International Masters in Environmental Science

The Road towards Sustainable Transportation in the USA: Exploring the feasibility to enhance non-motorized modes in the case of Scranton, Pennsylvania

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Abstract: The United States is an automobile dependent society that has been shaped by cultural, political and economic trends, causing non-motorized modes, walking and bicycling, to play a minor role in the transportation system. The dependence on automobile use has impacted society and the environment, especially as many auto trips that are 3-4 miles can be substituted by bicycling and walking. Displacing automobile use with non-motorized modes can have many benefits. However, it is difficult to change the lifestyles, attitudes and habits of Americans without jeopardizing the quality of life. The aim of this paper is to enhance the convenience of non-motorized modes by identifying the current trends, barriers and benefits while simultaneously decreasing automobile use through appropriate measures and strategies that can help shape a more sustainable transportation system through an illustrated case study in Scranton, PA for the future.

Keywords: Bicycles, Walking, Automobile Dependency, Sustainable Transportation, Economic Measures

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1. Introduction

The United States is a car dependent society, which has been shaped by cultural, transportation and economic priorities. Cities across the U.S. have given a high priority to automobile transport and capital for the development of transportation and suburban infrastructure, causing low-density growth further from city centers. As cities are becoming more dispersed and decentralized with fast-food restaurants, drive-up ATMs, and strip malls with large parking lots, Americans rely heavily on their automobiles and less dependently on alternatives modes of transport. Mobility determines many societal developments and vice versa. Without mobility, vital societal functions, such as work, shopping and social activities, cannot take place in the USA,. The use of the automobile has become not so much a choice but a necessity in the auto built cities, causing a high automobile dependency (Newman & Kenworthy, 1999, p. 31). The availability and accessibility of transport dictates how, where and when we travel (Kingham et al, 2001). Travel behavior surveys have shown that the modal choice for most journeys in the U.S. is made by car, even when many of the journeys are less than 2 miles (Pucher et al, 1999), despite the strong potential to commute by non-motorized modes (walking and bicycling[1]). The aim of this paper is to explore the feasibility of enhancing non-motorized modes in an urban setting while simultaneously decreasing automobile dependency for short trips. In addition, this paper intends to demonstrate how to achieve the social, economic and environmental pillars of a sustainable transportation by shifting an urban transportation system to the most sustainable mode, walking and bicycling, for future generations in the illustrated case of Scranton, PA.

The demand and use of vehicles has had economic, social and environmental impacts on society as pollution, noise, consumption, congestion, negative health impacts and social inequity are increasing. These impacts have caused a heightened awareness that the transportation of people and goods in the United States is currently not sustainable, especially in comparison to other countries. For example, even though the U.S. has fewer than 5% of the world's population, the nation consumes 25% of the world's fossil fuels, while emitting roughly 20% of greenhouse gases, which leads to climate change (Friedland et al, 2003).

At the same time, non-motorized modes of transport are becoming more widely regarded as a vital element of sustainable transport systems to decrease the levels of automobile use in urban systems. There are many benefits to replacing short trips by car with walking and cycling, including health and environmental benefits, and a more attractive urban environment. However, it is recognized that non-motorized modes throughout the United States are "impeded by the lack of tradition of cycling and walking for utilitarian purposes and by the marginal legal, cultural and infrastructure status" of non-motorizes modes in the auto-based transport systems (Pucher et al, 1999). There are many barriers, which are often considered inconveniences that deter the use of non-motorized modes within the urban infrastructure. Such barriers can be travel time, safety, physical conditions (weather and topography), and infrastructural barriers (insufficient road cycle network, unsafe crossings, and parked cars) (Pucher et al, 1999; Rietvald & Daniel, 2004; *Stangeby*, 1997, p. 28-31). Many cities, nationally and internationally, have introduced successful programs that have facilitated bicycling and walking for short trips, even though volumes of motorized traffic is anticipated to increase (Tolley, 2003, p.1). There is a great potential for other communities, such as Scranton, to implement measures that would increase the convenience of non-motorized transportation, while reducing automobile dependence for many short trips to create a more sustainable transportation system in the long term.

Sustainable transportation needs to be integrated socially, economically and environmentally. The definition of sustainable transport for the context of this paper follows the most widely cited definition of sustainable development from the World Commission on Environment and Development, also known as the Brundtland Commission:

[1] Bicycling, cycling, and biking are used interchangeably throughout the text.

"Sustainable transport is transportation that meets the current needs without compromising the ability of future generations to meet their own needs" (Black, 2000; p. 141; Tolley, 2003, p. 1).

The social, economic and environmental dimensions of sustainable transportation, such as energy consumption, air pollution, land use, noise, social inequity, and the economic costs of car use, need to be addressed in order to fulfill the many far-reaching goals of sustainable transportation. (Black, 2000; Newman & Kenworthy, 1999, p. 7-10; Olsson, 1999). Accordingly, it is important for communities around the world to implement sustainable agendas at all levels. There are currently many strategies that can increase sustainable transportation as a whole, which include: improving the technology; improving alternative modes of transport such as public transit, walking and biking, and; including the economic instruments, such as pricing and financing of sustainable development *(*Greene, 1997; Gärling et al., 2000). Additional measures need to include traffic management strategies, such as traffic calming schemes to slow traffic and create more livable, urban environments, and; an integrated land use and transportation planning and growth management strategies that prevent urban sprawl and redirect growth back to more compact, mixed land use environments. If walking and bicycle use are to increase, there need to be many changes on several levels, including political and social.

There are currently several public policies in the U.S. that are supportive of non-motorized modes, particularly the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 and its successor the 1998 Transportation Equity Act for the Twenty-First Century (TEA-21). These policies have provided federal funding for bicycling and walking projects throughout the U.S. In the short run, it is important to provide the necessary infrastructure to encourage the use of bicycles by increasing the convenience and safety of non-motorized modes. In the long run, it is important to decrease the convenience of automobiles and to allow communities to have more alternatives to driving (Noland & Kunreuther, 1995). Nevertheless, there needs to be a paradigm shift for political and public support, acceptance, and use of walking and bicycling if it is to be a viable option to automobile transportation. It is difficult to change the culture, habits and attitudes of communities, since people do not want to make personal sacrifices of reducing car use without a positive trade-off. People need to understand that living in a city with a sustainable transportation system will be attractive and worth living in. As people become educated and informed on this issue, they will, hopefully, understand, accept, and prefer to live in a clean, safe, healthy urban environment with alternative transportation compared to a polluted, congested, unhealthy, car-dominated urban city. Therefore, this paper intends to highlight the problems, trends and barriers that are currently preventing a sustainable transportation system in the United States.

2. Objectives

The main objectives of this study are to focus on the feasibility of enhancing the use of non-motorized modes while simultaneously reducing automobile dependence for a more sustainable transportation system in the United States. The case of Scranton, PA is used to illustrate, exemplify, narrate, and visualize the information presented and "serve as a vehicle" to understand, describe and analyze the trends, barriers and benefits of enhancing a sustainable transportation system.

The main research questions are:

- What are the factors and impacts that cause automobile dependence throughout the U.S.?
- What is the role of non-motorized modes within an urban transportation system in the U.S. and in the case of Scranton?
- What factors influence the attractiveness of non-motorized transport?

- What strategies or measures can be taken to reduce automobile dependence and increase non-motorized modes to achieve a more sustainable transportation system in a nation known for its 'car-culture'?
- Can an urban community, such as Scranton, shift its lifestyles, attitudes and habits from motorized to non-motorized modes for short trips without jeopardizing the quality of life?

The main objectives are:

- To review the benefits and barriers of bicycling and walking;
- To investigate a community's attitude and cultural dynamics towards motorized and non-motorized modes;
- To determine the indicators of automobile dependence and its impacts;
- To analyze the measures needed for a more sustainable transportation network with the integration of non-motorized modes;
- To investigate the measures governments are taking at local, state and federal levels for the adoption of non-motorized modes;
- To determine if a sustainable transportation system can be achieved in Scranton by encouraging a political and social paradigm shift.

3. Hypothesis

In this report, it is hypothesized that there are many factors that lead to American's car dependence, causing a limited use of alternative modes. At the same time, there are many deterrents and inconveniences in the use of non-motorized modes, such as lack of proper infrastructure, safety concerns, and time aspects that influence the decision to commute by car instead of bicycling or walking for shorter trips. It is hypothesized that if the proper infrastructure for walking and bicycling was improved, and if political and economic measures are taken, individuals can be more influenced to commute by non-motorized modes for short trips. With these hypotheses in mind, bicycle and pedestrian transportation can be significantly improved, in the case of Scranton, as a feasible way to reduce the negative impacts caused by urban transportation and automobile use, which, in turn, will create a more sustainable transportation system with societal benefits.

4. Methods

The methodology, which is both descriptive and analytical, addresses the objectives of this research through literature review and qualitative interviews from Scranton, PA. Qualitative interviews were used as a primary source with subjects that include community members (students and employees) and governmental representatives from the local, state, and federal sectors, in order to obtain an illustrated background for the case study. The role of qualitative interviews allows the subjects interviewed to convey their experiences, observations and descriptions of the case in order to get a deeper understanding of the central themes discussed. The nature of the qualitative research interview differs from the quantitative method, which results in numbers, by allowing a more factual, descriptive level of data (Kvale, 1996, p. 29-37). The questions for the interviews were given in a structured format, but unstructured in a manner that allowed a dialogue for spontaneous, open and flexible information. In addition, the questions differed according to the subjects interviewed, i.e. there was a separate format for the community members and for each of the governmental representatives (see Appendixes A & B). The community members' interview questions focused on their current travel habits and attitudes towards non-motorized and motorized modes within the case study area. Since the study area focuses the central Scranton area, which is more favorable to shorter distance trips, community members in this study were required to live within 4-5 miles of the Scranton area to be able to

commute by non-motorized modes. Aliases were given to the names of community members to protect their privacy. The questions for the governmental interviews intend to better depict the policies supporting non-motorized modes, the funding available, and the role the government at the local, state and federal levels has in supporting non-motorized modes as a means for sustainable transportation. Tables 1 and 2 provide some of the necessary, personal information about the interviewees, which can be used as a reference guide for the following text. Note that when the city of Scranton is mentioned in the text it is setoff by italics, so the reader can differentiate between the literature review and the case study. The same applies to the interviews, which are also italicized, so it is apparent to the reader when the data from the case study is presented.

Table 1. Interview Information of Community Members (Employees and Students) in Scranton

Alias	Age	Occupation	Owns a Vehicle	Owns a Bicycle	Distance to Work/School[a]	Length of Time to Work /School[b]	Mode Choice of Distance Covered	Date of interview
Kelly	29	social worker	yes	yes	3 miles	10 minutes	car	15-Jul-04
Michelle	30	social worker	yes	no	3-4 miles	5 min	car	15-Jul-04
William	49	director of non-profit organization	yes	yes	5 miles	10 min	car	15-Jul-04
Ted	23	Small business owner	yes	no	3 miles	5 min	car	24-Sep-04
Helene	51	professor	yes	yes	1 mile	15-20 min	foot	8-Nov-04
Julia	18	high school student	no[c]	no	5 blocks	3 min (car) 10 min (foot)	car	6-Jul-04
Michael	18	high school student	yes	yes	4 blocks to school, 5 blocks to work	2 min (car) 20 min (walk)	car	6-Jul-04
Sarah	18	university student	yes	yes	400 yards	3-4 min	foot[d]	20-Sep-04
John	20	university student	yes	yes	400 yards	2-3 min	car	22-Sep-04
Sam	21	university student	yes	yes	3-4 miles	5-10 min	car	22-Sep-04

Note: [a & b] The figures for distance and time are estimated by the interviewees, and may not be accurate numbers in the actual distance and time. [c] Julia has a car in use, but does not own one. [d] Sarah is a freshman student that is not permitted to have a vehicle at school.

Table 2. Interview Information of Governmental Officials (Local, State, and Federal)

Name	Title	Government Agency	Date of Interview
George Parker	City Engineer	Scranton's Department of Public Works and Environmental Problems	15-Jul-04
Richard Cochrane	Bicycle and Pedestrian Coordinator	Pennsylvania Department of Transportation	6-Jul-04
John Fegan	Bicycling and Pedestrian Project Manager	United States Department of Transportation	24-Sep-04

5. Limitations

This paper acknowledges the many strategies for achieving a more sustainable transportation system, but, to attain a more detailed analysis, intends to focus more specifically on the role of non-motorized modes. The interviews may not give a complete representation of the case study's transportation system, but it attempts to understand the application of motorized and non-motorized modes. The qualitative interviews may also be limited in scope since they only give a small representation of the habits, lifestyles, attitudes and opinions of subjects in the case study. Since there is a lack of data for Scranton's transportation system, this paper compares Scranton to U.S. statistics, assuming that it follows the same trends. This assumption can cause a misrepresentation for the actual data in the case study. For better understanding on the use of non-motorized modes in the city of Scranton, more research, such as a statistical study on modal use, should be done to understand the travels patterns of the public. In addition, a further investigation in all transportation sectors should also be further developed in Scranton. This will allow any gaps and/or limitations carried out in this study to be further addressed.

6. Background for the Case of Scranton, Pennsylvania

Figure 2. Location of Scranton, PA in the USA. Source: USGS, 2004

Figure 2. Location of Scranton in Lackawanna County. Source: PennDOT, 2004

Scranton is located Lackawanna County in northeastern Pennsylvania (see Figure 1 and Figure 2). The city's population is over 76,000 (US Census, 2000a), making it one of the larger cities in population within the Pennsylvania State. The city of Scranton has a hilly topography with an elevation of 754ft.[2] Scranton has a temperate climate with the average coolest month in January (34 ^{o}F or 1.1 ^{o}C) and the average warmest month in June (83 ^{o}F or 28.3 ^{o}C). The city has a total precipitation of 37.56 inches[3] a year with an average of 3.13 inches per month (The Weather Channel, 2004). Scranton is a geographically smaller city with a total land area of 25.2 square miles and a population density of 3,029 per square mile (U.S. Census Bureau, 2000a).

Scranton was built in 1866 because of the abundance of anthracite coal and iron in the area. The city quickly grew as the mining industries shaped the area. Scranton was once known as the "Electric City," because it was the first city in the United States with an electric powered trolley

Figure 3. Scranton, PA in 1916. Source: Lackawanna Historical Societv. 1995

[2] 1 foot = 0.304 meters
[3] 1 inch (in) = 2.54 centimeters (cm)

system that was built in 1886, as shown in Figure 3 (Electric City Trolley Museum, 2004; Lackawanna Heritage Authority, 2004). Before the advent of the car, most destinations were either reached by foot, bicycle, horse and buggy, and/or trolleys and trains that allowed residents to travel up to 75 miles in the area (Electric Trolley Museum, 2004).

Scranton has since become an 'auto city' that is more dependent on automobiles than other modes of transportation, especially as the trolley system ended after WWII. The case of Scranton is presented as a backdrop of the U.S. transport system, since it is assumed that Scranton follows the same trends as the rest of the country. Therefore, it is important to note some important statistics of Scranton are compared to U.S. statistics to get a better understanding about the case for the preceding sections. Table 3 provides demographic information about the population of Scranton, including the sex and age distribution, employment status, and income in comparison to the Untied States demographic information. As shown in Table 3, Scranton generally has fewer children (under 15) and more elderly people (65 and over) than the U.S. on average. The population in Scranton as a whole is generally older with a large portion of the potential workforce in the age bracket of 15-64. The median income is also fairly lower than in the U.S. (US Census Bureau, 2000a, 2000b).

Table 3. Demographic Information for Scranton, PA and the United States

	Scranton, PA		United States	
Subject	Number	Percent	Number (thousands)	Percent
Total Population	76,415	100	281,422	100
Male	35,543	46. 5	138,054	49
Female	40,872	53.5	143,368	51
Age Distribution				
Under 15	13,088	17.5	72,294	25.6
15-34	21,235	27.8	67,034	24
35-64	26,729	35	107,102	38
65 and over	15,363	20.2	34,992	12.4
Employment Status				
Population 16 and over	62,472	100	217,168	100
Female	34,672	55	112,185	51
Unemployed	2,578	4.1	7,947	3.7
Income				
Median Houshold income	$28,805	X	$38,556	X

Note: (X) not applicable. Source: US Census Bureau, 2000a, 2000b; USDOT, 2002

The greater Scranton area has a strong Central Business District (CBD) that hosts many local businesses and governmental buildings, such as the Court House. Many residents do not currently live in the CBD area, but live in the outskirts within the city limits and in suburban areas in close proximity to the city. The city of Scranton also has several universities and colleges, including the University of Scranton and Marywood University with over 6,000 students in undergraduate and graduate schools (U.S. Census Bureau, 2000a). According to the 2000 Census, Scranton is an educated city with 78.2% of residents holding a high school diploma and higher. 4.1% of the population over the age of 16 is unemployed, while 10.1% of families are living below the poverty line (Census Bureau, 2000a). Many of the residents living in the central area could be university students that have a lower income of less than $25,000. Meanwhile, many of the older residents live outside the city center in the outlying areas.

