Reducing CO_2 emissions through the development of a sustainable urban transportation system: the Trinidad case study

1.0 Introduction

The negative impacts of carbon dioxide emissions from the transportation sector on air quality have been well documented over the past two decades, with particular attention being paid to its contribution to global warming and the resulting climate change phenomenon (United Nations, 1987). As such, numerous modifications have been made to the transportation policies and air pollution laws of several of the world's largest CO_2 emitters e.g. Canada, the UK, Australia, and the US. This is not only because they are viewed as the primary cause of the problem, but also as there is agreement by a number of international organizations such as the UN, FAO and PAHO, that preservation of the atmosphere depends greatly on the actions of the more developed and industrialized countries. While this is accurate, it has the propensity to take the environmental responsibilities associated with transportation management and air pollution off the shoulders of countries with relatively small land masses and populations, regardless of how high their CO_2 emissions per capita are.

The oil and natural gas producing twin island Republic of Trinidad and Tobago, located in the Southern Caribbean, is an ideal example of such a scenario as its CO_2 emissions per capita in 2004 were ranked fifth highest worldwide, surpassing those of the United States, the majority of Europe countries, Canada, the Caribbean and Latin America, yet it only accounts for 0.1% of the total global CO_2 production (World Bank: Carbon Dioxide Information Analysis Centre, 2004). As of 2002, Trinidad had a population of approximately 1.25 million and an overall land area of 4,828 km^2 (Agard & Gowrie, 2002). Being a Small Island Developing State (SIDS), it is much more vulnerable to the sea level rise expected to accompany global warming and climate change. As such, the question arises as to whether it is feasible for small developing countries with high levels of poverty and population growth such as Trinidad to seek to minimize their CO_2 emissions, in light of the fact that they are undeniably incapable of playing a considerable role in the reversal of the global warming trend.

The Brundtland Report (United Nations, 1987) cited the use of fossil fuels for industrial processes and transportation as the primary reasons why CO_2 air concentrations increased from 280 parts of CO_2 per million parts of air by volume in pre-industrial times, to 340 in 1980. Additionally, it projected that this number would double between 2050 and 2100, and thus urged that governments seek to lower CO_2 emissions for the well being of the planet and "our common future". As compelling an argument as this is, developing countries are not sufficiently motivated to make lower CO_2 emissions a priority, since they are more often focused on meeting the basic domestic needs of food, housing and transportation for their populations. Yedla, Shrestha, & Anandarajah (2005) suggest that it may therefore be more beneficial to approach the reduction of CO_2 emissions from the transportation sector in developing countries such as Trinidad, not as the primary goal, but rather as a by-product of sustainable development, which should rather be the paramount objective.

Sustainable development is most commonly defined in accordance with the Brundtland Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". According to the Vision 2020 National Strategic Plan intended to help Trinidad achieve 'developed country' status by the year 2020, sustainable development is a priority. However, it is unlikely that 'developed country' status will sufficiently motivate the government and people of Trinidad to deliberately implement transportation management strategies to lower CO_2 emissions, if there is no conviction that a continuation of current levels will indeed compromise the future of both present and coming generations. As such, there needs to be greater understanding of the relationship between high CO_2 emissions from the transportation sector, and its impacts on economic productivity, quality of life, health and environmental resilience.

Cervero (2001) contends that realization of the goal of sustainable development requires careful integration of urban development and transportation strategies, as transport systems have the tendency to increase accessibility and induce growth, thereby leading to even higher CO_2 emissions. This in turn has the potential to compromise the environmental, social and economic well being of cities, and entire island systems such as Trinidad, through congestion, reduced production and revenue generation, air pollution and associated declines in health and quality of life. As such, this paper seeks to:

1. Identify the reasons why Trinidad's current transport system contributes so heavily to its high CO_2 emissions;
2. Understand how the current state of transport compromises the well-being of the environment, economy and society; and
3. Determine the obstacles that currently prevent the realization of a sustainable urban transportation system.

2.0 Literature Review

The concept of sustainable transportation systems came into use as a logical follow-on from the idea of sustainable development and generally involves modes of transport, and systems of planning consistent with the wider concerns of sustainability. There is no single definition for what constitutes a sustainable urban transportation system. However, the European Union Council of Ministers of Transport describes it as one that:

I. "Allows the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations;
II. Is affordable, operates fairly and efficiently, offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development;
III. Limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes, while minimizing the impact on the use of land and the generation of noise" (Victoria Tranport Policy Institute, 2009).

