''THE PUBLIC ADMINISTRATIONS EFFORTS OF ATHENS AND LONDON AGAINST TRANSPORTATION EMISSIONS''

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I hope the readers of this thesis embrace my concerns for air pollution and my interest to improve the air quality people all around the world breathe.

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Table of Contents

List of Abbreviations

AQMA	Air Quality Management Area
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon dioxide
CRES	Center of Renewable Energy Sources and Saving
EVs	Electric Vehicles
GAA	Greater Athens Area
GHG	Greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GWP	Global Warming Potential
HFC	Hydrofluorocarbons
HDVs	Heavy duty vehicles
IPCC	Intergovernmental Panel on Climate Change
LAQM	Local Air Quality Management
LLAQM	London Local Air Quality Management
Kwh	Kilowatt hour
NF_3	Nitrogen trifluoride
NMVOC	Non-methane volatile organic compounds
NO_x	Nitrogen oxides
N_2O	Nitrous oxide
O.SY	Road Transport
Pb	Lead
PFC	Perfluorocarbons
PM_{10}	Particulate matter of 10 micrometers
SF_6	Sulfur hexafluoride
SO_2	Sulfur Dioxide
ULEZ	Ultra Low Emission Zone
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization

Abstract

The present thesis examines the climate action plans of Athens and London. The reason why Athens and London were selected is because of the fact that air pollution caused many deaths in these places. In 2015, due to air pollution there were 7.216 deaths in Athens (Hellenic leaders, 2017). Respectively, in London ''thousands of premature deaths'' were the result of bad air quality (Mayor of London, n.d). In addition, the reason why transportation emissions is the focus of this research is because road transportation forms ''by far the major source'' of air pollution in urban environments (Progiou, 2011, p. 1). Focusing on the measures which aimed to reduce transportation emissions it found out what are the differences between the way the two administrations approach and handle GHG emissions that come from transport. The research showed that Athens administration allocated four policy instruments which depended on international guidelines, whereas London authorities provided eleven policy instruments that depended on technological developments. The employment of technology from London side provided tools which contributed in the emission measurements and mobilized citizens to act by acquiring devices that facilitate in the efforts against air pollution. Additionally, the Athenian authorities chose to cooperate with municipal services to create and implement their plan. On the contrary, London strategy was the result of collective action between various actors (Municipality of Athens, 2017), (Mayor of London, 2018). Important role for the differences between the two action plans played the financial and social context of each city, since it affected the measures which citizens could adopt. The Greek financial crisis limited the financial ability of citizens to adopt environmentally friendly habits which cost (such as an electric car). Whereas Londoner's financial status enabled them to adopt such habits. The promotion of eco-driving, biking and walking as alternative means of transport and administration's efforts to familiarize drivers with eco-driving formed common characteristics of the Athenian and London plan (Municipality of Athens, 2017)(Mayor of London, 2018).

Researching the government actions of the Athenian and London administrations, the present thesis contributes to cover the ''lack of knowledge'' which Rykkja, Neby and Hope discovered that exist around the issue of governmental actions towards climate change (Rykkja, 2013, p. 106). Rykkja et al. claimed also that comparisons between countries are rare (Rykkja, 2013, p. 106). Therefore the present research contributes further in covering this gap by comparing how the cities of Athens and London deal with transportation emissions.

Chapter 1: Introduction

In this section, the background of the environmental problem of air pollution will be addressed. Focusing on the transportation emissions in the cities of Athens and London, the coping policies of these two cities will be discussed and compared, to find out what are the differences between them. Over the years environmental issues have increased significantly. Air pollution forms one of the environmental problems which torment our planet, having serious consequences on people's health. These consequences vary from ''increased hospital admissions and emergency room visits to increased risk of premature deaths'' (WHO, n.d). According to WHO, ''nine out of ten people breathe polluted air'', which kills 7 million people on a yearly basis (WHO, n.d). Governments on local, national and international level take action to protect the environment and people from the effects of air pollution.

At this point, it is important to understand how climate change and air pollution are linked. Atmosphere is polluted from soil (e.g pesticides), water (e.g phosphorous), noise (e.g sound of industries) and air pollutants (e.g transportation and industrial emissions), which can be ''found in the atmosphere'' as substances or ''chemical compounds'' (Anwar., 2016). Their presence in the atmosphere brings alterations to climate (EPA, 2019). More specifically, while ozone ''warms the climate'', components of particulate matter (PM) warm or cool the climate (EPA, 2019) . A characteristic example is ''black carbon, a particulate pollutant from combustion'' which warms our planet, when ''particulate sulfates'' cool the atmosphere (EPA, 2019) .Low air quality can affect climate change and vice versa. The warming of atmosphere together with ''climate change has the potential to increase ground-level ozone'' in lots of territories (EPA, 2019). This might lead to ''challenges for compliance with the ozone standards'' in the next years (EPA, 2019).

This research focuses on the efforts of the local authorities of Athens and London to reduce transportation emissions. The focus is on the domain of road transportation because vehicle emissions are by far the biggest ''source of atmospheric pollution'' in cities (Progiou, 2011, p. 1). Emissions from road transportation lead to global warming since they are connected to ''CO_2, NH_3, CH_4 and N_2O emissions'' (Progiou, 2011, p. 1). In both of these cities, administrations engaged to act through a series of actions which aim to improve the air of Athens and London respectively. The reason why these specific cities were selected for this research, is because of the fact that air pollution priori caused many deaths in these places. Specifically, in Athens it has been recorded that, there were 7.216 deaths in 2015 due to air pollution (Hellenic leaders, 2017). In London, approximately half of the air pollution of

the city is caused by ''transportation emissions'' which lead to'' thousands of pre-mature deaths every year'' (Mayor of London, n.d).

This situation led the local administration of Athens and London to act towards the mitigation of the climate change effects. Athens aims to participate actively in the efforts against climate change and decline the greenhouse gas emissions GHG[1] in the city. As they stated, these actions will benefit not only the environmental domain, they will also increase the employment opportunities and will measure expenses for energy costs (Municipality of Athens, 2017)**.** London administration recognizing the health consequences which transportation emissions cause aimed to protect its citizens from hazardous air (Mayor of London, n.d). Both of them tried to improve the air quality breathe by their citizens and protect the environment but they have approached the issue in a different way. Their different approaches are connected to social and economic factors that play a crucial role in framing policies.

The present project aims to examine in depth the climate action plans of Athens and London in relation to the transportation sector. It takes into account the different contexts of the cities. Focusing on the measures which target to transportation, the present research aims to find the differences between their action plans. In order to investigate this, the main attention will be paid on answering the general question: What are the differences between the actions the two administrations use to fight transportation emission in their cities?. More specifically, this question will be analyzed by responding the following research sub-questions below:

1. What is the policy actor's perception of air quality in the two cities?
2. With which policy strategies are London and Athens fighting against transportation emissions. And which are the conditions for doing so in both contexts?
3. How do the policies aiming at the reduction of transportation emissions differ in London and Athens; which similarities can be noted?

First, I will discuss how the transportation emissions are fought from the public administration perspective in Athens and London. Subsequently, the comparison of the strategies will reveal under which circumstances the local administration took part in the fight against climate change, what were the tools, the aims and measures of the strategies.

[1] ''A Greenhouse gas is any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere. By increasing the heat in the atmosphere, greenhouse gases are responsible for the greenhouse effect, which ultimately leads to global warming'' (Lallanilla, 2019).

The comparison will highlight the priorities each city has, their similar or different characteristics, approach and context. The result of this comparison will help to identify with which strategies the two administrations choose to fight the same ''enemy''-transportation emissions, in order to protect their citizens and environment at the same time.

The example from Athens and London case proves that air quality is directly connected with the quality of people's lives. ''Air pollution was thought to have caused 64,000 deaths in the UK in 2015, including 17,000 fatal cases of heart and artery disease'' (Matthews- King., 2019). Correspondingly, in Athens 7.216 died in 2015 due to bad air quality (Hellenic leaders, 2017).Therefore, air pollution represents the cause of some public health problems due to the altered composition of air properties containing hazardous substances (WHO, n.d).

1.1 State of research

''Central policymakers, governments, climate researchers, and research funders'' highlight the need to create and implement ''climate change policies'' (Rykkja, 2013, p. 106). Rykkja, Neby and Hope studied how this is handled ''with in current social science research'' (Rykkja, 2013, p. 106). According to their research ''climate change is a huge contemporary research topic'' (Rykkja, 2013, p. 106). Although, there is a ''lack of research'' emphasizing on existing government actions, multilevel governance, and implementation'' (Rykkja, 2013, p. 106). So far the research on climate change is ''mainly empirical'' and focuses on individual cases (Rykkja, 2013, p. 106). Comparison between countries are infrequent and a limited number of studies ''focus on theory development'' (Rykkja, 2013, p. 106). A huge number of the researches is ''published in interdisciplinary journals'', where necessary knowledge from the fields of ''political science and public administration research'' may be missing (Rykkja, 2013, p. 106). This is noteworthy, thinking ''the frequent call for policy action and commitment'' and the focus of the complicated and ''multilevel/ cross sectoral nature of the problem of climate change'' (Rykkja, 2013, p. 106). This points out that many scientists ''working with climate policy issues are climate (or environmental) researchers rather than political scientists, sociologists, or experts on public administration'' (Rykkja, 2013, p. 124). This might show that ''climate change is a fairly new policy issue'' and that the field which emphasize on ''policy, politics and social relations have not come round it yet'' (Rykkja, 2013, p. 124). This is the reason that the article of Rykkja, Neby and Hope has primary position of the present thesis. It gave me the stimulus to research the problem of air pollutions-which is directly connected to climate change from a public administration perspective.

Giardullo et al. investigated ‘’the social constraints’’ which affect ‘’air quality governance’’ in four countries of EU (Giardullo, 2016, p. 58). Beginning from the measures which were already applied, the researchers outlined ‘’the structure of double-delegation in policymaking for air quality governance’’ (Giardullo, 2016, p. 58). The delegation starts from European Union to national governments, who assign ‘’to regional and local authorities’’ the limits to implement measures (Giardullo, 2016, p. 58). ‘’The comparison had been made possible through the analysis of operationalised categories such as domain, objectives and modalities on air quality plans’’ (Giardullo, 2016, p. 58). According to Giardullo et al. the failure in achieving the air quality standards which EU introduced does not mean that there is a lack of knowledge. On the contrary, it is the result of complicated ‘’entanglements of social forces’’ (Giardullo, 2016, p. 58). Their research highlighted the division ‘’of such complexity into its social component’’ (Giardullo, 2016, p. 58). They also draw attention to the necessity to encourage a unified ‘’approach for air quality policy as a strategy’’ for the creation of new future measures (Giardullo, 2016, p. 58).

Williams examined ‘’the main events, pressures and constraints in the evolution of air quality policy’’ from 1952 until 2002 (Williams M. , 2004, p. 15). According to his research in the beginning of that period there was no clear ‘’recognition of air quality monitoring, modelling, control or policy’’; now the focus is on goals ‘’with implementation underpinned by legislation’’ (Williams M. , 2004, p. 15). The current air quality issues which concern societies are more complicated in comparison to those of 1950. The biggest question ‘’for the future’’ is to what extend ‘’further measures to reduce emissions will command public acceptability’’ (Williams M. , 2004, p. 20). Politicians should learn from past events and should remember that people’s expectations regarding ‘’environmental quality’’ have increased over the years (Williams M. , 2004, p. 20). Furthermore, it is very important to keep eyes open for ‘’new evidence’’ in order to identify problems soon and create the necessary ‘’future policies for air quality’’ (Williams M. , 2004, p. 20)

Boucher and Graindorge studied ‘’the political, economic, social and legal issues of air pollution’’ (Boucher, 2017, p. 1)**.**According to their study, environment in France ‘’is protected by the French legislation’’(Boucher, 2017, p. 8).This means that environment has significant value and it is protected by the national legislation exactly as ‘’secularity or democracy’’ are protected(Boucher, 2017, p. 8).In China environmental protection has also a ‘’constitutional value’’ in contrast with Canada where there is no clear ‘’recognition of a free standing environmental right in the Canadian Constitution’’ (Boucher, 2017, pp. 8-9). In the

light of their study, state is the overarching actor in the efforts against air pollution because it has the ‘’resources, power and means’’ to create legislation and tackle air pollution (Boucher, 2017, p. 20). Cities are the best choice when policies need to be implemented on local level. This happens because cities are affected by air pollution the most. Citizens are also part of these actions against air pollution (Boucher, 2017). According to Boucher and Graindorge, national agencies are called ‘’to implement environmental regulations’’ to improve air quality (Boucher, 2017, p. 22). ‘’Non-public actors… such as associations or NGOs’’ play also important role in the efforts against air pollution (Boucher, 2017, p. 20). In their study they also mentioned the example of Chile. In Chile, ‘’air quality is measured in several stations’’ (Boucher, 2017, p. 23). In accordance with the air quality various things such as the use of ‘’specific vehicles’’ are prohibited (Boucher, 2017, p. 23). This example fits with the one of London, where local administration introduced a measure according to which Londoners have to use eco-friendly vehicles in areas of the city which appertain to ULEZ (Ultra Low Emission Zone)(Mayor of London, 2018). London Mayor applied that measure by implementing charges to the vehicles which contribute to air pollution. In the same study is also mentioned the example of Oslo where incentive measures for electric cars were introduced. This measure reminds also London where there is a shift to electric cars (Mayor of London, 2018). These measures and the whole action plan of London are described in chapter 5.

The Center for Climate and Energy Solutions (C2ES) proposed policies which aim to the reduction of transportation emissions. According to their policy brief ‘’Transportation, energy use and emission are determined by three elements’’: the fuels used by the vehicles, the features of the vehicles and the ‘’total miles travelled’’ (C2ES, 2008, p. 1). A strategy which aims to achieve reduction of the GHG emissions which come from transport should focus on these three aspects (C2ES, 2008, p. 1)

Greene and Baker from the Center of Public Policy in cooperation with Steven E. Plotkin from the Argonne National Laboratory studied the reduction of GHG emissions which come from transportation domain in United States. According to their research ‘’ The U.S. transportation sector is a major source of global GHG emissions’’ (David L. Greene., 2011, p. 84). In order to eliminate the damage due to climate change, U.S and other countries would have to limit their GHG emissions. It is expected that U.S will achieve ‘’reductions in GHG emissions on the order of 50 percent or more by 2050 cost-effectively’’ (David L. Greene., 2011, p. 84). This will be achieved through the implementation of ‘’strong policy measures’’,

''the advanced vehicle technologies and low-carbon energy sources''(David L. Greene., 2011, p. 84). ''State and local governments and metropolitan planning organizations around the United States'' have proven that it is possible to eliminate ''the demand for motor vehicle travel while preserving or enhancing accessibility to homes, businesses, and leisure activities'' (David L. Greene., 2011, p. 84). According to Greene, Howard and Plotkin ''no single technology, no single policy, and no single mode is able to accomplish'' a great reduction in transportation emissions (David L. Greene., 2011, p. 85). Only a wide strategy which would depend on ''strong public support'' and on technological developments could lead to GHG emissions ''reductions of that magnitude'' (David L. Greene., 2011, pp. 85-86). Transportation will continue to be the basis for the national economy of United States and to contribute to the quality of life of American people ''to 2050 and beyond' (David L. Greene., 2011, p. 86). Due to the fact that the technological development ''and future energy prices'' are not certain, the strategy for the reduction of GHG emissions has to be flexible (David L. Greene., 2011, p. 86). Lastly, the report of Greene, Howard and Plotkin shows that with cost-efficient measures, '' plausible technological progress and shifts in consumer behavior'' the U.S will eliminate the emissions which come from transportation ''by 65 percent below 2010 levels by 2050'' (David L. Greene., 2011, p. 86).