Over the years, Scranton has experienced a range of flourishing development and depression. However, many state that Scranton is on the beginning of a "second birth' with a recent boom in all types of development. As Scranton is undergoing development and growth,

there are many projects, such as Scranton Tomorrow (2004) and PA Hometown Streets Program (PennDOT, 2004) that are trying to preserve, restore and reestablish the cultural and historical heritage of the city's urban vitality. The city of Scranton is a typical example of a North American city, which was once built to host a vital, vibrant urban center that was pedestrian friendly with a successful trolley system, but has been rebuilt to accommodate the automobile with limited accommodation for non-motorized modes and public transportation. There are many factors that explain the current situation. The following chapters intend to reveal automobile's lead role in the transportation systems (Chapter 7) and the minor role of non-motorized modes (Chapter 8) as appears throughout the U.S. and in the case of *Scranton.* There is great potential to reduce car use in Scranton through improving conditions for non-motorized modes and implementing economic instruments, as examined more in detail in Chapter 9.

7. Automobile Dependency

*"Automobile dependence is the cigarette smoking of the 21st century" (*Railroad Resource Center, 2004).

Throughout the United States, Americans depend heavily on automobiles. Automobile dependency is difficult to change, because the attitudes, behaviors and desires of the car culture are heavily intertwined socially, politically and economically. There are also many impacts, environmental, social and economic, that make the current transportation system unsustainable. The driving forces and impacts of automobile dependence need to be defined and understood in order to shift towards a more sustainable transportation system for future generations.

7.1 Driving Forces of Automobile Dependency

In the U.S., there have been many driving forces that have caused the car dependent culture to emerge. The following section describes the many factors and trends of automobile use, including land use and transportation trends and the current costs of transportation.

7.1.1. Land Use and Transportation Trends

Over the course of the 20th century, networks of roads and highways, estimating about 4 million miles, were built by federal and state funding that has encouraged the development of once-inaccessible tracts of land (Miller, 2004, p. 655). As roads were being built, development followed. After World War II, the federal government gave incentives provided by the GI Bill, such as house loans, for people to move from cities to develop on the edge of cities and towns in low density communities, commonly known as urban sprawl (Ayers et al, 2004). Urban sprawl has become part of the American way of life by increasing the need to drive as shops, work and schools are further away. Land use and travel patterns in the U.S. are a function of one another.

Zoning laws throughout the U.S. have typically separated residential and commercial land development, leading to dispersed development. People have moved from the crowded, congested, and noisy cities to less crowded neighborhoods in the suburbs. As the suburban lifestyle emerged, cities began to lose their functional purposes since businesses also moved outside the city to accommodate the suburban residents (Beatley & Manning, 1997). City centers were once the central hallmark to active, urbanized communities with a built environment of sidewalks, transit, and in-neighborhood retail shops. Cervero & Kockelman (1997) state, "the built environment is thought to influence travel demand along with three principal dimensions: density, diversity and design." Cities in the U.S. were once built with higher densities, more land-use diversity, and a pedestrian-oriented design. As cities' characteristics changed and urban sprawl developed, travel demand, trip generation and vehicle miles traveled increased.

Many cities across the United States have grown dramatically over the years with poor planning and development as people progressed further away from city centers, causing cities to

be decentralized and dispersed. The low population density, caused by land use planning, has an impact on passenger transport. Unlike many of the compact European cities with well-integrated and supported energy efficient public transport with bicycle and walking paths, Americans live in the suburbs further from the city centers (Miller, 2004, p. 671). As cities began to decentralize and disperse, use of the automobile became more of a necessity than a choice, as Newman & Kenworthy (1999) stated. Overall densities decreased to less than 30 people per hectare. 60% of the population resides in low density suburbs outside of urbanized areas (Beatley & Manning, 1997). Residents in sprawling communities drive three to four times more than those living in efficient, well-planned areas that offer better transportation choices (Sierra Club, 2004). According to Miller (2004), dispersed cities in the United States can use up to ten times more energy per person for transportation than those living in compact areas, because the proportion of trips made by car in suburban areas is higher and the trips are longer than in central cities (p. 671). Accordingly, the building of new roads accelerates urban sprawl and promotes longer commutes between cities and suburb areas. Therefore, drivers use more gasoline. Since much of the taxes on gasoline are used to build roads in the U.S., the cycle is perpetuated as suburban development progresses further away, causing traffic volumes to increase (Miller, 2004, p. 671-672).

The dispersed patterns of the suburban lifestyle and development have necessitated a heavy reliance on automobiles, resulting in increased traffic and longer commutes. The average American spends 334 hours per year, 55 minutes a day or 42 eight hour working days a year behind the wheel of their car (USDOT, 2004b). 3.3 million Americans are known as "stretch commuters," who travel at least 50 miles one-way to work (USDOT, 2004a). In Los Angeles and New York City, 1.3 billion hours are lost each year because of traffic delays. The annual costs of traffic delays from road congestion amount to $48 billion per year, or $640 per driver (Parry, 2002). Congestion has become a problem in the transportation sector, which are often solved by building additional lanes and roads to increase the capacity (Black, 1996). The building of additional lanes and highways only creates a further problem of congestion and gridlock and causes additional impacts on the environment and society. As Mayeres et al (1996) acknowledges that congestion is specific to each part of the road network, adding a car to a city street, which is primarily a one-lane road, is different that adding a car to a four-lane highway, because adding one car to urban traffic slows down all other cars using the urban network.

The case of *Scranton, PA* has followed the same land use and transportation trends as other U.S. cities. Scranton is a smaller city with higher population density, but it is smaller in comparison to many of the large metropolitan areas, such as NYC and Boston. Richard Cochrane, Bicycling and Pedestrian Coordinator for the Pennsylvania Department of Transportation (PennDOT), said during an interview, *"The population density" in Scranton "is not that great, but higher….It is not like going to Philadelphia, where there are a lot more people commuting by bicycle and the population densities are higher."* Scranton, on the other hand, is a growing city, which will likely increase in population density. Richard Cochrane remarked, *"Growth is still important in this area (Scranton); people still want growth, especially with jobs"* (pers. comm., July 7, 2004). According to a survey that uses U.S. census data, *Scranton* is ranked 98th in the amount of square miles of sprawl during the period of 1970 to 1990. Scranton has contributed to the 14,545 square miles[4] of urban sprawl over the 20 year period, covering 9 million acres[5] of natural habitats, farmland, and other rural spaces (Kolankiewicz et al, 2001). Figure 4 shows the urban density for the Scranton area, while Figure 5 shows the urban growth of the area over 1990. As the city of *Scranton* continues to grow and develop its suburbs, people are moving further away from the city, making longer commutes and further contributing to environmental impacts.

[4] One mile is equal is 1.6 kilometer.

[5] One acre is equal to 43,560 square feet (4046.856 square meters). An acre that is square in shape measures about 208.7 feet (63.6 meters) on each side. There are 640 acres in a square mile.

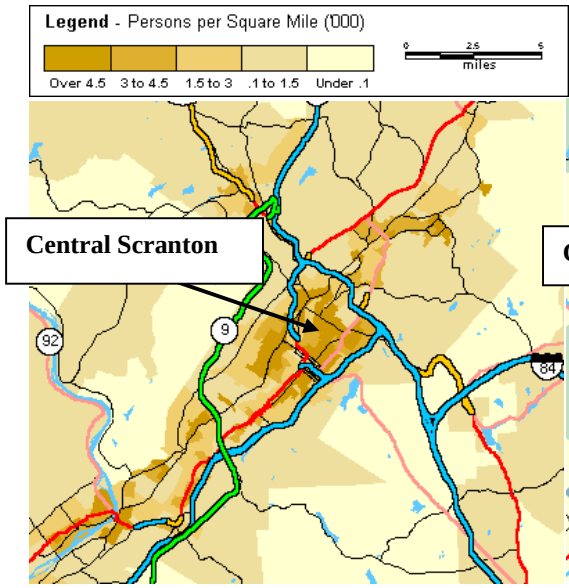

Figure 4. Map of Urban Density in Scranton, PA. Source: STI. 2004

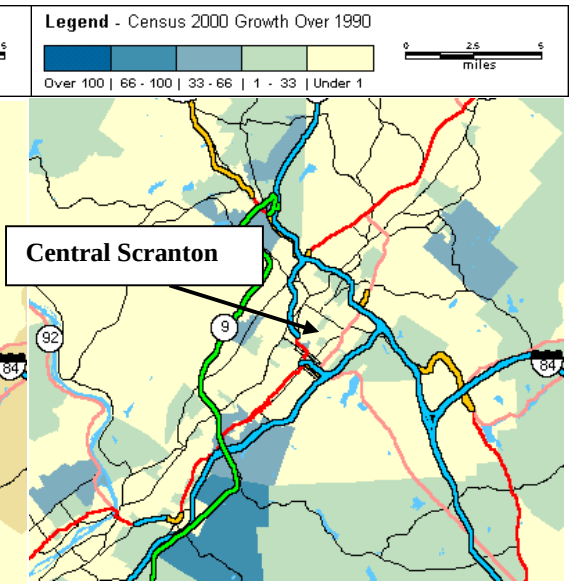

Figure 5. Map of Urban Growth in Scranton, PA. Source: STI, 2004

Since 48% of trips by all modes are shorter than 3 miles in the U.S., there is great potential for growth of alternative modes, in particular non-motorized modes (Pucher et al, 1999). However, cars are almost always given priority over walking, biking and mass transport. Access to low density suburban areas is currently perceived to be cheaper and faster by car than by public transport. Moreover, low density housing reduces the viability of alternative modes, especially since mass transit is mainly only available to high population densities, such as New York City and Boston (Beatley & Manning, 1997) and the distances between destinations are greater, making trips by non-motorized modes time-consuming.

The 2001 National Household Travel Survey stated that 87% of the proportion of trips was by personal vehicle in the U.S. with a smaller proportion on alternative modes. Table 4 presents the distribution on travel modes as percentage of trips. Since non-motorized modes are shorter than other trips on average, non-motorized modes generally take higher percentages of trips than actual miles traveled. The proportion of vehicular trips by purpose also fluctuated with 44.6% for family and personal business and 17.7% for work and work related trips, as shown in Figure 7 (USDOT, 2001). The trends in car use and journey-to-work distances have been substantially increasing, and have shown no signs of stabilization in U.S. cities (Newman & Kenworthy, 1999, 105).

Table 4. Proportion of Trips by Mode in the U.S. (in percentage)

Personal Vehicle	87.0
Personal Vehicle with Single Occupant	37.6
Personal Vehicle with More than One Occupant	48.9
Transit, including School Bus	3.2
Walk	8.6
Bike	1.0
Other	0.7

Source: USDOT, 2001; Rietveld & Richards, 2004

Trends in the U.S. transport modes are considerably different compared to European countries, as shown in Table 5. Many European countries, which have high standards of living, have developed an extensive transportation system with the integration of many alternatives for work, recreation and utilitarian activities (Komanoff & Pucher, 2003, p. 451; Hydén et al, 1998; Pucher et al, 2003; Rietveld & Daniel, 2004; Stangeby, 1997). These countries, such as the Netherlands, Denmark and Sweden, have applied effective measures to increase the share of alternative modes and decrease the use of the automobile. The people in these countries also live in more compact areas with mixed land uses, making the journeys more amenable to walk and bicycle.

Table 5. Percent of Trips per Transport Mode for Various Countries

Country	Bicycle	Walking	Public Transportation	Car	Other
United States	1	8.6	3.2	87	0.7
Netherlands	30	18	5	45	2
Sweden	10	39	11	36	4
Denmark	20	21	14	42	3
Canada	1	10	14	74	1

Note: the numbers are adjusted to more recent reports. Source: USDOT, 2001; Pucher, 1998; Rietveld & Daniel, 2004.

The city of *Scranton* has 32,028 commuting trips to work, by people that are 16 years of age or older, according to the 2000 Census statistics. 28,525 of these trips are traveled using an automobile and the remaining 3,503 travel by other means. Table 6 shows the proportion of work trips by modes in total numbers and percentages, in *Scranton*, compared to U.S. figures. The figures for Scranton follow the same trends as the national statistics, but with almost 3% less commute trips to work by public transportation and 4% more walking trips to work. As Table 6 reveals, Scranton is car dominated with fewer proportions of work trips by alternative modes.

Table 6. Number and Percent of Work Trips by Mode in *Scranton* and the United States

	Scranton		United States	
Commuting to Work	Number	Percent	Number	Percent
Workers 16 years or older	32,028	100	128,279,228	100
Personalized Vehicle (drove alone)	23,773	74.2	97,102,050	75.7
Personalized Vehicle (car pooled)	4,752	14.8	6,067,703	12.2
Public Transportation	580	1.8	3,758,982	4.7
Walking	2,217	6.9	3,758,982	2.9
Other means	222	0.7	1,532,219	1.2
Worked at Home	484	1.5	4,184,223	3.3
Mean Travel Commute Time (Minutes)	18	X	25.5	X

Note: (X) not applicable. Source: U.S. Census Bureau, 2000a, 2000b

The U.S. is the world's most automobile dependent society with car ownership averaging 750 automobiles per 1,000 residents. Interestingly, households in the U.S. have more vehicles on average than drivers[6], as the mean number of vehicles per household is 1.9 while the average number of drivers in a household is 1.8 (US DOT, 2000). Cars represent two-thirds of the 25 million passenger vehicles and the remaining one-third are represented by sports utility vehicles (SUVs), minivans, and light trucks (see Figure 7) (Beatley & Manning, 1997; Cervero, 2001). SUVs, which are fuel-inefficient vehicles, are very popular in the United States. Light trucks and

[6] The driving age in the U.S. is 16 years.

SUVs represent "one out of every two family vehicles sold and will be the fastest growing source of global warming gases in the United States over the next decade" (Fullerton & West, 2002).

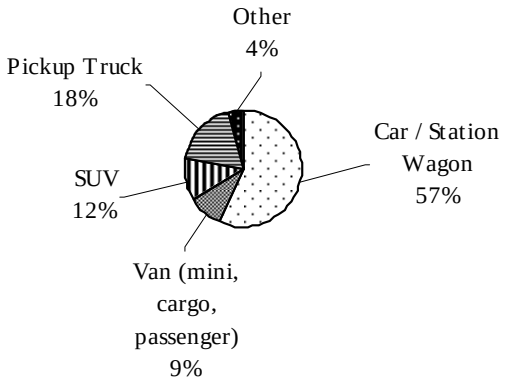

Figure 6. Proportions of Vehicles by Type. Source: USDOT. 2001

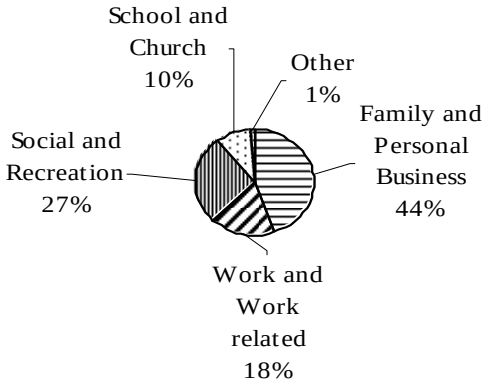

Figure 7. Proportions of Vehicle Trips by Purpose. Source: USDOT. 2001

Transport and land-use planning have caused travel patterns in communities to be completely automobile dependent. Rajan (2004) states, "Many personal travel decisions are not quite personal, but are strongly, if not irrevocably, influenced by the prevailing urban forms." Rajan further states that the many contextual factors, such as the proximity of households, schools, jobs, public services, and government policies may influence automobile dependence, but individuals can alter their behavior by reducing car use through altered mode choice or trip length and better coordination of daily activities. Michelle, a 30 year old social worker, stated in an interview, *"There is really nothing close to me to walk to"* (July 15, 2004). John, a 20 year old college student reaffirmed, *"There are not really any places to walk to; you usually need to drive everywhere"* (September 22, 2004). On the other hand, Helene, 50, professor, who commutes most often on foot, stated that there are many things to do within walking distance. *"I can walk to my doctor's office on foot, the post office I can go on foot…I can go shopping at the mall on foot, there are restaurants downtown, I can pretty much do everything I need to on foot*" (November 8, 2004). Helene lives a bit closer to the city, which may influence her perception on the walking distance in the city. However, it is important to note that during the interviews many lived in a closer proximity to the city than they actually stated before the location of their homes to the city was measured on a map after the interview. As a result, the proximity of households, jobs and other activities may actually be closer in distance than they are currently perceived. Cervero & Kockelman (1997) state that from the perspective of the travel demand theory, the physical structure of places (i.e. trip origins and destinations) is relevant to the understanding of travel behavior. If there was more physical structures within closer proximity, people would leave their cars at home. "*There are not a lot of places around to walk to. If there was I would*" (Julia, 18, high school student, July 6, 2004). There may be many places to walk and bicycle in the city of *Scranton*, but people are just in the habit of commuting by car, so they might feel that daily activities are not within close proximity to travel by non-motorized modes.

