

The Environmental Impact of Automobiles on Sustainable Development

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1. Indispensable Automobile

The dream or vision of Henry Ford was to mass-produce automobiles and supply "one running palace for every house." Today, his dream seems to have been realized in some parts of the world. Modern cars are comfortable. They are equipped with such luxuries as stereo systems, car phones, and air conditioning. Most American households have at least two cars. In Los Angeles, there are more cars than people.

In 1903, the first automobile was imported to Korea and was given to the last king, Gojong of the Lee-Dynasty. By July 1997, the registered number of automobiles exceeded 10 million and Korea became the 15th country to have more than 10 million cars in the world. The auto industry has become a very significant part of our economy. In 1996, the auto industry produced 2,850,000 and exported 1,210,000 cars, earning \$10.4 billion. Today one out of 4.6 persons owns a car, and experts predict that by 2015 we will have 24,000,000 cars before being stabilized.

Recently, many environmentalists warn that the passenger cars are not a good means of transportation, especially in large cities. With the increasing usage of

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passenger cars, urban planners of large cities are faced with problems like traffic congestion, increasing air pollution, and deteriorating living conditions within the city. In short, passenger cars (simply, cars from now on) in a large city do not seem to be a viable alternative to sustainable urban transportation.

Table 1 shows the increasing length of roads and the decreasing distance per one car. Although the total distance of roads has increased by 220% during 30 years, the distance per one car has decreased from 813m in 1965 to 9m in 1995. It is no wonder that city dwellers are afflicted with such urban problems as air pollution, traffic congestion, noise nuisance, and the risk of car accidents.

Table 1. Increased Length of Roads and Decreased Distance per One Car

Year	1965	1975	1985	1995
Number of cars	42,000	194,000	1,113,000	8,469,000
Total length of road (km)	33,700	44,900	52,300	74,200
Distance per one car (m)	813	231	47	9

The confounding problem related with the increased number of cars is that Koreans drive daily twice as much than their American counterpart, and four times more than the average Japanese driver. Table 2 shows the average daily driving distance among several countries in the world. Considering the daily driving distance, it is valid to say that there may be 20 million cars in Korea instead of registered 10 million in 1997.

Table 2. Average Daily Driving Distance (1990)

Country	Korea	U. S. A	Germany	Japan	Spain
Driving distance (km)	64	40	38	28	18

In large Korean cities, most people commute by car and complain about the slow traffic, reckless drivers, and dirty air. Increased number of cars in limited road areas cause terrible traffic jams with most drivers wasting time, energy, and patience. In Seoul, the average driving speed is less than 20km/h (12.5 miles per

hour), although the situation has improved in the case of buses mainly thanks to the bus-only lane system introduced recently. In the near future, it will be literally impossible to rely on driving as a means of commuting. Simply put, the car may not be a sustainable means of transportation, especially in large cities.

2. Negative Effects of Automobile

2.1 Energy Consumption

Table 3 shows that when one person drives a car, it is the least efficient mode of transportation in terms of energy consumption. Buses are twice as more energy-efficient, and bicycle is 52 times as more energy-efficient than driving a car. Almost 40% of total energy is consumed by automobiles in America. In 1996, Korea paid \$19.8 billion for the import of petroleum in 1996, and 30% of the oil was consumed by the transportation vehicles.

Table 3. Energy Consumption by Various Means of Transportation

Transport	Car	Bus	Train	Walking	Bicycle
Energy(cal/km/person)	1,153	570	549	63	22
Ratio	52	26	25	3	1

Source : World Watch Institute. 1990. *State of the World*.

Simply calculated, by using public mode of transportation such as buses and trains, we can save half of our energy consumption, almost \$10 billion in one year. Experts predict that the world-wide oil reserve may be depleted in 50 years.

2.2 Environmental Pollution

As already experienced by many urban commuters, cars are the primary source of air pollution. They can tell the difference of the air quality between downtown and in the suburbs by odor alone. The contribution by automobiles to the total

air pollution is varied among gases, but overall 80% of air pollution comes from the cars. Specifically, 83% of carbon monoxide and 89% of hydrocarbons originate from exhaust gas.

Table 4. Contribution of Various Sources to Overall Air Pollution (1994)

Source	SO _x	NO _x	CO	HC
Transportation	17.3	56.6	83.1	89.0
Industry	52.1	27.7	1.5	1.2
Power - Plants	20.6	10.8	1.5	8.8
Heating Facility	10.0	4.9	13.9	1.0
Total	100%	100%	100%	100%

Source : Ministry of Environment. 1996. *White Paper on Environment*.