In 2002, the World Bank estimated that over 500 thousand people in developing countries die annually, as a result of transport related air emissions and a similar amount from traffic accidents. In Trinidad, 740 people lost their lives and 13,634 were injured as a result of transportation accidents during the period 1997-2001 (Central Statistical Office, 2002). Statistics such as these justify the need for careful transportation planning as they expose the negative impacts that current urban transportation trends are having on the environment, the population and the economy. Litman (2002) argues that when the impacts of poor transportation systems are combined, the result is a reduction in sustainability and resilience as evidenced in Figure 1 which shows the negative impacts of inefficient urban transportation systems on the environment, economy and society. To counteract these, Litman (2002) advocates the implementation of strategies that increase transportation system efficiency as the most effective ways to make progress toward sustainability objectives, particularly in urban areas.

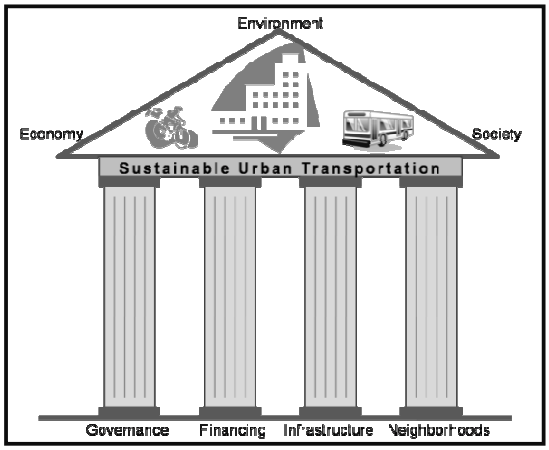
Figure 1: Negative Impacts of Inefficient transportation systems on sustainability objectives.

Economic	Social	Environmental
Traffic congestion	Inequity of impacts	Air pollution
Mobility barriers	Mobility disadvantaged	Climate change
Crash damages	Human health impacts	Habitat loss
Transportation facility costs	Community cohesion	Water pollution
Consumer transportation costs	Community livability	Hydrologic impacts
Depletion of non-renewable resources	Aesthetics	Noise pollution

Source: Litman, 2002.

Kennedy *et al* (2005) also recognize the potential for the negative by-products of an inefficient transportation system, specifically vehicle emissions, congestion and auto dependency, to reduce the quality of life of persons in urban areas. As such, they hypothesize that a sustainable urban transportation system can be realized through the establishment of the "four pillars of sustainable transportation": suitable regional and municipal governance, financing, infrastructure, and integrated land use planning for neighbourhoods. Figure 2 illustrates how the establishement of the "four pillars" can in turn assist in the maintenance of the environment, economy and society.

Figure 2: The "Four Pillars of Sustainable Urban Transportation".



Source: Kennedy, Miller, Shalaby, Maclean, & Coleman, 2005.

Examples of cities that have achieved success in establishing the "four pillars" are seemingly rare. Toronto came close in the 1950's but was unable to maintain its accomplishment due to the fact that it failed to adapt its governance structure to the exponential growth of the region. More recently in the late 1990's, Singapore was able to develop what was deemed a "world class transport system" by its Land Transport Authority (LTA). Closer examination by May (2004) of the actions of the LTA over the past 30 years confirmed the need for the a single tier of government, horizontally aligned with the relevant planning authorities to be authorized in decision making in order to ensure rapidity. May (2004) also stresses the importance of a comprehensive long-term transportation strategy with a sound economic basis which focuses on land use policies, transportation demand management, infrastructure improvements, public transport enhancements and most importantly, the integration of these components. The experiences of Toronto and Singapore substantiate the claim by Coaffee (2008) that environmental resilience and sustainability cannot be realized without careful management of the built environment, which includes the design of both neighborhoods and transportation infrastructure, as they shape travel decisions and patterns.

Cervero (2001) acknowledges that there are inherent difficulties in attempting to simultaneously establish the "four pillars" of a sustainable urban transportation system and puts forward that it is due to urban and transport development occurring at different paces. Land use changes take place constantly and are somewhat fluid in nature. Large scale transportation projects on the other hand are much more rigid and occur over much longer time increments. Planners are therefore confronted with the challenge of effectively coordinating them, often in the absence of sufficent financing and public approval. To make matters worse, the benefits of careful transport-land use integration often are not evident until a decade or more into the future. Naturally, this is at odds with political systems that demand solutions with short term benefits, i.e. IMTO ("in my term of office"). To combat this phenomenon, Boarnet & Crane (2001) advocate a paradigm shift from auto-mobility planning to accessibility planning as a means of achieving a sustainable urban transportation system and reducing CO_2 emissions.