7.1.2. Social and Economic Trends

Mobility and transport have played a central role in achieving many social and economic goals, as household and driver characteristics are having an impact on mobility, transport and the choices of vehicle types (Choo & Mokhtarian, 2004). Population growth and demographics, such as age and gender are some of the driving forces that are not only affecting urban sprawl, but also

Americans' dependence on vehicles and travel related patterns. People are living longer and more active lives than 100 years ago. Since people are living longer, their mobility is also increasing, so there are more old workers and drivers on the roads (Rosenbloom, 2003). Collia et al (2003) state that older Americans (age 65+) travel 89% by personal vehicles. However, older adults are less mobile, taking 22% less trips than those under 65, because they take fewer trips, travel shorter distances and take shorter travel times (Collia et al, 2003; Rosenbloom, 2003). Alternative modes become a necessity when older drivers have to give up automobile travel. At the same time, older people traveling by alternative modes are rapidly declining in the U.S., accounting for only 2% of daily travel (Collia et al, 2003; Rosenbloom, 2003). This is because alternative modes are not as accessible in suburban areas where 56% of the population resides (Rosenbloom, 2003). Low levels of accessibility for elderly citizens is unsustainable by creating equity problems and social inclusion

Employment is an additional important driving force, impacting on the demand of passenger transport. Transportation is critical to business and personal economic security. William, 49, director of a non-profit organization stated during an interview that his car is necessary in order to attend meetings outside the area. *"Sometimes those meetings are just a phone call away, so if they call in the mornings, I would have to be there in the afternoons. I would rather not be vehicle-less"* (July 15, 2004). In addition, many employers supply a vehicle and pay for the costs of that vehicle for their employees. Therefore, since workers are not paying for the costs of the vehicle, including gas and maintenance, they do not feel restricted from driving. In an interview, Michelle, who does not drive to work because of the parking problems in *Scranton* as well as the recent increased gas prices, stated *"My husband gets everything paid for with his vehicle, so we never take my vehicle anymore….Why should we pay?"* (July 15, 2004). Thus, those individuals, who have a vehicle that is paid for, will continue to drive despite barriers, such as higher gas prices and parking problems, which would normally deter automobile use.

At the same time, the demand for transportation services depends on average national income. Households with an average income of less than $25,000 are 9 times more likely to be without a personal vehicle than households with an income greater than $25,000, as the National Household Travel Survey (2001) states. However, around 10% of households in the nation do not own a car, as shown in Table 7. Therefore, it is evident that the wealthier people are more likely to own a motorized vehicle. The city of *Scranton* has a median household income of over $28,805 with 79% of the population owning 1 or more vehicles (see Table 7) (U.S. Census Bureau, 2000a). In *Scranton,* 21% of the population is without a vehicle, whereas statistics for the U.S. population state that only 10.3% does not own a vehicle. The difference between the two can be due to the higher median income in the U.S. ($38,556), which is almost $10,000 more than Scranton. Income also has an impact on the type of car purchased (U.S. Census Bureau, 2000a, 2000b). Wealthier people are more likely to choose a luxury car or SUV, because of consumer preference and their status seeking lifestyles, and since they can afford fuel and an expensive vehicle (Choo & Moktarian, 2004; Freidland et al, 2003). Most people who do not own a car hope to buy one someday (Miller, 2004, p. 674).

Table 7. Number and Percent of Household Vehicles in *Scranton* and the United States

	Scranton		United States	
Vehicles Available	Number	Percent	Number	Percent
None	6,440	21	10,861,067	10.3
1	12,783	41	38,123,613	34.2
2	8,933	29	40,461,920	38.2
3+	3,147	10	18,033,501	17.1

Source: U.S. Census Bureau, 2000a, 200b

In addition, there are more wage earners per family as the number of women in the workforce has also increased 72% since 1972 (Lehner-Lierz, 2003, p. 123; USDOT, 1995, 2004b). Even though there are more women in the workforce today than previously, women are still continuing their distinct lifestyle patterns of household activities and specific travel patterns. As Lehner-Lietz (2003) states, "Women combine and co-ordinate their complex transport needs in transport chains (p. 125)." Therefore, women have distinct lifestyle patterns, which have become another driving force to passenger transport. Men, on the other hand, are not as involved in these distinct travel patterns of domestic work and employment as women are. Men, however, are commuting longer distances to and from work than woman (USDOT, 2004b; Lehner-Lietz, 2004, p. 126).

Transportation accounts for 17% of the gross domestic product (GDP) and represents 18% of American household spending, which is the second largest household expenditure after housing (Cambridge Systematics, 1999). Much of the U.S. economy is built on producing automobiles and its services. Automobiles and related industries, such as road building, gasoline, and services, generate at least 25% of the gross national product (GNP) (Paehlke, 2000, p.88). The production of automobiles and services can further explain the American demand and consumption of transportation. The nation's economic prosperity is tied to transport systems to allow for efficient collection and distribution of people, raw materials, goods, etc. However, Cervero (2001) states that even though the current transportation has, in some ways, positively increased the nation's economic productivity and modernization, mobility has, in many other ways, negatively increased environmental and social impacts.

7.1.3. Costs of Transportation

Private vehicles are the most heavily subsidized form of urban transportation (Rees, 2003, p. 12), which can explain the widespread overuse and dependency on automobiles in the U.S. Automobiles have both direct and indirect subsidies, making vehicles relatively affordable (Newman & Kenworthy, 1999, p. 62). A study by the World Resources Institute stated in Miller (2004) explained, "Federal, state and local governments provide automobile subsidies amounting to $300-600 billion a year (depending on the costs included), an average subsidy of $1,200-2,400 per vehicle" (p. 672).

Subsidies, combined with low fuel costs, few road tolls and free parking have resulted in heavy car use, even for short trips (Komanoff & Pucher, 2003, p. 458). The price of gasoline is an indicator for the high passenger transportation use in the United States. Gasoline in the U.S. is cheaper than bottled water, which has contributed to the driving habits of Americans. Since gasoline is inexpensive, car use is supported and encouraged by the government because it does not include the full cost of driving. According to Miller (2004), 80% of all federal gasoline tax revenue is used to build and maintain highways (p. 677). This encouraged the investment of highways instead of alternative transportation modes, leading to higher costs of transportation, which has essentially increased automobile use, traffic congestion, urban sprawl and environmental impacts. Since there has been a greater emphasis on road construction and less on transit and non-motorized environments, cities face economic and social problems by reducing the quality of the urban environment (Newman & Kenworthy, 1999, p. 54-55). Greene & Kenworthy (1997) note that energy consumption by transport and low urban densities are a "consequence of inexpensive transport: people drive more because the travel is cheap…and so they can live in low-density suburbs." Despite the capital productivity from the money invested in roads, as many studies have indicated, there is a greater potential for a long term economic growth in cities that spend more on transit and non-motorized modes (Newman & Kenworthy, 1999, p. 55).

In the past year the price of gasoline has increased by $0.60 with estimates that the price will exceed $2 a gallon. According to an article by the Washington Post, the high increased prices of gasoline have had little or no effect on changes in American's automotive car-buying behavior

or tastes, because Americans still prefer the gas-guzzling SUVs (Brown, 2004). During interviews, when asked if the recent oil prices have impacted their driving, many of the community members responded that it had not, but it has made them more aware of their driving habits. William, 49, responded that he gets *"angry and frustrated…but I still fill it up when I need to. I have been more cautious of the trips I make" (*July 15, 2004). Ted, 23, also responded that it had not impacted his driving at all, and when asked if gas prices or transportation costs continued to increase, he replied *"I think if the prices continue to rise, people will use alternative sources.…If gas prices are raised, then people will walk and bike"* (September 24, 2004). George Parker, Engineer, *Scranton's* Department of Public Works, stated that *Americans may become aware, but they are not going to stop driving because of increased gas prices*. He further stated that *if gas prices increase, people may buy more gas efficient vehicles instead* (pers. comm., July 15, 2004). According to an article written by Porreto (2004) from the Associated Press, the increased price of gasoline has resulted in a 25% increase in the registration of hybrid vehicles in the past couple of months. Newman & Kenworthy (1999) noted that the price of gasoline and disposable income are determining factors in how residents in cities travel through car ownership, travel demand and level of car use (p. 78). Some speculate that the cheap prices of gasoline cannot remain forever (Brown, 2004; Lovins et al, 2004). Hopefully, this will be a force that drives Americans to change their current mobility patterns by purchasing more energy efficient cars, by reducing their vehicle miles traveled, and by utilizing available public transport and non-motorized modes, as it did during the 1970s oil crisis (Meyer, 1999). It is becoming more apparent that the hidden costs of transport have environmental, social and economic impacts that need to be accounted for.

7.2 Environmental, Social and Economic Impacts

The car dependent lifestyles of Americans have contributed to environmental, social and economic impacts. Automobiles consume and fragment land, pollute the air, devour fossil fuels, contribute to global warming, reduce habitat species, and cause acid deposition. In addition, transportation systems cause noise pollution, water pollution, dislocate populations, and create social inequalities for communities. Many of these factors create short term and long term problems that are not sustainable, especially as the hidden costs are accounted for.

7.2.1 Transportation Energy Consumption

As mobility is increasing, energy consumption from the transportation sector in the United States is also increasing. The transportation sector is primarily dependent on fossil fuels. Gasoline, reformulated gasoline, diesel fuel, propane, etc. are all deriatives of petroleum, which is a finite resource. According to Lovins et al (2004), America's mobility is 96% fueled by oil costing a quarter-trillion dollars and is consuming 7 of every 10 barrels the nation uses (p. 1). The 225 million motor vehicles in the US consume 40% of the world's gasoline (Miller, 2004, p. 386), and in 2002 consumed 26.7% of total energy in the U.S., of which 96.8% is from petroleum (United States Department of Energy, 2003). In 2001, approximately 16% of transportation expenditure from households was for purchasing gasoline and motor oil (USDOE, 2003).

Energy consumption and environmental effects are calculated by passenger travel demand, modes/types of vehicles, and occupancy per vehicle (Mindali et al, 2004). According to the U.S. Department of Energy (USDOE) (2003), there is an average of 2 vehicles per household with an average occupancy rate per vehicle of 1.57 for automobiles, 1.76 for SUVs, and 2.22 for vans. The amount of vehicle miles traveled (VMT) are growing at a faster rate than vehicles and more than twice the rate of population (USDOE, 2003). VMT increased 149% from 1970 to 2001 (EPA, 2003) with the average annual miles per household vehicle in 2001 at 11,000 miles (USDOE, 2003). Since most cities throughout the United State have a low density with few alternatives available, the population has a greater demand to drive their vehicles. They have also

been driving longer distances to and from work and other activities (USDOE, 2003). Consequently, Americans generate higher VMT, increasing energy consumption. In addition, SUVs, pickup trucks and vans have increased on the roads, because they are considered a popular, safe vehicle (See Figure 6). However, these SUVs and light trucks consume more energy, and produce 20% of CO_2 emissions in the U.S. (Miller, 2004, p. 385-386). The average new car in 1999 obtained 28.3 miles/American gallon (mpg) while the average light truck had 20.7 mpg (Friedland et al, 2003). Other SUVs, such as the Ford Excursion and Chevrolet Suburban have a fuel consumption of about 12 mpg (UNDP, 2000, p. 428). These large, inefficient vehicles are having impacts on the environment and energy consumption, especially as they are growing in popularity.

Average fuel efficiency for new cars in the U.S. improved from 1975 to 1985 because of the government mandated Corporate Average Fuel Economy (CAFE) standards. However, the average fuel efficiency between 1985 and 2003 leveled off because of the increase demand for large sized vehicles (Miller, 2004, p. 385). Higher mobility per capita and shifts from bus, trains, and local transport has also counterbalanced efficiency. These shifts have increased energy consumption, especially as energy prices for gasoline remain low (UNDP, 2000, p. 177). Fuel efficiencies for motor vehicles need to be improved, in order to reduce energy consumption and environmental impacts from the burning of fossil fuels. Personal decisions to purchase a more energy-efficient vehicle and to use alternative modes, such as non-motorized modes and public transportation can also have an impact on energy use and the environment.

There has been a debate on the future of petroleum as to whether or not there may be enough petroleum-based fuels to extend into the 22nd century (Black, 1996). Additional reserves may be found, which will probably increase consumption, but it will also increase the impacts cause by the burning of these fuels, even if fuel efficiencies improve. Many estimate that global consumption will peak in 2018 or 2025, and then will predictably decline (Black, 1996; Lovins et al, 2004). As the debates continue on the future outcome of this non-renewable resource, it is necessary to take the precautionary steps in preventing another oil crisis because of the vulnerability to world oil market disruptions; in preventing the high consumption of fossil fuels; in preventing the environmental impacts caused by this consumption, and; in preventing the hidden costs associated with fossil fuels and the transportation systems.

7.2.2. Air Pollution

Motor vehicles are the largest source of air pollution and smog. Transportation produces at least 50% of the air pollution in the United States (Miller, 2004, p. 673). Carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), suspended particulate matter (SPM), volatile organic compounds (VOC) and lead (Pb) are common or "criteria" air pollutants that are emitted by vehicles. In addition, carbon dioxide (CO_2), which is caused by the burning of carbon-based fossil fuels, is another major air pollutant that is emitted into the atmosphere. The presence of these chemicals in sufficient quantities and duration in the atmosphere causes harm to the ecosystem and can alter the climate (EPA, 2004; Miller, 2004, p. 421-420). The primary pollutants, which are emitted directly into the troposphere, and secondary pollutants, which are primary pollutants in the troposphere that react with other chemicals to form new pollutants, are equally hazardous to both the environment and human health. These pollutants can also produce photochemical smog and acid deposition in many urban and surrounding areas, causing harm to living organisms and materials. Ozone (O_3) is a common air pollutant that is caused by the chemical reaction of VOCs and nitrogen oxides to form chemical smog (Miller, 2004, p. 421-422). "Trends in criteria air pollutants, visibility, acid deposition, and toxic air pollutants provide a picture of the nation's air quality" (EPA, 2004).

According to the United States Environmental Protection Agency (EPA) (2004), roughly 159 million people, more than half the U.S. population, live in counties where the air quality is unhealthy and does not meet the air quality standards. California, which has one of the strictest air

quality requirements in the country, has been found to have the worst air pollution, along with Texas and Colorado (EPA, 2004). People living in these areas can have adverse health effects caused by the poor air quality. Some of the pollutants, particularly ozone, NO_2, and SO_2 are primarily associated with respiratory-related effects for both children and adults, including asthma, respiratory symptoms (coughing, chest pain), and irritation of the lungs. Carbon monoxide primarily affects people with cardiovascular diseases by reducing oxygen in the blood. Particulate matter, on the other hand, has both respiratory and cardiovascular effects, causing lung and heart diseases. In addition, people exposed to toxic air pollutants in sufficient concentrations may also have other harmful effects, such as cancer, damage to the immune system, cardiovascular and respiratory effects, and neurological, reproductive, and developmental problems (EPA, 2004; Miller, 2004, p. 437).

According to the PA Department of Environmental Protection (2004) and the National Resource Defense Council (2004), the city of *Scranton* has higher air quality standards than other cities. The risk ratio, which presents the risk of the number of premature deaths attributable to air pollution is 1.08 and the attributable deaths per 10,000 people was at 49 (NRDC, 2004). Figure 8 shows 5 major air quality pollutants for *Scranton* and surrounding regions. Ozone (O_3) is a major problem for *Scranton* and other cities across the U.S. (STI, 2004).

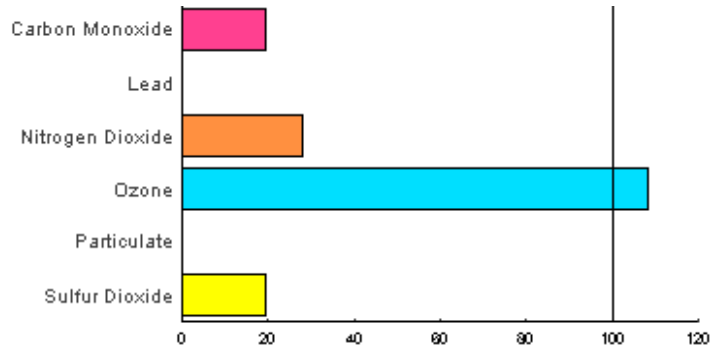

Figure 8. Major Air Pollutants in *Scranton* and Surrounding Regions. Source: STI, 2004

Air pollutants, especially acid deposition can also have negative impacts on the environment. Pollutants are transported and deposited on soils and surface water, which can be potentially harmful to animals, plants and crops (EPA, 2004). Air pollutants, mainly from ozone (O_3) cost $2 to $6 billion per year from agricultural losses, reducing the U.S. food production by 5-10% (Miller, 2004, p. 439). In addition, air pollutants from vehicle emissions have reduced visibility and have caused property damage that has eroded and discolored buildings, stones, metals, statues and other objects, and damaged rubber, fabrics and paint. Damage to buildings from acid deposition is estimated at $5 billion per year (EPA, 2004; Miller, 2004, p. 439).