John Middleton dealt with the policy implications of the American ''Clean air act'' for state, local and federal programs (Middleton, 1969, p. 1). According to his book ''Public policy and air control'' which focused on the American clean air act, actions were taken on state and local level but also with Federal assistance (Middleton, 1969, p. 2). One big aim of the act was to achieve reduction of the noxious emissions. The way to achieve this reduction was ''to proceed from air quality standards to an implementation plan which restricts the emission of air pollutants'' (Middleton, 1969, p. 4). ''Air quality standards'' were very important for this process (Middleton, 1969, p. 4). By ''setting air quality standards'' a state sets ''air quality goal in terms of desired limit on levels of that pollutant in the ambient air'' (Middleton, 1969, p. 4). When setting a goal like this, ''the most important consideration'' is the ''protection of public health'' (Middleton, 1969, p. 4). Also, air quality standards have to be consistent with specific statements ''of the intend of the Air quality act'' (Middleton, 1969, p. 4). Firstly, they have to protect public health and second they have to be accomplished ''regardless of cost'' (Middleton, 1969, p. 4). In addition it is clear goal of the act to protect and improve the air quality ''of the Nation's air resource'' (Middleton, 1969, p. 5). ''To be consistent with the criteria'' air quality standards have to take into account ''the

effects of both short- term and long- term exposures'' (Middleton, 1969, p. 5). Also, ''attention must be given to the public health implications of any air quality standards proposed for adoption'' (Middleton, 1969, p. 5). Thirdly, ''it is the expressed intend of the Air Quality Act that attainment of air quality standards'' has to be achieved within a logical time frame(Middleton, 1969, p. 6).

In the framework of the ''United Nations Environmental Program (UNEP) the report ''Actions on air quality'' was created (UN Environment Program, n.d). The focus of this report was global policies and programs that aim to improve air quality. In the light of this report, 29% of the cities all around the world ''have adopted Euro 4 and above (or its equivalent)'' emission standards (UN Environment Program, n.d). ''22% are actually on Euro 5 or 6''(UN Environment Program, n.d). However, ''half of the countries in the world (90) have not adopted any vehicle emission standards'' (UN Environment Program, n.d). On the other hand, Norway form a characteristic example of countries where the purchasing ''of electric vehicles'' is promoted (UN Environment Program, n.d). Singapore is another country where the use of public transport, cycling and walking are motivated with a ''public and non-motorized transport system with a citywide network of walking and biking paths, trains and buses'' (UN Environment Program, n.d). This reminds of the actions of Athens and London administration, who motivated citizens to use public means of transport, walking and cycling as alternative means of transportation (Municipality of Athens, 2017) (Mayor of London, 2018). In addition, Norway's shift to electric cars, reminds of London administration's efforts to stimulate citizens acquire electric vehicles (Mayor of London, 2018).

On the other hand other researchers examined air pollution by focusing on the relationship of the latter with transportation emissions. Some of them focused of the effects of these emissions on people's health, whist others focused on effects of transportation emissions on the air quality therefore on the environment. London and Athens form two cities where the air pollution was high thus analysts chose them for their research. Christina Alpopi and Sofia Elena Colesca examined the air quality of big cities in Europe (Alpopi, 2010). They chose the cities of Amsterdam, Berlin, Brussels, London, Paris, Oslo, Prague, Rome and Bucharest. According to their study London was the most polluted city ''in case of nitrogen dioxide pollution'' on 2009 and in case of sulfur dioxide pollution London was third after Bucharest and Paris (Alpopi, 2010, p. 105)

George Mackerron and Susana Mourato agree with the findings of Alpopi and Colesca for nitrogen dioxide in their study ''Life satisfaction and air quality in London'' (MacKerron,

2009, p. 1442). According to their analysis, London does not meet the limit for nitrogen dioxide (MacKerron, 2009). Additionally, they found that most of London citizens believe that the air quality in their city is a huge problem and ''up to two thirds believe that it affects their quality of life''(MacKerron, 2009, p. 1442). In contrast to this, the study of Williams and Bird, named'' Public perceptions of air quality and quality of life in urban and suburban areas of London'' which focused on Wood Green and Wimbledon respectively, advocates that citizen's ''perception of air quality is not a reliable indicator of the actual levels of air pollution in their area''(Williams, 2003, p. 253)

Air quality in the city of Athens awakes the interest of researchers. A characteristic example is the study of Alexia Economopoulou and Alexander Economopoulos named '' Air pollution in Athens basin and health risk assessment'' (Economopoulou, 2002). According to their research,'' the levels of all classical pollutants'' except ''SO_2 and Pb'' exceeded ''the WHO guidelines'' already from 1989. This was expected to affect citizen's health (Economopoulou, 2002, p. 277).

Progiou and Ziomas conducted also a research on the Greater Athens Area (GAA). They studied the ''road traffic emissions impact on air quality'' of GAA (Progiou, 2011, p. 1). They advocated that the biggest source of pollution in urban areas is transportation emissions. Furthermore, passenger cars (PC) are connected to CO, MNVOCs and CO_4 emissions whilst PM_{10} and NO_x come from heavy duty vehicles (HDVs). Lastly, they found out that older vehicles ''are responsible for'' the biggest part of the emissions (Progiou, 2011, p. 1).

Fameli and Asimakopoulos conducted '' a road transport emission inventory for Greece and the Greater Athens Area'' (Fameli, 2014, p. 770). In their research they advocated that ''road traffic is responsible'' for the biggest part of air pollution in Athens (Fameli, 2014, p. 782). They also agree with Progiou and Ziomas that PCs emit out CO and NMVOC emissions and they added that these type of vehicles are connected also to VOC and CO_2 emissions. Regarding the HDVs they found out that besides PM_{10} and NO_x, they are also connected to $PM_{2.5}$ emissions (Fameli, 2014)

From what was discussed above it is clear that air pollution was examined by many researchers. Some of them examined air pollution in relation to its policy implications while others used an environmental perspective. As Rykkja, Hope, and Neby proved knowledge on the issue of climate change from a political science and public administration perspectives are missing (Rykkja, 2013). The present research contributes to change that, since it

examines how the authorities of Athens and London deal with transportation emissions from public administration point of view.

Studying the researches which were mentioned above, many similarities were found in the ways different administrations chose to deal with air pollution. Shift to eco friendly vehicles, motivation to use public transport, biking and walking as alternative means of transportation form common characteristics between air pollution strategies all around the world. Although, the different contexts of each city or country does not enable authorities to adopt exactly the same measures. A characteristic example of that fact is the air quality actions of Athens and London against transportation emissions which are examined in the present study.

Air pollution in Athens and London has been examined in other projects before. However, the present project went a step further and did something new. Studying the air quality findings- from previously conducted projects and from the action plans of the two administrations, I examine the air quality strategies of these cities and their contextual characteristics. This helps to find out the differences in compared two cities- Athens and London where transportation emissions reduced the air quality conditions. Moreover, the present research examines how the administrations of these cities deal with transportation emissions in their territories-what policy instruments they allocate, what measures they implement and which actors cooperate for the implementation of each action plan. This helps to find out the differences between the way the administrators of Athens and London address and fight the same problem, the emissions which come from transportation.

Chapter 2: Framework for analysis

2.1 Theoretical framework

As mentioned before, the research of Rykkja, Neby and Hope formed the sparking to study how transportation emissions are handled in Athens and London. In their research they pointed out that climate change is a problem which is mainly examined by ''climate or (environmental) researchers rather than political scientists… or experts on public administration'' (Rykkja, 2013, p. 106). Their findings in combination with the research of Giardullo et al. formed jumping off point for the present research. Giardullo et al. studied the social limits which affect the ''air quality governance'' in four European countries (Giardullo, 2016, p. 58). They based their research on the comparison of four European countries. More specifically, their comparison depended on the analysis of the ''operationalised categories such as Domain, Objectives and Modalities on air quality plans'' (Giardullo, 2016, p. 58).Taking the opportunity from Rykkja, Neby and Hope and being inspired by the comparative study of Giardullo et al. the present thesis examined something that was not examined before. It studied the climate action plans of Athens and London focusing on the measures for transportation emissions in the two cities. Examining the government actions of the local authorities of these cities, the present project contributes to cover ''the lack of research'' which Rykkla, Neby and Hope found out that exist on the subject of government actions towards climate change (Rykkja, 2013, p. 106). Rykkja, Neby and Hope claimed also that comparisons between countries are infrequent (Rykkja, 2013, p. 106). The present thesis contributes also to cover this gap by comparing how two European cities deal with transportation emissions. The perspective which is used by the present research is this of public administration and helped to find out how each local government handle the issue of transportation emissions- which is mostly handled by environmental scientist. The comparison of the present thesis depends on the three pillars Borras and Edler theory, which is described below in that section.

The focus of the present research is on comparison. This means that it is useful to apply a comparative method that enables to give answers to the research questions. The comparative lens through which the cases of Athens and London were examined aimed to find the similarities and differences between the strategies of the two cities. Both cities face air quality problems. Transportation emissions form major source of pollution in Athens and London (Progiou, 2011)(Mayor of London, n.d). The local administrations in these different societies act to improve the air quality their citizens breath. The present research examined

how these administrations choose to approach and act against transportation emissions in order to find the differences between two climate action plans.

Since the object of this research is directly connected with the creation and/or adoption of new policies it is important to understand in which ways policy could be approached (Colebatch, 2006), under which circumstances problems of the political scene are negotiated and handled (Stegmaier, 2014).Firstly it is important to mention that ''any pragmatic guide which aim to action is based on a cognitional plan of connected meanings which explain the process of action, in other words it rests on theory''(Colebatch, 2006, p. 6).

The administrations of Athens and London act against the problem of air pollution. In order to improve the air quality of their cities they created policies and a plan to implement. Their cases fit with the procedure of governance of discontinuation which is discussed by Stegmaier in the book ''The governance of socio-technical systems'' (Stegmaier, 2014). ''Governance-makers'' form the people in charge who give solutions to problems which afflict the society (Stegmaier, 2014, p. 113). Governance of discontinuation is one of the processes they can follow in problematic situations. The creation of a policy and the formation of a governance plan depend on the process of problematization. It is important to understand governance as a procedure comprehending and determining problems in a way that cooperative action is motivated in a commonly acceptable manner (Stegmaier, 2014)**.**

Discontinuation need to be understood as an interpretative procedure where ''problems are negotiated and enacted in politicized interactions'' (Stegmaier, 2014, p. 113). Alterations, opinions or in the formation regarding a problem or a solution in political scene might lead policy to an end. Thus, termination comes when the policy makers see that discontinuity is the right thing to choose or the only possible solution. It is worth mentioning, that policy termination does not stand alone. In contrast it is escorted by policies which focus on the discontinuation (Stegmaier, 2014).

This ''governance of change'' refers to the way actors on the social or state scene act either deliberately or as advisors aiming to achieve change (Borras, 2014, p. 24)**.** Borras and Edler created a framework of three pillars which provide a total view of ''how systems change'' is organized in a complicated context (Borras, 2014, p. 24).

In the cases of Athens and London, the administrations of the cities took measures which would change the ones which preexisted. These measures aimed to protect the atmosphere and therefore people's health. Also, in order to achieve a better air quality, citizens would

change their attitudes, habits and way of thinking. Each city worked in different ways to achieve change. In order to compare these ways it is necessary to examine and compare certain parameters in both cases. The framework of the three pillars provides the factors that need to be examined- context, instruments, measures and actors (Borras, 2014, p. 24). These parameters will be examined through a comparative lens, which will enable to find similarities and differences between the two climate action plans.

The first pillar includes the structures which are provided through the interaction in the ''institutional set-up in a system on the one hand and new technologies and knowledge on the other'' (Borras, 2014, p. 24). Additionally, the first pillar encompasses the representative's ability to manage in complex systems and ''align positions for a system change'' (Borras, 2014, p. 24). The second pillar, forms the ''governance instrumentation'' in change procedures (Borras, 2014, p. 25). The concept of governance ''brings forward the understanding'' that common action require complicated ''forms of public-private interaction'' (Borras, 2014, p. 24). This kind of interplay is called '' governance instrumentation'' and aims to form social action (Borras, 2014, p. 24).The third pillar deals with the ''legitimacy and democracy of socio-technical and innovation systems'' and the procedure of managing their alteration (Borras, 2014, p. 24). This forms a crucial part of governance as a common social procedure. These pillars provide us the opportunity to ask questions regarding ''the who, the how and the why of governance of change'' (Borras, 2014, p. 25). It is worth mentioning, that due to the uncertainty which is created by changes and because of the ''the compliance discretion'' of the institutions and the agents' past experiences, governance of change is not an easy and without controversies procedure (Borras, 2014, p. 42). It is a procedure which includes lots of instruments which might be led by forces from the political or social scenery. The way these systems are governed is constantly developed with ''heterogeneous institutional arrangements and multiple instruments'' (Borras, 2014, p. 42). This makes the governance scattered and the role of legitimacy very important for the comprehension of ''change and its governance'' (Borras, 2014, p. 42).

The heuristic of Borras and Edler formed the base to answer the research questions of the present project. It is very important to mention that the theory was not used exactly as it is. In contrast it was used in a way that serves the answer of the research questions. Pillars reflect the instruments, the measures and the actors of the climate action plans of Athens and London. More specifically, the first pillar reflects the instruments which each city

allocates to achieve its aim**.** The second pillar reflects the activities which people in charge create and implement to motivate the public to act for the reduction of transportation emissions**.** The third pillar is connected with the actors who cooperate to regulate the issue of air pollution (Borras, 2014). ''Actors are the object and subject of the collective coordination'' (Borras, 2014, p. 24).

The cases of Athens and London were compared on the basis of their contexts, instruments, measures and actors. This comparison showed the differences and similarities between the instruments each city allocates, the activities which were organized to achieve their aim and the actors who participate in the efforts against transportation emissions. The context was added in the comparison because it plays a crucial role when policies are created and introduced by authorities. This happens because not all societies can adopt the same measures. For example, the financial status of each community influences citizen's ability to adopt and follow policies.

In the first sub-question, mentioned in the prior section: ''What is the policy actor's perception of air quality in the two cities?'' I focused on the air quality of Athens and London. I laid out information for the air status in the two capitals in order to give a clear picture of the air pollution in the two cities and the gravity of the problem. This way it is clear what the local administrations have to confront.

