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Review Article

Review Effects of Environmental and Health Replacement Diesel Bus with Electric Bus in Tehran Mega City

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ABSTRACT

In recent years one from important requests of people in Tehran and others mega cities in Country, Attention to air pollution issue. Fossil fuel of point Sources (such as buildings) and also Diesel fuel of mobile Sources (Bus and General transportation), there are two main Sources of air pollution. In Tehran too, according to the latest municipality report. They account for half of the airborne particles. One of the main causes of pollution in Tehran is the problem of fuel and therefore eliminating diesel engines and converting them to clean energy such as electricity has been one of the applicable strategies for air pollution control. The purpose of this study was to investigate the health and environmental effects of replacing diesel fuel with powered electric buses in Tehran. Looking at the cost of replacing diesel bus fuel consumption and pollution costs. Result, the amount of social costs associated with carbon generation in all public buses is estimated at about 6786.72 $ per day for a daily commute, estimated at about 2477152.8 $ per year. The social cost of carbon footprint on all private sector buses is estimated to be about 8665.92 $ per trip, then estimated at about 3163060.8$ per year. On the other hand, the average daily mileage of each bus is 120 kilometers. Studies have estimated the cost of $ 0.08 to travel 1.6 km for a bus. Therefore, it is estimated that the cost is approximately 0.05 $ per kilometer and the health cost is 6 $. So, the cost of a daily commute for the entire private sector bus is estimated at 4393140 $ over a year. Conclusion, Fuel consumption per 100 kilometers of a bus in Tehran is about 46 liters. On the other hand, the direct and indirect impacts of air pollution impact on the individual, local and national economies. It has always been difficult to accurately measure these effects.

Key words: Diesel fuel; Electric bus; Air pollution; Health costs; Environmental costs

INTRODUCTION

In general, compliance with standards will have a large impact on the amount of hazardous pollutants in the car and, consequently, on the health of the general public, respiratory diseases, especially in children. The major pollutants in diesel fuels are the family of sulfur oxides (SOx), nitrogen oxides (NOx), and suspended particles (PM). Diesel particles emitted from diesel engines are known as (DPM) or Disel PM, which carry carcinogenic elements such as benzo Pyrenes in soot or black carbon or Soot or (Soot Particles) and have a diameter in the range of 0.1 micrometer or 100 nanometers.

Countries around the world have introduced strict standards for the dangerous effects of these newly identified particles, such as the average daily concentration of suspended particles less than 10 microns (PM10) and less than 2.5 microns ($PM_{2.5}$). The Australian standards are 50 μg / m^3 and 25 μg / m^3 respectively, and in the European Union for the PM_{10} standard μg / m350, in Hong Kong 100 and 75, respectively, in Japan 100 and 35, and in the United States 150 and 35 μg / m3, respectively.

The World Health Organization (WHO) calls the aforementioned particulate matter "Group1 Carcinogens" and the deadliest pollutants that can penetrate deep into the lungs and lungs and enter the bloodstream to disrupt DNA. Individuals' blood and heart attacks and premature deaths have been reported. A study of 313,000 people in Denmark found a 22 percent increase in lung cancer among people with an increase 10 μg / m3 in the concentration of suspended particles below 10 microns (PM_{10}) per μg / m3. Also, with each increase in 10 μg / m3 at concentration of suspended particles below 2.5 microns, 36% increase in lung cancer versus againstof 10% increase in $PM_{2.5}$ has been observed. These tiny particles, by entering the cardiovascular system and passing through the cells and reaching the brain, have caused the exacerbation of Alzheimer's disease [1].

The family of pollutants (NOx) also provide aging by entering the respiratory system and creating ozone by combining with volatile

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chemical compounds (VOCs), reducing lung and lung function, especially in children. In combination with moisture and ammonia, NOxs also produce nitric acid and pollute the environment. The NOx standard is usually referred to as the NO_2 pollutant standard, which has adverse effects on human health. Acceptable levels of NO_2 (PPHM) contamination are 5 and reported in sensitive areas of India (PPHM) 1/6. The WHO's one-hour standard for NO_2 pollutants is also set at PPHM 20.