As previously mentioned, the burning of fossil fuels from vehicles has increased the concentrations of greenhouse gases, particularly CO_2, causing the earth's atmosphere to warm, which is commonly known as global warming. The possible consequences of global warming include changes in climate, agricultural productivity, water supplies and sea level (Miller, 2004, p.451). The United States contributes 25.5% of the global total CO_2 emissions (Miller, 2004, p.451). In 2001, the U.S. carbon emissions released 1,559 million metric tons into the atmosphere, where nearly half was from oil use. The transportation sector accounts for nearly one-third of carbon emissions (USDOE, 2003). A 5 mile trip produces almost 3 times the emissions per mile as a 20 mile trip at the same speed, because of cold start-up emissions and start-stop driving (Fullerton & West, 2002), so replacing short trips with bicycling and walking could potentially have a large reduction on air pollution and the impacts of global warming.

The ambient average concentrations of air pollutants have improved over the past 20 years, according to the Environmental Protection Agency (2004), as technologies improve fuel efficiencies. There have been several laws, such as the Clean Air Acts of 1970, 1977 and 1990 that have taken measures to regulate and enforce states and cities to improve air quality. Six of the most common air pollutants have been reduced by 25%. The EPA (2003) states that these improvements in national air quality have occurred while the GDP increased 161%, energy consumption increased 42%, and VMT increased by 149%. Even though there has been a decline in emissions, there needs to be a greater emphasis by the government to have more stringent regulations to curtail air pollution. If cities and states do not comply with the current less stringent standards, air quality throughout the country and the world will continue to get worse. In addition, the United States has not signed the Kyoto Protocol, which can help make further reductions in greenhouse gases. The Climate Stewardship Act, which is the first major bill presented in the U.S. to control climate change and curb global warming that would reduce emissions to 2000 levels by the year 2010, is being currently proposed in the US government. However, the Union for Concerned Scientists (UCS) (2004) states that the bill is unlikely to pass during the current congress. Nevertheless, it is an attempt to raise the issue of climate change and increase support for action.

7.2.3. Noise Pollution

Noise pollution is a type of air pollution that has harmful impacts on human health. Noise is often defined as an unwanted sound that is either too loud for comfort or is an annoying mixture of sounds (McKinney & Smooch, 1998, p.488). According to Miller (2004, p.688), noise can impair or interfere with hearing, can cause stress and accidents, and can hamper concentration and work efficiency. Traffic noise needs to be reduced to a level which ensures that nobody is exposed to significant health impacts. It is often difficult to impose policies to reduce noise pollution because noise is subjective and dependent on people's hearing sensitivity (McKinney & Smooch, 1998: 488). In order to reduce the undesirable effects of traffic noise, there needs to be effective legislation that controls land use near highways, silences vehicles, and mitigates noise control on highway projects. However, at local, regional and global scales, there are different measures to control and regulate the effects of noise. Noise can be controlled at the source, as it travels to the person through mufflers and/or by protecting the person through noise barriers or highway sound attenuation walls that typically reduce net traffic noise. Acoustic materials can also be placed on buildings to reduce the noise that travels through the air to the person. In addition, people can also wear earplugs that will provide additional protection from noise impacts (McKinney & Smooch. 1998, p.489). However, an increase in non-motorized modes, which are essentially noise free, will only decrease the impacts of noise, especially if they displace the automobile.

7.2.4. Land Degradation

Transportation systems have had impacts on the biodiversity and habitats of species, as well as watersheds and water resources (Miller, 2004, p. 671). Forests, agricultural land, and rural areas are being cleared away to pave for roads and development as mobility and urban sprawl is increasing. Since 1960, the U.S. has lost an average of 1.5 million acres of land a year (Rajan, 2004). These developments have fragmented the land, inhibiting wildlife corridors and decreasing agricultural land. Barriers caused by roads pose a significant impediment to wildlife movement at all scales. Fences and concrete barriers are built along roads to prevent wildlife from causing accidents. However, not only do roads create barriers to wildlife movement, they also have demographic effects, such as the alteration of animal communities, reduction of biological diversity and increased threat of extinction to species (Miller, 2004, p. 673). As the traffic volumes increase and areas continue to sprawl, the problems continue to grow. Better land use and transportation planning can prevent or remove these barriers by constructing more efficient

roads, by determining wildlife habitats and movement patterns, and by decreasing the amount of development on open space by re-urbanizing cities.

7.2.5. Social Impacts

Transportation can cause physical barriers to the American population. People need access to work, shops, public services and leisure time activities, so citizens need to be assured of efficient transportation. However, this is not always the case, especially in low density areas, where public transportation is not widely available. The United States development and land use patterns have manifested a range of social barriers by maximizing distance and dispersion, diminishing proximity and density, and segregating jobs, services and income levels by requiring transportation by car (Beatley & Manning, 1997; Hawken et al, 1999). As households are separated from community centers and activities, making it difficult to walk and bike, the sense of community is lost within the urban form. Michael, 18, high school student, stated that neighborhoods in *Scranton* would *"probably be friendlier, if people would get to see each other more. You would see your neighbors more often. You probably would make more friends"* (July 6, 2004). Livable, healthy, active communities are on the decline, because many people stay behind the wheel of their car, even for short distances that are accessible by walking and biking.

Obesity is another factor that is impacting the U.S. society. 64% of Americans adults are overweight or obese (CDC, 2004). Obesity in Pennsylvania alone has increased 92% among adults from 1990 to 2000. Land use patterns, mobility patterns and distance walked are important associations with obesity. The current sprawling urban form and the amount of time spent in automobiles have had a tremendous impact on the growing concern of obese Americans. According to Frank et al (2004), there is a likelihood of a 6% increase in obesity for each additional hour spent in the car. On the other hand, each additional mile and a half walked per day is likely to reduce obesity by 4.8% (Frank et al, 2004). Accordingly, as Americans become more car dependent, they are increasing their chances of becoming obese or overweight.

The function of transport by automobile in the United States is limited to groups of people, who do not have public access to recreation, commerce, education, and community involvement. The working poor, elderly, disabled, and youth are often left stranded as the subsidization of roads increases at the expense of transit (Beatley & Manning, 1997). The increased car dependency that is associated with new patterns of development and lifestyles has also contributed to the social and economic exclusion of citizens who do not have the use of a car. These groups of people have a barrier to social activities, especially if public transportation is not provided for them. In addition, the building of transport infrastructure can dislocate people, lower property value, and create unaesthetic landscapes (Miller, 2004, p.676-677).

At the same time, traffic can have impacts on populations who walk or bike. Roadways can present significant barriers, such as heavy, high speed traffic, dangerous intersections, and the absence of sidewalks, for bicyclists and pedestrians traveling to and from destinations. As a result, people in the United States have spent six times more on highways than other forms of transport (Miller, 2004, p. 677), because it is considered safer, faster and more convenient to drive a car than walk or bike. However, automobile use contributes to a large proportion of accidents and fatalities in the U.S. Over 40,000 Americans die and 1.3 million are injured in motor vehicle accidents annually (USDOT, 2004b). As the proportion of trips by car continue to increase and as people are traveling farther, accidents and fatalities will increase. Black (2000) writes "Surely, we cannot and should not view a transport system that kills and maims millions as sustainable." Therefore, reducing mobility accidents is a vital element for a sustainable transportation system.

7.2.6. Economic Impacts

Transportation in the United States does not include the full marginal costs. Even though the building of roads is said to feed the economy with economic benefits, there is a growing

understanding that the total costs of transportation needs to be accounted for (Carter; 2001, p. 307-309; Miller, 2004, p. 672; Newman & Kenworthy, 1999, p. 55-58). Many of the hidden transport costs include congestion, pollution, smog, accidents, noise and inequitable access to mobility. If the external costs of transportation were internalized, there would be a reduction in pollution, the use of fossil fuels would be minimized and the destruction of habitats would be prevented (Carter, 2001, p. 307).

It is also important to mention that the military, subsidy, social, and environmental hidden costs of oil dependence could exceed oil's current price on the market, as mentioned by Lovins et al (2004, p. 17). Lovins et al (2004) emphasize in the report *Winning the Oil Endgame* that oil has many hidden costs that could mount up to $10 billion or several tens of dollars per barrel (p. 14-21).[7]

Making drivers pay for the external costs they cause has become an important principle in transportation economics (Mayeres et al, 1996). Unfortunately, this principle is not being put into use, as market prices fail to include 33-50% of the total social costs of transportation (DeCicco & Mark, 1998). There needs to be better comprehension about the hidden costs of transportation since there are many uncertainties. However, the full costs of driving are not accounted for and should, therefore, be reflected in the costs.

8. Non-Motorized Modes of Transport

The many driving forces causing an increase in car dependence throughout the U.S. have led to impacts on society and environment. Therefore, it is necessary to understand the barriers and beneficial factors that are associated with non-motorized modes (walking and biking) in order to enhance a mode shift for a more sustainable transportation system. As funding has dramatically increased for non-motorized modes with the federal Inter-modal Surface Transportation Efficiency Act (ISTEA) in 1991 and the 1998 Transportation Equity Act, there has been an increase in efforts to promote walking and bicycling programs in recognition to the many benefits associated with these modes (Pucher et al, 1999). Even though many States across the country are supporting pedestrian and bicycling programs, mainly for recreational use, there are many barriers prohibiting communities to adopt these programs. Many of these barriers, which have been indicated in several national and international studies, such as the National Bicycling and Walking Study (2001) and the Walcying study (Hydén et al, 1998; Stangeby, 1997) include safety, hindrances in infrastructure, weather and topography, and a lack of tradition in the culture's auto-based transport systems.

8.1. Trends in Bicycles and Walking

Walking and bicycle use depends on many personal factors including general activity patterns and personal attributes, such as age, gender and income. The Nationwide Household Travel Survey (NHTS), formally known as the National Personal Transportation Survey (NPTS) is a comprehensive daily travel behavior survey that has been conducted periodically in the US for over 30 years to give an estimate on the modal share for daily use. Data from the 1990 and 1995 NPTS and the 2001 NHTS states that the number of non-motorized trips has increased almost 2% from 7.9% to 9.5% (USDOT, 1995). According to the 2001 NHTS, walking accounted for 35.3 billion trips or 8.4% of the proportion of trips by mode while bicycling was 3.3 billion trips or 0.8% (see Table 4). The number of bicycle trips in the U.S. has almost doubled over the

[7] Lovins et al (2004) state that gasoline's total externalities are in the magnitude of $4.6-14.1 per gallon. The environmental externalities are estimated at ~$0.14 per gallon or $6 per barrel ($35 billion/year in 2000). The externalities for climate change are ~$0.12 of the $0.14 (p.18). In addition, there are incurred costs from the buying and defending oil, which jeopardizes national security, in a region with ethnic, religious and political conflicts.

past two decades and the percentage of trips by bike rose from 0.6% to 0.9% (Komanoff & Pucher, 2003, p. 451; Pucher et al, 1999). Meanwhile, the number of walking trips has decreased over the years with a slight increase from 1995-2001, as shown in Figure 9. More than half of the trips taken by bike and a third by walking were for social or recreational activities (Komanoff & Pucher, 2003, p. 451-452; Pucher et al., 1999; USDOT, 2003b). Table 8 shows data from the 1995 NPTS of the 65 million bicycle and walking trips a day for trip purposes. This indicates that walking and bicycle use in U.S. has a minor role in the transportation system, especially since the number of driving trips has increased at a rate that eclipses that of walking and bicycling (USDOT, 2001).

The 2001 NHTS shows that roughly 8% of trips taken were by walking (USDOT, 2001). Collia et al (2003) stated that data from the 2001 NHTS showed that people ages 19-64 walked 7.5%, while people over 65 walked 8.4%. Bike trips account for roughly 0.9% of commuting (USDOT, 2001). Bicycle use in the U.S. is more concentrated among children and younger male adults. In the U.S., cycling decreases with increasing age (Pucher et al, 1999), since age has an impact on the physical fitness of people (Rietveld & Daniel, 2004). According to Komanoff & Pucher (2003) cycling is highest among ages 5-15 at 3.3%, and falls for each successive age group to just 0.2% for the age group of 65 and older (p.452).

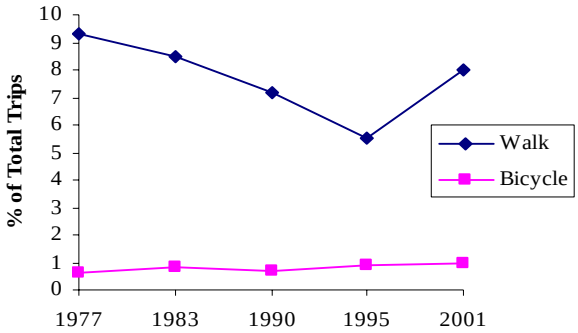

Figure 9. Walking and Bicycling Trips, 1977-2001.
Source: USDOT, 1995

The city of *Scranton*, as shown in Table 6, has roughly 7% of walking trips being commute trips to work, while less than 1% of the commutes to work were by bicycling and other means. Walking was the second highest form, after automobiles, of commute trips to work, which shows that people do walk to work in the city of *Scranton*. However, these modes play a minor role in *Scranton's* transportation system.

Table 8. Trip Purposes for Non-motorized Modes in the United States, 1995

Trip Purpose	% of All Bicycle Trips[a]	% of All Walking Trips[b]	Millions of Bicycles Trips	Millions of Walking Trips
Commuting to Work	8	7	0.72	3.9
Social and Recreational	60	34	5.4	19
Family and Personal	22	43	1.9	24
School and Church	9	14	0.81	7.8
Other	1	2	0.09	1.2

Note: [a] Percentage calculated from the 9 million daily bicycle trips. [b] Percentage calculated from 56 million daily walking trips. Source: USDOT, 1995

Bicycling is more common among men than women (Pucher et al, 1999; Rietveld & Daniel, 2004). The modal split, according to Komanoff & Pucher (2003), is 1.3% for men and

only 0.5% for women (p. 452). Income is also a factor in bicycle use, which has a clear impact on the choice set by individuals in the U.S. (Pucher et al, 1999; Rietveld & Daniel, 2004). Komanoff & Pucher state, "The modal share is 3 times higher among households earning less than $15,000 than for households earning more than $80,000 (p. 452)." Households with a higher income are more likely to walk or ride a bike for recreation than utilitarian purposes, because they can afford an automobile. However, poor households are less likely to own a car and are also living in central cities, where the commute is shorter making it easier and cheaper to cycle and walk (Komanoff & Pucher, 2003, p. 452; Pucher et al., 1999).

Studies have indicated, as the National Bicycling and a Walking Survey (1992) state, that access to an automobile is highly correlated with the choice made as a travel mode. Therefore, the survey further states that limited use of non-motorized modes may have less to do with the negative perceptions of these modes, but rather on the high perceptions and availability of motorized vehicles (p. 12). On the other hand, there are currently many barriers or factors that are recognized as inconveniences to the utilization of non-motorized modes, which also contribute to the limited use of walking and bicycling.

8.2. Factors Influencing the Attractiveness of Walking and Bicycling

Many factors influence the decision to commute by a particular travel mode. Despite the increase in the modal share of walking and biking of roughly 10% in recent years, the U.S. still depends heavily on the automobile. There are many barriers that cause bicycling to still be a 'fringe mode,' especially for short trips. Many of these barriers such as time, distance, weather and topography, are considered an inconvenience, and have reduced the amount of walking and biking.

8.2.1. City Size and Density

A city's size and density has an influence on the role of transport modes. When a city is built with a low density in population, it is more difficult to reach a destination because there are greater distances between point A and B. Accordingly, the greater the city's size and the larger the lower density development, the more difficult it appears for communities to travel by non-motorized modes, not only because of the amount of time it takes, but also because the transportation infrastructure is built for automobiles. Smaller, more compact areas, as Komanoff & Pucher (2003) note, are more amenable to walking and biking, because destinations are shorter and more accessible. However, many cities in the U.S. are moving further from the compact, mixed land use areas. Many of the inner cities in the U.S. are older, higher density areas that were built pre-World War II before the dependence on automobiles, but are sprawling outward, as explained in the previous section. Many of the 'Auto Cities' have a central business district (CBD) in the heart of the city with a high concentration of jobs and few residents, causing people to travel further distances to reach work.

The city of *Scranton* is a smaller, higher density area, making non-motorized modes easier to use and access. However, the city of Scranton is a typical 'auto city' that uses automobiles as its main transportation mode for many destinations, which are in close proximity and could be reached by foot or bike. Helene, 51, stated, *"A city this size, and this compact, as some people would say crowded, is absolutely perfect for walking"*(November 8, 2004).

8.2.2. Distance and Time

Distance is among one of the top factors deterring people from walking for utilitarian purposes, because it requires more time since it is a slow mode of transportation (USDOT, 1992, p. 7). The amount of time that it takes to travel by bike or walking is a large deterrent in the United States' fast paced, high speed society, because many perceive the car to be the fastest mode. The transaction time to park and pick up the car is not always counted for during commutes, making bicycles a competitive mode to automobiles. As cities are built to

accommodate the automobile, walking and biking are considered 'time constraints' and 'time pressures' since they have to compete with the automobile (Goodman & Tolley, 2003, p. 76). The potential time savings are often ignored with non-motorized modes. It may take more time sitting in traffic or driving around to find a place to park the car, than it would be to either walk or bicycle. When asked if time would be saved because of the current parking problems in *Scranton,* Michelle, 30, responded during an interview:

"You know to be honest, it might equal out. I figure to walk from my house to work, it would take probably half an hour, and I tend to walk pretty quick, so you figure that the time I drove from my house to town and drove around the block a couple of times, depending on the time of day, it could be a half an hour" (July 15, 2004).