In the second sub-question: ''With which policy strategies are London and Athens fighting against transportation emissions, and which are the conditions for doing so in both contexts?''I focused on the way in which the local administrations of these two cities handle transportation emissions, in order to improve the air quality of their cities and therefore the citizen's quality of life. The current social, economic and cultural characteristics of each city differentiate them from other places. These characteristics form the context of the cities and they are important when the local governments construct policies. The context and conditions under which policies are created are significant, because they determine which measures can be implemented in which city, in accordance to what citizens are able to adopt. For example, the financial status of citizens influences their ability to adopt environmental friendlier habits such as an electric car. In Borras and Edler terms, the second sub-question helps to find the instruments each local government allocates, the measures she implements to tackle transportation emissions and under which set-up they do it (Borras, 2014).

The third sub-question ‘’How do policies aiming at the reduction of transportation emissions differ in London and Athens; which similarities can be noted?’’, was examined from a comparative perspective in order to find the differences and similarities between the two strategies. The aim in those cities is to improve the air quality their citizens breathe. Although, the way the administrators choose to approach the issue is not entirely the same. The study of the measures which are introduced in these cities, led to the unveiling of the similarities and differences between these activities. The aim of these activities was the one which was discussed by Borras and Edler- to motivate citizens to act. In Borras and Edler terms, the third sub-question helps to compare which actors cooperate in each action plan and what measures they implemented to achieve their aim (Borras, 2014).

2.2 A public administration perspective on fighting transportation emissions in the two cities

Over the years, the discourse about climate change in relation to greenhouse gas emissions from air pollution becomes a public priority. In order to mitigate climate change effects, governments all around the world participate in global efforts which aim to protect the environment and people’s health. In this section will be discussed the public administration efforts of the local administrations of Athens and London to reduce GHG emissions.

In the city of Athens, the municipality took part in the ‘’Mayor’s initiatives’’ called the ‘’Covenant of Mayors’’ and the ‘’Compact of Mayors’’, in order to help the global efforts against climate change and decline the greenhouse gas emissions in the territory of Athens(Municipality of Athens, 2017, p. 7). Through the action and application of these measures the local government of Athens aims to achieve ‘’not only energy and environmental benefits but also financial benefits through the decrease of the energy costs’’ (Municipality of Athens, 2017, p. 7). Social benefits will come from the creation of new jobs for the citizens (Municipality of Athens, 2017).

The first part of the climate action plan aims to ‘’improve the energy efficiency of municipal buildings and infrastructure, as well as increasing the city's energy efficiency’’ (Municipality of Athens, 2017, p. 7).

The actions were selected in accordance with the ‘’greenhouse gas emissions inventory’’ (Municipality of Athens, 2017, p. 7). The use of energy ‘’in the municipal, residential and commercial sector was collected with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) standard’’ (Municipality of Athens, 2017, p. 7).Additionally,

''the management of the organic fraction of municipal solid waste and the related emissions'' were considered (Municipality of Athens, 2017, p. 7). The greenhouse gas emissions in Athens were calculated at 5.069.040 tones of CO_2, this means 7,63 t/ capita(Municipality of Athens, 2017, p. 7). These sources of pollution are:'' the residential, commercial and municipal sector, manufacturing industries and the industrial procedure, on road transportation, public transportation, fugitive emissions, solid and biological waste and waste water''(Municipality of Athens, 2017, p. 7). The domain of transportation which is the focus of this project, produces 1.064.529 GHG emissions tones CO_2eq (on road transportation produces1.015.754 and public transportation produces 48.775 GHG emissions tones CO_2eq (Municipality of Athens, 2017, p. 8)

In order to achieve its aims the local administration of Athens, arranged actions for the ''improvement of the municipal fleet and its right use combined with actions'' for the familiarization of drivers with eco-driving and the implementation of a ''sustainable urban mobility plan'' (Municipality of Athens, 2017, p. 8).

It is worth saying that, the Athenian authorities admit that they do not have the complete administrative authority, to force citizens to put into effect the actions, which help to decrease the emissions. Although, the local authorities would promote the implementation of actions that contribute to save energy and reduce the emissions that harm people's health (Municipality of Athens, 2017). This would be achieved through cooperation with the bodies of the central and peripheral administration, the private domain and NGO's '' (Municipality of Athens, 2017, p. 9).

In comparison with London, it has been reported that London, road transportation emissions are responsible for approximately half of the city's air pollution (Mayor of London, n.d). Exhaust fumes from London vehicles caused many of ''premature deaths every year'' and the poorest Londoners who do not own a car, have serious health issues due to air pollution (Mayor of London, n.d). According to the Mayor of London- Sadiq Khan ''London's air is a public health crisis'' (Mayor of London, n.d). He believes, that breathing healthy air is a right for all citizens. Thus, he organized actions to ''#LetLondonBreath'' (Mayor of London, n.d). The fact that London actions are introduced globally for the first time makes them innovative. More specifically, London is the first city owning the biggest ''electric bus fleet'' on global level and the first ''Ultra Low Emission Zone'' in the center of the city (Mayor of London, n.d). Furthermore, these actions aim at the source of the pollution, since they fight areas with the most unhealthy air, trying simultaneously to motivate Londoners of all ages to

act for air quality (Mayor of London, n.d). Giving special attention to schools, the local administration of the city tries to protect the children(Mayor of London, n.d). Additionally, the actions are highly effective since, according to the measurements of the municipality it is expected to achieve the reduction of threatening ‘’transport NOx emissions by 45%’’within two years (Mayor of London, n.d). King’s London college deals with the monitoring of pollution, giving education a star role (Mayor of London, n.d). Last but not least, actions that facilitate citizens to use environmentally friendlier ways of transportation makes it easier for London people to act for air pollution. The fact that the local municipality introduced actions which encompass both children and citizens of older age means that London’s perspective act from top to the bottom, including all citizens regardless of their age in the efforts against air pollution (Mayor of London, n.d).

Chapter 3. Methodology

Research method and its verification

For the present research, qualitative methodology was used. The roots of qualitative methods are found at ancient times-'' from the Greek Herodotus to Marco Polo'' (Taylor, 1984, p. 7). Qualitative methods are found not only on social sciences but also in other fields such as political science, geography and others. The term '' qualitative methodology refers to the ''broadest sense to research that produces descriptive data'' (Taylor, 1984, p. 7). When conducting a research, the aspects of validity, reliability and replicability play a crucial role. Reliability refers to the notion that the same measurement process, conducted by the same or another researcher at a different time ''can produce the same result (assuming the phenomenon under study has not changed)'' (Schwarz- Shea., 2012, p. 93). Replicability forms a standard for evaluating a research as a whole (whilst reliability refers to specific measures). Replicability ''concerns the question of whether the same research project, from data "collection" to analysis, would, if carried out by another researcher, produce the same results'' (Schwarz- Shea., 2012, p. 93).Validity is connected to ''whether the particular indicator used by the researcher measures what it is supposed to measure'' (Schwarz- Shea., 2012, p. 92).

Validity, reliability and replicability protect the research from the ''presence'' of the researcher (Schwarz- Shea., 2012). This comes from the supposition that the researcher is able to create knowledge from the '' research setting.. from a point external to it''(Schwarz-Shea., 2012, p. 95). This is what is called objectivity of the researcher -to keep ''emotional and physical distance'' from the object which is studied (Schwarz- Shea., 2012, p. 95).

3.1 Research design

The research design used in the research was inspired by the research design of Grounded Theory. Grounded theory was referred for the first time in 1967. It was created to develop a unified whole of concepts which gives a careful reasoning for social phenomena which are studied. ''A Grounded theory should both explain and describe'' (Corbin, 1990, p. 5). Pragmatism and Symbolic Interactionism are the sources from which Grounded Theory derived. Despite the fact that, it is not necessary to learn these ''philosophical and social orientations'', in order to use the method, two important rules should be kept in mind. Firstly, the fact that phenomena are constantly changing due to social developments, it is significant to create change during the procedure in the method (Corbin, 1990, p. 5). The second rule is connected to a clear link with ''determinism'' (Corbin, 1990, p. 5). ''Strict

determinism is rejected, as is nondeterminism'' (Corbin, 1990, p. 5). People seem not to always use the means to control their lives by their reaction to situations. They have the ability to choose in accordance with their opinions, which are often correct, regarding the alternatives they find. Thus, Grounded Theory not only reveals pertinent conditions but also identifies how people act to altered conditions and to the consequences of their choices (Corbin, 1990). In the present research, Grounded theory was not followed exactly as it is. In contrast it formed source of inspiration which helped to identify how the local administration of Athens and London act towards the polluted atmosphere their vehicles created among other reasons and what they do to reduce transportation emissions and improve the air quality they breathe. More specifically, in the heart of this research lies the comparison between the ways these cities chose to reduce transportation emissions. According to Glaser and Strauss grounded theory depends on comparisons which are very helpful when we want to create new facts (Glaser, 1967). To compare the two action plans, categories were created in accordance with the method of Strauss and Corbin. It is worth to mention, that the method of Strauss and Corbin was not used exactly as it is. It was slightly amended so it may serve answering the research questions of the present project. The research starts with an open coding which aim to create ''concepts that seem to fit the data'' (Kelle, 2005, p. 7). The usual ''tendency is simply to take a bit of the data (a phrase or sentence or paragraph) and translate that into a précis of it'' (Kelle, 2005, p. 7).This became possible by the coding paradigm. Instead of the four items which Strauss and Corbin proposed, the two action plans were studied and coded in the following codes: context, policy instruments, measures and actors. The categories arise from the theory of Borras and Edler where the present research depended for the answer of the research questions. Their theory includes the notion of collective actions which aims to ''shape social action'' (Borras, 2014, p. 24). These actions are translated into measures for the present research. This happens because most of the actions which the administrations of Athens and London introduced had to be followed by citizens, therefore these actions had the form of measures. The measures each administration implemented for the reduction of transportation emissions were divided in technological, communicative, regulative measures and other measures in accordance with their content. Regarding policy instruments, they form the link between '' policy formulation and policy implementation'' (Mohammad, 2012, p. 99). Policy instruments are frequently ''known as governing tools as well'' (Mohammad, 2012, p. 99). In the present research, policy instruments form the tools which Athens and London

administrations allocated to achieve their aims. The categories which were created for the present thesis help to compare and find the differences between the way the two administrations deal with transportation emissions.

3.2 Data collection

The data comes from policy documents of the local government of Athens and London which provides information regarding how transportation emissions are handled in those cities. Additionally, the report of European Environmental Agency gives insights about the air pollution in Europe in 2018. Books and academic and newspapers articles which discuss the consequences of air pollution on people's health, the effect of Brexit on environment and the shift of cities to environmentally friendlier methods provide data to the present research.

My research is based on desk research. All the information was collected through the process systematic literature review. More specifically, the phrases/ keywords: air pollution in Athens/ London, Athens climate, London climate, ambient air pollution, climate change, transportation emissions, consequences of air pollution on health, air pollution sources, air pollution policy; were used in order to gather the necessary information. The sources of the literature are: Scopus, Taylor and Francis, Web of Science, Lisa, Google Scholar, Science Direct. The official web pages: Mayor of London, C40 Cities, World Health Organization, Environmental Protection Agency, European Environment Agency formed alos sources of valuable information. The time frame played crucial role in the selection of the literature. In order to learn the air status of the cities and the measures which are applied there I selected the literature which refers to the last 20 years. This time frame gave the opportunity to provide information which are as updated as possible. The articles which referred to older dates were published on 1967, 1969, 1990 and 1984. The reason these articles were selected is due to the fact that, they provided valuable information for the connection between public policy and air pollution and for Grounded theory. Also, the reliability of the citation number of the publications formed an important criterion for the selected literature, since the information has to be reliable. Arranged in the list below are the documents which were analyzed for the present research.

Main Research Question	
Policy Documents	1. Climate Action Plan Part A: Mitigating Climate change Reducing Greenhouse Gas Emissions in the City of Athens 2. London Environmental Strategy
1st Research Sub-question	
Policy Documents	1. Climate Action Plan Part A: Mitigating Climate Change: Reducing Greenhouse Gas Emissions in the City of Athens 2. London Environmental strategy
2nd Research Sub-question	
Policy Documents	1. Athens Resilience strategy for 2030 3. Climate Action Plan Part A: Mitigating Climate change Reducing Greenhouse Gas Emissions in the City of Athens 2. London Environmental strategy
3rd Research Sub-question	
Policy Documents	1. Climate Action Plan Part A: Mitigating Climate Change: Reducing Greenhouse Gas Emissions in the City of Athens 2. London Environmental strategy

It is worth to mention that, aside from the documents which are arranged in the table above, websites from the local municipalities of Athens and London formed sources of information for the actions which the local authorities took. Additionally, the website of WHO, Environmental Protection Agency and European Environment Agency provided information for the consequences of air pollution on people's health and the sources of air pollution respectively. The newspaper article ''Air pollution responsible for more deaths that smoking, study says'' by Matthews- King gave insights regarding the link between air pollution and deaths (Matthews- King., 2019). In addition, the newspaper article '' Air pollution after Brexit: Will UK air quality deteriorate when we leave the EU? Will the Clean Air strategy change?'' by Taylor formed source of information for the possible consequences of Brexit on the air quality strategy of London (Taylor J. , 2019). The Journal articles '' Social Profile Report on Poverty Social Exclusion and Inequality before and after the crisis in Greece'' and '' The Greek crisis: Causes and implications'' by Katsikas et al. and Kouretas and Vlamis respectively formed valuable sources for the Greek economic crisis and it effect on the Greek society (Kouretas G.P., 2010) (Katsikas, 2014). The journal article '' Road traffic emissions impact on air quality of the Greater Athens area based on a twenty years emissions inventory'' by Progiou and Ziomas provided information regarding the impact of road transportation on the air quality of Athens (Progiou, 2011). The book '' The Governance of Socio-Technical Systems: Explaining Systems'' by Borras and Edler and specifically their

concept with the three pillars formed the theory where the answer of the research questions depended (Borras, 2014).

Lastly, during the research process to collect information, I found out that the researches where air pollution is examined from an environmental and chemistry perspective were more, compared to the researches where the issue of air pollution is studied from a public administration perspective. Therefore, finding sources which approach air pollution and transportation emissions from a policy and public administration point of view needed more effort. This happens because as Rykkja et al. claimed there is a ''lack of research'' examining the issue of climate change from policy perspective (Rykkja, 2013, p. 106)

3.3 Data analysis methods

The heart of the present research depended on comparison. This means that, the data were analyzed through a comparative lens. Before comparing the data, categories were created. The categories helped to shorten the focal aspects and facilitated the comparison between the two action plans. The collected information was categorized to the following groups: context, policy instruments, measures and actors. These categories helped in the organization of the collected data and made the comparison between the two cases easier. The ''context'' category was examined in accordance with the context of each city. More specifically, the financial status of the cities was compared. The ''measures'' category was examined in accordance with the number of measures and the content of each measure. Regarding the content of measures, they were classified in technological measures, communicative measures, regulative measures and other measures. Policy instruments were examined in accordance with their number and content. The ''actors'' category was examined in accordance with the number of actors who participated in the implementation of the action plans. Each category of the Athenian plan was compared to the corresponding category of the London plan. This comparison led to the unveiling of the differences between the two action plans.