Since the 1960s, transport planners have been solving urban transport problems according to the classic scientific deductive approach of data collection, goal definition and future demand determination (Curtis, 2008). However, there are two intrinsic deficiencies to this method. Firstly, transport planners are not encouraged to advocate land use change as a means of achieving a more effective transport system. Secondly, solutions evolve in isolation from considerations regarding land use and the environment. Over the long term, this method of planning has led to urban transport systems that compromise the overriding goal of sustainability (e.g. through congestion, excessive energy use and pollution) by promoting a culture of auto-mobile usage (Bertolini, 2005). Personal mobility can be seen as a double

edged sword because on one hand, it yields benefits such as increased productivity and flexibility, but on the other hand, it increases vehicle ownership and social injustice which leads to congestion, pollution and elevated land and energy consumption (Kennedy, Miller, Shalaby, Maclean, & Coleman, 2005). Furthermore, as time passes and congestion and pollution increases, productivity declines due to increased travelling times and deteriorating health.

Accessibility planning is in many ways the complete opposite of auto-mobility planning. It focuses on minimizing the need to travel and enabling the entire population (not just those who can afford a motor vehicle) to spend more time productively at desirable locations. By decreasing the overall amount of travel each person does, and improving the ease with which it is done, the environment and resources can be conserved, while social justice is promoted (Boarnet & Crane, 2001). Other sought-after by-products include reduced congestion and pollution, and by extension CO_2 emissions.

Figure 3: Comparison of mobility planning and accessibility planning.

Mobility Planning		**Accessibility Planning**	
Road construction & expansion		**Land use management initiatives**	
Motorways,freeways	Beltways, interchanges	Compact development	Mixed uses
Road hierarchies	Arterial expansion	Pedestrian focus	Transit villages
Intelligent transportation systems		**Telecommunication advances**	
Navigation systems	Real time informational systems	Tele-commuting	Tele-working
Positioning systems		Tele-communities	Tele-shopping
Transportation system management		**Transportation demand management**	
One-way streets	Rechannel intersections	Ridesharing	Preferential parking for HOVs
No curbside parking	Ramp metering	Parking pricing/ management	Ride programs
Large scale public & private transport		**Comm. scale public & non-motorized transport**	
Heavy rail transit	Commuter rail	Light rail transit	Trams
Regional bus-ways	Private toll-ways	Community based paratransit	Bike / walk paths

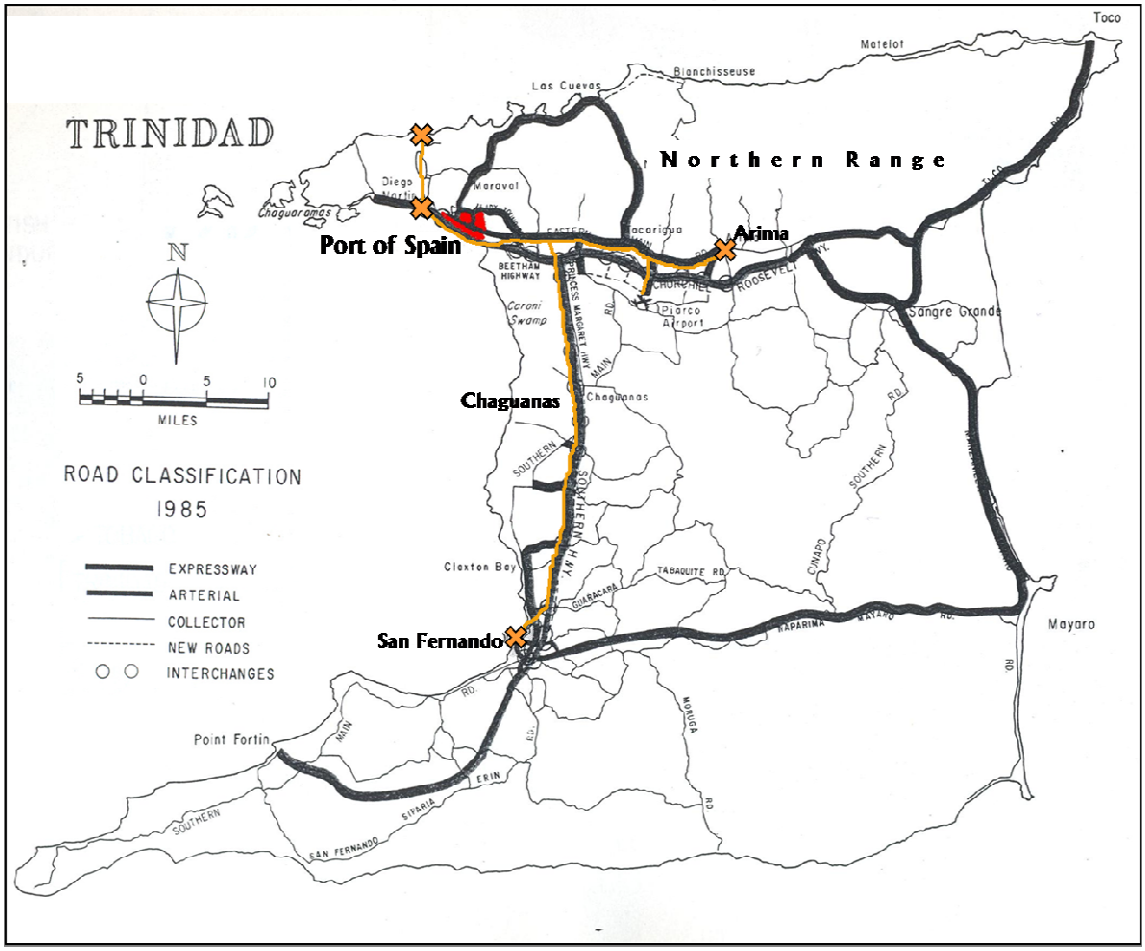
Source: Adapted from Cervero, 2001.

