 2005

The feasibility study on Iskandar Malaysia (2009) shown that transportation demand will increase drastically from 3.8 billion passengers-kilometers in 2005 to 7.8 billion passenger-kilometers by 2025. As part of urban planning in Iskandar Malaysia, transportation is one of the important factors that will determine the level of gas emissions. However, this can be reduced by making more sustainable oriented land use planning, especially housing area.

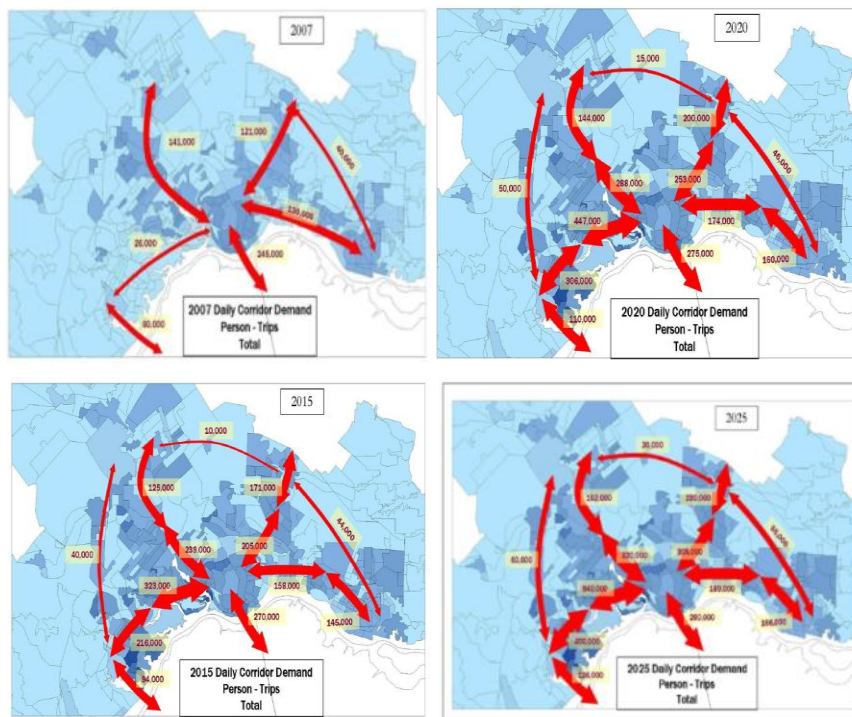


Figure 5.0 Current and future travel demand in IRDA.

Figure 5.0 above shows the four major existing corridors in the Johor Bahru region, namely Johor Bahru-Singapore (Johor Causeway), Johor Bahru-Skudai, Johor Bahru-Ulu Tiram and lastly, Johor Bahru-Pasir Gudang. The highest daily demand is at Johor Causeway with 245,000 person/trips per day followed by Johor Bahru-Skudai (141,000 person/trip per day) and Johor Bahru-Pasir Gudang (130,000 person/trips per day) respectively.

A high proportion of travel on the Johor Causeway is attributed to the large number of Malaysians commuting daily to work in Singapore, of which 60% are on motorcycles (IRDA, 2010). The Johor Bahru-Skudai corridor's trips demand originates from densely populated areas along the Skudai Highway. Meanwhile, Johor Bahru-Pasir Gudang has a relatively high number of trips mainly due to active movements of employment and residential trips heading to and originating from the key industrial and housing areas. Trip demand on this link predominantly arises from residential trips.

At present, Johor Bahru-Skudai appears to be the most populated corridor while Johor-Bahru Nusajaya is the least. By the year 2025, Johor Bahru-Pasir Gudang will emerge as the most populated corridor due to an increasing urbanization of residential developments along Jalan Pasir Gudang corridor.

5.0 Conclusion

The adoption of low carbon society concept as one of the 'champion' paradigm for sustainability relating issues of climate change and rapid urbanization is important for urban planners or transportation planners to make decision on the policy options. As for Iskandar Malaysia studies as shown the increase of travel demand from the year 2007-2025, transport planners should play a vital role to reduce the travel making by people. This can be done through integrating with land use planning, promoting sustainable transportation systems, green transportation vehicles, walking or bicycling as an option to reduce carbon emissions.