In the analysis of the cases below in the fourth chapter of this thesis, the description of the two action plans, the aim of the two administrations and the air quality of the two cities are discussed. This serves multiple aims. More specifically, the description of the air quality helps the reader to understand the gravity of the problem in the two cities. The description of the action plans contribute to provide the necessary information regarding the actions the two authorities take to deal with air pollution in Athens and London respectively. The aims of the two action plans make clear what the Athens and London administrations aim to

achieve. Hereupon, the description of the policy instruments helps the reader to comprehend what tools the local authorities allocated to achieve their aim. The description of measures which were implemented in the two cities shows the reader what are the actual measures the local administrations implemented in the two cities to reduce transportation emissions.

It is worth mentioning that the Athenian Climate action plan was in Greek. Therefore in order to include the necessary information which I collected from this document, I translated the parts which referred to the actions that aimed to reduce transportation emissions from Greek to English.

3.4 Limitations

The present research examines the actions the local administrations took and the measures they implemented to reduce transportation emissions in their cities, but does not examine the power struggles that might existed during the creation of the plan, if these struggles affected the plan and how . Furthermore, the present project takes into account the financial status of the Athenian community to explain the choices of the local administration but does not examine other social forces that might affected the decisions of the Athenian administration regarding the measures they chose to implement.

The effectiveness of the measures which is discussed in this research is based on the expected results of those cities and not on results from actual measurements after the implementation of the actions. This is because of the fact that, local administrations of Athens and London introduced measures for the reduction of transportation emissions but they did not conduct tests in order to check the results of their actions. They only stated the anticipated reduction in emissions.

4. The cases

4.1 Air quality in Athens

This section focuses on the case of Athens. More specifically, the air status of the city, the characteristics of the Athenian climate and the causes which create air pollution in the city are discussed. Arranged in the table below are the main attributes of the Athenian climate and the factors which pollute city's atmosphere according to (Municipality of Athens, 2017, p. 23), (Progiou, 2011, p. 6).

Table 1.Athens climate, air pollution and transportation

Athens climate	1. Mediterranean climate 2. Mild and rainy winter 3. Warm to very warm and dry summer
Factors which created air pollution in Athens	1. Increasing urbanization 2. global climate change due to the greenhouse effect 3. disaster of suburban greenery from forest fires 4. natural variability of climate
Transportation factors contributing to air pollution in Athens	1. 'high levels of particulates 2. nitrogen dioxide 3. Ozone 4. Non-methane volatile organic compounds (NMVOC) 5. Carbon monoxide(CO) 6. Methane (CH_4) 7. Nitrogen oxides (NO_x)

The climate of the Greek capital is Mediterranean and it is characterized by mild and rainy winter and warm to very warm and dry summer. In the light of a research which was elaborated on 2011, by the ''Climate Change Impact Study Committee on behalf of the Bank of Greece.. the alterations of the Athens climate in the last decades are intense because of various factors which are mainly anthropogenic''(Municipality of Athens, 2017, p. 23). These factors are the ''increasing urbanization, global climate change because of the greenhouse effect, the disaster of suburban greenery from forest fires and the natural variability of climate''(Municipality of Athens, 2017, p. 23). It is worth noting that this research noted the ''increased urbanization'' and forest fires as local sources of air pollution in Athens, discussing also global sources such as the ''natural variability of climate'' and climate change as causes of air pollution in the Greek capital.

The inventory which the Athenian municipality conducted made the sources of air pollution in Athens more explicit. According to their inventory standard sources such as buildings and transportation form the two largest sources of air pollution in Athens. Trash handling is the domain which pollutes Athens the least (Municipality of Athens, 2017).

''The average annual temperature in Athens has been rising since the 1970s'' (Municipality of Athens, 2017, p. 23). From 1970 until 2011 the temperature increased by 1,3℃. According to climate models, the temperature will rise by 2℃ in summer, for the period of 2021-2050 and 4℃ for the period of 2071-2100 (Municipality of Athens, 2017, p. 23).

Over the last years, ''the Greater Athens Area (GAA)'' confronts ''atmospheric pollution problems'' which are connected with ''high levels of particulates, nitrogen dioxide and ozone'' (Progiou, 2011, p. 1). Road transportation in addition with the ''complex geomorphology'' and the ''subtropical Mediterranean climate'' of the Greek capital create the air pollution which concerns the city (Progiou, 2011, p. 1).

In 2009 personal cars (PCs) where the biggest sources of Non-methane volatile organic compounds (NMVOC), carbon monoxide (CO) and Methane (CH_4). Heavy duty vehicles (HDVs) were connected with particulate matter of 10 micrometers (PM_{10}) and nitrogen oxides (NO_x) emissions. It is worth mentioning that the biggest part of these emissions came from ''older vehicles'' (Progiou, 2011, p. 6). The figure 1 below shows the ''PM_{10} in the GAA for all kind of vehicles ''according to their age''(Progiou, 2011, p. 6).

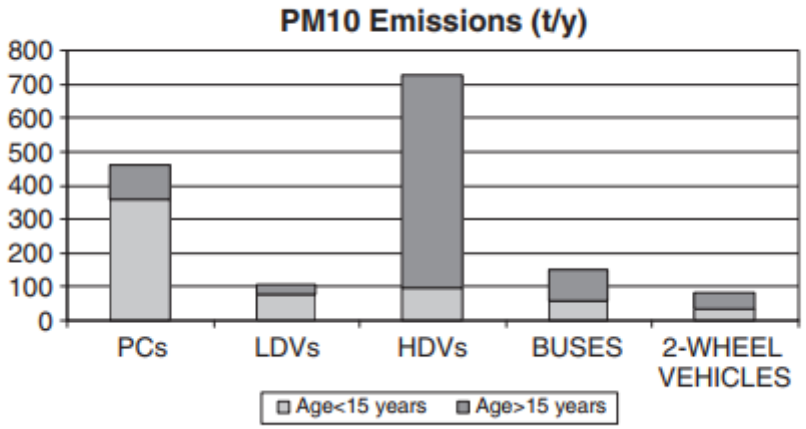

Figure 1.Particulates emissions in the GAA for year 2009 for all vehicle categories according their age'' (Progiou, 2011, p. 6)

From figure 1 is clear that, the age of the vehicles and the ''corresponding engine technology'' influence their emissions (Progiou, 2011, p. 7). This was chiefly appertain to cars and HDVs. The aged fleet include also ''low duty vehicles (LDVs), two wheel vehicles and buses'' (Progiou, 2011, p. 7).This connection between the emissions of the old vehicles and the related ''air pollutant levels'' showed that an efficient strategy in relation to PM_{10} and NO_2 should encompass'' circulation restriction measures or fleet renewal for older HDVs

whereas PCs seem to be more implicated with hydrocarbons, and thus, ozone concentrations'' (Progiou, 2011, p. 7).

According to measurements of the local administration of Athens in 2014 the road transportation is one of the biggest pollutants in the city of Athens. Specifically, on 2014, road transportation produced 1.015.754 tons of CO2eq and ''public transportation (metro, tram)'' produced 48.775 tons of CO2eq (Municipality of Athens, 2017, p. 10).

More specifically, the inventory of the GHG in Athens showed that the CO_{2eq} emissions were equal to 5.069.040 tones which means 7,63 tones per resident. 1.064.529 of these emissions came from the domain of transportation. The municipality aims to reduce these emissions by 40% which is equal to 2.027.616 tones by 2030 (Municipality of Athens, 2017).The target in reduction in transportation emissions is -41,70% which is equal to 423.567 tones CO_{2eq}(Municipality of Athens, 2017).

Therefore, the local administration of Athens participates in the global actions which aim to mitigate climate change and improve the air quality of cities. Athens took part in the initiatives ''Compact of Mayors'' and ''Covenant of Mayors'' (Municipality of Athens, 2017, p. 10). Implementing these measures would have not only ''environmental and energy'' benefits (Municipality of Athens, 2017, p. 10). It would also help in the decrease of ''energy costs'', in the creation of new job positions (Municipality of Athens, 2017, p. 10).

The beginning of these actions against climate was the 21st board meeting of the United Nations (UN) for climate. In this board meeting named COP21 took part agents of the member states of the agreement of UN ''for climate change (UNFCCC)'' (Municipality of Athens, 2017, p. 12). The result of the conference formed a significant treaty for the protection of climate, since the agents of 195 states who took part, agreed to limit the increase of the temperature under 2℃ compared to the pre-industrial era. They agreed in attenuating the increase to 1.5 ℃ until the end of the 21st century. Scientist claimed that if this limit will be surpassed the consequences on climate ''will be irreversible'' (Municipality of Athens, 2017, p. 12).The treaty was attested in the beginning of October on 2016. Greece attested the treaty on 5/10/2016 (Municipality of Athens, 2017).

Another important event which took place in parallel with COP21, was the ''International Conference of Local Leaders for Climate'' in Paris. It was organized by the city of Paris and the organizations Bloomberg Philanthropies. It has the support of the certified cities network such asC40, Local Governments for Sustainability (ICLEI) (ICLEI , n.d) and others. Cities play a very important role against climate change, because most of the policies should be

organized and implemented on local level. Result of this session was the ''Paris City Hall Declaration'' (Municipality of Athens, 2017, p. 12)

The administrators of the cities ''were committed among others to support ambitious plans with long-term aims'', such as the shift to cities which use exclusively renewable energy sources or reduction of GHG emissions around 80% until 2050. In addition they agreed to improve the cooperation among the cities and their cooperation with international organizations, national governments, the private sector and the civil society'' (Municipality of Athens, 2017, p. 13)

Regarding the initiative '' Compact of Mayors'', it was officially announced on September of 2014 in the summitry of UN for climate change. Although, due to the need of co-ordination among the cities to fight climate change on global level, the conflation of the initiatives ''Compact and Covenant of Mayors'' was announced on June of 2016. The new name was ''Global Covenant of Mayors for Climate and Energy'' (Municipality of Athens, 2017, p. 13). This treaty started officially on 1/1/2017. The cities which took part are committed to help in the reduction of CO_2 in their territory and to implement plans for the ''acclimatization to climate change'', improving the durability of cities in the consequences of this environmental problem (Municipality of Athens, 2017, p. 13).

In order to take part in this treaty, each city should affirm their commitment either via the supportive platforms or with a letter of intent. Secondly, in one year after the affirmation of commitment each city should develop an inventory regarding the CO_2 emissions for the domains of transportation and buildings, identify the danger for climate and apply a report to the responsible platforms -Carbon Disclosure Project (CDP) and Carbon Climate Registry (CARBONN).The third step is the ''Reduction Targets and Measurements System''- the update of the inventory for CO_2 emissions from the management of waste, the goal setting to reduce emissions and the delineation of a tracking system. Lastly, each city should create an action plan for the confrontation and acclimation in climate change for each city within three years counting from 2017(Municipality of Athens, 2017, p. 14)

The municipality of Athens participates actively in ''international networks and initiatives'' that aim to sustainable development. This participation provides knowledge to the municipality. This knowledge facilitates the implementation of actions towards climate change and the resilience of the city (Municipality of Athens, 2017). ''C40, 100 Resilient Cities, Eurocities'' and ''Global Covenant of Mayors for Climate and Energy'' form the international networks and initiatives which help the municipality of Athens act against

climate change and protect the environment (Municipality of Athens, 2017), see table 4.2 of the Climate action plan of Athens.

4.1.1 Description of the Climate Action Plan of Athens

At this phase the climate action plan of Athens will be described. Assorted in the table below are the duration of the plan, the duration of the inventory and the accountable organizations according to (Municipality of Athens, 2017, p. 27).

Table 2: Main points of the Athenian plan

Duration of the climate action plan of Athens	2016-2030
Duration of the GHG emissions inventory	April-December 2015
Accountable organizations	Local administration of Athens in cooperation with the ''General Secretary of the Municipality of Athens'' , the Department of Environment of the Project Directorate City and Urban Environment and the Office of Durability and Sustainability of Athens and the monitoring team.

The collection for the GHG emissions inventory took place from April till December 2015. The Department of Environment of the Project Directorate City and Urban Environment was responsible for the collection and the processing of the data. Additionally, the office of Durability and Sustainability of Athens participated in the processing of the plan. The Climate Action plan of Athens forms integral part of the Athens Resilience Strategy. This strategy aims to make Athens a ''responsive, embracing and inspirational city, that is proud, green and citizenled'' through a series of actions. (100 Resilient Cities, (n.d), p. 28). This program is inaugurated by the Rockefeller Foundation and aims to change the way cities around the world deal with their biggest and long term challenges (100 Resilient Cities, 2019).

A monitoring team was contacted, in order to check the improvement of the plan. Whenever is needed this team would cooperate with the municipal services, in order to collect the necessary information. If required, these people make suggestions to the responsible bodies, in order to amend the plan. The ''Greenhouse Gas Inventory'' and the Climate Action Plan of the city play important role in tracking the implementation of the actions (Municipality of Athens, 2017, p. 28). The ''Climate Change Action Plan Monitoring Team for the Reduction of GHG emissions will collaborate with the ''Monitoring Group for the Action Plan for Adaptation to Climate Change'' (Municipality of Athens, 2017, p. 28).

''The GHG emissions inventory is the quantity appraisal of the GHG emissions which are emitted to the atmosphere'' (Municipality of Athens, 2017, p. 29). These emissions come

from actions that take place in a city. ''The emissions quantity is traced per activity'' (e.g transportation) ''for a specific time period'' (Municipality of Athens, 2017, p. 29).

4.1.2 Aim of the climate action plan of Athens

Athens administration set a general aim but also individual aims for the domains which cause air pollution in Athens. In this section the general aim and the aim for the domain of transportation are discussed according to (Municipality of Athens, 2017, p. 26).

Table 3: Aims of the Athenian plan

General aim	40% reduction of GHG emissions by 2030
Aim for the domain of transportation	41,70% reduction of the GHG emission which come from road transportation

According to the report of C40 '' Deadline 2020'', the cities of the network had to take measures directly, in order to achieve the aim they had addressed when the Paris agreement was ratified. According to the research of C40, the decisions would be made by 2020 will determine if the aim to reduce global warming will be achieved. Additionally, it is stated in the report that the emissions per resident- of the network ''should be reduced from the average of 5 tCO_2eq/resident to 2,9 tCO_2eq/ resident by 2030'' (Municipality of Athens, 2017).

The municipality of Athens realized the need for action and the benefits these action will bring, thus they aim to reduce the GHG emissions to 40% by 2030 in comparison to the GHG emissions of 2014 (Municipality of Athens, 2017, p. 26).The action focus to the buildings and facilities, transport and management waste because these are the three main domains that create air pollution in Athens (Municipality of Athens, 2017).

