EVALUATION OF THE EFFECTS OF TEHRAN’S MUNICIPALITY MEASURES ON DECREASED CO2 GREENHOUSE GASES: A CASE STUDY OF URBAN TRANSPORTATION

1Farzad Obeyd Rahmani, 2*Shahram Gilaninia, 3Mehdi Homayounfar
1- MA Student in urban management, urban orientation, Islamic Azad University, Electronic Branch of Tehran province, Tehran, Iran
2* Associate professor of Industrial Management Department, Islamic Azad University, Rasht branch, Rasht, Iran (Corresponding author)
3- Assistant professor of Industrial Management Department, Islamic Azad University, Rasht branch, Rasht, Iran (supervisor)

Abstract

The source of 80% of greenhouse gases in Tehran is due to gasoline fuel and the high volume of cars. In 2009, protection of Tehran climate has been on the agenda of urban management. All measures that officials are currently pursuing in urban management, try to decrease the air pollution of Tehran city through decreased greenhouse gases. However, according to the report of U.S. Energy Information Agency and the World Health Organization, Iran has the 10th ranking in Emission of greenhouse gases and 8th ranking in air pollution in the world. The main basis of air pollution in Iran is emission of carbon dioxide and other pollutants. Pollutions due to transportation of the vehicles which are in the form of gases emitted from exhausts, as well as uncontrolled city planning are some of the main reasons of air pollution. The aim of present study is to access the effective factors in emission of greenhouse gases in Tehran. The results of this field study show that how we can prevent the extent of the emission of abovementioned gases.

Keywords: The World Health Organization, greenhouse gases, gas emission, urban transportation.

1. Introduction

Emission of greenhouse gases is one the causes of reduction in the average age of mortality that has reached to its minimum level. Moreover, increased heart and lung diseases, neurological disorders due to fiber degradation, pregnancy diseases and other related diseases are some of the irreparable damages that are as a result of increased greenhouse gases in Tehran in recent decade. Increased temperature due to greenhouse gases has led to disruption in the balance of climate system and has resulted in increased heat. Sometimes, this issue has caused significant reduction in groundwater resources and Tehran has faced the shortage of water. Increased population and increase in the number of cars, urban buses and etc. has made municipality’s manager to be faced a fundamental challenge.

The lack of a unified urban management has caused disorders in public transportation; moreover, social, economic and environmental damages are other challenges due to uncontrolled emission of greenhouse gases. Therefore, systematic evaluation and investigation
of the performance of Tehran’s municipality will result in awareness of this organization’s strengths and weaknesses and if this evaluation be precise and comprehensive, it can be more successful in management of transportation and lowering greenhouse gases and its favorable outcomes will lead to increased health condition of Tehran population, medical cost avoidance, and other valuable benefits. Measuring the total extent of CO2 emission in Tehran, establishing a specified system, and considering all relevant sources in domain of different districts of Tehran are some of the objectives of this action.

Greenhouse gases can result from different sources inside the city. Due to the importance of the performance of Tehran municipality as a strong public institution which is managed by people, this problem can be investigated in transportation sector. Measuring the extent of carbon emission, average carbon emission by each citizen and by each vehicle is carried out through the evaluation of greenhouse gases emission or other computational operations called carbon calculation. When the extent of carbon emission is specified, some strategies can be taken into account in order to decrease its extent, for example by technology developments, better management of processes and products, green public procurement (GPP) (providing goods and services in a way to decrease their environmental effect through their life cycles), CO2 capture and storage, consumption strategies, carbon reduction and other methods. Systematic transportation for determining the best way of carbon emission calculation, reducing carbon emission by developing alternative projects such as electricity or solar energy or forest landscape restoration are some ways of carbon reduction and are often known as carbon adjustment.