Travel time influences the mode choice between origin and destinations, as Cervero & Klockelman (1997) suggest, especially for the built environment. Even though *Scranton* is becoming an edge city, many residents still live within close proximity to the city center, making some destinations more accessible by foot or bike. However, the current perception of the built environment throughout the city is more conveniently reached by car than by foot or bike, despite the parking problems that exist around the city, particularly in the CBD area. The city, that was once built to accommodate walking and bicycling and a transit system with an electric trolley, is now thought to be built almost entirely for the automobile, which causes many to feel that it takes too much time to walk and bicycle and that it is faster to commute by car. Many that commute early in the mornings also feel that they have time pressure in getting up earlier for work in order to take the extra time to walk or bike. Michelle said, "*Personally, the only barriers I would think would be time. If I would walk to work that would involve me getting up an extra 45 minutes earlier to be able to walk to work, which would take 30-40 minutes*" (July 15, 2004). Julia, 18, high school student, had a similar comment, "*I usually don't walk, because I would have to get up earlier, about 10 minutes*" (July 6, 2004). Ted, 23, small business owner, stated, *"The distance does not bother me, it is just the time factor"* (September 24, 2004). At the same time, many don't realize that more free time might be saved during the day by walking and biking to work or other activities, than for those who devote the time to exercise (USDOT, 1992, p.8). Theoretically, if many commuters live within 5 miles of the city, then there should be a higher proportion of people commuting by non-motorized modes (USDOT, 1992, p.40).

Distance is relatively small within the city of *Scranton* since it is a smaller, more compact area. Many that work in the CBD will walk during the day since it is inconvenient to drive to locations that are within close proximity because of the current parking problem. Thus, people that work in the CBD may find it a hassle to drive during the day because of traffic and parking, which promotes the incentive to walk. Kelly, 29, said that *she doesn't drive to work, but gets dropped off, because of the parking problems in Scranton, but she walks during lunch to do errands* (July 15, 2004). However, it seems that those that live close enough to walk or bike still drive to work and other activities, because there are not enough disincentives to make driving inconvenient.

However, if there are more locations of shops within closer distance to their residence, people would consider walking and biking. Sam, 21, commented, "*If facilities, such as shopping centers were closer, I would consider walking*" (September 22, 2004). Currently, many of the shops exist within the CBD area; however, many people do not live in the downtown or CBD area. *"The problem is that no one lives downtown…If you were trying to get somewhere, such as rushing to a movie, you will have to get in your car and drive"* (Ted, 23, September 24, 2004). Many of the grocery stores that exist in the area are on the outskirts of neighborhoods. Since these grocery stores are often cheaper to shop than the local mini-marts, people would rather drive to the larger stores than to walk to the closer, smaller stores.

Many compare *Scranton* to other larger U.S. cities, such as New York City and Philadelphia. They state that since cities have larger population densities and greater traffic congestion and appear to be more compact, they are more suitable to bicycling and walking. For example, in an interview Ted, 23, small business owner, said *"I think in NYC, for example, it is quicker to ride a bike, because you can weave in and out of traffic and get to where you want to go. Scranton is not quite big enough, where a bike would be quicker"* (September 24, 2004). In rebuttal to this statement, the city size, as in NYC, is much larger in geographical area compared to Scranton, so the distance between destinations and the city size within larger urban areas can be much greater and will take longer time to commute by foot, bike, and/or motorized vehicles. Larger cities, such as NYC, do have a greater congestion problem than *Scranton*, but considering the city size or area, Scranton can be more suitable to non-motorized modes. The travel distance between the destinations is a lot shorter in Scranton compared to the larger cities. As stated by Helene, *"A city this size, and this compact...is absolutely perfect for walking"* (November 8, 2004). *Scranton* has the characteristic of a dense, pedestrian-friendly city with some mixed-use use and downtown destinations that has a higher potential to use non-motorized modes and transit than a sprawling, automobile dependent suburban neighborhood with a segregated land use. However, non-motorized modes and even public transport play a minor role, despite these characteristics.

8.2.3. Environmental Conditions

The climate and topography can deter people from using non-motorized modes for short trips in an urban transportation network. When the weather conditions are extreme with snowy, rainy winters and/or hot, humid summers, people would rather commute by a vehicle, despite the distance of the trip. However, weather is considered a daily factor dependent on the forecast. If a city has a hilly terrain, people are mainly deterred to ride a bicycle. According to the Walcying (Hydén et al, 1998) study, the geographical terrain is not a negative aspect for walking. Climbing hills on a bike is considered more strenuous than riding on flat surfaces. Hilly terrain can also be less appealing for commuters, because they become exhausted and sweaty (USDOT, 1992).

In *Scranton, PA*, the climate and topography is not entirely conducive for non-motorized modes. *Scranton*, which is located in a hilly environment, is characterized by cold, rainy and snowy winters and warm, humid summer months. In an interview, Richard Cochrane, PennDOT's Bicycle and Pedestrian coordinator, stated, "*Between the terrain and the climate, I don't think that bicycles are going to be a major portion of the transportation network, as much as I wish they would be"* (pers, comm., July 7, 2004). Helene, 51, stated that "*Some people don't like the hills. Scranton is not a homogenous area....also there is the whole weather thing, apparently we are all really afraid of cold and wet"* (November 8, 2004). On the other hand, when asked in an interview as how the city of *Scranton* can support a bicycling and pedestrian program with these environmental conditions, John Fegan from the USDOT noted:

"The city of Seattle and the city of San Francisco are very hilly cities and have very active bicycle and pedestrian programs. They might not have the same winter weather that you have, but places that make a commitment to walking and biking figure out ways to deal with those. Particularly European cities, especially in the northern European cities have a lot of people walking in difficult terrains and difficult weather and I think that truthfully it comes down to the commitment to doing it" (pers. comm., September 24, 2004).

Pedestrian and bicycling programs have been incorporated in many U.S. cities with the same environmental and geographical characteristics as *Scranton*. The city of Seattle in Washington has both a hilly terrain and a wet climate, making it more of a challenge to walk and bike. However, it has been rated twice by *Bicycling* magazine as the best cycling city (Komanoff & Pucher, 2003, p. 455; Pucher et al, 1999). Madison, Wisconsin is another example of a smaller

size city with an extensive bicycling population supported by the government, but has a harsh, snowy winter (Pucher et al, 1999). During an interview, Helene, 51, stated that the weather should not make people disinclined from walking or bicycling:

"When it rains, I have a waterproof jacket and an umbrella, and my feet get a little wet by the time I get home, but they dry, it's not a problem. In the wintertime, you wear boots; it's also not a problem. But most people couldn't imagine, it's cold, it's raining—it's not that big of a deal" (November 8, 2004).

Therefore, Scranton has the potential to support and promote non-motorized modes, even with its current climate and topography, but it will require people to be willing to use these modes under these environmental conditions. It is difficult to change people's attitudes, but with the proper infrastructure and measures more people will use these modes, despite the environmental conditions.

8.2.4. Non-motorized Infrastructure

A lack of proper infrastructure, undoubtedly, has an impact on the shares of non-motorized modes within an urban network. If bicycle lanes, sidewalks and crosswalks are either lacking or non-existent, people will be deterred from commuting by these modes, and will, instead, resort to a motorized vehicle. Other physical barriers may exist, such as high curbs, parked cars on the side of streets, making the risk of cars and car doors hitting a cyclist, causing a barrier to the use of these modes, as shown in Figure 10. Helene, 51, states that parked cars on the road and the non-existence of bike lanes has deterred her from riding her bicycle. She said:

"You have to ride in the street with cars and there are cars parked along side the street so that it's really dicey. You are really not supposed to ride bikes on sidewalks, because they are for pedestrians. There is no place where bikes can be safe" (November 8, 2004).

Figure 10. Bicyclist Riding Along Parked Cars on Adams St. in *Scranton, PA.* (September 22, 2004)

Another factor preventing people from cycling for utilitarian purposes is the lack of places to park the bicycle. Sam commented that there are *"not enough ample places to store your bike"* throughout the city of *Scranton* (September 22, 2004). Michael reiterated, *"I don't know really any places that have bicycle parking, but maybe I have not been really observant about it"* (July 6, 2004). Instead, those who do cycle will lock their bikes to telephone poles (George Parker, Department of Public Works, July 15, 2004) or other types of infrastructure in un-secure areas. The lack of bicycle parking facilities can also pose a greater fear of theft. *"When you are walking, you just worry about yourself, but if you were to ride a bike then you have to worry about you and the bike….if I biked I would have to worry about where I put it with a lock"* (Sarah, 18, September 20, 2004). Throughout the city of *Scranton*, there are no known bicycle parking areas at local shopping centers, such as the Steamtown Mall, the court house, local businesses and schools, including the University of Scranton.

On the other hand, it may be more difficult to build the necessary infrastructure for bicycling lanes since there is limited room to expand the streets to accommodate them. Richard Cochrane, PennDOT's Bicycle and Pedestrian Coordinator further states, *"I have trouble*

visualizing, especially in the urban environment, where there would be room for separate lanes" for bicycling" (pers. comm., July 6, 2004). Helene, 51, further commented on the built environment of *Scranton*, where the streets are narrow, "*The streets were laid out for a different era, so by the time you park cars on either side of the street, you can barely get 2 cars driving. So where does the bike go? You get squashed*" (November 8, 2004). Many of the city streets and sidewalks appear to be in need of repair, which can inhibit people from walking and/or bicycling on the street. If the design and implementation of bicycle and pedestrian facilities are available in an urban network, there will be a higher potential for more people to use them for work and utilitarian purposes.

Figure 11. Motorists Declining to Stop for Pedestrian at Crosswalk on Mulberry Street in *Scranton.* (September 22, 2004)

The city of *Scranton* currently has a vast amount of sidewalks that can be utilized for walking. Many people, who work in the downtown area, seem to walk during the day after arriving to work by car. "*Walking in the city is quite reasonable because the city is quite old. People have no problem walking, because the sidewalks are broad and there are signals at every intersection"* (Richard Cochrane, PennDOT Bicycle and Pedestrian Coordinator, July 7, 2004). In an interview with Helene, she stated, *"Walking in the city is lovely, it's a very walkable place"* (November 8, 2004). According to the 2000 Census data, 7% of residents in Scranton walk to work, because the infrastructure is available to walk with sidewalks and walking signals. Nonetheless, many others feel that "*many of the sidewalks and roads are in need of repair"* (Helene, November 8, 2004); "*that the city was dirty…and would be more attractive to walk if they cleaned it up* (Julia, July 6, 2004)*;* and, *the roads are not geared towards pedestrians anymore"* (Kelly, July 15, 2004).

8.2.5. Personal Safety

In many urban environments, bicyclists and pedestrians are competing with high speeds and large volumes of traffic. As many studies have indicated, safety is a top reason why people do not commute more by foot or bike. There have been 5,000 fatalities in the U.S. annually due to bicycle and pedestrian accidents (USDOT, 2002). This is a significantly lower amount of casualties compared to the number of automobile accidents. Many of the bicycling causalities are not caused by an automobile accident, but rather by the cyclist (USDOT, 2003b). Those that cycle often in traffic may feel safer compared to those who have never cycled in traffic, as the National Bike and Pedestrian Study (1992) reveals, but these cyclists usually choose a safer route with better road conditions (p.10). Kelly, 29, stated, *"When I ride in the street, I feel unsafe, as if someone was going to hit me"* (July 15, 2004). Further, Helene, 51, who used to cycle often in *Scranton* and had 3 accidents on her bicycle, states,

"I have had 3 accidents. I do not ride in the city anymore, there are no bike paths here, there's no safe place and all the cars are parked in the street so it's very hard to see a bicyclist. I have learned that I'm not good at that, after 3 accidents, I have conceded defeat. I used to all the time, part of the reason I got in those 3 accidents" (November 8, 2004).

The protection of pedestrians and bicyclists from cars seems to go unnoticed throughout the U.S. Pucher et al (1999) state that, even though the government has a series of regulation for safety of automobiles with air bags and seat belts, the safety for pedestrians and bicyclists are

largely ignored. At the same time, there is a lack of enforcement when automobiles do not yield to pedestrians and cyclists, despite the fact that pedestrians at a crosswalk have the right of way in almost all states (see Figure 11). In an interview with Sarah, 18, university student, she conceded that not all drivers stop when you are at a crosswalk, *"even though it is a law or rule. This means that you need to be careful, because not everyone follows the law"* (September 20, 2004).

The fear of crime is another issue that deters people from walking and biking. Theft of bicycles is a major disincentive to bicycling, especially if there is no proper and secure place to park a bike. Many are deterred from walking at night because of the fear of safety. Michelle, 29, answered, during an interview, that one of the barriers to walking is *"feeling unsafe…especially at night*." She continues, *"The crosswalk (signals) don't always work, and the pathways are not well lit. With the rise in crime and fear, they should make things better, instead of ignoring it"* (July 15, 2004). Similarly, Helene, 51, who does walk often, stated, *"There are some places that are lovely, and you feel very safe walking through, and I think there are places that people feel very uncomfortable walking through. People often are afraid to walk at night; regardless what part of the city they are in"* (November 8, 2004). In a study from the city of Seattle, 19% of the respondents stated that they would increase walking if there was reduced crime and safer streets (USDOT, 1992, p. 30). Many of the interviewees also stated this as a solution to walking in areas of the city, *"cleaning up those places and making them safer, would be the only thing they can do to improve walking"* (Helene, November 8, 2004). Meanwhile, *"boosting up patrol on foot and bike"* (Kelly, July 15, 2004) and increasing enforcements on drivers are seen as other solutions to increase the safety of pedestrians and cyclists.

8.2.6. Inconveniences

The inconvenience of carrying groceries and other heavy items is often recognized as a major barrier to walking and bicycling. Since many Americans purchase most of their items in a larger supermarket once or twice a week, they often buy many items at once, instead of buying a few items that they need. In an interview, William, 49, stated, *"Obviously, if I am going to the grocery store, I am going to take my car,"* because of the many items to carry (July 15, 2004). Helene, 51, also stated that *"usually grocery shopping involves a car to haul great quantities of food"* (November 8, 2004). Taking children to and from school or transporting other passengers may be another barrier to bicycling or walking (USDOT, 1992; Stangeby, 1997, p. 38-39).

A recognized inconvenience of walking and biking is getting sweaty, especially when you are traveling to work. Many of the employed interviewees mentioned this during the interview. Kelly, 30, noted, *"If I were to cycle to work today, this probably would not be my most comfortable outfit. Maybe if I had shorts on or my exercise pants that I would wear to the gym, I would feel more comfortable to bicycle" (July 15, 2004).* When asked if there was showering facilities available at work would she use them, she replied, *"No…. I like my shower, my stuff and I will just feel like a nomad carrying all my stuff around with me"* (July 15, 2004). Michelle, 29 responded, *"I don't think I would ever walk or bike, because of the way I have to dress to work…I don't want to be sweaty"* (July 15, 2004). However, she also stated that if showering facilities were available she would pack clothes and take them with her.

Other obstacles to non-motorized modes that cause people to drive their vehicle are the need of their car at work. As mentioned earlier, William, director of a non-profit organization, stated that *he does not want to be car-less, because he always has to travel to meetings outside the city* (July 15, 2004). Also, in an interview with Ted, a small business owner, he emphasized that *he relies on his car (SUV) to transport items for work* (September 24, 2004). These obstacles can be overcome with trip planning and chaining, an integrated transit system throughout the area, and a shift in attitudes and habits.

8.2.7. Culture, Attitudes and Habits

People may choose not to bicycle or walk because it is considered the 'un-cool' thing to do. The use of non-motorized modes can be considered a "children's activity or as socially inappropriate for those who can afford a car (USDOT, 2003b)." Two interviewees stated that bicycling is not considered cool when asked what some of the barriers to bicycling are. Julia, 18, high school student, answered that one of the barriers to riding a bicycle is: "*The fact that a lot of people don't really think that bicycling is cool"* (July 6, 2004). Sarah, 18, university student, agreed *"It (riding bikes) is not what many people do. I really don't care what people think, but I think that riding bikes is kind of weird"* (September 20, 2004). Pucher et al (1999) state that there is no single image of cycling in the U.S., but a multitude of perceptions on the different types and contexts of cycling. Cycling for recreation is often seen as youthful and vigorous that is associated with sports and fitness. John, a 20 year old male noted that *he rides his bike almost entirely for recreation and health* (September 22, 2004). Another image is that people bicycling or walking, especially those who commute for utilitarian purposes are seen as too poor to own a vehicle. Individual perceptions play a role in the decision of mode choice. When asked what the overall neighborhood environment would be like if there were more people riding and walking and less people commuting by car in Scranton, Sarah, an 18 year old university student, answered:

"I don't think it will ever happen. If it were to happen, it would be weird. It would be kind of like China, because there would be so many populations of bikes, since a lot of people bike over there…People, who are small minded, would complain about walking and bicycling here" (September 20, 2004).