Production of family pollutants (SOx) Sulfur oxides are mainly emitted by diesel vehicles, and the amount of SO2 produced is a function of the amount of sulfur in diesel fuel. While until the 1990s, the SO2 standard was often not announced in the 5/3 ppm range and its risks were not known, but with the increasing recognition of the effects of sulfur in diesel fuel, various countries have gradually introduced stricter standards [2}.

Since 1990, diesel fuel has been common in Sweden at 0.005% or 50 ppm. And especially for diesel vehicles used in closed environments, such as ports and warehouses, or in urban development activities. The standards introduced by the European Union on acceptable amounts of sulfur in diesel fuel are introduced and reduced in Euro 2 (500 ppm), Euro 3 (350 ppm), Euro 4 (50 ppm) and Euro 5 (10-15 ppm) standards, respectively. And. India has enforced diesel fuel with 50 ppm sulfur in New Delhi and 12 other major cities since April 2010. In Brazil, diesel with 50 ppm sulfur has been used for urban areas and 500 ppm for remote areas.

Since 2006, the US Environmental Protection Agency (USEPA) has designated diesel fuel with ultra-low sulfur (ULSD) for US road vehicles and has implemented diesel feeds at Honda, Subaru and Toyota factories. This has led to a very significant percentage (90%) in the reduction of NOx, PM and SO2 pollutants. At the forefront of the goal is a clean diesel fuel program (ULSD) that reduces the percentage of sulfur or sulfur in the fuel, which has immediate health benefits. This measure also provides an opportunity for diesel engine manufacturers to pursue the advanced technological tools needed to further reduce sulfur pollutants (SOx) in favor of public health and the environment [3].

In 2011, Abedi et al. presented a model for estimating the environmental impact of the public transport sector in Tehran. Both the metro and BRT models have a positive external consequence and GDP have a negative external consequence [4].

In 2011, Abedi et al. Evaluated the renovation of Tehran's minibus fleet with an economic-environmental assessment. In total, the modernization of 400 minibuses of Tehran's minibus fleet cost 110,199,995,232 Rials for Iran Khodro Diesel and 152,951 vehicles. 995.232 Rials for the minibuses produced by Zamyad Company. Reduction of foreign costs, maintenance and supply of fuel in this project has been felt, but the high price of new diesel minibuses has led to the cost of the project [5].

In 2012, Barkhodarian with fuel engine tests and their role in evaluating the quality of fuel for gasoline and diesel vehicles, found that to optimize the formulation of fuels in order to improve efficiency, minimize engine problems (sediment formation and clogging of fuel sprays), improve Fuel economy and reduction of emissions from car exhaust are used [6].

Many factors play a role in air pollution in large cities. But the most important cause of air pollution in the city, mobile sources of pollution production include light and heavy vehicles. According to available statistics, more than 75% of air pollution in the metropolis of Tehran is the result of these mobile resources. According to research, the main causes of air pollution in Tehran in the field of mobile sources of pollution can be classified as follows:

- Motor vehicles moving on the streets and city thoroughfares including passenger cars, taxis, motorcycles, buses, minibuses and trucks
- Aircraft, including the entry and exit of aircraft from the airport
- Rail vehicles including trains, locomotives and subways in and around the city In this study, we seek to investigate the effect of replacing electric buses with diesel in Tehran as a pilot.

RESEARCH METHODS

First, the cost of diesel and gasoline buses is examined.

A. Diesel side costs:

The status of diesel emissions from buses is divided into the following two parts by buses:

First: Direct carbon emissions during the combustion of diesel fuel (due to the fuel per gallon or 4.55 liters of diesel, about 9.97 kg of carbon is emitted, and after analyzing the social costs, an average of $ 36 per ton Is carbon dioxide)

Second: The emission of suspended particles, ozone, sulfur dioxide, nitrogen oxide and other pollutants due to combustion of diesel fuel, which pollutes heart disease, respiratory problems and increases the risk of carcinogenicity. (For example, the estimated estimated cost of sanitary exterior in a heavy diesel car in this class is $ 0.8 per 1.6 kilometers.)