2. The statement of the problem

Generally, the sources of air pollution can be divided into two groups: natural sources, and human sources or man-made sources. Human sources are themselves divided into two groups: one is industrial and urban (traffic) sources, and the other is rural and agricultural sources. A brief study will be carried out regarding urban sources of traffic. The increase in the number of gasoline and diesel vehicles will result in creation of CO2, SO2, CO, and hydrocarbons. The source of 80% of greenhouse gases in Tehran is due to gasoline fuel and the high volume of cars. In 2009, protection of Tehran climate has been on the agenda of urban management. All measures that officials are currently pursuing in urban management, try to decrease the air pollution of Tehran city through decreased greenhouse gases. However, according to the report of U.S. Energy Information Agency and the World Health Organization, Iran has the 10th ranking in emission of greenhouse gases and 8th ranking in air pollution in the world. The main basis of air pollution in Iran is emission of carbon dioxide and other pollutants. Pollutions due to transportation of the vehicles which are in the form of gases emitted from exhausts, as well as uncontrolled city planning are some of the main reasons of air pollution. Based on the classification of U.S. Environmental Protection Agency (USEPA), one the main sources of air pollution is in transportation sector. This is a big challenge faced by Tehran municipality and has resulted in adoption of decisions that will be analyzed necessarily. In this process, we can decrease the pollution of Tehran city by adoption of systematic methods of planning in different districts of Tehran, using suitable cars and fuels, and applying the pollution control technologies. The measures of Tehran municipality and public transportation system are crucial in this plan. Urban buses, public transport fleet, taxis, personal and single-seat cars, and motor cycles emit large quantities of greenhouse gases into the air. These gases cause greenhouse effect in the atmosphere and can hold the heat for a long time. Today, the extreme addition of greenhouse gases to the atmosphere has resulted in increased temperature of the Earth. Carbon
dioxide (CO2) is one of the most important of these gases. Population growth, increase in the number of motor vehicles, increased use of gasoline and diesel fuels, poor quality of the fuels, non-standard cars, and the lack of appropriate filtering in public transport fleet are some of the reasons of this pollution. Moreover, the lack of observance of international rules and standards regarding the amount of produced CO2 in purchased vehicles by municipality for devoting them to public transport fleet, inappropriateness of urban context, and sometimes inappropriateness of geographical situation of highways, all are the causes of air pollution and emission of greenhouse gases. With respect to the fact that in recent years, the Environmental Protection Agency has taken no serious actions about reducing greenhouse gases, the actions taken by Tehran municipality for reducing greenhouse gases are acceptable. The municipality of Tehran has taken some measures in this regard by setting out an agreement that these measure will be evaluated.

These measures are carried out in order to decrease air pollution and have been effective in reduction of greenhouse gases. Iran joined the Kyoto Protocol in 2004 and has some commitments to it, but Iran has not so far been able to use the protocol’s advantages very well. One of the advantages of this protocol is that developed countries should transmit modern and clean technologies to developing countries, but Tehran municipality has not so far taken a serious measure in this regard. This protocol and measures that the municipality of Tehran utilizes in realization of a clean city can be very useful. This specifies what measures municipality should take in this regard. Furthermore, the other serious problem that leads to municipality’s failure in realization of its goals, i.e. creating a clean city and reducing greenhouse gases, is the lack of unified urban management. Considering the presence of Tehran in Kyoto Protocol and in Rio Convention which is related to greenhouse gases, what are the other necessary measures for evaluating the performance of Tehran municipality?

3. Background of the research

In 2008, James Hansen who is one of the NASA scientist and his research team reported through an article in “Open Atmospheric Science Journal” that the world is in “danger zone”. In that time, the level of carbon dioxide was equal to 385 parts per million (ppm). However, the level of carbon had reached 392/94 parts per million in May 2010.

Hansen and his research team had reported that reducing the consumption of coal –the main source of atmospheric carbon dioxide production – can prevent the level of this gas from reaching 400 parts per million by 2030. However, they had warned that even with reduction of greenhouse gases emission, atmospheric carbon dioxide will still influence on the Earth climate for centuries.