Pucher et al (1999) wrote, "The perceptions of cycling as lying outside the mainstream of American life discourage bicycle use." In order for walking and bicycling to be used more widely, there needs to be greater acceptance by peer groups. Otherwise, walking and bicycling will generally be used for recreational and health purposes in the U.S., and not for utilitarian purposes. As mentioned in the following section, there are many beneficial factors to bicycling, and it is important to understand people's habits and attitudes, because they are the ones who will have the impact on bicycling and walking for various purposes.

8.3. Benefits to Bicycling and Walking

There are many benefits associated with bicycling and walking, for example, health and environmental benefits, and an attractive, healthy, and safer community. These benefits are frequently becoming recognized as having positive impacts on the population.

8.3.1. Health Benefits

With many Americans leading an inactive lifestyle, causing many health problems for the population, it is important to recognize the benefits that walking and biking have on communities. As mentioned earlier, obesity is a growing health concern that has been increasing at an epidemic rate. There are many factors, such as genetics, behavior, and environment that contribute to the overweight population. As many people are walking less because of the built environment and spending more time in their automobiles, they are increasing their risk of being overweight and obese (Frank et al, 2004). Many programs from the U.S. Center for Disease Control and Prevention (CDC), the Pennsylvania Department of Health (PennDOH) and the Pennsylvania Bike and Pedestrian Plan are recognizing that is important to integrate physical activity by walking and biking into people's daily life, such as work, shopping and social activities (CDC, 2004; PennDOH, 2003; PennDOT, 2004; Pucher et al, 1999). In addition, regular physical activity can reduce the risk of coronary heart disease, stroke and other chronic diseases. Low to moderate levels of exercise will also help reduce health care costs and improve the overall quality

of life (USDOT, 2003b). Stress levels can also be reduced, especially those that are associated with noise levels, since non-motorized modes are essentially quiet modes.

Many of the interviewees in *Scranton* recognized the health benefits, and stated that people, both young and old, living in *Scranton* and throughout the United States are out of shape, which might contribute to the low use of non-motorized modes. Some attributed it to *"laziness,"* while others stated that people, especially kids are *"playing video games and watching TV"* too often. Many interviewees stated that they currently walk and bicycle for exercise, including some trips that are taken by car to walk around local parks, such as Lake Scranton and Moosic Lake. During an interview, Michelle, 29, stated, *"I see more people walking for exercise than I do see people riding bikes"* (July 15, 2004). Many recognized the health benefits for communities, especially if the infrastructure was improved for walking and biking. Kelly, 30, stated that if there were more pedestrian walkways and bike paths, *"it would probably bring people out in the community more, which would make the community appear more friendly, more health conscious – to make people try to lose weight"* (July 15, 2004). While William, 49, stated, *"I think the infrastructure with bike lanes would certainly increase biking, whether it was getting back and forth to work or on Saturdays and Sundays by getting on your bike to ride,"* which would increase non-motorized modes for both utilitarian purposes and recreation (July 15, 2004).

8.3.2. Environmental Benefits

Non-motorized modes emit zero emissions, which have obvious benefits to air and noise pollution. Non-motorized modes do not consume and produce the environmental damages in extracting, processing and transporting the materials and fossil fuels that the automobile industry does. However, some feel that an increase in non-motorized modes would have little benefit to the environment, because people will continue to drive. For example, in an interview, George Parker, Scranton's Department of Public Works' engineer, stated that *there will be some lowering of emissions if bicycles and pedestrians areas were improved, but it still would not be significant enough it have a greater impact. People will continue to drive. It may lower car use by 1,000, but it will not have an overall effect on the environment* (pers. comm., July 15, 2004). According to a study by the USDOT (2004), the public savings from reduced pollution, oil consumption and congestion costs have been estimated between 5 and 22 cents for every automobile-mile replaced by bicycling and walking. The National Bicycle and Pedestrian Study (1992) also compared the amount of emissions and fuels use of automobiles that are displaced with bicycling and walking. These 1992 figures that were quantified by the USDOT from 1990 absolute figures were estimated at:

- Petroleum: 420-1,590 million gallons of motor gasoline, or 0.4%-1.5% of fuel consumed by U.S. passenger vehicles.[8]
- CO_2: 4.2-15.5 million tons, or 0.4%-1.6% of passenger vehicle emissions.
- CO: 370,000-1,355,000 tons, or 1.4%-5.0% of passenger vehicle emissions.
- NOx: 10,100-37,500 tons, or 0.3%-1.2% of passenger vehicle emissions.
- VOCs: 33,900-121,000 tons, or 0.7%-2.6% of passenger vehicle emissions.

The study also states that, "bicycling and walking would also save higher percentages of CO and VOC emissions, than CO_2 and NOx, in part because the short auto trips displaced by bicycling and walking are proportionately emission-intensive for CO and VOCs" (p. 5). Increasing non-motorized modes in urban environments can also reduce levels of ozone and carbon monoxide so

[8] This figure reflects only gasoline that would have been consumed by motor vehicles displaced by bicycling and walking; it excludes energy required to manufacture, store, and service the vehicles or the fuel itself (e.g., refining energy).

they can meet air quality standards required by the Clean Air Act. However, it is important to note that bicycling and pedestrian programs need to be combined and coordinated with effective and efficient public transportation systems, as well as more environmentally friendly automobiles, in order to achieve a more sustainable transportation system.

In rebuttal to George Parker's statement, there will be positive benefits and savings if bicycle and walking replaced just 1,000 cars on the roads. In addition, the environmental benefits of the use of non-motorized modes were mentioned during many interviews in *Scranton*. Many identified the environmental impacts caused by automobiles. They understood that increasing bicycling and walking in neighborhoods would *"probably bring people out of their cars"* which would have *"less traffic"* (Kelly, July 15, 2004) and a decrease in "*air pollution, water pollution, natural resources, such as oil consumption, and ozone"* (John, September 22, 2004). As time continues and as non-motorized modes play a more dominate role in Scranton's transportation, the numbers of non-motorized modes will increase, which will increase the overall environmental benefits.

8.3.3. Social and Economic Benefits

Increasing non-motorized modes in transportation systems will offer additional travel options. This will benefit those who do not have access to an automobile or who want to use other options for certain trips (USDOT, 2003). Bicycles are also at a low cost, making them affordable to almost every social class.

As more people are walking and bicycling, traffic speed throughout the city can also decrease as drivers become more alert and aware of these non-motorized modes. This can make it safer for both motorized and non-motorized modes. The USDOT (2003) stated that roadway improvements that accommodated bicycles have actually reduced the "frequency of certain types of motor vehicle crashes." Walking and bicycling can also help reduce congestion in urban environments, since they take up far less space than automobiles. These benefits of a pedestrian-bicycle friendly community also encourage greater activity in the residential and commercial areas. Sarah, 18, noted that the overall environment would be improved if there was an increase in non-motorized modes, which *"would probably get more out into the city if people were walking and bicycling around downtown, which would be more attractive"*(July 6, 2004). Furthermore, John Fegan, USDOT's Bicycle and Pedestrian Program Manager, stated:

"The more active modes, bicycling and walking, will not only help people become more physically active as part of their day to day lives, but they provide alternatives to the sole use of motor vehicles. They clearly have environmental benefits of reducing air pollution and traffic congestion, and those kinds of societal problems that a lot of places have not" (pers. comm., September 24, 2004).

8.4. Funding for Non-Motorized Modes

Even though bicycling and walking are marginal modes compared to the automobile, there has been significant progress in adopting projects that improve the non-motorized infrastructure throughout the United States. Before 1990, States and municipalities spent little money to improve pedestrian and bicycle conditions. ISTEA in 1991 and its 1998 successor TEA-21 set the stage for the U.S. "to develop a national inter-modal transportation system that was more economically efficient and environmentally sound" that would "consist of all forms of transportation in a unified, interconnected manner" (Clarke, 2003, p. 435). Bicycle and walking are eligible for funding from almost all the federal-aid highway money, transit and other programs (USDOT, 2004). In an interview with John Fegan, Project Manager of the Bicycle and Pedestrian Program at the USDOT, he stated that *surface transportation programs funds can be used to support non-motorized modes of which 10% is the Transportation Enhancement funding program. Moreover, federal highway funds, national highway system funds, scenic byway money,*

recreation trails funding and just about all of the funding programs is eligible for biking and pedestrian projects (September 24, 2004).

TEA-21's Transportation Enhancements (TE) offer communities funding opportunities to expand transportation choices, such as non-motorized facilities, scenic routes, and recreational access. TE funds can also contribute to the restoration and revitalization of local and regional economies by renovating streets, restoring historic buildings, etc., as long as the projects are listed in one of the 12 eligible categories and related to surface transportation (USDOT, 2004). When asked about the availability of TEA-21 TE funds for *Scranton's* city network, John Fegan from the USDOT said:

"They are available, but there is competition at each locality, which has their own specific mechanisms for determining which projects to fund, but bicycling and pedestrian projects are certainly eligible for transportation enhancement funds. In fact, in the history of the enhancements programs, I believe, over half the money has been spent overall on bicycling and pedestrian projects out of the eligible categories and activities that you can spend enhancement money on" (pers. comm., September 24, 2004).

Most of this money (86%), however, is for off-highway paths and trails. 13% of TEA-21 bicycle funds went to on-road bicycle facilities and 1% for biking or connections to public transit (Komanoff & Pucher, 2003, p. 453). The State of Pennsylvania has extensive network of cross-state routes and rails-to-trails, which are mainly used for recreation, making the Commonwealth of PA a national leader (PennDOT, 2004). Richard Cochrane, Bicycle and Pedestrian Coordinator for PennDOT, stated that there are roughly *"700 miles of rail-to-trails in PA, which is the second or third largest in the country"* (pers. comm., July 7, 2004). However, the city of *Scranton* has no current bicycle facilities incorporated into the urban transport system. It appears that much of PennDOT's non-motorized programs are devoted to recreational programs and not necessarily for non-motorized projects in urban environments, such as *Scranton*. Richard Cochrane, PennDOT, stated, *"There are trails on the fringe of the CBD, but not integrated into the city."* He further mentioned, that *there are trails within Lackawanna County, which are slowly gaining momentum, as people live along these trails*" (pers. comm., July 6, 2004). This statement reassures that if bike paths are built in the city, they will potentially gain momentum in usage over time. However, it is apparent that measures need to be applied in order to shift commuters from a car to walking and bicycling.

9. Measures

The current transportation sector is characterized by excessive automobile use and a disproportionately small amount of non-motorized modes, which is inefficient and environmentally harmful. Improving the efficiency of the transportation system with respect to environmental impacts can be a complex issue, involving traffic management, infrastructural designs, and a paradigm shift of cultural attitudes. People's lifestyles and attitudes need to change in order to have an efficient and effective transportation system. However, the public needs to have incentives to shift towards different modes of transportation. Each local authority ought to adopt a 'local' Agenda 21 by entering into a dialogue with its citizens, local organizations and community businesses in order to understand the information needed for formulating the best strategies (Sitarz in Newman & Kenworthy, 1999, p. 21). Governments need to have coordinated, well designed, long term plans for transportation management, such as the inclusion of non-motorized infrastructure with more balanced access to people, places, goods and services. These improved transport efficiencies can also further reduce traffic volume and congestion, especially at peak hours of traffic. In order to further improve the efficiency of the transport sector and reduce the environmental, social and economic impacts, measures need be taken at all levels of the transportation sector. There is no clear cut solution to reduce automobile dependency while

simultaneously increasing non-motorized modes, but several different measures should be applied collectively. Some of these schemes that restrict and reduce car use and increase the shares of non-motorized modes include land use and transportation policies, and increasing and internalizing transportation costs.

Many of these measures may appear radical in nature, and will receive some resistance politically and socially. Therefore, it is important to note that the application of the presented measures have been effective in many cities nationally and internationally. Further, to achieve an increase in non-motorized modes towards an environmentally sustainable transportation (EST) system, the Organization of Economic Cooperation and Development (OECD) has developed guidelines for governments that addresses many of these measures and policy instruments (Geurs & van Wee, 2003, p.32-47; OECD, 2000). These measures can be an effective and efficient way for a city, such as *Scranton*, to implement a more sustainable transportation system.

9.1. Integrated Land Use and Transportation Planning

In order to reduce the demand for motorized transport and increase non-motorized modes, planning of land use and transportation systems needs to be improved and integrated. The demand for motorized transport, particularly the automobile, has typically affected the environment and land use patterns, and vice versa. Transportation and land use patterns have resulted in high levels of automobile dependency with limited transportation alternatives that have typically ignored environmental impacts (Litman, 2003b) and have led to poorly controlled growth. The current land use in the U.S. is clearly an essential part of the transportation problem. Therefore, it is necessary to tackle the land use planning to reduce urban sprawl, re-urbanize city centers and integrate mixed land use developments. 'New urbanism' or 'neotraditional' planning is becoming a popular concept for local governments to reduce high automobile dependency through an urban design that caters to walking and biking (Crane & Crepeau, 1998; Newman & Kenworthy, 1999, p. 143). A sustainable transport policy needs to address the supply side of transport by providing more alternatives and by making vehicles fuel-efficient, and also address the demand side by decreasing the trips traveled by car (Carter, 2001, p. 308).

Land use and transportation planning systems at all levels of government need to be better coordinated to reduce the dependencies and demand for motorized transport. As Carter (2001) states, transportation planning systems are increasingly being used in areas both as a carrot to encourage alternative forms of travel, such as public transportation, cycling and walking, and as a stick to discourage car use (p.309). Improved land use zoning that encourages mixed land use with higher densities is a highly recognized measure in achieving sustainable development that gives more people access to social and economic opportunities. As people are living closer to work and other activities, the need for a car would be decreased since these activities are closer to walk and bike (Noland & Kunreuther, 1995; Rees, 2003, p. 14). Geurs and van Wees (2003) state that the 'spatial-infrastructural constellation' should promote and facilitate short distance trips by allowing more access to activities without using an automobile (p. 38). Many European countries and some cities in the U.S. have applied techniques that have integrated both land use and transportation planning with a complex policy mix (Greene & Wegener, 1997).

Cervero (2001) writes, "Planning for the movement of people, goods and ideas about cities and regions requires a systems framework." Cervero further continues that mobility planning, which includes time, trip generation, trips distribution, and modal split needs to be understood and improved by accessibility planning, which is the planning of origin and destinations closer together and more accessible while planning for sustainability and livability. This means that there needs to be a mix of planning strategies that will collectively improve the balance of the built environment, emotional and behavioral associations with automobiles, and lifestyle patterns, such as family and job needs (Rajan, 2004).

9.1.1. Smart Growth Techniques

The vast majority of Americans want to live in the suburbs, where there are limited alternatives to the vehicle. Therefore, it is necessary for policymakers to find ways to reduce suburban development and to implement measures to reduce the traditional dependency of automobiles, as environmental conditions worsen from business as usual (BAU) trends. Cities could apply smart growth techniques to encourage development that requires less dependence on vehicles. Miller and Hoel (2002) define smart growth "as a range of regulatory, financial and educational practices that may help coordinate transportation and land use through integrated planning." Smart growth uses sustainable or ecological land use planning and zoning laws that discourage urban growth and low-density sprawl, and direct growth to certain areas, and by developing areas to be more environmentally sustainable with the protection of land (Miller, 2004, p. 679). There are a range of smart growth techniques that would provide urban areas with more transportation options and less traffic, which would also improve the quality of life in more compact areas. Some of these techniques would include zoning initiatives, financial initiatives and educational initiatives. Zoning initiatives could create a more compact, mixed land use environment. Financial initiatives could revitalize urban districts. Educational initiatives could promote a dialogue for community members and governmental officials (Miller & Hoel, 2002).

9.1.2. Transportation Demand Management

Transportation demand management (TDM, also called Mobility Management) is a popular strategy to reduce automobile trips, encourage alternatives to driving, and create more efficient land use. TDM is intended to improve the efficiency of urban transportation networks, while incorporating environmental and social impacts into the transportation planning process (Meyer, 1999). TDM strategies include commute trip reduction programs (changes in trip frequency, mode, destination, route and time), parking management, improved bus service, road pricing, rideshare programs, and land use management policies (Litman, 2003a, p. 573; Litman, 2003b; USDOT, 2003). Litman (2003a) states that many transport problems cannot be solved without TDM (p. 573). He further states that TDM does not eliminate travel by automobiles, given that cars can be an efficient option for certain types of travel, but is intended to reduce the amount of car travel (p. 573). A comprehensive TDM program is able to reduce automobile travel by 20-40% by "prioritizing travel based on the value and cost of each trip" (Litman, 2003a, p. 574). There should be more priority on transit, ridesharing and non-motorized modes since they generally cost less than single occupant automobile travel, in terms of road space, parking costs, pollution emissions, etc.