B. Electric side costs:

There is no direct emission in electric vehicles, and the only indirect greenhouse gas emissions in the battery charge section are the average emission rate of 0.33 kg of carbon per kilowatt hour. Therefore, the total carbon emissions associated with charging a battery is 3.56 tons per year, and using the social cost of carbon $ 36 per ton of carbon dioxide, the annual cost of carbon for this sector is estimated at $ 130 per year. The estimated cost for an electric vehicle is $ 0.0177 per mile in 2005, which is projected to be $ 0.0149 by 2030 (Figure 1-5).

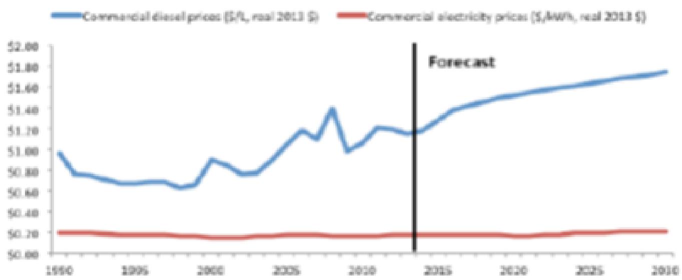

Figure 1: History of forecast of diesel and electric energy prices (1990-2030).

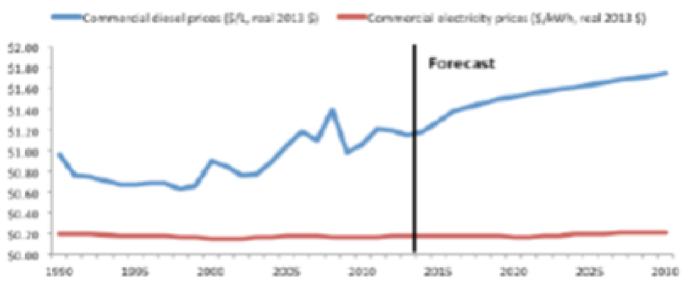

Figure 2: Predicting greenhouse gas emissions on Euro 4 diesel buses by 2030.

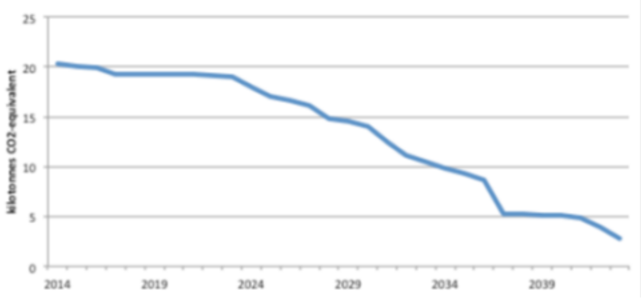

Figure 3: Predicting the annual emission of greenhouse gases when replacing diesel to electric buses by 2030.

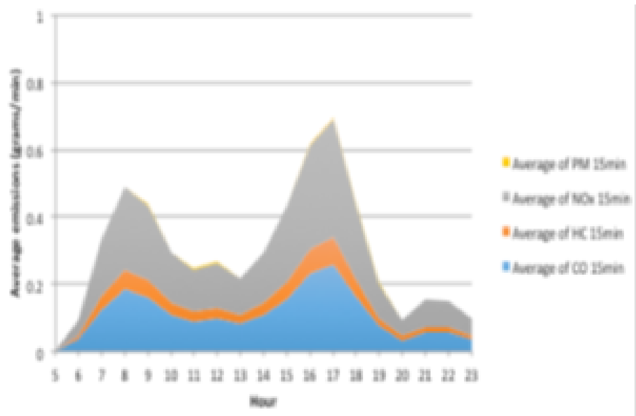

Figure 4: Comparison of the prediction of the hourly emission status of pollutants in diesel and electric buses in 2030