Few places aside from the Netherlands and Singapore have been successful in implementing accessibility oriented transportation plans. In both cases, the development of compact mixed-use urban neighborhoods played a vital role in decreasing travel demands and furthering transport-land use integration (Curtis, 2008). However, this cannot occur in the absence of a healthy regional (i.e. decentralized) economy, without which there will continue to be a single downtown core. Instead, experience has shown that cities should aim to have several small but strong regional centers offering residential, commercial, and recreational opportunities. The employment of auto-equalizers (i.e. measures that remove the built-in incentives that encourage people to drive rather than use public transit) such as parking pricing has also been proven to be a successful means of inducing changes in land use and encouraging more environmentally sustainable travel behavior (Cervero, 2001).

3.0 Overview of Transportation in Trinidad

Trinidad's transportation network has been largely shaped by the topography of the island because it determines where persons can build their homes. Transport has also been influenced by the island's history of coastal oil exploration, industry and shipping. As such, the majority of the population is concentrated along two major routes: 1) the 'east-west' corridor, which runs along the foothills of the Northern Range; and 2) the north-south corridor which passes along the Gulf of Paria coast. This is evidenced by the fact that while the population density of Trinidad in 2002 stood at 254 persons/km^2, the densities of Port of Spain and San Fernando were 5,118 persons/km^2 and 8,552 persons/km^2 respectively (Agard & Gowrie, 2002).

Figure 4: Map of Trinidad showing the current road network in relation to the main urban centers & the proposed location of the Rapid Rail (shown in orange).