4.1.3 Policy instruments of the climate action plan of Athens

In the present section the policy instruments which the Athenian authorities allocated are discussed. Arranged at the table below are the instruments which city's administration assigned for the implementation of the plan according to (Municipality of Athens, 2017, pp. 29-32,46)

Table 3: Policy instruments of the Athenian plan

Policy instruments	1. ''The Global Protocol for Community- Scale Greenhouse Gas Emissions (GPC)'' 2. GHG emissions inventory 3. ''Standard emission factors'' 4. ''TREMOVE model''

The Global Protocol for Community- Scale Greenhouse Gas Emissions (GPC)

The International Protocol includes guidelines for the composition of the GHG emissions inventory. This determines the demands which should be met by the primary data and suggests alternative ways for the emissions appraisal. Before GPC, every city could compose its individual appraisal which did not show the real dynamic of each city towards climate change. GPC gives a clear picture of the situation in cities and of the efficiency of their actions which the local authorities introduce to mitigate climate change (Municipality of Athens, 2017).

The geographical limit of emissions inventory often coincides with the geographical limits of a city or with the limits of a broader metropolitan area. Also, it should refer to the emissions which were emitted within a period of 12 consecutive months. The inventory includes data not only for CO_2 which is directly connected with the greenhouse effect, but also for other gases like methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFC), perfluorocarbons (PFC), Sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). These emissions come from ''stationary sources, transportation, waste, agriculture, forestry and other land use'' (Municipality of Athens, 2017).

According to GPC, the emissions come from three scopes. The first scope refers to direct emissions, which are connected with the processes and activities that take place inside the city. The second scope includes indirect emissions which are produced outside the city and are linked to the use of grid-supplied energy from the net or/and with district heating. Lastly, other indirect emissions, which are the consequence of other activities that are connected with the city, but they take place outside its borders. Cities have to create a basic reporting at least for the stable sources (scope 1 and 2)-the use of grid supplied energy or other kind of energy that comes from buildings and establishments, transportation (scope 1 and 2) and handling of discard that are produced in the city and handled inside or outside of the city (scope 1 and 3) (Municipality of Athens, 2017).

The process of the GHG emissions inventory in the municipality of Athens

Based on the data available in 2014, the inventory process was developed in two phases. The first phase referred to the data collection for the municipality activities that contribute to the production of emissions linked to the greenhouse effect. These emissions are very important for the city, since they are linked with the operation of the municipality. This means that the municipality could implement activities to reduce these emissions. The municipality should form a role model for the citizens in order to motivate them to act in the

fight against climate change (Municipality of Athens, 2017). The second phase refers to the data collection for the whole city. Specifically, it is linked to the energy consumption from the domestic domain, the private transportation, industries etc. It refers to domains where the municipality has no competence to introduce measures. Although, it has the ability to promote measures which can help the reduction of emissions by 2030 (Municipality of Athens, 2017).

Standard emission factors

Standard emission factors played an important role for the implementation of the plan and the calculation of GHG emissions. These factors were based on the ''Directives of the Intergovernmental Panel on Climate Change (IPCC)'' (Municipality of Athens, 2017, p. 32). The Standard quotients ''are based on the carbon content of each fuel, as is the case with national ones statistical inventories of GHG emissions under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol'' (Municipality of Athens, 2017, p. 32).

Wherever it was necessary, emission quotients were used especially for the city of Athens in accordance with GPC methodology. In the international unit system SI, ''the metric ton of each gas (ton) and the carbon equivalent ton (tn) (tCO2e)'' are the unit of measurement of GHG emissions (Municipality of Athens, 2017, p. 33).

The carbon dioxide equivalent (CO2e) gives the ability to compare the different GHG, since each of them affects differently the phenomenon of global warming. Carbon dioxide equivalent (CO_2e) is calculated multiplying the emissions of each of the GHG by the potential Global Warming Potential (GWP) over a period of 100 years. Greece uses the GWP in its national GHG emission reports in the framework of its commitments to UNFCCC, the same was used in the emissions inventory of the Municipality of the Greek capital. This way the sizes were comparable to the national reports (Municipality of Athens, 2017).

Tremove model

Tremove model is developed in the University of Leuven in 1997. It is constantly renewed and it is used for the estimation of the aftereffect from the policies in transportation domain regarding the gas emissions. The model of TREMOVE provides forecasting for the fleets and the traversed kilometers for all the European countries by 2030 (Municipality of Athens, 2017, p. 46).

According to the Athens climate action plan, the emissions which are linked to transportation domain come from every kind of conveyance or from track guided vehicles. In the Athens inventory were included the data from transportation that take place inside the city limits, but also the use of electrical energy by the track guided vehicles or other means of transportation which operate with electric energy (e.g trolley) (Municipality of Athens, 2017).

In the calculation of GHG emissions that come from the road transportation that takes place inside the city limits is included the movement of vehicles (public utility vehicles, buses, scooters, etc.). GPC suggests various ways to calculate the transportation emissions. In all these methodologies, only one part of the real transportation that takes place inside the city is assessed. The factor that makes it difficult is the adversity in calculating accurately the number of the vehicles, the traversed kilometers inside the city limits and the use of different kinds of fuels from the various vehicles which are moving in the city e.t.c. In case of the municipality of Athens, there is a great difficulty in the calculation because of the fact that the municipality borders with many other municipalities inside the basin (Municipality of Athens, 2017).

The Department of Fuels and Lubricants (fuels sales approach) of the Department of Supplies and Warehouses provided data for the consumption of fuels by the vehicles of the municipality for 2014. Furthermore, data were collected for the vehicle fleet. On 2014, the municipality had 1.053 vehicles.402 of them were garbage trucks; 480 were project machineries (basketry, loaders, tractors, trucks e.t.c.); 106 were motorcycle/ motorbike and tricycles; 32 of them were public utility vehicles and 15 of them were bicycles. Approximately 850 from the vehicles above used diesel fuel; 128 used petrol; 32 were operate with natural gas and 10 of the vehicles were electric (Municipality of Athens, 2017).Most of the vehicles had technology EURO 3; 278 had technology EURO 4 and 20 of the vehicles had technology EURO 6. In 2015 only 137 of the garbage trucks operated. Also, a more extensive inventory increased the number of Motorcycle/ motorbike, tricycle to 201 (Municipality of Athens, 2017).

Information from the model TREMOVE was used for the estimation of the vehicles which are moving inside the municipality and the traversed kilometers per type of vehicle per kind of road (e.g autobahn, civic road). On municipality basis the data were reduced by the proportion of the population. Additionally, on the basis of the guidelines which are given by the European Environmental Agency (EEA) data were used for the fuel consumption by usual

cars. The result of these data and calculations was the total fuel consumption in the municipality, which was 77.149.335 kg for diesel fuel, 231.007.103 kg for benzine, 18.584.921 kg for Compressed Natural Gas (CNG) and 163.399 kg for Liquefied Petroleum Gas (LPG) (Municipality of Athens, 2017).

The scope 2 includes the emissions of the road transportation that come from trolleys which are moving inside the Athenian basin. Trolleys form an environmentally friendly mean of transportation because of their low emissions in gas, noise and heat. According with Road Transport S.A (O.SY), the company allocates 356 electric conveyance, with approximately 15-20 years of life (Municipality of Athens, 2017).

The trolley fleet of the municipality is maintained in the framework of O.SY Corporate Social Responsibility. It is an ecological and silent mean of transportation which has up to 3 times bigger energy-efficient in comparison to conventional buses, expelling 6 times less gas pollutants per kilometer. This makes them a useful tool towards the reduction GHG emissions (Municipality of Athens, 2017).

‘’In the case of fixed track transport (tram, train, metro), the calculations focused on the means of transport which are moving inside the municipality of Athens (metro 1, 2, 3 and tram)’’ (Municipality of Athens, 2017, p. 50). ‘’For the calculation of emissions that come from fixed track transport’’ the ‘’Hellenic Statistical Authority… and a relevant research of the Athens Urban Transport Agency’’ formed the source of information. More specifically the Hellenic Statistical Authority provided information regarding ‘’the number of passengers ‘’ and the Athens Urban Transport Agency provided information in regard to ‘’the average traveled distance that a passenger is travelling by public transport’’ (Municipality of Athens, 2017, p. 50). This helped in the calculation of the yearly passenger kilometers. In order to trace these to the administrative boundaries of the Athenian municipality, ‘’the number of stops of the three means of transport within the Municipality were used (Municipality of Athens, 2017, p. 50).

4.1.4Measures of the climate action plan of Athens

In the present section the measures which Athenian administration implemented will be discussed. They are divided in two groups- municipality fleet measures and private transportation measures in accordance with the domain they referred. The measures are also categorized in accordance with their content (technological, communicative and regulative). Arranged at the table below are the corresponding categories according to the (Municipality of Athens, 2017, pp. 86,87,88,89,92)

Table 4: Measures of the Athenian plan

Municipality fleet measures	Tech.[2]	1. ''Replacement of the municipality vehicles'' 2. Efficient ''use of the municipal fleet and its fuels''
	Com.[3]	1. ''Eco-driving''
Private transportation measures	Reg.[4]	Implementation of the Sustainable Urban Mobility Plan (SUMP) **SUMP actions:** 1. Bike sharing 2. Development of pedestrian areas 3. institutionalization of speed limits especially outside schools, 4. ''replenishment of access roads to stations'' and public transport stations 5. parking control, 6. ''abatement of the mobility of heavy transport'' 7. reinforcement of the bicycles network 8. ''green ring application'' 9. ''car sharing'' 10. ''car and van pooling''

The actions in the domain of transportation are two. The first one refers to the implementation of measures which are linked with the fleet of the municipality and the reduction of the fuels they consume. The second is about application of action which aims to reduce the private transportation. It is worth saying that the Municipality does not have big competence on the public transport. Although, through co-operations and with the development and application of a plan for the Sustainable Civil Mobility, the Municipality can help to save valuable resources from the reduction of private transportation and the promotion of the use of public transport (Municipality of Athens, 2017).

The energy benefits will be 2.840 MWh per year and the emissions and the GHG emission will be 707 tCO_2eq reduced per year. Furthermore, due to the fuel saving the costs will be

[2]technological
[3]communicative
[4]regulative

reduced. The upgrade will cost 5.000.000 € and the responsible service is the Mechanical Directorate (Municipality of Athens, 2017).

The operation of the municipality fleet depends on diesel. Most of the vehicles have technology EURO 3 and Euro 4. Their replacement by vehicles with newer engine will help in the reduction of pollutant emissions and in the saving in the fuel consumption, due to more efficient combustion in the engine. The municipality auctioned 25 garbage truck, which have technology EURO 6 and are environmentally friendly. All in all, is suggested the replacement of 20% of the present fleet by 2030, since ''most of them will have completed their expected life expectancy'' (Municipality of Athens, 2017, p. 86). ''Overall, it is estimated that there will be energy savings of 2,840 MWh per year and a reduction in emissions of 707 tCO2eq per year'' (Municipality of Athens, 2017, p. 86)

The next measure is about eco-driving, which is an economic and ecologic way of driving that aims to save fuels since the lower fuel consumption means ''reduced emissions of pollutants and gases contributing to greenhouse effect'' (Municipality of Athens, 2017, p. 87). The Ministry of Infrastructure and Transport created a platform named '' e-drive academy'' which focuses on ''road safety'' issues and addresses to all kind of people who use the roads (passengers, drivers, professional drivers). This platform aims to inform and raise awareness to these people. Furthermore, it includes a special reference on ''eco or smart driving issues and the benefits it has, providing simple advice to drivers'' (Municipality of Athens, 2017, p. 87).

Using this platform and the platform of the Center of Renewable Energy Sources and Saving (CRES), the Municipality informed the drivers and the people in charge for vehicle maintenance, regarding the principles of green driving (Municipality of Athens, 2017, p. 87). Some of the measures and suggestions for the drivers of the municipality are to drive carefully and avoid burst of speed; to prefer lower gears and higher gear ratio; to switch off the engine when they stop; to use oils and tires with low friction coefficient; to adjust the engine regularly and check the tire pressure often (Municipality of Athens, 2017).

The adoption of the practices above can be very efficient for fuel saving. More specifically, the Municipality will save 10% of the municipality vehicles fuels which means 2.422 MWh energy saving per year and 585 tCO2eq reduction in the emissions per year (Municipality of Athens, 2017).

The third measure is connected to a more efficient use of the municipal fleet and its fuels and a plan which aims to educate drivers. More specifically, the local administration

organized an inventory of the municipal needs and of the regular vehicle timetable. They re-scheduled the timetable in order to reduce the traveled kilometers and save fuels. Additionally, they implemented a management system for the fleet and bunkers. For example, they use of a ‘’smart sensor system in the bins waste that signals when they are filled’’ (Municipality of Athens, 2017, p. 89). This way, they can reduce the bus itineraries and adjust the sanitation accordingly. The installation of sensors in vehicles which will measure the tire pressure for example’’, will form a reminder for the maintenance of the vehicles e.t.c. This means a more efficient use of the fleet. Lastly, the installation of gas in the tanks and the enactment of fuel use limits in accordance with the itineraries can lead to an important reduction in the consumption (Municipality of Athens, 2017). This will lead in the 20% reduction in fuel use. All in all, there will be 4.845 MWh energy saving per year and 1.169 tCO2eq emission reduction per year (Municipality of Athens, 2017).

The second type of actions which refers to the private transportation includes the SUMP. SUMP form one of the aims of the Overall Plan for Urban Intervention of the Municipality of Athens. It refers to an environmentally sustainable and cohesive city and it is connected mainly with contemporary, non- polluting transit and with the mobility which is done by foot or by bicycle (Municipality of Athens, 2017).

Furthermore, due to the fact that the municipality was chosen by IBM in the framework of ‘’ Smarter Cities Challenge’’ for 2015, it addressed the improvement of the quality of life in the commercial and historic center of Athens as challenge. This would be done by ‘’the retrieval of public space, elimination of illegal parking of cars and scooters and by bringing it to a place at which people want to live, work and visit’’ (Municipality of Athens, 2017, p. 90). Thus, aiming to ‘’traffic congestion, to improved access for citizens and people with disabilities; to the increase of public transport use and to the reduction of traffic load consequences on the environment; IBM experts came up with a series of proposals for the historical and commercial triangle’’ (Municipality of Athens, 2017, p. 90).

Additionally, the municipality received subsidy from the Green Fund in order to implement the Sustainable Urban Mobility Plan (SUMP). The SUMP analyzes methodically the present and future status of measures planning and assessment. These measures are proposed by the European and international practice as the best for every kind of situation of new policies implementation and new forms of cooperation, ‘’highlighting of new funding sources and proper and accurate programming’’ (Municipality of Athens, 2017, p. 90). ‘’These plans aim to contribute in the improvement of mobility in the city based on the

principles of sustainable development'' (Municipality of Athens, 2017, p. 90). The final aim is to insure a better quality of life for citizens and the environmental protection (Municipality of Athens, 2017).