Unfortunately, it is a challenge, as Pogue (1999) states, "to find the right mix of incentives and/or disincentives that will encourage travelers to change their normal travel routine….and getting people interested in implementing effective demand management actions." Most conventional transportation planning favors automobile travel improvements and often ignores the environmental and social impacts of transportation. Non-motorized modes are often ignored in transportation planning, as Litman (2003a) acknowledges, because transportation officials assume that an increase in travel speed and volume is favorable and a decrease in mobility or shift to slower modes is undesirable (p. 577). In an interview, George Parker, a city official in Scranton, reaffirmed Litman's statement that *it is difficult to change the minds of the people to bicycle and walk more, because they are slower modes in our high speed society* (July 15, 2004).

Non-motorized modes are an essential component to TDM strategies, because many automobile trips can be substituted by walking and biking. Typical urban areas can shift 5-10% of automobile use to bicycling and pedestrian modes (Litman, 2003, p. 576), as long as proper TDM strategies are applied. If the non-motorized modes are also used in conjunction with public transportation, there will be a greater reduction in automobile use, which will have many benefits on congestion, health, air pollution, energy consumption, and an overall pedestrian-bicycling

livable community (Litman, 2003a, 2003b; Meyer, 1999; USDOT, 2003). The following methods can be used to improve and encourage the use of non-motorized modes, and at the same time decrease automobile use:

- Internalize the full costs of transportation;
- Enhance non-motorized modes in planning, funding and transportation surveys;
- Improve the non-motorized infrastructure to create an attractive, accessible environment;
- Implement growth management policies through zoning and development of higher density and mixed-use, and;
- Introduce traffic calming schemes (Black, 2000; Litman, 2003a, 2003b, Meyer, 1999).

9.1.3. Traffic Calming Schemes

Traffic calming schemes are a feature of TDM strategies that are intended to reduce traffic speeds and volumes by creating a street design with a greater emphasis on pedestrians, cyclists and residents (Litman, 2003a, p. 582). Traffic calming schemes have many design features that include bumps and raised pavement areas, reduced street parking and reduced areas of streets designed for automobile travel. The traffic-calming objectives, as stated by the USDOT (2003b) and Newman & Kenworthy (1999, p. 146), are intended to:

- Improve the urban environment for non-motorized modes;
- Reduce the barriers that motorized traffic cause to pedestrians and bicyclists;
- Reduce the dominance of cars on roads by reclaiming space;
- Increase the safety and decrease the severity and number of accidents in traffic;
- Reduce local air and noise pollution and fuel consumption;
- Reduce crime;
- Enhance aesthetic values of urban environment, and;
- Enhance the local economy by creating a more livable environment.

Traffic calming has positive impacts for local environments that want to alter road design and layout without rebuilding a street system (Newman & Kenworthy, 1999, p. 146). “Design schemes can not only make destinations more accessible and conveniently reached by foot and bike…, but can also reward pedestrians, cyclists and transit riders with amenities (like shade trees and civic squares)” (Cervero & Kockelman, 1997). George Parker, city engineer with the *Scranton’s* Department of Public Works, stated that *Scranton has previously tried to adopt traffic calming on streets in Scranton, but has met resistance and opposition to the actual design and layout.* He stated that *some argue that parked cars are a way to calm traffic, and that pedestrians feel safe when a parked car is between them and the street. He also stated that planted trees in a median will block the lit pathways to the street as well as views in an intersection* (pers. comm., July 15, 2004). This concludes that there are many ways to calm an urban street, and that there needs to be acceptance and understanding about what the overall aim is meant to accomplish. Traffic calming is not meant to eliminate car traffic, but to reduce the amount of automobile travel for certain types of trips and in certain areas while increasing the shares of non-motorized modes.

An important aspect of traffic calming is that it improves investments by revitalizing the local urban community by promoting a better, more livable environment. City streets that were once being abandoned to suburban sprawl are being reclaimed as traffic calming techniques are applied to create a more walkable and bicycable community (Litman, 2003a; Newman & Kenworthy, 1999.)

9.2. Alternative Policies to Promote Walking and Bicycling

A more comprehensive program of alternative policies needs to be applied in the U.S. to promote walking and bicycling through better law enforcement, expanding bicycle and walking facilities, enhancing campaigns and/or special promotions and expanding political action. Many of the proposals mentioned below are by Pucher et al, 1999 and Komanoff & Pucher, 2003.

9.2.1. Clarify cyclists' legal rights

As mentioned in sections 8.2.4 and 8.2.5, cyclists and pedestrians are often deterred from using these modes because of safety concerns, it is important to clarify their legal rights. Motorists, who do not often yield to non-motorized modes, should be held accountable for their actions. This would help improve and encourage the use of these modes (Pucher et al, 1999).

9.2.2. Expand non-motorized facilities

Expanding bicycling and walking facilities is an important factor in increasing the shares of non-motorized commuting, especially for short trips. These facilities could include bike paths, which are either separated or integrated with pedestrians, increased and improved sidewalks, pedestrian bridges and tunnels, benches to sit and relax, and safe bicycle parking racks and devices. Noland & Kunreuther (1995) state, "increasing the convenience of bicycling should increase the level of usage," and at the same time, "increasing the convenience of bicycling commuting can also be used as a method of decreasing the convenience of automobile commuting." Expanding non-motorized facilities and using traffic calming strategies are integral ways to improve non-motorized modes. John Fegan, the USDOT Bicycling and Pedestrian Program Manager, stated during an interview:

"One way they (the city of Scranton) could do is to set a mode share goal of increasing whatever their current percent of trips by walking and bicycling to some larger numbers in the future. They can develop supportive policies for facilities and programs that provide more facilities and/or enhance the safety of walking and biking. They can really look at their policies and see how they can be changed, if they want to encourage walking and biking. Specifically, they can look at their road design standard and see if there is a way to more customarily include space for bicyclists and pedestrians" (pers. comm., September 24, 2004).

9.2.3. Make all roads bikeable

Since the U.S. has a heavy reliance on the road networks for auto use, it is important to make all roads bikeable. Every city street should allow bicycle commuters, but roads need to be improved 'through wider curbside lanes and shoulders, drain grates replacements, pothole patching, clear lane striping, and bike active traffic signals" (Pucher et al, 1999). Richard Cochrane, Bicycle and Pedestrian Coordinator for PennDOT, stated that it is necessary to *"improve the facilities to the point where those facilities are comfortable for a lot of people. Secondly, widen the roadways or improve the shoulders of the roadway," to allow room for bicyclists, so all roads are bikeable* (pers. comm., July 7, 2004).

9.2.4. Integrate non-motorized modes with public transportation

Bicycle and pedestrian programs need to be developed and built with a quality transit system. Since it is impossible to walk and bike everywhere in an urban environment, it is essential to enhance public transportation with the integration of bicycling and pedestrians trips at the end of the transit trip (Newman & Kenworthy, 1999, p. 164). Included among these enhancements could be bicycle parking racks, adjacent to pedestrian shelters that are located at public transportation stops. Therefore, people can walk and bike to short, local trips and take public transport for longer, cross-city trips. Currently, as mentioned previously, *Scranton's* public transportation is an underutilized transportation mode. Ted stated, *"Public transportation is*

unattractive in Scranton, there is limited hours for buses and obviously there is no subway" (September 24, 2004). Therefore, both non-motorized modes and public transit needs to be better integrated in the *Scranton* area to create a more sustainable transportation system.

9.2.5. Hold special promotions, campaigns and links to wellness benefits

In order to increase the overall share of non-motorized modes, it is important for cities and local communities to hold special promotions and campaigns, such as Bike-to-Work week and Critical Mass Riders. These programs can help increase the overall awareness and support of non-motorized modes (Komanoff & Pucher, 2003; Pucher et al, 1999). Richard Cochrane, government official from PennDOT, stated *"accommodations of brochures, flyers, TV, air radio"* are ways to let people become more educated about the benefits of walking and bicycling (pers. comm., July 6, 2004).

As studies have indicated, walking and bicycling have many health and environmental benefits when used as a frequent mode of transportation. Walking and bicycling are not only cheap ways of getting from point A to point B, but also have many benefits in reducing emissions, energy consumption and combating obesity. Linking these benefits to wellness could increase the use of these modes. The U.S. Center for Disease and Prevention and other various programs are trying to integrate the physical activity of walking and bicycling into everyday lifestyles and routines, such as working, shopping and leisure activities. The League of American Bicyclists also helps give resources, promotions and campaigns for community members and governmental officials to increase bicycling to work and other activities. When urban environments are more amenable to non-motorized modes, the share of these modes will increase and the overall wellness of the community will be improved (CDC, 2004; Pucher et al, 1999; WHO, 2002). Promotions and campaigns can inform, educate and motivate people about the overall benefits of walking and bicycling and help the shift towards more sustainable, bicycle and pedestrian friendly policies.

9.2.6. Broaden and intensify political action and community participation

Political action is essential in order to bring about changes in public policy and to encourage more and safer cycling and walking (Pucher et al, 1999). Political action needs to take place at all levels of the government: federal, state and local. Community members must also participate and exert pressure on government authorities, so their views are heard in order to implement an agenda and funding for non-motorized facilities. Since there is available funding for non-motorized modes, communities must be willing to implement bicycling and pedestrian programs. John Fegan from the USDOT said,

"The decisions on providing these programs and facilities are being made at the state-level of government and the local level of government…a lot of localities are looking at where they are getting pressure to provide different types of facilities, so it really depends on decision makers at the state and local level as to whether they decide to spend federal transportation money, for example, on motor vehicle improvements and/or pedestrian and bicycle improvements (pers. comm., September 24, 2004).

9.3. Economic Instruments

Economic measures can be useful in implementing policies that not only reduce automobile use, but increase the shares of pedestrian and bicycle modes. Economic instruments, such as fuel taxes and congestion pricing, are some of the approaches that are becoming more recognized, but are not very popular, in making the travel costs more apparent. Market-based instruments (MBIs) internalize the external costs into the price of a good by governmental intervention in the markets. MBIs aim to provide an incentive for polluters to reduce their pollution by applying the polluter-pays principle through taxes and costs of goods and services

(Carter, 2001, p. 295). There are many constraints politically and socially in implementing economic policies that protect the environment and control pollution. However, in areas where economic instruments are already in use, they have been effective and efficient in lowering automobile use and shifting to more sustainable modes by managing activities of the people through an underlying cost benefit analysis. As the costs of environmental effects of pollution, health impacts and social impacts from transportation are estimated, it is clear that including these costs will be an important way to curtail the impacts caused by automobiles. In achieving an environmentally sustainable transportation (EST) system, there needs to be a combination of regulatory and pricing instruments in order to change mobility patterns, as well as land use and infrastructural policies, (Geurs & van Wee, 2003, p. 39). Pucher et al (1999) state that a sizeable increase in the price or inconvenience of driving would encourage people to find alternatives to traveling and will begin weaving out the domination of automobiles in daily transport. However, alternatives need to be available and accessible if the costs of transportation increase.

9.3.1. Congestion Pricing

Fair and efficient road pricing schemes are measures that can reduce non-essential trips, traffic congestion, and environmental impacts. As Parry (2002) notes, the traditional response to limiting congestion was to increase the road capacity by building more roads and expanding existing ones. Expanding road capacity not only draws users away from mass transit and non-motorized modes, it increases the congestion on the roads and drives the average cost of mass transit up, because it is being used less (Parry, 2002; Small, 1997). Congestion pricing is an approach that is designed to reduce the need to drive, which would decrease congestion and improve sustainability. Small (1997) argues that congestion pricing is a solution with strong consensus among transportation economists because charges are higher at high peak hours and lower on off-peak periods. At the same time, it reduces the amount of start-stop driving, which consumes oil and produces emissions. As previously mentioned, the amount of time wasted in congestion and the fuel consumed incurs many external costs in urban mobility. Congestion policies are a cost-effective way to reduce congestion and help encourage alternatives to driving, especially during peak hours, by using mass transit, re-scheduling trips to non-peak hours and walking and biking (Parry, 2002).

There are many economic gains in achieving an effective congestion pricing policy as drivers pay for the cost of driving, especially during the high peaks. Unfortunately, congestion pricing does not reduce the impacts of automobile dependence if the money from congestion pricing is used to build more roads; if companies' pay for the congestion charges, and; if drivers shift to "rat-running" through neighborhoods as they utilize routes that are not being charged (Newman & Kenworthy, 1999, p. 183). At the same time, congestion fees are difficult to implement, mainly because of strong opposition from motorists who "previously had the 'right' to travel freely on the roads" (Parry, 2002).

During many of the interviews, many recognized that congestion, in the city of *Scranton*, is not a problem, as compared to NYC and Philadelphia. Congestion pricing can be a possibility to reduce automobile use in *Scranton*, but the barriers in implementing, enforcing and calculating it, could make it an unacceptable and difficult measure. However, congestion does occur at certain times of the day and in localized areas. If a congestion tax was introduced in the city of *Scranton*, it could encourage those that live closer to the city to use non-motorized modes. Moreover, those that live further from the city could be encouraged to use public transport to get to work and other activities in order to avoid paying the fee, as long as an effective public transport system was provided.

9.3.2. Fuel Taxes

The current price of oil does not reflect its true cost to the economy, national security and the environment (Lovins et al, 2004). Fuel taxes, such as a Pigovian, which is an appropriate

externality tax, are argued to be an effective pricing scheme that raises the costs of driving by including the external costs of transportation. Several studies (Fullerton & West, 2002; Rajan, 2004; Small, 1997) have indicated that gasoline taxes that include the external costs can be an effective, efficient measure to curtail driving and encourage other alternative modes. An appropriate fuel tax that includes the full costs of driving would be about $5-7 for each gallon (Miller, 2004, p. 672). Fullerton & West write, "If a Pigovian tax were available, it would induce households to drive fewer miles, to buy more fuel efficient cars…to purchase cleaner fuels, to avoid cold start-ups, and to perhaps drive less aggressively," and for the purpose of this study, to shift people towards non-motorized modes. Unfortunately, in the United States, 80% of federal gasoline tax revenue is used to build and maintain highways, which has encouraged governments at all levels to invest in highways instead of mass transit and non-motorized modes (Miller, 2004, p. 677). These revenues need to be allocated more towards alternatives and less on the development and maintenance of highways.

Fuel taxes have been an effective measure in European countries to reduce automobile dependence (Mayeres et al, 1996; Small, 1997; Johnstone & Karoustakis, 1999). However, fuel taxes alone cannot reduce the automobile dependence and its impacts, but needs to be used in conjunction with vehicle and other emissions taxes. High level of fuel taxes would also be economically unfeasible and would be met with strong resistance from the public sector. The implementation of fuel taxes will also have an impact on lower incomes, especially if they need to travel to work. Gasoline taxes have so far been publicly and politically resisted in the U.S. However, Paehlke (2000) and Miller (2004) state that tax burdens caused by a fuel tax can be equivalently shifted from income taxes, property taxes, etc. to allow for more effective measures that integrate environmental, social and economic values by compensating for gasoline taxes. The gradual increase of federal and state fuels taxes can help to achieve these goals while minimizing the 'political costs' and the resistance from the consuming public. Those increases, however, should be properly allocated to supporting non-motorized modes of transportation. European countries have fuel prices that are 3 to 4 times higher than in the U.S. These fuel prices reflect more of the external costs of transportation, and have been an effective, efficient way to reduce automobile use (Greene & Wegener, 1997). Using the techniques that many of the European nations have applied would generally have a greater impact on the role of decreasing automobile use while simultaneously increasing non-motorized modes.

9.3.3. Vehicle Taxes

The use of vehicle taxes has proved to be an effective way to reduce automobile impacts, such as air pollution, in European countries that have implemented such techniques. Vehicle taxes are levied on the basis of characteristics of the type and size of vehicle, engine size, fuel type, horsepower, etc. (Fullerton & West, 2002; Johnstone & Karoustakis, 1999). Johnstone & Karoustakis (1999) state that vehicle characteristic taxes are an "alternative incentive-based instrument" that is environmentally motivated. Further, a combination of vehicle characteristic taxes is designed to approximate the external costs of transportation by personal vehicles. These taxes would target emissions more directly. At the same time, a purchase tax on a new vehicle that includes the external costs could be applied. Larger cars, such as trucks and SUVs would have a higher sales tax, because they have greater impacts on fuel consumption and emissions. Moreover, a discounted sales tax could be applied to those that purchase fuel efficient vehicles.

Vehicle taxes would not only reduce the automobile dependence, but more particularly the number of larger, fuel-inefficient vehicles would also be reduced. At the same time, these taxes would not have a large impact on lower incomes, because they can chose to purchase a smaller and more fuel efficient vehicle to reduce the amount of taxes that will be otherwise imposed on them. Vehicle characteristic taxes would give an incentive for people to purchase a cleaner, environmentally friendly vehicle. However, it will not completely reduce automobile

dependence and use and will not completely help shift towards non-motorized modes if applied alone.

9.3.4. Emissions Taxes

An emissions tax is another pricing scheme that would charge an emission per VMT during annual vehicle inspections and maintenance (Fullerton & West, 2002; Meyer, 1999). As this tax would give an incentive to reduce emissions by keeping cars maintained, it does not reduce driving. This scheme is also imperfect because emissions per mile (EPM) is not measured perfectly, as Fullerton & West (2002) state, since it does not reflect how a vehicle is driven (i.e. short tips, cold start-ups, and start-stop driving).