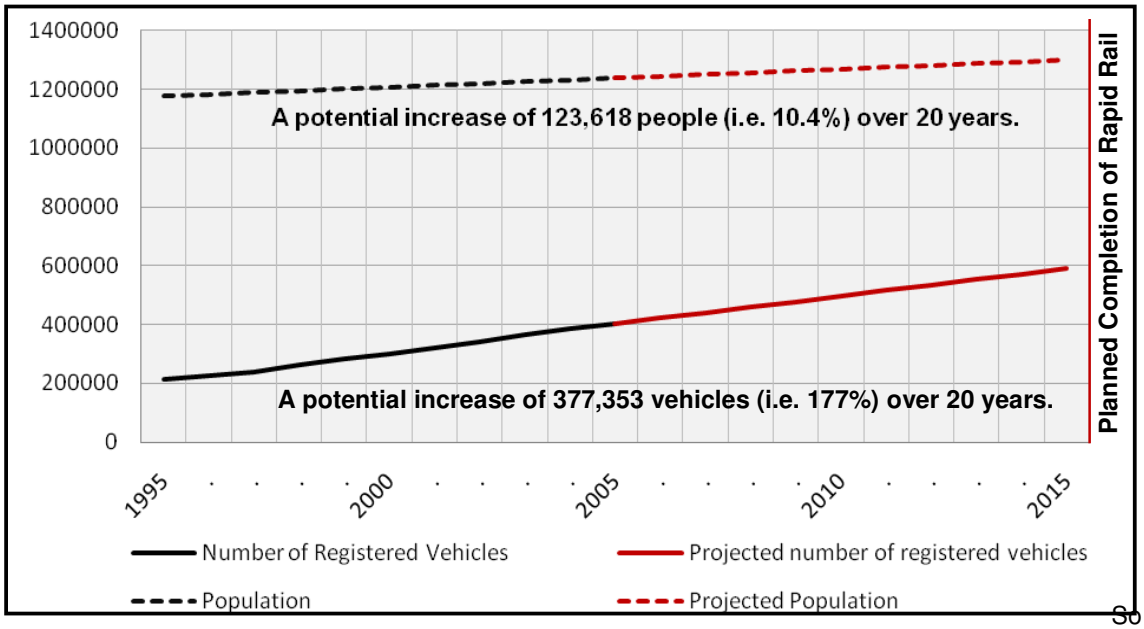


Source: Central Statistical Office , 2000; and Genivar, 2001.

Exorbitant land and rent prices in and around Port of Spain and San Fernando have also resulted in the formation of several 'bedroom-communities' lacking in employment opportunities and amenities. In 1997, Labor Force Surveys showed that approximately 108,500 jobs were available in Port of Spain i.e. 24% of the total number of jobs available in Trinidad. However, 79% of the persons working in Port of Spain resided outside of its boundaries (Halcrow Group Ltd., 2000). Since then, the population of Port of Spain has declined significantly, and the Central Business District has expanded, leading to increased numbers of persons commuting into Port of Spain daily. The average distances which persons are required to travel to access suitable employment have also been lengthened. Transport authorities theorize that this trend was linked to the liberalization of the foreign used vehicle market in 1997, and the increase by 36% in the gross national income per capita between 1999 and 2001, which made motor vehicles more affordable for the average person and caused a sharp spike in motorization levels (Central Statistical Office , 2000).

When compared to countries in South America, Latin America and the Caribbean, Trinidad had the highest motorization levels with a population of 1.23 million people and approximately 402,000 registered motor vehicles in 2005 i.e. 325 vehicles per thousand persons (Central Statistical Office , 2000). However, transport infrastructure and urban form have not been able to keep pace with the increase in travel demand, thereby resulting in severe congestion, prolonged travel times and declines in the productivity index of the island. In 2006, the Ministry of Transport and Works estimated that the average Trinidadian spends in excess of 3 hours a day travelling.

Figure 5: Growth in the number of registered vehicles compared to the population growth between 1995 and 2015 in Trinidad.



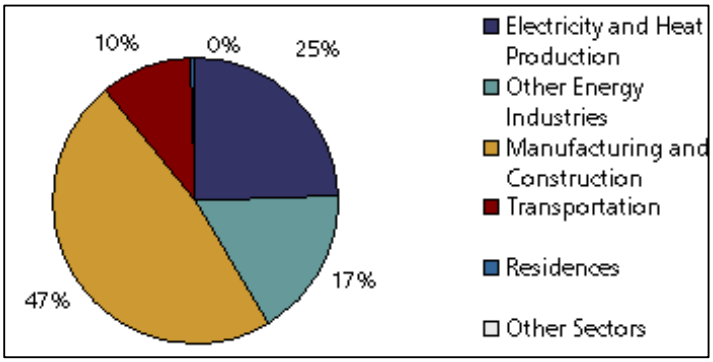
Source of data: Licensing Office, Ministry of Transport, 2005, and Central Statistical Office, 2002.

Congestion is most severe along the main routes leading into Port of Spain and the Central Business District itself. This can be explained by the fact that 85% (221,000 vehicles) of the vehicles entering Port of Spain daily are private automobiles carrying a total of 330,000 persons. The other 15% (39,000 vehicles) are a combination of PTSC buses, taxis and maxi-taxis carrying a total of 270,000 persons i.e. 45% of all people entering Port of Spain daily (Genivar, 2001). Despite the problems associated with private vehicle usage, such as increased congestion, lack of parking and loss of productivity, and the availability of a designated congestion-free east-west bus route, customer levels for the public bus service declined from 16.3 million in 1990 to 6.4 million in 1998 (Environmental Management Authority, 2001). This has been attributed to:

I. Persons having to walk significant distances, often along steep roads to access transport hubs along the major corridors and within Port of Spain;
II. Crime and safety concerns;
III. The lack of public information as it relates to availability, routes and schedules; and
IV. An overall poor public perception of the public transport services (PTSC, 2007).

Underuse of public transport systems, coupled with extreme overuse of the private automobile has led to exceptionally high CO_2 emissions per capita from the road transport sector. In 1998, transportation was shown to be responsible for roughly 10% of Trinidad's total CO_2 emissions (World Resources Institute, 2006). This statistic was later substantiated by the International Energy Agency which claimed that CO_2

Figure 6: CO_2 emissions by sector, Trinidad, 1999.