With respect to the vastness of Tehran, the existence of different districts in this city, the studies of different bases in this domain, increasing development of science and technology and review of the research background, no serious actions have been taken about evaluating the performance of Tehran’s municipality in terms of reducing greenhouse gases and about the performance of related organizations such as National Organization of Municipalities and Villages Administration, Interior Ministry, National Organization of Public Transport Fleet, and urban services domains. Hence, this study can provide a significant help in evaluating the reasons of increased greenhouse gases in Tehran in recent years as well as evaluating the municipality’s measures about reducing the amount of these gases and suggesting do’s and don’ts and suitable strategies. The innovation of this study can be very useful and valuable for improving an enhancing health condition of the society.
Evaluation and analysis of the performance of Tehran municipality and other related institutions in terms of reducing greenhouse gases and the quality of urban services in public transportation sector and evaluation of the similar cities’ performance regarding greenhouse gases reduction are some of the ideal objectives of this research.

The overall objective of this study is to evaluate the existing statistics and information in terms of the relationship between urban cars, buses, minibuses, natural gas vehicles, taxis, personal cars, traffic plan, motorcycles, and the state of traffic plan management. Assessment of technical factors, product engineering, and existing standards in Iran and other countries which have good situation regarding the emission of greenhouse gases are some of the specific objectives of this study. Practical objectives of this study include evaluation of traffic plan, assessment of high volume of motorcycles and substitution plan of electric motors for reducing greenhouse gases, evaluation of hybrid cars in reducing greenhouse gases and evaluation of municipality’s performance and existing strategies. Tehran’s municipality, all municipalities of different districts in Tehran, National Organization of Municipalities and Villages Administration, Interior Ministry, Environmental Protection Agency, National Organization of public transport fleet, Taxi Association and Bus Association can use the results of the research practically. (Gilaninia, 2015).

4. Research questions

Primary question

Do the measures of Tehran’s municipality influence on the control of greenhouse gases?

Secondary questions

1. Do the renewal of public transportation fleet and its optimization influence on the control of greenhouse gases?
2. Do the mismanagement in Tehran’s municipality influence on the control of greenhouse gases?
3. Do the performance of Tehran’s municipality and other related institutions in terms of public transportation influence on the control of greenhouse gases?
4. Do the products of car factories and municipality’s instructions regarding the purchase of public vehicles influence on the control of greenhouse gases?
5. Do the type and quality of provided fuels in gas stations influence on the control of greenhouse gases?
6. Do non-standard vehicles in urban public transport fleet and the lack of effective technical inspection influence on the control of greenhouse gases?
7. Does notifying Tehran’s citizens of negative consequences of greenhouse gases influence on the control of greenhouse gases?
8. Does increase in per capita green space influence on the control of greenhouse gases?

5. Research hypotheses

Primary hypothesis

The measures of Tehran’s municipality influence on the control of greenhouse gases.

Secondary hypotheses

1. The renewal of public transportation fleet and its optimization influence on the control of greenhouse gases.
2. The mismanagement in Tehran’s municipality influence on the control of greenhouse gases.
3. The performance of Tehran’s municipality and other related institutions in terms of public transportation influence on the control of greenhouse gases.
4. The products of car factories and municipality’s instructions regarding the purchase of public vehicles influence on the control of greenhouse gases.
5. The type and quality of provided fuels in gas stations influence on the control of greenhouse gases.
6. The non-standard vehicles in urban public transport fleet and the lack of effective technical inspection influence on the control of greenhouse gases.
8. Increase in per capita green space influence on the control of greenhouse gases.

6. Conceptual and operational definition of technical words and terms

**Greenhouse gases**
They include Carbon Dioxide, Dinitrogen Oxide (laughing gas), Methane, steam and Nitrogen. The reason why these gases are called greenhouse gases is that they create a greenhouse space surrounding the Earth.

**Carbon monoxide**
Carbon monoxide (CO) is a gas that is produced by incomplete burning of Carbon. It is very toxic, but it doesn’t have any special color or smell. Hence, it is called “invisible killer”. Carbon monoxide has 300 times greater affinity for hemoglobin than oxygen. It is interesting to know that there is about 5% Carbon monoxide in the blood of all of us but if this extent reaches to 20% it will result in our death.