The SUMP should aim for a system of combined ways of transport; which will be accessible and will cover the mobility needs of all citizens and visitors. It should balance the different desires ''between citizens, business and industries'' and serve the balanced and integrated developing ''modes of transportation, their goals for sustainability, economic development, social justice health and environmental quality'' (Municipality of Athens, 2017, p. 90). SUMP system also improves the relationship of cost and benefit between the different networks; it ''makes the most out of the existing road network and existing public networks transportation''; it improves the attractiveness of the city, the quality of life of people, since it motivates them to exercise by walking or cycling and protect them from accidents (Municipality of Athens, 2017).

The energy benefits form another aftereffect of SUMP system. It helps to reduce the energy consumption and GHG. It aims to make mobility gentle and not to increase the speed; ''to organize the input according to hours that will not adversely affect the quality of the road environment'' (Municipality of Athens, 2017, p. 91). Input will form one of the criteria for the positioning of various businesses and activities. SUMP system will be based on ''a public transportation pricing system and parking'' (Municipality of Athens, 2017, p. 91); it will promote sustainable transport solutions which do not need new infrastructure. Some of these solutions are the '' car sharing and car and van pooling'' (Municipality of Athens, 2017, p. 91). People with special needs are taken into account since, SUMP systems serves their access with interventions which are designed according to their needs. This systems ''leads a long-term strategy for the development of the city'' (Municipality of Athens, 2017, p. 91). Although, it includes also business planning which have direct priority, schedule and sources of funding (Municipality of Athens, 2017).

The municipality has already applied the first phase of the strategic plan which addresses to sustainable mobility. This will be specified by SUMP. In this plan ''is analyzed the importance of the city center and how the transformation with road reconstruction projects and with a different organization will meet social and technical goals'' (Municipality of Athens, 2017, p. 91). Main aims should be the shift to environmentally friendly cars, to protect delicate places from cars and limit speed. Also, the transport of pedestrians and

bicyclers will have priority in public spaces. The transportation will be served mainly by the mass transit (Municipality of Athens, 2017).

As a result, the cars will be less in the city center. This is misunderstood, since people think that their transport will be limited, which is wrong. SUMP aims to make transportation soft and pleasing. Cars will be changed by bicycles, walking and mass transit (Municipality of Athens, 2017).

The development of pedestrians areas, bike sharing, institutionalization of speed limits especially outside schools, parking control, ‘’abatement of the mobility of heavy transport, reinforcement of the bicycles network and green ring application’’ form some of the measures which are encompassed in the SUMP system (Municipality of Athens, 2017, p. 92). The last measure bans ‘’the circulation of old trucks and buses in Athens, aiming to improve the quality of the atmosphere’’ (Ministry of Environment and Energy, n.d).

These actions will aim to limit the use of cars by 25% and the increase of the public transport use by 20% compared to 2017; to motivate citizens to cycle and walk. In order to encourage Athenians to walk, parts of public areas will be redeveloped. The protection and saliency of the historic city center and the promotion of environmentally friendlier transport solutions such as the use of electric vehicles form also aims of the actions (Municipality of Athens, 2017).

Simultaneously with the actualization of SUMP measures, it is necessary to inform and sensitize citizens regarding ‘’the alternative ways of transport or measures which could lead to fuel saving and emissions reduction’’ (Municipality of Athens, 2017).

If the attribution of all the engines will be improved by 20% for the benzene engines and 10% for diesel engines, the energy saving will be 1.606.944 MWh per year and reduction of emissions will be 421.106 tCO2eqper year (Municipality of Athens, 2017)

From what was described above it is clear that Athens administration implemented measures which would bring environmental, energy but also economic benefits to the municipality. The replacement of diesel vehicles with ‘’vehicles of newer technology’’ helps in the reduction of GHG emissions and in the reduction of the fossil fuels consumption (Municipality of Athens, 2017, p. 86). Specifically, the administration chose to replace 20% of the fleet which run on diesel until 2030. Thus, the municipality will achieve bigger reduction of the GHG emission and 20% saving in fuels consumption. The promotion of eco driving measures will save 10% of fuel consumption (Municipality of Athens, 2017). The third

measure ‘’efficient use of the municipal fleet and fuels’’ also contribute in the saving of fuels consumption (Municipality of Athens, 2017, p. 88).

The fact that Athens administration implemented measures which bring environmental but also economic benefits should not be disregarded. When policies are framed the context (e.g financial status of the local society, history, geographical characteristics) of each community should play important role. The Greek financial crisis which began on 2009 affected the financial abilities of Greeks. This means that expensive actions like purchasing an electric car would be difficult for most of Greek people. Therefore, Athens administration chose to implement measures which Athenians could afford. The promotion of cycling, walking and public transportation as means of transport form characteristic examples of environmentally friendly and low cost measures at the same time.

The measures which were implemented in Athens are divided in three categories- technological, communicative and regulative measures. Technological measures are the measures which depend on technological developments and enable people to mobilize in environmentally friendly ways. The second category of measures depended on the communication which local administration developed between municipal authorities and citizens. Communicative measures aimed to motivate Athenians to adopt eco-friendly habits regarding their transportation. Regulative are the ones which Athenians have to follow, since these measures have the form of rules.

The technological measures which Athens administration implemented depended on purchasing new eco friendlier vehicles. Furthermore, they chose to manage the municipal fleet and its fuels in an environmentally friendlier way. The communicative measure they preferred, was to familiarise drivers with eco-driving. Lastly, the regulative measures focused both on the exploitation of the already existing means such as reduction of the mobility of heavy transport and promotion of cycling, but also on the construction of new infrastructure such as ‘’replenishment of access roads’’ to public transport stations and development of pedestrian areas (Municipality of Athens, 2017, p. 92). It is worth mentioning that the local government of Athens chose to introduce measures which the local community is able to adopt. Therefore, the measures are directly connected with the context of the society. The Greek financial crisis brought lots of changes in Greek status. This means that Athens administration had to introduce measures which Athenians could afford and adopt.

4.2 Air quality in London

This section focuses on the case of London. More specifically, the air status of the city, the characteristics of the London climate and the causes which create air pollution in the city are discussed. Arranged in the table below are the main attributes of the London climate and the factors which pollute city's atmosphere according to (Encyclopaedia Britannica, n.d), (Mayor of London, 2018, p. 44).

Table 5.London climate, air pollution and transportation

London climate	''equable climate… with mild winters and temperate summers''
Factors which created air pollution in London	1. Vehicles 2. buildings 3. construction 4. transboundary pollution

The ''first Clean Air Act'' which took place sixty years ago helped London to reduce ''the levels of benzene, lead and sulphur dioxide pollution''(Mayor of London, 2018, p. 40). Although, London still suffers from the pollutants of ''particulate matter (PM_5, PM_{10} and black carbon) and nitrogen dioxide (NO_2)''(Mayor of London, 2018, p. 41). More specifically, London failed to meet the standards of NO_2 and particulate matter(Mayor of London, 2018). ''Most of PM emissions'' in London come from ''road traffic'' and NO_x is caused by ''road transportation and heating systems'' (Mayor of London, 2018, p. 43).

The status of London's atmosphere is directly connected to ''the weather, local geography and emissions sources'' from within and outside the city (Mayor of London, 2018, p. 44). ''Vehicles, buildings, construction and other sources contribute significantly to the air pollution'' of the city (Mayor of London, 2018, p. 44). It is worth saying that transportation emissions form the biggest pollutant in London, since approximately half of the air pollution of the city comes from the domain of transportation (Mayor of London, n.d). A factor that makes the fight against air pollution more difficult is that the pollution is also transboundary. Sources outside the city cause approximately ''half (48 per cent) of the contribution to the estimated death risk from long term exposure to $PM_{2.5}$ in London as a whole'' (Mayor of London, 2018, p. 54). This forms the cause also for the most of the health consequences which are linked with ''short term exposure'' (Mayor of London, 2018, p. 54).

This situation creates health problems for Londoners of all ages. A characteristic example is that ''a baby born in 2010 and exposed to that same level of air quality for its entire life'' is expected to live approximately two years less (Mayor of London, 2018, p. 54). Furthermore, the air pollution in London on 2010 ''caused 3.000 hospital admissions''(Mayor of London, 2018, p. 54). The economic consequences of these health effects were'' estimated as being

up to 3.7 bn'' per year (Mayor of London, 2018, p. 54). Bad air quality is also an obstacle for the ''lung development'' of children (Mayor of London, 2018, p. 54). Although, there is ''emerging evidence'' that improving air quality will help to counteract these events (Mayor of London, 2018, p. 54).

4.2.1 Description of the climate action plan of London

At this phase the climate action plan of London will be described. Assorted in the table below are the duration of the plan and the accountable organizations according to (Mayor of London, 2018).

Table 6: Main points of the London plan

Duration of the climate action plan of London	2016-2050
Accountable organizations	Local administration of London in cooperation with the national government, environmental Organizations and London boroughs.

The Mayor of the city hasthe legal obligation to determine measures and plans ''in this strategy to achieve compliance with the legally required air quality standards''(Mayor of London, 2018, p. 58).Though, he has not all the resources to improve the air status of the city on its own. Thus, this climate plan includes actions for ''all the organizations'' which can help in the fight against air pollution. Therefore, the national government, ''London boroughs and Environmental Agency'' form parts of this strategy (Mayor of London, 2018, p. 58). ''The Mayor will help the boroughs'' to implement their legal obligations and whenever it is necessary he will guide them regarding how they will achieve their goals (Mayor of London, 2018, p. 58). In addition in order to support them he ''will operate the reformed London Local Air Quality Management (LLAQM) framework'' which determines the steps the boroughs should make (Mayor of London, 2018, p. 58).

The national government plays a very important role for the strategy for air quality. Government ''is required to have an Air Quality Plan'' which will achieve the improvement of air quality as soon as possible (Mayor of London, 2018, p. 58). Furthermore, the national government ''needs to give'' (Mayor of London, 2018, p. 58) more powers to the local administration of London. With these powers the local administration can help to discard the vehicles which pollute the atmosphere ''and use fiscal and other incentives'' to motivate citizens to use vehicles which are environmentally friendlier(Mayor of London, 2018, p. 58).Lastly, the public sector has to ''reduce emissions and exposure to pollution'', to sensitize and inform people regarding the issue of air pollution(Mayor of London, 2018, p. 58).

4.2.2 Aim of the climate action plan of London

London administration set a general aim but also individual aims for the domains which cause air pollution in their city. In this section the general aim and the aim for the domain of transportation are in focus according to (Mayor of London, 2018, pp. 40,110).

Table 7: Aims of the London plan

General aim	1. Make London the city with ''the best air quality.. by 2050'', 2. protect Londoner's health 3. and reduce inequalities
Aim for the domain of transportation	1. London's entire transport system to be zero emission by 2050

''The Mayor of London has some of the most ambitious plans to tackle against climate change''(Mayor of London, 2018). The aim of London administration is to make London the city with ''the best air quality..by 2050'', protecting Londoner's health and reducing inequalities(Mayor of London, 2018, p. 40).This aim will be achieved through the accomplishment of sub-aims. More specifically, London administration aims to protect Londoners by reducing their exposure to bad air quality especially in areas like schools. They aim to ''achieve legal compliance with UK and EU limits as quickly and effectively as possible'' (Mayor of London, 2018, p. 70). This will be achieved through the active participation of London boroughs, government and public. The main obligation to secure compliance with air quality standards ''rests with government'' (Mayor of London, 2018, p. 70). ''Control over fiscal incentives and the power to legislate'' form ways through which government could achieve compliance (Mayor of London, 2018, p. 70). Furthermore, they act to set ''tighter air quality targets for a cleaner London, meeting…WHO health-based guidelines'' (Mayor of London, 2018, p. 41).

The Mayor is dedicated to act for better air quality. Although, he concedes that pollution will be high for some years, because of the failure of older policies and past inertia. Furthermore, the administration of London cooperates with the national government in order to get enough funding and powers and fight this demanding problem (Mayor of London, 2018, p. 41).

Brexit formed a matter of concern for London administration. The Mayor of London expressed his worries regarding the consequences of the Brexit ''on the environment and on air pollution in particular''. In a report which referred to the effects of Brexit on the city of London, he called ''ministers to 'guarantee' that environmental regulations, monitoring and

enforcement standards will be strengthened in the aftermath of Brexit, rather than weakened'' (Mayor of London, 2017). The ''Secretary of State for the Environment, Food and Rural Affairs, Andrea Leadsom MP'' stated that ''only two-thirds of the EU environmental regulations would be directly brought in the UK law'' (Mayor of London, 2017). According to Katie Nield- a layer of Client Earth, there is a general part ''of EU legislation that sets air quality standards and legal limits for concentrations of air pollutant in the UK'' (Taylor J. , 2019).

''At the moment, these standards will stay in place immediately after Britain leaves the EU'' regardless UK leaves ''with or without a deal'' (Taylor J. , 2019). This happens because, despite the fact that the standards come from the legislation of EU ''they are now set in domestic law'' (Taylor J. , 2019). According to Nield, UK government ''will be bound to follow EU air quality standards in the immediate term'' (Taylor J. , 2019).

While Britain ''is still in EU the government's commitment to maintaining air quality standards in regulated by the European commission'' (Taylor J. , 2019). Nield said that ''European Commission'' began legal procedure ''against the UK government last year'', when the national government of UK alluded to ''European court for its failure to comply with air quality standards'' (Taylor J. , 2019). She added that it is a matter of concern how the UK government will manage the replacement of ''this regulatory body after Brexit'' (Taylor J. , 2019).

''The Office of Environmental Protection'' is the new body which will replace European Commission (Taylor J. , 2019). ''The independence and power of this body ''to enforce environmental laws after Brexit'' is questioned (Taylor J. , 2019).

Nield compared ''air quality standards to those set by the WHO'' and she stated that they are not sufficient to protect human health (Taylor J. , 2019). Also, she called the national government to commit ''to legislate for stricter air quality standards ''(Taylor J. , 2019). On the other hand, a spokesman from the Department for Environment, Food, Agriculture and Rural Affairs, said that the UK government is dedicated to act for air quality. That is why they created a £3.5 billion plan to achieve reduction of the emissions which come from transportation domain. He also said that their ''new Clean Air Strategy'' was characterized by WHO as an example which should be followed from countries all around the world (Taylor J. , 2019).

4.2.3Policy instruments of the climate action plan of London

At the present phase the policy instruments which the local authorities of London devoted are discussed. The instruments are divided into two categories- national policy instruments and local policy instruments. Arranged at the table below are the corresponding categories according to (Mayor of London, 2018).