Source: World Resources Institute, 2006.

emissions from this sector had risen by 21.7% between 1990 and 1999 to a total of 1,570 thousand metric tonnes in 1999, undoubtedly due to increased motorization levels. To complicate matters further, data from the Environmental Management Authority in 2001 revealed that over 60% of the registered vehicular fleet in Trinidad is over 10 years of age, making it unlikely that they were manufactured with emission controls. If the current rates of growth in vehicle ownership and population continue, the overall emissions originating in the transport sector are likely to rise by more than 100%, even in light of more fuel efficient vehicles – see figure 5. In 1998, a pilot program intended to analyze emissions and enforce the provisions of the Motor Vehicle and Road Traffic Act prohibiting the release of visible vapors was jointly conducted by the Transport Division of the Ministry of Works and Transport and the EMA using portable equipment. The result was that a significant proportion of the sampled vehicles failed United Kingdom emission standards while others could not be tested due to fear that the level of smoke being emitted would clog the filtering system and foul the equipment (Environmental Management Authority, 2001). It is therefore imperative that the transportation sector is addressed, as the current unsustainable modes of transport are not only compromising productivity levels, health and quality of life, but also the environment, particularly through excessive CO_2 emissions.

4.0 Factors contributing to the lack of a sustainable urban transportation system

Both the government and the general public recognize that the current transportation system is costing the country economically, socially and environmentally. As such, attempts are being made to minimize the negative effects. However, relatively little attention is being paid to the underlying causes. This section thus examines how the deficiencies of Trinidad's transportation system prevent establishment of the 'four pillars' of sustainable urban transportation.

4.1 Governance and Legislation

The Ministry of Works and Transport (MOWT) is tasked with the responsibility of making transport development and management decisions. However, due to the nature of transportation, MOWT is often required to work in conjunction with the Ministries of Finance and Planning, Housing and the Environment when making major decisions. Meanwhile, similar divisions exist in duplication within the organizational structure of MOWT itself. Private consultants are also frequently appointed to carry out independent studies aimed at identifying specific problems and making recommendations. Unfortunately, this practice has contributed to a lack of horizontal integration between governing finance, land use planning and environmental bodies. It has also produced a number of recommendations which do not have the political support required for implementation. The fact that the last comprehensive National Transportation Plan approved by Parliament was published over forty years ago in 1967 stands as evidence of poor integration. In the absence of such a plan, decision making is destined to be done not only in a top-down ad hoc manner, but also in response to problems, as opposed to functioning in anticipation of urban growth, technological advancements and land use changes. There is also a tendency for institutional unaccountability to abound, since there is no standard to measure progress against.

The decision making process is further hindered at the second level of the hierarchy where statutory bodies such as the Public Transport Service Corporation, the Environmental Management Authority, the Town and Country Planning Division and the Maxi Taxi Association exist. In addition to providing various services, these units are expected, according to their legislative mandates, to do regular data collection and public consultation exercises. This is to ensure the provision of high quality services, as well as a solid basis for decision making. However, on several occasions, data collection is done at irregular intervals and often published so late that it becomes irrelevant to the process.

Aside from the inefficient decision making process, the goal of sustainable urban transportation is sabotaged by the lack of suitable legislation, and the inability of the relevant authorities to enforce existing traffic management laws. For instance, the Motor Vehicle and Road Traffic Act does not stipulate acceptable emission levels for green house gases.

However, it does state that there should be no visible vapors emanating from vehicles in use. This has proven difficult to enforce as it is based on the traffic officers' observation as opposed to scientific tests using reliable equipment. The result is that most vehicles are inspected annually when they go for their 'fitness' license (Environmental Management Authority, 2001). The employment of traffic management strategies and the enforcement of penalties has also been proven to be a difficult task as it relates to parking, speeding, insurance and driving under the influence (Ministry of Works and Transport, 2009).

4.2 Financing/Economics

From 1991 to 2000, Trinidad experienced an average annual growth in GDP of 3%, mainly as a result of the amount of natural gas being exported to the United States (World Resources Institute, 2006). Since then, oil and natural gas exports have increased significantly, with large spikes in the prices being experienced from 2006 to 2008. The state was thus able to boast a surplus of TT$7.9 billion in its 2008 income and disburse a total of TT$5.5 billion to the Infrastructural Development Fund (Ministry of Finance, 2009).The Government of Trinidad acknowledges its dependency on the energy sector for income, but is seeking to diversify the economy as there is uncertainty about the continuation of the demand for petroleum products in the next fifty years. Nevertheless, there is some degree of surety that it will sustain Trinidad economically for at least another 10 years, thereby ensuring financing for transportation development among other things.