**Kyoto Protocol**
This treaty was signed by the countries of the world with the aim to oblige them to reduce the effects of greenhouse gases and the negative consequences of global warming. This treaty was adopted in Kyoto, Japan, on December 1997 and it was open for signature from March 1998 and it was finalized in 15 March 1999. The Protocol specified the required percentage of greenhouse gases reduction and the year of the fulfilment of this affair. The intended gases include: Carbon dioxide, Methane, Nitrous oxide, Sulfur hexafluoride, HFCs and PFCs. Moreover, rich countries not only have been obliged to implement the provisions of the treaty, but also to help other countries in this regard.

**Rio Protocol**
This conference was held in Rio de janeiro, Brazil, from 3 to 14 June 1992 and more than 150 leaders and representatives of the world’s countries have participated in it.
This major global conference which is known as “Earth Summit” or “Rio Summit”, attracted the global attention to the most important human issue in 21th century, i.e. environment.
The results of Rio Conference include: Rio Declaration about environment and development, Agenda 21 or the statement of principles for sustainable global development, the
Forest Principle, and two important conventions or international treaties about biological diversity, and UN structural treaty about climate changes.

**Carbon dioxide (CO2)**

Carbon dioxide is produced as a result of carbon oxidation during the process of fuels combustion. In fact, during the combustion conditions, the volume of carbon in aggregate fuel will change to CO2. Of course, incomplete combustion will lead to creation of CO2. A minimal fraction of carbon will change to CO2 and the majority will change to CH4 and CO. In molecules except CO2, carbon is generally doubled because it finally will change to CO2. Some parts of carbon will remain as soot and ashes.

**Climate change**

Climate change is the emergence of gradual irreversible changes in total Earth system and atmosphere. These changes emerge in atmosphere as a result of gradual increase in greenhouse gases. Following the increased thermal radiation emitted by these gases towards the Earth and heat trapping between the Earth surface and other greenhouse gases, general temperature of the Earth will increase and will result in emergence of some phenomena all around the world which are directly related to increased temperature.

In order to carry out systematic scientific researches, we require a theoretical and scientific framework. We use a conceptual model to consider all effective factors in reduction of greenhouse gases and to evaluate the performance of related organizations in this regard. With respect to different studies carried out in this field, modeling reliable articles about greenhouse gases, the model of vehicles conversion to non-fossil fuels, optimal conversion of the engines of exhaust filtering, this model will be used as an effective factor for detection of the effect of these factors in reducing greenhouse gases.
The amount of greenhouse gases in Tehran

- Renewal and optimization of public transport fleet
- Mismanagement of municipality in terms of slow control of greenhouse gases
- The performance of Tehran’s municipality
- The products of car factories
- Type and quality of fuels
- Non-standard vehicles and the lack of effective technical inspection
- Giving information to citizens
- Green space per capita

**Figure 1- modified model (Gilaninia, 2015)**

In order to carry out systematic scientific researches, we require a theoretical and scientific framework. For collecting information we have used some sources such as questionnaires, statistics derived from questionnaires, information available in air pollution monitoring stations and Tehran municipality and also other relevant institutions and organizations. In this study, the performance of Tehran’s municipality will be evaluated.

7. **Statistical population, sampling method and sample size (if available and possible)**

For example, from 2003 to 2012 the evidences suggest that in late September and October of 2012, Tehran experienced 13 days of unhealthy air and 17 days of healthy air. In late September and October of 2011, the Citizens of Tehran have breathed unhealthy air for 22 days and healthy air for 8 days. In sum, from 2003 to 2012 (only late September and October), the citizens of Tehran had 109 days of unhealthy air, 186 days of healthy air and only 5 days of clean air. The air quality in a district is influenced by the amount of pollution emission by vehicles, commercial and industrial units, households, and weather condition. However, in equal weather conditions, if the emission of pollutants increases, the air pollution will increase too. Using public transport vehicles and reducing the use of personal cars have important role in reducing air pollution. The realization of this goal will involve the cooperation of different urban institutions such as municipality, National Organization of Public Transportation, Environmental Protection Agency and citizens.