Table 8: Policy instruments of the London plan

National Policy instruments	1. National Diffusion Tube Bias Adjustment Factor Spreadsheet
Local Policy instruments	1. The London Local Air Quality Management Framework (LLAQM) 2. Monitoring air pollution 3. Pollutant concentration maps 4. Diffusion tubes 5. Low-cost sensors (PM) 6. Clean air route finder 7. Electric vehicle charging points 8. Charging points for inhabitants

The London Local Air Quality Management Framework (LLAQM)

LLAQM is the statutory procedure through which the administration of the city has to check the ''air quality'' among its borders. It aims to define ''if the air quality objectives which were established within the Air Quality Regulations 2000 and the Air Quality (Amendment) Regulations 2010'' would be achieved in a particular territory (Mayor of London, 2018, p. 61). The system of London was part of a national framework which was managed by Defra[5]''Department for Environment Food & Rural Affairs''(GOV.UK, n.d). Although, in 2016 the Mayor introduced ''a bespoke system'' for London, the ''London Local Air Quality Management Framework''(Mayor of London, 2018, p. 61) , which was created to stimulate intensive working, in order to ''help address'' this important problem (Mayor of London, 2018, p. 61). This updated version of the LAQM (Local Air Quality Management) system would contribute to protect or increase the'' air quality resources'' (Mayor of London, 2018, p. 61).

Due to the fact that London faces challenges that other British cities do not face, the capital has different ''LAQM guidance'' from the other cities in the country (Mayor of London, 2018, p. 61). Thus the LLAQM prerequisites are the following:

- to keep on the monitoring and evaluating of ''air pollution'' in their territory

[5] Defra is ''the UK government department responsible for safeguarding '' the British ''natural environment... the food and farming industry'' of the country and to continue the agricultural economy of UK which is constantly growing(GOV.UK, n.d).

- to secure ‘’an Air Quality Management Area (AQMA)’’ is announced for the areas where ‘’air quality objectives and EU limit Values’’ are exceeding
- to make sure that an ‘’Air Quality Action Plan’’ is introduced in ‘’AQMAs’’. The plan needs to ‘’be updated every five years’’ at least. Also its progress has to be assessed every year.
- to ‘’complete the annual monitoring and Action Plan update reports’’ (Mayor of London, 2018, p. 61).

Monitoring air pollution

Sadiq Khan- the Mayor cooperates with ‘’King’s College London to improve the way he informs’’ Londoner (Mayor of London, n.d). His priority is citizens who are more exposed to bad air quality. The College will inform ‘’schools, care homes and GP’s surgeries..for incidents of ‘’moderate, high and very high pollution’’ (Mayor of London, n.d). Furthermore, ‘’low cost monitoring systems’’ which citizens can buy give the opportunity to residents and vulnerable groups to participate in the fight against air pollution (Mayor of London, n.d). These systems form useful tools which provide helpful information when the people know how to use them.

‘’Hundreds of lower tech measurement are also made using diffusion tubes’’ (Mayor of London, 2018, p. 6). Most of the funds for these monitors come from London boroughs ‘’as part of LLAQM framework’’ (Mayor of London, 2018, p. 6). ‘’Most boroughs have at least one or two’’ stations which monitor on a continuous basis (Mayor of London, 2018, p. 6). The place where these monitors will be installed is very important. The most significant thing to consider in places like the British capital is ‘’the how near monitors are to’’ the sources of emissions (Mayor of London, 2018, p. 8). In London pollution is bigger ‘’near busy roads’’, thus ‘’most monitoring sites are categorized as kerbside, roadside or urban background’’ (Mayor of London, 2018, p. 8).

Pollutant concentration maps

For those who wish to install their own monitoring system, the Mayor created ‘’pollutant concentration maps’’ of London ‘’within the London Atmospheric Emissions Inventory (LAEI)’’(Mayor of London, 2018, p. 10). These maps and the ‘’local knowledge’’ help people to find the places with bad air quality (Mayor of London, 2018, p. 10). It is worth-saying that alterations in the air quality are difficult to be detected ‘’even with the most accurate monitors’’ (Mayor of London, 2018, p. 14). This happens because of the fact that pollution

depends on factors which people cannot manage such as weather(Mayor of London, 2018, p. 14).

Diffusion tubes

These devices are small plastic test tubes which include a substance that ''reacts with NO_2 in the air'' (Mayor of London, 2018, p. 15). Councils use these tubes to complete the data which are automatically monitored. Their cost is low and they are efficient when someone wants to measure NO_2. They are already set up by laboratories where they should be returned in order to be analyzed. Their cheap price gives the ability to install tubes and measure NO_2 in different places in the same territory. Tubes can measure from 2 to 4 weeks (Mayor of London, 2018).

Tubes have limitations. Specifically ''they can report large over or underestimates'' (Mayor of London, 2018, p. 17). This is what they call bias. This bias needs to be identified and the results need to be ''adjusted accordingly'' before the findings are included in the report (Mayor of London, 2018, p. 17).

National Diffusion Tube Bias Adjustment Factor Spreadsheet

This spreadsheet gives the solution to the contingency of bias. Specifically, the bias can be identified through the comparison with studies which examine the same issue. These studies are gathered in the ''National Diffusion Tube Bias Adjustment Factor Spreadsheet'' which include ''adjustment factors calculated from diffusion tube studies'' (Mayor of London, 2018, p. 17). The results should be compared to the limit of 40μg m-3, which is set by EU and it forms ''the legal limit for annual average NO_2 concentrations'' (Mayor of London, 2018, p. 17).

Low- Cost Sensors (PM)

Sensors can measure various pollutants such as NO_2, PM, O_3 and CO. They ''give readings in near real time and do not need to go to a laboratory'' (Mayor of London, 2018, p. 18). ''Some sensors..send the results via wi-fi to a smartphone app'' and others ''require you to download results after the measurement study''(Mayor of London, 2018, p. 18). It is worth mentioning that not all sensors are trustworthy and that some sensors can measure some pollutants when they cannot measure others(Mayor of London, 2018).

Clean Air Route Finder

The mayor has funded the ''Cleaner Air Better Business (CABB) project'' which created ''an interactive map'' that informs the citizens for routes with low pollution (Mayor of London, n.d). Users put in the route and the application shows them ''a low pollution

walking option'' (Mayor of London, n.d). ''CABB ..has created a tool which enables all of the project's Business Improvement District partners to place'' this map on their web-pages (Mayor of London, n.d).

Electric vehicle charging points

Sadiq Khan- introduced ''the infrastructure for electric vehicles (EVs)'' in the city (Mayor of London, n.d). This will ease the change ''from diesel to electric vehicles'' for Londoners (Mayor of London, n.d). This tool will contribute to clean the London air in order to become ''a zero carbon city'' with zero emissions from the domain of transportation ''by2050'' (Mayor of London, n.d).

The charging points will allow citizens and professionals like ''taxi drivers'' to charge their vehicle quickly (Mayor of London, n.d). In contrast with the classic ''charge points'' which might take up to 8 hours to charge the vehicle completely, these ''rapid charge points'' reduce the charging time to ''20-30 minutes'' (Mayor of London, n.d).

In less than 2 years the Transport for London (TfL)''have installed 180 rapid charge points'', Thus the network of the city reached the ''200 rapid charge points'' with the contribution of some partners from the private domain (Mayor of London, n.d). Although, most of the charge points ''are on land or roads managed by'' TfL (Mayor of London, n.d). In order to motivate citizens and professionals to take EVs a big enlargement of these charging points is needed (Mayor of London, n.d). To achieve this goal it needs cooperation between the municipality,'' boroughs and private sector'' (Mayor of London, n.d).

Charging points for inhabitants

Regarding the'' charging points for residents'', Sadiq Khan cooperates with the Councils of London to set up ''standard charge points'' on London streets and modernized lamps which will enable citizens ''who cannot charge their EVs at their home'' to access charging points (Mayor of London, n.d). Also, 25 boroughs stated that they are interested to contribute to this initiative and gave '' £4.5 funding'' (Mayor of London, n.d).

4.2.4 Measures of the climate action plan of London

This section focuses of the measures which the local authorities of London applied. They are divided in three groups- municipality fleet measures, private transportation measures and other measures in accordance with the domain they referred. The third category is consisted of various actions. Arranged at the table below are the corresponding categories according to (Mayor of London, 2018, pp. 65,66,67,68,77,78,83,97,101,102,113,116).

Table 9: Measures of the London plan

Municipality fleet measures	**Reg.**	1. '' phasing out fossil fuelled vehicles and prioritising action on diesel''
	Tech	1. ''electric or hydrogen'' single decks by 2020 2. from 2020 until 2025 TfL will use buses which are hybrid and have Euro VI technology 3. 80% of double decks in central London will be electric or hybrid by 2035. 4. 50% of single decks will be electric or hybrid by 2025 in inner and outer London 5. 90% of single decks buses will be electric or hydrogen by 2030 6. All ''single decks buses'' in inner or outer London will be ''electric or hydrogen'' by 2035 7. Double decks in inner and outer London will meet ''Euro VI stadards'' by 2020 8. ''more than 85% of double decks'' will be ''hybrid, electric or hydrogen'' by 2025 in inner and outer London 9. ''60 % of double decks'' will be ''hybrid by 2030 and 40 % will be electric or hydrogen'' by 2030 in inner and outer London 10. By 2035 20% of double decks will be hybrid and 80% will be ''electric or hydrogen'' 11. ''all cars in GLA group support fleets being zero emission… by 2025'' 12. ''all new cars and vans in GLA group fleets'' and response vehicles to be zero emission from 2025 13. ''all heavy vehicles…in GLA'' to be ''fossil fuel-free from 2030'' 14. ''the GLA group fleet'' to be ''zero emission'' by 2050
Private transportation measures	**Com.**	1. ''pan- London alert system'' 2. ''Mayor's School Audit program'' 3. Promotion of eco-driving 4. Motivation to supply and increase ''the take up of low emission vehicles through regulatory, procurement and pricing incentives'' 5. ''National car labeling scheme''
	Tech	1. ''Creation and conservation of LAEI'' 2. Upgrading of all the ''newly licensed taxis'' to be zero emission capable'' 3. Introduction of the ''Cleaner vehicle checker'' 4. ''Deployment of the ultra low emission auxillary power units in vehicles'' 5. Upgrade of the ''black taxis to zero emission capable'' by 2025
	Reg.	1. ''reduction in total vehicle kilometers'' 2. ''All new private hire vehicles'' ''to meet continually improving minimum emission standards''
Other measures	**Tech.**	1. ''personal and localized monitoring by London boroughs'' 2. monitoring and check the levels of pollution by boroughs
	Com	1. The promotion of cycling, walking and use of public transport 2. ''national communication infrastructure''

	Reg	1. ''local zero emission zones'' 2. Extension of the ULEZ

According to the environmental strategy of London, citizen's health forms a priority for ''Mayor's efforts to improve air quality'' (Mayor of London, 2018, p. 64). Thus, he wants to ensure'' that Londoners and especially those in places where the air pollution is higher, are able ''to reduce their exposure'' in bad air quality (Mayor of London, 2018, p. 65). Therefore, when pollution if high or very high, information regarding the quality of air will be available, in order to help citizen's protect their health. This will be achieved through the improved ''pan-London alerts system'' which will inform the organizations and give advices (Mayor of London, 2018, p. 65). This way it is insured that, ''decision makers have information'' regarding the air pollution and ''evidence-based advice on how to respond'' (Mayor of London, 2018, p. 65).

London experiences ''episodes of high pollution…a few times'' during the year (Mayor of London, 2018, p. 65). ''Very high pollution'' events are even more infrequent (Mayor of London, 2018, p. 65). In these situation is vital for citizens to have the necessary information in order to act and protect their health. For this reason, ''real time alerts'' will be provided when ''high or very high pollution episodes'' happen (Mayor of London, 2018, p. 65). The ''broadcasting information'' will be provided in bus stops, metro stations ''and on roadside signs'' (Mayor of London, 2018, p. 65). In addition to this communicative action, the Mayor will try to ''engage with under-reached groups such as older people'' (Mayor of London, 2018, p. 65). He will cooperate with government to secure that the city of London has all the necessary means to apply ''emergency measures; for example ''limited road closures, vehicle restrictions, or restrictions on the use of fossil fuels'' when ''high pollution'' events occur (Mayor of London, 2018, p. 65).

The second measure refers to the protection of younger Londoner's and ''disadvantaged people'' (Mayor of London, 2018, p. 66). These groups include ''schools, nurseries, other educational establishments, care homes and hospitals'' (Mayor of London, 2018, p. 66). Sadiq Khan claimed that he will motivate the boroughs of London to use their funding through TfL (Transportation for London) for ''Local Implementation Plans'' to reduce air pollution and, exposure ''around schools on journeys to and from school'' (Mayor of London,

2018, p. 66). To achieve this, the ''Mayor's School Audit program is created at 50 schools'' of the city (Mayor of London, 2018, p. 66). These schools are located in areas where pollution is higher. This program will help boroughs to identify the actions they will take to ''reduce exposure and emissions'' (Mayor of London, 2018, p. 67). Furthermore, the use of ''the audit concept'' will be promoted to health administrations, other educational institutions, ''boroughs..and sensitive sites'' like '' care homes and hospitals'' (Mayor of London, 2018, p. 67). For more actions for the unprivileged, financing for big ''air quality programs'' will need plans to describe how the actions will protect those who are exposed to bad air quality or how they will help territories with high pollution (Mayor of London, 2018, p. 67).

The third measure refers to the sources of air pollution. To fight air pollution it is helpful to identify the sources it comes from. Therefore the administration of the city ''will produce and maintain the LAEI'' (Mayor of London, 2018, p. 68). This will enable citizens to understand which are the sources of pollution and how they are connected to present and future pollution. LAEI will help to determine the consequences of air pollution on Londoner's health, ''exposure and health inequalities'' (Mayor of London, 2018, p. 68).

According to the fourth measure Sadiq Khan will cooperate with London boroughs to secure the current network which keep record of the air quality and improve it by making advantage of **''**new technologies and approaches such as personal and localized monitoring'' (Mayor of London, 2018, p. 68). Boroughs has keep record and report on the ''local air quality'' (Mayor of London, 2018, p. 68). They will achieve that using the ''LLAQM framework'' (Mayor of London, 2018, p. 68). ''The GLA, TfL, and London boroughs fund and maintain'' one of the most ''extensive automatic monitoring networks'' of any city around the world (Mayor of London, 2018, p. 68). Furthermore, it is ''supplemented with additional monitoring'' (Mayor of London, 2018, p. 68). This precise monitoring help to confirm the overall ''pollution modelling'' which the Mayor makes available via LAEI (Mayor of London, 2018, p. 68). The London administration will supervise this network and will insure that the locations which help to understand the long-range trends or calculate the effect of local policies ''are not removed or moved'' (Mayor of London, 2018, p. 68).

The fifth measure refers to the reduction of the emissions ''by phasing out fossil fuelled vehicles, prioritising action on diesel and enabling Londoners to switch'' to ways of transport which environmentally friendlier such as cycling, walking and use of the public transport(Mayor of London, 2018, p. 71). This reduction in use of private cars will lead citizens of London to a healthier way of living. Days free of cars in London will give citizens

the opportunity to experience their city ''from a different perspective'' and improve the air quality they breathe (Mayor of London, 2018, p. 71).