Shortages of financial resources for public transit and infrastructural improvements have limited the development of sustainable transportation systems worldwide. However, in the case of Trinidad, available financing has actually worked against the realization of a sustainable urban transportation system because of the poor manner in which funds have been utilized (Ministry of Works and Transport, 2009). For instance, while the Public Transport Service Corporation and the Environmental Commission (which are experiencing institutional and physical deficiencies) had total expenditures of TT$285 and TT$9.3 million respectively, fuel subsidies by the state, which enable car ownership, amounted to TT$2.2 billion in 2008. Diesel and unleaded gasoline fetched standard prices of TT$1.50 / US$0.25 and TT$2.70 / US$0.40 per liter (far below those in North America, Europe and the rest of the Caribbean) while the price of unleaded gasoline, which pollutes the air less, was raised from TT$3.00 to TT$4.00 in 2008 (Ministry of Finance, 2009). Subsidies such as these put car ownership within the financial reach of a larger sector of the population and encourage unbridled use of fuel, preference for unleaded gasoline, and an overall erosion of environmental conscience as it relates to resource usage and air pollution. When this is coupled with the availability of cheaper, less efficient foreign used cars, and insignificant motor vehicle importation, registration and licensing fees, it becomes evident that there are incentives for creating congestion and pollution.

In the 1980's, Singapore faced similar challenges in that land was scarce, population densities were high and economic growth was taking place. The result was a substantial increase in the demand for cars. Transportation authorities recognized the potential for congestion, loss of productivity and pollution and responded by instituting pricing policies in the form of importation, ownership and licensing taxes, parking fees, road pricing and highway tolls. Collectively, these policies were successful in restraining car ownership and energy usage by extension (Olszewski, 2007). Despite the similarities and successes of Singapore, Trinidad has taken a very different route thus far in its attempt to create a sustainable urban transportation system. Essentially, it has furthered the agenda of auto-mobility planning, as opposed to accessibility planning. This trend is also evident in the stipulated parking requirements for new developments (Town and Country Planning Division, 1989) as well the availability of free curbside parking in Port of Spain. Without a doubt, the Trinidadian society is being made to bear the economic, social and environmental costs of excessive car ownership, as the government continues to subsidize its true costs and neglect opportunities to restrain usage and develop public transit.

4.3 Infrastructure

Like most other places that have pursued auto-mobility planning, Trinidad has consistently sought to increase its road capacity over the last 30 years through major highway construction programs. Unfortunately, this trend has been accompanied by state failure to provide viable public transit options. Consequently, maxi taxi (i.e. mini-bus) services have been provided by the private sector to fill the gap created by the state. In 2008, the PTSC had a fleet of approximately 300 buses transporting 12-115 passengers each, an increase by 250% since 2003 (Ministry of Finance, 2009). The Maxi Taxi Association on the other hand, had 550 registered maxi taxis, 350 of which pay an annual fee of TT$1,200.00 to use the priority bus route along the east west corridor (Ministry of Works and Transport, 2009). The majority of PTSC buses operate from 6am to 6pm during the week mostly without a definite schedule stating which buses pass certain points at standard times (Public Transport Service Corporation, 2009). The maxi taxis also operate without specific stops at given times, but because they are privately operated, they respond much more to demand, thereby working longer hours and exercising more flexibility as it relates to their routes and customer requests. Without doubt, the maxi taxis provide a valuable service. However, the problem with this arrangement is that the maxi taxis are very difficult to manage and regulate, and more so as it relates to the quality of services being provided, since there is no other viable option for the public. Furthermore, because maxi-taxis attend to the majority of public transport needs and are not subsidized, decisions by the Maxi Taxi Association carry a lot of weight, often giving them the upper hand when negotiating with the state.

4.3.1 Recent and Planned Projects

Despite the grave deficiencies in the public transport system, the state has continued to pursue infrastructural developments which nurture the auto-mobility culture. The most recent of these projects was the Churchill Roosevelt/ Uriah Butler Highway Interchange intended to allow persons living in the southern areas of Trinidad to access Port of Spain with relative ease. It was deemed to be a priority by the state because of the extreme congestion being experienced during peak hours. The absence of a designated priority bus route linking the southern settlements to the north also meant that not only private vehicles suffered by having to waste hours waiting in traffic, but also the PTSC buses and maxi taxis (Ministry of Finance, 2009). Other projects which the state justifies as suitable means of alleviating congestion include several 6 lane highways – shown in figure 7 below. More likely than not, these developments will work to increase auto-mobility, promote car ownership and boost CO_2 emissions from the land transportation sector.