The studies conducted in Iskandar Malaysia gives new platform for decision makers to start thinking on promoting sustainable lifestyle through comprehensive transportation planning systems. In such, the study also gives indication to other states or countries on the importance of implementing relevant policies as well as strategies to have better transportation system.

Besides that, this paper promotes low carbon society concept to be carried out nationwide and eventually, will have clearer scenarios on current CO₂ and energy demand all over the place, particularly in Malaysia.

With the increasing level in transportation demand, decision makers, comprises among others, urban planners and transport planners will have to think beyond and more realistic. Instead of looking for infrastructure-based solution, the 'soft' elements in society should be considered as a new paradigm to solve transportation problems. The understanding on travel behaviour will be essential and significance to and should be taken into consideration before planning new ideas related to town or transportation planning.

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References

- Antipova, A., Wang, F. and Wilmot, C., Urban Land Uses, Socio-Demographic Attributes And Commuting: A Multilevel Modeling Approach, *Journal of Applied Geography*, 2011, 31, 1010-1018.
- Belzer, D. and Autler, G., Countering Sprawl With Transit-Oriented Development, *Issues in Science and Technology*, 2002, 19 (1), 51-58.
- Donaghy, K. P, Poppelreuter, S and Rudinger, G., 2005. *Social Dimensions of Sustainable Transport*. Ashgate Publishing Limited, England.
- Handy, S., Cao, X. and Mokhtarian, P., Correlation Or Causality Between The Built Environment And Travel Behavior; Evidence from Northern California. *Transportation Research Part D*, 10, 2005, 427-444.
- Ho, C.S, et al., Low Carbon Urban Development Strategy In Malaysia – The case of Iskandar Malaysia Development Corridor, *Habitat International*, 2012, 1-9.
- IRDA., 2010. *Iskandar Malaysia Blueprint Report*.
- Jones, P.M., et al., 1983, *Understanding Travel Behavior*, Gower Publishing Company Ltd. England.
- Kowloosky, M., Kluger, A. & Reich, M., 1995. *Commuting Stress: Causes, Effects and Methods of Coping*, Plenum. New York, NY.
- Litman, T., *Changing Travel Demand: Implications for Transport Planning*. Institute of Transportation Engineers. *ITE Journal*, 2006, 76 (9), 27-33.
- Prillwitz, J. & Barr, S., Moving towards sustainability? Mobility Styles, Attitudes And Individual Travel Behavior. *Journal of Transport Geography* 19, 2011, 1590-1600.
- Saqr, K.M & Musa, M.N., A perspective of the Malaysian Highway Energy Consumption and Future Power Supply. *Energy Policy*, 2011.
- Sim, L.L, et al., Integrating Land Use and Transport Planning to Reduce Work-Related Travel: A Case Study of Tampines Regional Centre in Singapore. *Journal of Habitat International*, 25, 2001, 399-414.
- Strathman, M.A, Mahmassani, H.S & Yen, J., Choice Model Of Employee Participation In Telecommuting Under A Cost-Neutral Scenario. *Transportation Research Record*, 1993, 1413: 42-48.
- Susilo, Y.O, et. al., The Influence of Individuals' Environmental Attitudes And Urban Design Features On Their Travel Patterns In Sustainable Neighborhoods In The UK. *Transportation Research Part D* 17, 2012, 190-200.
- Sullivan, M.A., et al., Choice model of employee participation in telecommuting under a cost-neutral scenario. *Transportation Research Record*, 1993, 1413: 42-48.
- Tiwari, R., Cervero, R., and Schiepper, L., Driving CO₂ Reduction by Integrating Transport and Urban Design Strategies. *Journal of Cities*, 2011, xxx,xxx,xxx.
- Wee, B.V., Evaluating the impact of land use on travel behavior: The environment versus Accessibility. *Journal of Transport Geography* 19, 2009, 1530-1533.