Table 4 indicates that the exhaust gases from automobiles are the leading polluter of air in terms of nitrogen oxides (NO_x), carbon monoxide (CO), and hydrocarbons (HC). Though not listed in Table 4, carbon dioxide (CO₂) is produced in a large quantity by fuel consumption, and contributes to global warming. Sulfur oxides (SO_x) and nitrogen oxides (NO_x) are the main sources of acid rain which destroy the forest, kill fishes, and harm micro-organisms in the soil. In addition to air pollution gases, automobiles emit CFC's (chloroflourocarbons, or freon gas) which are feared to be the main cause of ozone depletion in the stratosphere. These recent problems, such as global warming, acid rain, and ozone depletion are regarded as global environmental problems, and require that a joint effort be made by every country on this small but precious planet.

Some people may wonder whether the electric car may be a viable alternative to the air-polluting gasoline cars. It is true that the electric car, shown on TV and in newspapers, emits no air pollution gases at all. However, it is costly to generate electricity and recharge the batteries used by the electric car. It is estimated that the electric car consumes 25kwh in running 100km, and produces 16.6kg of carbon dioxide. To produce the same amount of electricity, we have to burn coal and produce 26.1kg of carbon dioxide, or consume oil and produce 21.7kg of carbon dioxide. Therefore, it is not energy efficient to use the electric

car. Although we may reduce air pollution by adopting the electric car, we accelerate air pollution at the place of power generation. Moreover, the electric car's batteries are another source of environmental pollution, and it is three times more expensive to produce an electric car than a gasoline car. Furthermore, tires wear out; producing suspended particles. Brakes wear out and release asbestos dust, which is another source of environmental pollution. Finally when we dispose of the used cars, they become solid waste which demands disposal cost. Therefore, we can say that people love cars but don't realize the environmental cost they are paying in the process of using them.

2.3 Economic Loss

It costs money to own and drive a car. People buy gasoline and pay automobile tax. A recent problem of driving a car, lies in the fact that we have to pay the additional cost of sitting helplessly in the middle of traffic congestion; wasting energy and time. In 1996, the cost of traffic congestion was estimated by the Ministry of Construction and Transportation, to be ₩14.7 trillion. Two thirds of the total congestion cost occurred in the metropolitan area; including Seoul and Kyongki provinces. Traffic congestion, along the national highways, increases the transporting cost of every product, and lowers the competitiveness of our products. In leaving the issue of traffic congestion along our national roadways unresolved, it is predicted that we will have to pay additional ₩2 trillion every year.

Air pollution forces people to pay additional money in the form of private cost. Insurance costs resulting from car accidents during 1987 through 1996 were estimated to be ₩20 trillion. People must wash clothing, paint their homes, and replace corroded wires more often. Also, they face increased costs in hospital fees due to frequent colds, asthma, and lung cancer. Some of these economic losses are neglected in the discussion of air pollution caused mainly by automobiles.

2.4 Social Impact

Cars can affect various parts of our social system. During the past 10 years,

100,000 people have died from car accidents. In 1996 alone, 35 people died every day, totalling 12,653 for the whole year. The number of people injured amounted to 356,000 which is equivalent to 975 people per day. Sadly statistics reveal that 13.2 persons per 10,000 cars died in Korea due to car accidents as compared to 2.1 persons in the U.S.A. and 1.5 persons in Japan. Furthermore, it is estimated that there are more than 1 million people in our country handicapped from car accidents.

The car is a fast means of transportation. It is convenient to drive to see our parents in the country, visit a sick relative in the hospital, or simply meet old friends. However, from my experience of living in Seoul for almost 25 years, I find myself avoiding visitations with my friends and relatives because of traffic congestion. I would rather stay home and watch TV during the weekends than drive a car to visit a friend or relative. Appleyard reports in his book entitled "Livable Streets" that people living in areas with little traffic have more friends and acquaintances than people living in areas of heavy traffic of the same city. Table 5 summarizes the study which indicates that cars make people isolate rather than communicate and socialize.

Table 5. Number of Acquaintances and Traffic Volume

Daily Traffic (cars/day)	2,000	8,000	16,000
Number of Friends	3	1.3	0.9
Number of Acquaintances	6.3	4.1	3.1

There is another psychological effect of car usage. Drivers of cars tend to feel superior to pedestrian. They think that they can move faster than those on foot. The driver need not worry about the rain or snow, and he feels safe and comfortable compared to the pedestrian. When I walk, I can admire the beauty of a fellow pedestrian. However when I drive, I can't see the face of the pedestrians. When I drive, I don't feel any interest in the other people. I become apathetic toward others. Even worse, I feel antagonistic to the crossing pedestrians who walk slowly and seemingly cause delays at the crosswalk. On the other hand,

the crossing pedestrian may not have a friendly feeling about the driver. It appears that cars make people in the city egocentric, apathetic, and antagonistic in the psychological point of view.