Figure 7: Planned Highway Development Projects for 2009-2017

Phase 1	Phase 2	Phase 3
Solomon Hochoy Highway extension to La Brea	A first-class road/tunnel from the East-west corridor in the vicinity of Curepe/ Tunapuna to the North Coast	A first-class Highway from Sangre Grande to Toco
San Fernando to Princess Town freeway		A first class road from Blanchisseuse to Toco
New freeway from Uriah Butler Highway to Trincity		A Highway from Penal to Guayaguayare
Churchill Roosevelt Highway extension to Manzanilla	A freeway from Princes Town to Mayaro	A highway from Manzanilla to Mayaro
A new north-south highway from Curepe to Princes Town/Rio Claro	A first class road from Moruga to Princes Town	

Source: Ministry of Works and Transport, 2009.

The state has also begun to develop a Rapid Rail Transit system at a cost of US$1.2 billion which they trust will “revolutionize the transport network” by the year 2015 (Ministry of Finance, 2009). Although it is customary to carry out a feasibility study for projects of this magnitude, no such thing was done prior to the state committing US$30 million to begin Phase I of the project. In the mean time, there are doubts by local transportation planners that this project will improve public transit and be able to maintain itself financially. Furlonge

(2008) argues that it will assist inter-urban transport, and neglect the existing difficulties associated with urban-centre transport. Furthermore, based on the size of the population, car ownership trends, difficulties associated with accessing transit hubs, and the reality that the state simultaneously plans to increase road capacity, it is unlikely that there will be sufficient usage to make the project financially sustainable. Figure 5 shows the projected relationship between the population and car ownership in relation to the planned completion of the Rapid Rail Transit system.

4.4 Neighborhoods, Land Use and Transport Planning

Residential development in Trinidad has been greatly influenced by a combination of topography and the high cost of land closer to employment centers. Commercial development on the other hand, has been centralized in urban areas such as Port of Spain and San Fernando, and to a lesser degree along major transportation corridors. Persons are therefore required to walk to the closest public transit hub and then travel relatively far distances to access basic amenities and suitable employment. This not only takes up valuable time, but also increases CO_2 emissions while making car ownership a more attractive option. For the majority of persons, once a car is within reach financially, it is the chosen option because current land use patterns do not promote walking, biking and other forms of sustainable transit. Based on the Singapore experience, Sim, Malone-Lee, & Chin (2001) recommend the development of compact regional centers with alternative residential and employment opportunities as a means of reducing work-related travel distances as well as the number of trips generated to the central business district. Furthermore, they contend that it will lessen dependence on existing traffic management measures and result in a more sustainable approach to land use and transportation planning. Miller & Ibrahim (1998) second the claim that this type of decentralization fosters more efficient land use relationships, less dependence on cars, urban efficiency and productivity, and concomitantly, less environmental pollution. However, such improvements can only be realized through highly coordinated planning on the parts of the Ministry of Works and Transport and the Ministry of Planning, Housing and the Environment.

5.0 Conclusion

Trinidad's lack of integrated land use and transportation planning has resulted in high levels of motorization and excessive CO_2 emissions, which compromise its economic and environmental resilience, the health and quality of life of the population, local rates of production, and its overall goal of becoming a 'developed' country. As such, it is imperative that the relevant transportation authorities begin to pursue a shift from auto-mobility planning to accessibility planning. As it stands, the main barriers to the realization of a sustainable urban transportation system are the prevailing attitudes to car ownership, and the existence of an urban form which does not promote public transit usage. To get beyond these hurdles, development of the "four pillars" is essential. May (2004) along with Lam & Toan (2006) also insist on the need for:

I. a defined decision making framework which complements land use planning strategies;
II. a comprehensive transportation plan/policy/strategy, addressing both inter-urban and urban-center transport alongside land use planning issues;
III. transportation management strategies which make car ownership more difficult and public transit more attractive;
IV. increased investment in public transport programs and infrastructure; and
V. a compact urban form offering residences, amenities and employment short distances from each other in regional centers and also near transportation hubs.

While seminal authors such as Demirdoven & Deutch (2004) argue that high CO_2 emissions can be constrained by the use of less environmentally damaging modes of private transportation, this case study shows that the factors surrounding high CO_2 emissions, such as elevated motorization rates, wreak havoc in a number of ways aside from environmental degradation when land is scarce. It is therefore in the interest of all involved parties to reduce

auto-mobility not only as a strategy to cut down CO_2 emissions and preserve the environment, but also a means to increased productivity, better quality of life, and health.

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