9.3.5. Other economic measures

Pricing strategies cannot achieve the optimal solution in an imperfect market and cannot address the sustainability issue alone, as DeCicco & Mark (1998) state. There also need to be a more comprehensive strategy that includes land use and transportation planning. However, it is important to note that many economic measures, such as congestion pricing, will result in other beneficial consequences, such as land use effects, since many are deterred from driving longer distances. Other strategies can include raised parking fees, tolls on roads, tunnels and bridges, and the phasing out of subsidies for automobiles and gasoline. Meyer (1999) further acknowledges that there are two ways to account for the true societal cost of trip made by a motorized vehicle. The first is to raise the cost of vehicles with motor fuel taxes or road tolls. This has been a difficult pricing scheme to implement, because of public and political resistance, especially since people already feel that taxes are too high. The second way is to target individual travel decisions and provide more alternatives to the user. If the true costs of vehicles were included and if proper infrastructure for alternatives modes was given, people are more likely shift to the alternative modes. However, as many studies (Fullerton & West, 2002; Greene & Wagner, 1997; Rajan, 2004) have indicated, full cost pricing needs to be examined further in order to be effectively applied in the U.S.

Analysts state that it is not feasible to include the hidden costs in the market prices of vehicles and fuels, because the public is unaware of the huge hidden costs they are already paying and strong lobbyists, such as oil and tire companies, automobile industries and road builders have strong opposition. Accordingly, there has been a lot of public resistance to taxes on vehicles and fuel, which causes a barrier to politicians implementing them (Rajan, 2004). As households strongly resist these economic instruments, despite the externalities, the underlying fact is that these policies play a significant role in shifting modes away from motorized vehicles to other forms of transport while significantly reducing the environmental, social and economic impacts that are already imposed. At the same time, many believe that an increase in fuel and vehicle characteristic taxes will cause a shift towards more sustainable vehicles, such as hybrid cars, rather than alternative modes. Even though technological approaches in producing more energy efficient, environmentally friendly vehicles will reduce oil consumption and air emissions, it is not likely to reduce the other impacts caused by automobiles. Rajan (2004) states, “In fact, research suggests that the more people are promised technological solutions, the less willing they are to reduce automobile use.”

Incentives could be made to those who walk and bike to work and to other locations. These incentives can be in the form of a tax break for those that walk or bicycle to various activities or in the form of reduced mortgage charges on federally financed loans for homeowners who do not use a car for work (Miller, 2004, p. 672). A tax shift, as previously mentioned, is another positive proposal that is favored by the public and has environmental, social and economic benefits. Although many of the incentives suggested may appear radical, in several interviews, there was some general acceptance and acknowledgment of them, even among habitual car owners. During an interview, Ted, 23, recognized *incentives as a way to increase*

people's use of non-motorized modes in Scranton, especially if they can show proof that they either don't own a vehicle, or if they walk or use a bike instead of using an automobile (September 24, 2004). Furthermore, Helene, 51, who is a habitual walker, did interpret today's dominance of car travel that is largely insensitive to positive incentives, by stating:

"There are all kinds of incentives for people to walk: for example, health reasons, losing weight which seems to be a big thing for people in this country. You will be healthier and you will probably lose weight if you just walk. You would think that's a big incentive, but it doesn't work at all. So that's why I say incentives don't seem to be enough, you have to use disincentives, big disadvantages to driving" (November 8, 2004).

There are many measures, both as incentives and disincentives that can be applied to attain a sustainable transportation system with the integration of non-motorized modes. Many of these measures need to be applied collectively to produce short and long run solutions for a more sustainable transportation system. It is important for policymakers and city planners to understand the impacts of automobiles on the transportation systems and that bicycles and pedestrians can provide relief to automobile use in urban areas. Richard Cochrane from PennDOT said, *"You need to improve the neighborhood environment before they would get out of their cars. It is a catch-22, but there would be fewer costs, less noise, less pollution and less congestion, so you would have an improvement and quality of life."* He further stated that it is certainly economically beneficial and feasible to manage short trips by foot and/or bike, but many do not realize it. *"If you look at paper dollars and percentages, it is much cheaper to do short trips without a car"* (pers. comm., July 6, 2004). Therefore, it is beneficial to give up the automobile for short trips since the costs are higher. The values in what society gains (the benefits), such as an increase in health, environmental, economic savings and urban vitality by walking and bicycling, are greater than the values in what society loses (the costs) by giving up the automobile. The cost benefit analysis can be a useful tool for policymakers to evaluate the implementation of non-motorized programs (Freeman, 2000, p. 190).

10. Discussion

The current transportation system in the U.S., as shown in the case of *Scranton*, is currently not sustainable. It has been revealed through the interviews that Scranton is car-oriented and through the literature review that this car-orientated urban society is not sustainable. As stated, there are many factors that have led to a high automobile dependence and a low dependence on non-motorized modes. *Scranton*, like the rest of America, depends on the automobile. People have grown into the habit of using their vehicle for most trips, even short trips that are less than 5 miles. During the interviews, many stated that once they started driving, they stopped riding their bicycle, and walking was mainly limited to social and recreational trips. Many understood the environmental impacts of automobile use, but have continued to drive regardless of this knowledge. Many contributed their dependence to time, laziness, work and a lack of infrastructure for alternative modes. At the same time, many community members of *Scranton* stated that increasing the convenience and safety of non-motorized modes is an important solution that will help shift people out of the car. All things considered, non-motorized modes can be a viable transportation option that can substitute for automobiles in an urban environment, particularly for short trips. Urban passenger transport plays a limited part in the transportation sector. Short trips that are suitable for non-motorized modes have a limited share of all miles traveled. Therefore, non-motorized modes will never be the entire solution to the unsustainable transport sector. However, it is important to recognize and understand the barriers and impacts that have shaped America's car culture by further developing solutions to improve the current situation.

Since it is difficult to produce a paradigm shift from motorized to non-motorized modes, it is important to apply measures that make it possible. First, it is important to increase the level of walking and bicycling commuting in the urban environment by providing infrastructure, such as pedestrian bridges, bike paths and bike parks, while increasing the safety of non-motorized modes. The design and structure that will accommodate non-motorized modes will need to be further developed by city and transport planners that will best integrate these modes. Second, increasing non-motorized modes in a transport system can help provide an urban environment with more alternatives to automobiles, which can decrease the convenience of automobiles (Noland & Kunreuther, 1995). Third, prohibiting and calming automobile traffic throughout areas of the city can also help discourage automobile use as speed and access is lowered. Essentially, this would also help increase the number of non-motorized modes. When speeds are lowered and automobiles are more restricted in an urban environment, the time aspect that influences the mode choice of automobile will be lessened since it takes longer to commute by a motorized vehicle. Consequently, non-motorized modes will be perceived as the faster mode. Fourth, a long term strategy would be to change current land use development and transportation planning to a "New Urbanism" approach that would also require people to live closer together with mixed land use, so employment, shopping and other activities are closer to residents. Fifth, it is also necessary to increase the public transportation system, which allows people alternative options for longer distance commutes across town. Increasing the frequency, duration and occupancy of a public transportation system is necessary for a city to shift towards more sustainable transportation. Public transportation and non-motorized modes need to be compatible and integrated, especially since not all trips can be taken by foot or bike in today's mobile society. For that reason, it is feasible for people to manage short trips by walking and bicycling and longer trips across the city by other transit means. Thus, it will be necessary to conduct a further study on *Scranton's* current transportation in order to adopt an efficient, effective program.

Bicycling and walking are cheap modes of commuting, making commuting relatively affordable. As Newman & Kenworthy (1999) states the "capital and operating costs of non-motorized mode infrastructure are also very modest when compared to road budgets, so there seems little justifiable impediment to improving these modes in all cities (p. 164)." As the hidden costs of automobile transportation are accounted for, it is apparent that commuting by an automobile is not sustainable, as more roads are being paved further into open landscapes; as the increase in energy consumption and vehicle emissions are impacting our environment, society and economy, and; as the car culture is reducing public interaction and public spaces from the loss of community and urban vitality. Therefore, it is important to re-urbanize and revitalize city cores with the integration of public transport, walking and bicycling to allow more access to and from destinations without an automobile. Re-urbanizing and revitalizing the urban core will also improve the economic growth as more businesses and residents move back into the city of *Scranton*. In addition, there will be more social equity and inclusion as isolated groups have more access to work, facilities, and services.

Many assume that since Americans love their vehicles, there will be opposition to measures that restrict auto use. Some of these measures may include higher fuel prices, congestion pricing, transportation demand management, etc., which may, at first, be met with resistance and opposition. However, over time, if campaigns are also administered during this time that enhances and educates the public on the benefits and incentives of non-motorized modes, there will be more public acceptance and less resistance or opposition to the lowering of automobile use. On the other hand, the implementation of some of these measures, particularly some of the economic instruments, may cause people to purchase more environmentally friendly vehicles. Applying technological fixes to automobiles, such as hybrid vehicles is not only politically feasible, but it also would address many of the impacts caused by automobile use. However, technological measures are not the only answer to sustainable transportation, because there need to be changes in travel behavior. There are many other impacts of the automobile,

socially, environmentally and economically, that cannot be band-aided by a technological fix. Some of these impacts include urban sprawl, land fragmentation, material and waste production, and social dislocation. In addition, non-motorized modes will still play a minor role on the road, causing a higher risk for those who do commute by foot or bike. If bicycling and walking programs and other alternative modes were enhanced while simultaneously increasing energy efficient vehicles, the United States' transportation system will become more sustainable, as the environmental, economic and social impacts are decreased through a technological fix, through travel behavior changes, and through better integration of land use and transportation planning. As a result, non-motorized would promote several sides of sustainability.

When cities have an agenda for accommodating walking and bicycling in their transportation system, problems, such as weather, topography, space for walking and bicycling, and general attitudes, will begin to dissipate because they are making a commitment to figure out ways to deal with these problems. Since attitudes, habits and the culture of the public are some of the most difficult aspects to change, governmental officials and city planners need to develop supportive policies for programs that provide and/or enhance the safety of walking and bicycling, as John Fegan, Pedestrian and Bicycling Program Manager at the USDOT, mentioned during an interview (pers. comm., September 24, 2004). At the same time, there needs to be a better understanding on the use of non-motorized modes to help give a better understanding of the role of non-motorized modes in the current transportation system. It is also important for local, state and federal officials to work collectively on improving pedestrian and cycling projects throughout the U.S. and as it applies to *Scranton, PA*, especially since funding is available for the development of these projects. Community participation will also help encourage these modes, as the in-depth interviews have illustrated that there is general acceptance, support and encouragement of non-motorized modes as a viable, sustainable transportation alternative to vehicle use. If community members work hand-in-hand with governmental officials and if governmental officials provide the necessary information, infrastructure and measures to community members, a more synergistic non-motorized program in *Scranton* and across the nation could be developed that could decrease automobile dependence and lead to a sustainable transportation system in the future.

11. Conclusion

Increasing the convenience of non-motorized modes while simultaneously decreasing automobile use will enhance sustainable transportation by creating a more sustainable and livable environment for future generations. As the current transportation has many environmental, social and economic impacts, it is necessary to tackle the problem sooner rather than later. As speculation about the severity of long term impacts exist, such as global warming, it is important to take the precautionary steps in order to decrease the negative externalities that are caused by automobile dependence. This may appear to be a far-reaching goal, but many communities throughout the world are beginning to take action as successful projects are being promoted and implemented. There is a general agreement that the business-as-usual trends of automobile use are not sustainable, and fundamental changes at all levels need to take place with a great emphasis on policies that support sustainable transportation. The introduction of non-motorized modes is one proposition that will help *Scranton* and other U.S. cities to reduce the impacts caused by motorized vehicles, and that will create many benefits to the population. With increased awareness, knowledge and understanding about these issues, an implementation of non-motorized programs has the potential to reduce car use; reduce accidents; reduce air pollution, climate change and global warming; reduce energy consumption; ease land fragmentation and urban sprawl; increase urban vitality through revitalization and re-urbanization; reduce the induced poverty and social dislocation, and; relieve the economic costs of automobiles. If achieved, *Scranton* will be a city on the road to sustainable development.

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12. Appendix

Appendix A: Community Member Interview Questions

Name: **Date:**

1. Gender: Female/Male
2. Age:
3. Education
4. What is your current main occupation?
5. How many residents are in your household?
6. Do you have a car in your use?
7. How many cars does your household have at its disposal?
8. How many people in your household have a driver's license, including yourself?
9. How often do you drive short car trips under 4 miles?
10. How do you usually cover distance?
11. How often do you drive to work/school in the summer months?
12. How often do you walk?
13. If so, do you walk for utilitarian purposes, such as shopping, appointments, etc., or is it more for recreation and health aspects?
14. Do you own a bicycle?
15. If so, how often do you use it? Do you ever cycle for utilitarian purposes?
16. How far is your home to your place of work/school?
17. How long does it take you?
18. Do you usually make errands on your way to/from school work?
19. Do you have parking facilities close to your workplace/school? If so, is it difficult to find parking?
20. Are there any traffic problems in the city, especially around the high peaks of the day?
21. What are factors that cause you to drive more, especially for utilitarian purposes?
22. What are attractors to walking?
23. Can you think of barriers that make people feel that walking is unattractive in Scranton? What are your main reasons for not walking more often?
24. What are important attractors to cycling?
25. Can you think of barriers that make people feel that cycling is unattractive in Scranton? What are your main reasons for not cycling more often?
26. Would you walk or cycle instead of going by car on journeys for various purposes, all of which are less than 3 miles away?
27. What solutions should be found to make drivers walk/cycle short routes more often?
28. What do you consider important improvements to make you walk instead of going by car?
29. What do you consider important improvements to make for you to cycle instead of going by car?
30. Are you aware of the current bicycling laws? Would having knowledge about the laws effect your decision to cycle?
31. Have the recent gas prices impacted your driving? If so, how?
32. If the gas prices continue to increase would you consider using an alternative mode, such as walking or biking that are short distances away?
33. What do you think the overall effects would be on the community, if walking and biking were improved?
34. Would you walk or cycle to those activities which are less than 3 miles away if there was proper infrastructure on the roads?
35. Would you walk or cycle to those activities which are less than 3 miles away if there was a reduction in cars on the road?
36. If you were to cycle or walk to those activities which you take the same route when you drive?
37. Are you aware of the environmental impacts that are caused by automobile use?
38. If so, does this ever impact your driving or consideration of using alternative modes?
39. Where do you live and work/school on this map?

Appendix B: Government Official Interview Questions (Federal)

Name: **Date:**

1. What are your views on sustainable transportation?
2. How can the US adopt an agenda for sustainable transportation?
3. What is the current land use planning in the city? For example, is there mixed land use or are the residences separated from commercial sites in and around the city?
4. How can current land use and transportation planning change to support a more sustainable transportation system?
5. How can walking and biking be used as an alternative mode to address the environmental, social and economic impacts caused by vehicle use for short trips?
6. Are bicycle and pedestrian programs a feasible way to achieve a more sustainable transportation system in a city network, such as Scranton, PA, that has a population of less than 100,000?
7. What role do you see non-motorized modes within an urban transport system?
8. Would increasing bicycling facilities in a city, such as Scranton, help reduce car use?
9. What are some of the benefits associated with non-motorized modes within a city's transport network?
10. What are some of the barriers?
11. How can the city overcome these barriers?
12. Why do you think that many cities do not adopt an agenda for the use of non-motorized modes of transport?
13. PA has hundreds of miles of rail trails and cross state bicycle routes that are mainly used for recreation, how can these routes be integrated into an urban network, in particular into a city like Scranton that would be used for short trips?
14. Are funds, such as TEA21 enhancement funds, easily attainable for the provision of bicycles and pedestrians in a city network, such as Scranton?
15. Are these funds difficult to apply for?
16. Who is eligible and what are the requirements for Enhancement funds?
17. What other funds are available that can support non-motorized facilities?
18. How much does it typically cost for a city, like Scranton, to develop the necessary infrastructure for bicycling?
19. Do you think it is worth it?
20. What funds are available for traffic calming schemes? Can the enhancement funds be available for traffic calming in a city network?
21. The weather and topography of Scranton are not entirely conducive to non-motorized modes, how can the city support a bicycling-pedestrian program with these environmental conditions?
22. Attitudes, habits, and the culture of the public is difficult to change, how can the city and state enhance a bicycling and walking program to encourage a shift from motorized to non-motorized modes?
23. How closely do federal, state and local officials work on pedestrian and cycling projects?
24. As many European countries have applied effective techniques that include the full cost of transportation, such as high taxes on gasoline and automobiles and other pricing schemes in order to reduce car use, is it possible for the US to take these measures as a long term solution to lower the levels of the automobile impacts?
25. Have the recent increased gas prices impacted people's driving habits, especially if they have many alternatives available to them?
26. Will increased gas prices or other transportation costs cause people to shift towards alternative modes, such as public transit and/or non-motorized modes, if these modes are made available?