3. Sustainable Transport System

From an environmental point of view, the car is like Aladdin's Lamp. Lots of harmful effects and smog result from car usage. For some, the car is an addiction impossible for them to give up. (It may be easier for many men to give up their wives than their car.) What is the alternative to the car as a means of sustainable urban transportation? In this section, this question will be discussed in depth.

3.1 Principles

The first principle of sustainable transportation in a city should be to let people walk. In most of the cities, urban planners are interested in building new roads and connecting roads in order to let cars drive fast. They are not interested in how to make roads walkable for the people. They tend to forget that there are many people who have to walk. Children walk to school, and the poor people who can't afford the luxury of a car have to walk. The streets should be designed for, and used primarily by the pedestrians, not cars. When people walk, they may encounter an acquaintance and have the opportunity to talk about the weather or politics. Thus, walking enables us to better socialize.

The second principle of sustainable transportation is to encourage bicycling. The bicycle is the most efficient way of moving people. It makes people healthy, and it is not fatal to collide with a running bicycle. Buses and subways consume energy, while a bicycle does not demand fossil fuel or electricity. Roads & traffic systems should be designed to let bicycles travel safely. Some European and North American cities have bike-only lanes, traffic lights for the bicycles, and parking lots for the bikes. People can move to the subway station, or bus station by riding a bicycle and park the bike at the station.

The third principle of sustainable development is to supply more buses in the city area. A bus can carry 40-50 persons compared to the maximum 5 persons by a car. A bus is 40 to 50 times a more efficient means of transportation than a one-man-driving car. In supercities like Seoul or New York City, a subway may be necessary. Without the support of a well-organized bus system, however, the subway system may not work efficiently. This is the current situation in Seoul.

The fourth principle is to construct a subway system for supercities having a population of more than 3 million. A subway system is far faster, and safer and more comfortable than the bus. However, we must bear in mind that it costs too much money to construct the subway system. Curitiba City, in Brazil, constructed a good network bus system at 1/80 of the cost necessary to build the subway system. At this point it is just enough to say that the subway is not the only alternative toward solving the urban transport problem. For medium-sized cities (population under 3 million), the bus system may be cheap and efficient alternative to an expensive subway system.

The last means to be adopted in finding a sustainable transportation is the car. Most urban planners in the world must think twice before they build new roads and increase the number of lanes within the city. They have to tame cars for the people, instead of taming people for the car. Cars should not be allowed to speed within the city area. They have to put more crosswalks, change public parking lots into playgrounds, and convert car lanes to bike lanes or sidewalks. A city designed for cars should be remolded into a city for people. This is the change which is happening in many of the European cities where they designate more no-car zones and set speed limits, and forbid using horns in order to tame the cars.

3.2 Myths

There are several myths related with urban transport systems, which are prevalent to urban planners and laymen as well. The first one is to believe that 'fast' is good. They believe vaguely that driving a car fast is better than driving slow. Fast driving will save time and money. Based on this myth, they build more roads,

build more lanes in order to allow cars to travel faster. Consequently, the urban planners of Seoul have built many overpasses and underpasses to aid traffic flow. Though the number of overpasses and underpasses in Seoul is the highest among the large cities in the world, the average speed of a car in Seoul is far slower than that of other cities which has no overpasses at all. The rules & regulations of the Seoul Police Agency stipulates that crosswalks should not be built within 200m distance from an overpass or underpass. Interestingly, a report written by American police states that "pedestrians are the main obstacle to impede the good flow of cars."

The second myth widely believed by the transport expert is that if they widen the road, the flow of traffic will be improved. From my experience of living in Seoul, this is not necessarily true. In the initial months following the widening of the road, the flow of traffic seems to improve. However, the wide road eventually brings more cars and the traffic congestion soon exceeds the previous level. Therefore, we should realize that without controlling the number of cars in the street, widening the road will result in more congestion, not less congestion.

The third myth about pedestrian - and - car relationships is that if we increase the space for pedestrians and reduce the lanes for cars, we will see a traffic explosion. This is not necessarily true. In 1975, Curitiba City converted six - lanes used by cars into a no - car zone for the people. Businessmen along the road protested and warned that a traffic explosion would occur around the area. Interestingly, there was no traffic problem at all. Rather, businessmen enjoyed more profit because more people came on foot. In 1995, Athens in Greece designated a no - car zone in order to save the ancient remains from air pollution. Almost 90% of the people voted for the proposal.