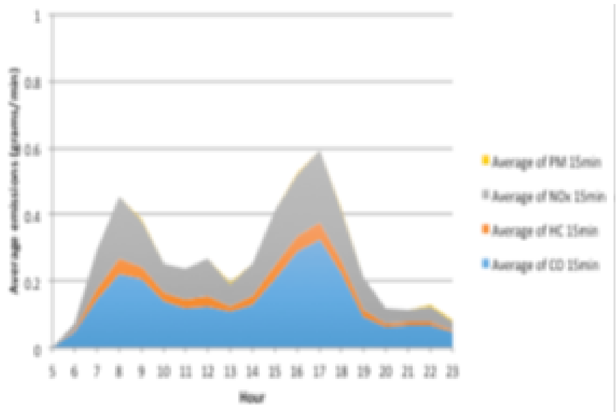

Figure 5: Comparison of the prediction of the hourly emission status of pollutants in diesel and electric buses in 2030

RESULTS

1. Social cost calculations based on carbon production assuming that the fuel consumption of a bus at 100 km is about 46 liters in Iran and one liter of fuel produces about 2.2 kg of carbon, the calculations are as follows:

46 * 2.2 = 101.2 kg carbon = 0.1 ton * 36 $ = 3.6 $

According to calculations, it costs $ 3.6 to travel 100 kilometers on a bus. On the other hand, each bus in Tehran has a daily traffic of about 120 km, and taking into account the 1571 buses of the public sector bus, this amount of travel and cost is calculated as follows:

1571 devices * 120 km = 188520 km

The daily survey of the public sector is 188,520 km, and for every 100 km of the survey, about $ 3.6 is the social cost of producing carbon, and for the total daily survey, the costs are calculated as follows:

(188520 * $ 3.6) / 100 = $ 6786/72

The total social cost of producing carbon on public-sector buses is estimated at $ 6,778,727 per day, and this is estimated at $ 247,77,152 over 365 days.

For the 2006 private sector bus, the following survey and cost are calculated as follows:

2006 * 120 km = 240720 km

The daily private sector survey is 240,720 km, and for every 100 km of survey, about $ 3.6 is the social cost of producing carbon, and for the total survey, it is calculated as follows:

(240720 * 3/6 $) / 100 = 8665.92 $

The total social cost of producing carbon in all buses in the private sector is estimated at $ 866,692 per day, and this is estimated at $ 3,316,3060 during the 365s.

2. Health costs:

According to studies, the cost per bus ride is estimated at $ 0.88, so it is estimated that it will cost about $ 0.05 per 1 km. On the other hand, the amount of health costs per 100 kilometers of travel is calculated as follows:

100 * 0.05 = $ 5

The daily walking distance of each bus in Tehran is about 120 km and the relevant cost is equal to:

(120 * 5) / 100 = $ 6

Based on the daily survey of all buses in Tehran, the cost of health is calculated as follows:

Total public sector buses 1571 devices:

1571 devices * 120 km = 188520 km

On the other hand, the daily cost of health is $ 6 per bus ride, which is 120 km. herefore, the daily cost of public transportation for the total daily bus travel is as follows:

(188520km * 6 $) / 120 km = 9426 $

This is estimated at $ 3440,490 during 365.

All 2006 private buses:

2006 * 120 km = 240720 km

On the other hand, the daily cost of health is $ 6 per bus ride, which is 120 km. Therefore, the daily cost of private buses for the total number of private buses is as follows:

(240720 km * 6 $) / 120 km = 12036 $

This is estimated at $ 439,3140 over 365 days.

3. Calculating the emission rate of air pollutants of a bus based on emission coefficients:

The amount of fuel consumption per 100 km of a bus in Tehran is about 46 liters, and on the other hand, considering that the rate of navigation of each bus is 120 km per day, so in this distance, the amount of fuel consumption is as follows:

(120 * 46) / 100 = 55.2 liters of daily consumption of a bus

Table 1.