The results of air pollution monitoring stations show that from 2002 to date, Tehran has spent 316 clean days and 25 healthy days in terms of Carbon monoxide level, 296 clean days and 45 healthy days in terms of Ozone level, and 131 clean days and 210 healthy day in terms of Nitrogen dioxide level. Regarding Sulfur dioxide which is an air pollutant, Tehran has experienced 341 clean days. This finding imply that Tehran has not experienced even one unhealthy day in terms of pollutant gases. Regarding suspended particles smaller than 10
microns, we have so far had 57 clean days, 274 healthy days, 9 unhealthy days and only one very unhealthy day which is related to dust entry from neighboring countries. Considering suspended particles with diameter less than 2/5 microns, we have seen a significant reduction in the number of polluted days. In terms of this parameter we have so far spent 3 clean days, 203 healthy days and 135 unhealthy days in Tehran. Generally, the qualitative condition of air indicates that from the beginning of current year till 24 May, Tehran has totally spent 3 clean days, 203 healthy days, 134 unhealthy days and one very unhealthy day that in competition with the same period in last year, air condition has improved significantly. Last year, Tehran experienced 25 clean days, 13 healthy days, 206 unhealthy days and 3 very unhealthy day. In contrast, in April 2001, we had 10 unhealthy days and one very unhealthy day; however, in March 2002 we did not experience very unhealthy days and the number of unhealthy days reduced to 6 days.

8. Instruments and methods of data analyses

This study is a causal research. Analyzing the data gathered from questionnaires, and analyzing information collected from different air pollution monitoring stations are some of the tools that have been used for collecting information in this study. We analyze the collected data by statistics software and present them in the form of tables and figures.

Conclusion

The results of air pollution monitoring stations show that from 2002 to date, Tehran has spent 316 clean days and 25 healthy days in terms of Carbon monoxide level, 296 clean days and 45 healthy days in terms of Ozone level, and 131 clean days and 210 healthy day in terms of Nitrogen dioxide level. Regarding Sulfur dioxide which is an air pollutant, Tehran has experienced 341 clean days. This finding imply that Tehran has not experienced even one unhealthy day in terms of pollutant gases. Regarding suspended particles smaller than 10 microns, we have so far had 57 clean days, 274 healthy days, 9 unhealthy days and only one very unhealthy day which is related to dust entry from neighboring countries. Considering suspended particles with diameter less than 2/5 microns, we have seen a significant reduction in the number of polluted days. In terms of this parameter we have so far spent 3 clean days, 203 healthy days and 135 unhealthy days in Tehran. Generally, the qualitative condition of air indicates that from the beginning of current year till 24 May, Tehran has totally spent 3 clean days, 203 healthy days, 134 unhealthy days and one very unhealthy day that in competition with the same period in last year, air condition has improved significantly. Last year, Tehran experienced 25 clean days, 13 healthy days, 206 unhealthy days and 3 very unhealthy day. In contrast, in April 2001, we had 10 unhealthy days and one very unhealthy day; however, in March 2002 we did not experience very unhealthy days and the number of unhealthy days reduced to 6 days. We recommend to future researchers to evaluate the presented model in terms of the commitment level of municipalities’ managers.

References

ADAC, 2003 www.adac.de, # Auto & Motorrad, # Kraftstoffe, # Energieeffizienzklassen


Bundesministeriums für Umwelt Naturschutz and Reaktorsicherheit and des Federal Republik Deutschland, response to an enquiry on 14.03.2002


Environmental Agency, 26./27.6.2003; Berlin 2003

Förderung des Radverkehrs in Deutschland, Bundesministerium für Verkehr, Bau und Wohnungswe, April 2002

Gilaniinia, 2015, Production engineering, Islamic azad university, rasht branch publisher. Shindell, Drew T.; Faluvegi, Greg; Bell, Nadine; Schmidt, Gavin


Mahmoudzade, Hatamipour, M.S. (2005). Carbon dioxide, an environmental challenge or a cheap and available raw material. 10th National Congress of Chemical Engineering in Iran, p 4147.


www.huppa.com www.agr.com
http://www.epa.gov/airmarkets/climtchg/index.html
http://www.bmvbw.de/Bestellservice-and-Downloads-.370.9154/National-Radverkehrsplan-2002-2012-FahrRad
http://www.adac.de/auto_motorrad/kraftstoffe_umwelt/energieeffizienzklassen/default.asp?i_d=0