3.3 Example - The City of Curitiba

Curitiba with a population of 2.3 million is located in the southern part of Brazil. In 1990, the United Nations designated Curitiba "the most livable city in the world." Time magazine in 1991, chose Curitiba as "the most environmentally sound city

in the world." Curitiba is a good example of how people can make a large city "environmentally sound and sustainable" through wise decision making and joint cooperation between urban planners and citizens.

The main idea behind making Curitiba's transport system sustainable was "No more roads!" Rather than making more lanes for cars, they designated the three lanes in the center of the road as bus-only-lanes. They built well-designed bus networks which totaled 514 km. On the surface, the bus network is similar to the subway system. People buy one ticket and can go anywhere in the city by bus. There are 20 transfer stations where they can transfer to other buses without stepping on the ground. Tube-like bus stations were built and people could easily transfer to other bus horizontally in one minute. The specially designed bus has five side-doors and can carry 270 persons at one time.

The reason for their decision to support the bus network rather than the subway was the cost consideration. They could not afford the expensive subway system, and they were not sure of the effectiveness of the subway in solving the urban transport problem. So they organized a committee and studied various alternatives. The result was the best bus network in the world at only 1/80 of the cost which was needed to build the subway system. Almost 80% of the commuters use the bus system. Compared to other cities having the same number of cars, Curitiba saved 25% on gasoline consumption. With the revenues saved, they built various cultural facilities. They built 70 public libraries, 20 theaters, 88 medical centers, 100km of bike-only lanes, and green parks totaling 30 million m². It is no wonder that 99% of the citizens answered in a survey, "I don't want to move to any other city."

4. Conclusion

It is wise for city planners to learn from the experience of other cities in the world. Several cities have supported a "car-centered" goal in their urban transport planning. For example, Los Angeles which relied on cars as a means of

transportation was obliged to build a subway system as late as 1993, after 'LA smog' became notorious in the textbooks on air pollution. Bangkok in Thailand had a good system of canals, but the planners filled up the waterways and made roads for the cars. As a result of a bad choice of transportation, the "Venice of Asia" became the "LA of Asia." I recall seeing a picture of a Bangkok policeman wearing a gas mask in the street. These days they wear masks made of cloth. The urban planners of Seoul have long concentrated on increasing the roads without success. In 1992, Seoul with 4 subway systems connected, was declared by U.N. as the second - most polluted city in the world.

Curitiba and European cities have set a good example. Curitiba has designated no - car streets of 1000m downtown. Delft City in the Netherlands was the first city in the world to introduce 'traffic calming' in order to tame cars. For urban planners in developing countries, the alternative seems to be clear. An integrated transport system based on buses and bus - only lanes should be introduced instead of passenger cars.

However, planners in Korean and Chinese cities do not realize that a car - centered city is not sustainable. Shanghai and Canton in China have forbidden bikes in some parts of their streets in order to facilitate the flow of cars. Furthermore, many car - oriented planners regard bicycles in the city as an obstacle to transportation. In Canton, where 33% of commuters use bicycles, city planners have set the goal of lowering the use of bicycles to 13% by 2010.

Many European cities, having a high concentration of automobiles, have realized that cars are no longer the best means of transportation. Many campaigns have been organized to reduce running cars in the streets. During 1994, the Hampshire County Council in England embarked on a three - year campaign to persuade transport users to travel without using private cars. The campaign, entitled 'Headstart', was based on the campaign message "Use you head, not your car." Although the county will spend £1.2 million, they have estimated that they will obtain a significant payback with a benefit to cost ratio of 26 : 1. This arises from an estimated 2% annum reduction in travel growth, with the benefits of less traffic congestion and less air and noise pollution. Additionally, a change in travel mode

would reduce public transport revenue support and less traffic would reduce highway maintenance costs. These direct savings should more than pay for the campaign. In Berlin, the residents of an apartment complex organized a Car Club under the "statt Auto scheme." They were tired of parking problems, and they reduced 400 private cars to 40 public cars. Most residents use public transit and those who need travelling or urgent business, drive a public car owned by the club.

We must change our perspective regarding urban transportation and the benefit of cars. Cars may be regarded as the blessing of a civilization only when a few people own them. Cars have become a monster that devours our precious gasoline, time, and friendships.

Schumacher once stated, 'small' is beautiful. To maintain a sustainable development 'small' is a necessary virtue to be respected. I would like to add, 'many' is not beautiful for our streets and citizens. "More is better" is not sustainable in a crowded country like Korea, and for the only one Earth as well.

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