DISCUSSION AND CONCLUSION

The total social cost of producing carbon on public-sector buses is estimated at $ 6,778,727 per day, and this is estimated at $ 247,77,152 over 365 days. The total social cost of producing carbon in all buses in the private sector is estimated at $ 866,692 per day, compared to an estimated $ 3,630,3060 during 365. On the other hand, for each day of the bus ride, which is 120 km, according to

Table 1: Calculate the amount of air pollutants emitted from fuel consumption using emission factors..

Type of pollutant	SO_x	NO_x	CO	NMVOC	SPM	CH_4	N_2O	CO_2
Diesel fuel emission coefficients in the transportation sector (every 1000 liters)	17.062	32.95	36.61	7.32	14	0.18	0.021	3674.7
Pollution rate per kilogram (daily)	0.78	1.81	2.01	0.022	0.77	0.01	0.001	147.66
Pollution per kilogram (annual)	284.7	660.65	733.65	8/03	281.05	3.65	0.365	53896
Pollution rate per kilogram (annually) of buses in the public sector	447263.7	1037881.15	1152564.15	12615.13	441529.55	5734.15	573.42	84670616
The amount of pollutants per kilogram (annually) in the private bus sector	571108.2	1325264	1471702	16108.18	563786.3	7322	732.19	108115376

studies, the cost of the bus for 1.6 km has been estimated at about $ 0.88, so according to calculations, about $ 0.05 is set for each kilometer. It is estimated at $ 6, so the total daily cost of a private bus is estimated at $ 439,3140 during 365. The amount of fuel consumption per 100 kilometers of a bus in Tehran is about 46 liters, and on the other hand, considering that the rate of navigation of each bus is 120 kilometers per day. On the other hand, the damage caused by air pollution directly and indirectly affects the individual, local and national economy. Accurate measurement of these effects has always been difficult. Direct economic damage can be caused by the gradual death of green spaces and forests due to exposure to NOx and ozone (O3) pollutants ... or damage to monuments, buildings and facades due to wear by suspended particles. (PM) or chemical compounds contaminating them. The closure of polluted urban areas and the consequent closure of the economic cycle of all financial and urban systems are other examples of direct economic damage. Having respiratory, heart and lung diseases or exacerbation of these diseases and as a result of various phenomena of air pollution and hospitalization of affected citizens in the home or hospital and entering their health and treatment cycle, direct and non-direct costs It includes direct. In the past, domestic and foreign organizations have provided different dollar-rial estimates for air pollution in Tehran during the year. Most of these estimates speak of the necessities and losses caused by the cost of patients or the deaths caused by air pollution. Inhalation of contaminated air containing carbon monoxide leads to an increase in blood carboxyhemoglobin, which in the affected person begins with headaches and boredom and progresses to death at high levels. Loss of diagnostic powers and other complications such as loss of vitality are also present. Now, formal economic valuation of life (at the time of death) or other complications that are not commonly seen is a very difficult task that is usually tied to philosophical, emotional, and conceptual issues and, in Fischer's words (1909), irreversible. It goes to the dollar. According to the theory and method of evaluation based on human capital, the lost life of a productive person also includes other losses that would return to the individual and national economic cycle if the injured person did not leave the economic cycle. In determining the role and share of pollutant sources, it is very important to pay attention to the type of pollutant and the conditions under which that pollutant is produced among the various pollutants in Tehran. For example, heavy and semi-heavy diesel cars have an important role and share in the production of sulfur oxides (SOx) compared to passenger cars. Nitrogen oxides (NOx) and suspended particles (PM) are responsible for this, and this role is getting bigger and bigger from sulfur oxides to suspended particles. Minibuses, trucks and buses have the largest share in the production of sulfur oxides with a share of 39%, 34% and 19%, respectively, according to previous studies. In the field of nitrogen oxide (NOx) production, trucks are responsible for the production of this pollutant in Tehran with 5.7%, 4% and 3%, respectively. Light and heavy trucks account for a total of 20% of all particulate matter, minibuses 10%, and buses 3% of the total, according to previous studies. At a glance, 1% and semi-heavy vehicles, including buses, trucks and minibuses, account for about 24% of Tehran's pollution.

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