In order to make transportation in London more sustainable the bus fleet will be cleaned ''phasing out fossil fuels, prioritizing action on diesel, and switching to zero emission technologies'' (Mayor of London, 2018, p. 75). Good services for buses are important to increase the use of public transport and decrease the use of private cars by Londoners. Although, it is significant that citizens will have access to a clean bus fleet. Thus, the Mayor of the city introduced that for the central London TfL will have only ''electric or hydrogen'' single decks by 2020 and from 2020 until 2025 TfL will buy double decks buses which are hybrid and have Euro VI technology (Mayor of London, 2018, p. 77). Furthermore, in the center of the city 80% of double decks will be ''electric or hybrid'' by 2035 (Mayor of London, 2018, p. 77). In inner and outer London, 50% of single decks will be ''electric or hybrid'' by 2025 and by 2030 90 % of single decks buses will be hybrid or electric (Mayor of London, 2018, p. 77). By 2035 all ''single decks'' buses which are moving in inner and outer London will be ''electric or hydrogen'' (Mayor of London, 2018, p. 77). Regarding the double decks in the same territory, they will meet the ''Euro VI standards'' by 2020 (Mayor of London, 2018, p. 77). By 2025 ''more that 85% of double decks'' in inner and outer London will be ''hybrid electric or hydrogen'' (Mayor of London, 2018, p. 77). By 2030 ''60 % of double decks in inner and outer London will be hybrid and 40% will be electric or hydrogen'' (Mayor of London, 2018, p. 77). By 2035 20% of double decks will be hybrid and 80% will be ''electric or hydrogen'' (Mayor of London, 2018, p. 77). By 2037 all TfL buses will be electric or hydrogen; which means that the whole bus fleet of London ''will be fully zero emission by 2037 the latest'' (Mayor of London, 2018, p. 76).

Taxis are also part of the administrative efforts of London against transportation emissions. According to the climate strategy of London, the administration of the city wants to make taxis in London the greenest ''taxi fleet… in the world'' (Mayor of London, 2018, p. 78). In order to eliminate diesel, ''all newly licensed taxis'' have been required to be zero emission capable'' from 2018(Mayor of London, 2018, p. 78). The London administration will also create ''financial incentives, infrastructure and regulation'' (such as ''taxi age limit at 15 years)(Mayor of London, 2018, p. 78). ''All new private hire vehicles'' have ''to meet continually improving minimum emission standards'' (Mayor of London, 2018, p. 78). These measures will lead to a completely ''zero emission capable taxi and private-hire fleet by 2033'' (Mayor of London, 2018, p. 78).

The next measure introduced the acceleration of the uptake of environmentally friendlier vehicles in the city by speeding up and extending the ULEZ. The Mayor has not the right to prohibit the use of diesel or other vehicles in the city. Although, he has the ability to implement charges to vehicles at specific locations of London ''including addressing congestion and emissions'' (Mayor of London, 2018, p. 78). Sadiq Khan will check the charging measures (''Congestion Charge, Low Emission Zone, ULEZ and the Silvertown Tunnel schemes'') to secure that they contribute to the efforts of the Mayor's transport strategy'' (Mayor of London, 2018, p. 78). The Mayor introduced also a ''Cleaner Vehicle Checker'' which help citizens understand the impact of their vehicle's emissions (Mayor of London, 2018, p. 78).

London administration motivates ''the supply and increasing the take up of low emission vehicles through regulatory, procurement and pricing incentives'' (Mayor of London, 2018, p. 83). The local administration promotes the good use of vehicles by creating a ''strategic consolidation'' and allocation network ''to protect industrial land'' and eliminate the effects of ''freight and servicing trips in the city of London (Mayor of London, 2018, p. 83). Furthermore, the use and development of the city's collection points is motivated. These collection points are placed on locations which are closed to citizen's homes such as in ''local shops'' (Mayor of London, 2018, p. 83). London's administration works to find other ways ''in which freight can be delivered and moved around'' (e.g''motorbikes for shorter… deliveries'' in the center of the city)(Mayor of London, 2018, p. 83). Additionally, the administration claimed that they will cooperate with the ''business community'' of the city and the ''public sector organizations'' to examine ''the timing of their deliveries and to use their procurement power'' to eliminate ''trips at the times of the day that when they have the greatest adverse impact'' on the citizens and the streets of London (Mayor of London, 2018, p. 83).

Sadiq Khan claimed also that they will act together with stakeholders to comprehend ''the barriers to deploying ultra low emission auxiliary power units on vehicles'' and motivate take up in London (Mayor of London, 2018, p. 83). ''Secondary engines, or auxiliary power units, are used on some vehicles to keep food deliveries ''cool or frozen''(Mayor of London, 2018, p. 83). Despite their small size these vehicles '' run on red diesel'' and ''are regulated to a lower standard than the main vehicle engine'' (Mayor of London, 2018, p. 83). There are alternatives with low emissions ''but they are not widely used'' (Mayor of London, 2018, p. 85).

Mayor suggested will also work ‘’with government, the boroughs, bus and coach operators, manufacturers, and other organizations’’ to tackle the emissions which come from ‘’unnecessary engine idling throughout London’’ (Mayor of London, 2018, p. 86). ‘’Parked buses, coaches… taxis’’ and locations like schools, transport interchanges, major tourist attractions… logistics companies’’ form the focus of this action (Mayor of London, 2018, p. 86).

The administration will use the LLAQM framework to help boroughs and ‘’require them to exercise their statutory’’ powers and duties to make air quality in London better according to the LLAQM framework (Mayor of London, 2018, p. 97). Boroughs have to monitor and check the levels of pollution. ‘’Under Defra statutory guidance’’ boroughs have to take part in the ‘’LAQM framework… and have regard to Mayoral guidance’’ (Mayor of London, 2018, p. 97). When pollution is big they have to ‘’ declare an air Quality Management area and implement an action plan explaining how they will act to tackle pollution(Mayor of London, 2018, p. 97).

The work of boroughs will be recognized by the award of ‘’Cleaner Air borough status’’ which the Mayor will give to ‘’high achieving boroughs’’ (Mayor of London, 2018, p. 100). According to the climate action plan of the city, Sadiq Khan will also support London boroughs and the businesses of the city to apply local actions through the ‘’ Mayor’s Air Quality Fund, including at least five borough Low Emission Neighbourhoods and five business Low Emission Neighbourhoods’’ (Mayor of London, 2018, p. 100).

Cooperation on national level is also needed. The Mayor will work with the national government because the latter has the appropriate tools to act for better air quality. Specifically, the government is able to ‘’promote legislation’’, change financial incentives, ‘’raise revenue and take national action’’ (Mayor of London, 2018, p. 100). The following measures would contribute to achieve compliance with the EU and UK standards (Mayor of London, 2018, p. 100).

Thus, Sadiq Khan ‘’calls on’’ the national government to introduce a new ‘’Clean Air Act’’ for the current century to establish Londoner’s right to clean air, ‘’a national retrofit certification scheme’’ to eliminate the ‘’compliance costs’’ of businesses (Mayor of London, 2018, p. 101). Also, the government is called to create’’ a retrofit fund for HGVs buses, coaches’’ and other vehicles and a ‘’national vehicle scrappage fund’’ which is necessary ‘’if compliance costs to people and businesses of such action is to be minimized’’ (Mayor of London, 2018, p. 101). This is needed because the government ‘’has encouraged dieselization’’ in the past which means that citizens bought

these vehicles ‘’in good faith’’ (Mayor of London, 2018, p. 101). It is also necessary to excise ‘’vehicle duty and capital allowances ’’to encourage the use of vehicles which are environmentally friendlier (Mayor of London, 2018, p. 101).

Additionally, ‘’a fiscal reformation should be complemented by a national car labeling scheme’’ to inform citizens regarding emissions from transportation domain ‘’at the time of purchase’’ (Mayor of London, 2018, p. 101). ‘’More electric vehicles and charging infrastructure needs to be unlocked by providing additional power’’ for the local administration (Mayor of London, 2018, p. 101). This will address ‘’structural powers’’, network of barriers and will provide funding ‘’through the office for Law emission vehicles’’ (Mayor of London, 2018, p. 101). A commitment is necessary to provide the funding to convert the taxi fleet of the city from ‘’black taxis to zero emission capable’’ by 2025 and discard the older taxis (Mayor of London, 2018, p. 101). The form of ‘’vehicle excise duty vehicle’’ should not make it difficult to the taxi drivers to swift to zero emissions taxis (Mayor of London, 2018, p. 101). Lastly, deterring the illegal removal of ‘’diesel particulate filters’’ through improved ‘’MOT testing and spot checks’’ (Mayor of London, 2018, p. 101). London‘s local administration calls for government funding because the £475 million are not enough to support the actions against transportation emissions since the problem is too challenging. Powers are needed ‘’to manage traffic’’ ‘’during high and very high pollution episodes’’, when specific vehicles need to be excluded and when it is necessary to set emission standards’’ (Mayor of London, 2018, p. 102).

Government has also the duty to provide information to the public ‘’during air pollution episodes’’ through the cooperation with media and through the implementation of ‘’national communication infrastructure’’ (Mayor of London, 2018, p. 102). London administration need the government’s permission ‘’to plan policy to take precedence over national planning policy’’ (Mayor of London, 2018, p. 102). The Mayor, London boroughs or the Environment Agency need to have efficient ‘’powers to control emissions from existing combustion plant have an ongoing impact on air quality’’ (Mayor of London, 2018, p. 102). It is also important to ensure that the Mayor has the statutory power to issue LAQM guidance to borough authorities under the ‘’Environmental Act of 1995’’ (Mayor of London, 2018, p. 102).

The national government is called also to help London boroughs to apply ‘’anti-idling measures’’ on the streets of the city by creating ‘’legislation fit for purpose and universally applicable’’ and to revise the ‘’current policy advice that parking charges should not be

linked to emissions'' (Mayor of London, 2018, p. 102). Local administration needed new powers to control emissions from Non Road Mobile Machinery (NRMM). This incorporates ''enforcement powers'' to ensure enhanced NRMM rules and for ''auxiliary power and refrigeration units on vehicles and trailers'' (Mayor of London, 2018, p. 102).

The Mayor of London will also cooperate with ''European institutions, European cities and city networks'' (Mayor of London, 2018, p. 104). This cooperation aims to minimize the impact of transboundary air pollution in the city of London, to secure ''strong source control measures and regulations are adopted at EU level'' (Mayor of London, 2018, p. 104). Due to the fact that, the air pollution in London is made outside of the city, it is challenging to improve London air (Mayor of London, 2018, p. 104). ''Sharing of the best practice and coordinated action'' is needed to improve the air of London (Mayor of London, 2018, p. 102).

Sadiq Khan claimed that he is committed to act in order to meet the WHO guidelines by 2030. That is why he joined ''the BreatheLife consortium, led by the WHO and Unites Nations Environment Programme'' (Mayor of London, 2018, p. 107). Through this cooperation London will work with various cities and countries to improve the technologies and ''tackle the transbountary contribution'' to secure that London meets WHO guidelines (Mayor of London, 2018, p. 107). The Mayor also will motivate ''the take up of ultra low and zero emission technologies'' to ensure that capital's transportation system is ''zero emission by 2050'' (Mayor of London, 2018, p. 107). This would contribute to eliminate air pollution and meet WHO guidelines. London administration, through TfL will cooperate with stakeholders to create and apply a plan that motivates the shift from diesel to zero emission vehicles. This will beachieved through ''financial incentives, the necessary infrastructure and regulation with the objective of achieving a minimum of 9,000 such vehicles in the fleet by 2020''(Mayor of London, 2018, pp. 107-109).

London administration will cooperate with various partners to reduce emissions ''from fleet vehicles in the GLA group, the London boroughs and the wider public sector by switching to zero emission capable vehicles'' (Mayor of London, 2018, p. 109). The GLA group has a significant role in illustrating ''the viability of technologies'' on a wider scale and affect the market (Mayor of London, 2018, p. 109). A characteristic example is that the'' London Fire Brigade has an electric support car fleet'' (Mayor of London, 2018, p. 109). In addition it has the ''ultra low emission cars to attend emergency incidents'' and other brigade business across the capital'' (Mayor of London, 2018, p. 109).

The cooperation of London administration with ''the Metropolitan Police Service and the London Fire Brigade'' aims to achieve ''compliance with the ULEZ and work towards'':

- ''all cars in GLA group support fleets being zero emission… by 2025''
- ''all new cars and vans in GLA group fleets'' and response vehicles to be zero emission from 2025
- ''all heavy vehicles…in GLA'' to be ''fossil fuel-free from 2030''
- ''the GLA group fleet'' to be ''zero emission'' by 2050

(Mayor of London, 2018, p. 109).

The public sector, ''London boroughs and the NHS will also be expected to lead by example and adopt similar dates'' (Mayor of London, 2018, p. 109). The Mayor will cooperate with TfL, the national government and various stakeholders to secure that systems are ''upgraded and robust'' (Mayor of London, 2018, p. 112). They will create plans to ''manage the energy demand'' which is related ''to the transition to ULEVs'' (Mayor of London, 2018, p. 112). Technology gives opportunities to ''use electric vehicles for energy storage'' and as mean to enhance the endurance of the grid (Mayor of London, 2018, p. 112). ''This will help London's energy system accommodate and manage the increased demand'' which is linked to this transition (Mayor of London, 2018, p. 110). To make it easier, UK government ''must invest to ensure the grid and energy network and available charging infrastructure is capable of hosting large number of electric vehicles'' (Mayor of London, 2018, p. 112). Strong planning rules on national level would make stronger the ''local requirements for infrastructure in new developments'' (Mayor of London, 2018, p. 112). This makes electric vehicles a useful choice for Londoners and enterprises (Mayor of London, 2018, p. 112). To proceed ''hydrogen alternatives to existing internal combustion engine vehicles'' London administration worked together with industry, people from the academic field ''and other stakeholders through the Hydrogen London Partnership'' (Mayor of London, 2018, p. 112). This has showed ''transport… and non transport applications of the technology'' through various projects (Mayor of London, 2018, p. 112). The ''Metropolitan Police's emergency response fleet'' acquired eleven vehicles which run on hydrogen, illustrating the important role which ''hydrogen fuels'' play (Mayor of London, 2018, p. 112). Sadiq Khan will try to incorporate ''hydrogen alongside electric technology into zero emission and alternative fuels plans for London'' (Mayor of London, 2018, p. 112).

Another measure is the implementation of ''local zero emission zones'' (Mayor of London, 2018, p. 113). In the light of the climate strategy of London, ''the Mayor through TfL

and boroughs and working with the government'' will apply ''local zero emission zones in the town centers from 2020'' and intend ''to deliver a central London zero emission zone from 2025(Mayor of London, 2018, p. 113). They also aim to implement wider ''congestion reduction measures to pave the way for larger zero emission zones in inner London by 2040 and then London-wide by 2050 the latest'' (Mayor of London, 2018, p. 113). In addition, incentives and supporting infrastructure are needed to motivate the shift to Ultra Low Emission Vehicles (ULEVs). Disincentives are also needed eliminate the use of vehicles which run on fossil fuel (Mayor of London, 2018, p. 113). This plan, ''including the vehicles and area it applies to, charge levels and hours of operation… discounts and exceptions or other restrictions is not developed yet. It will be developed in the very next years. Regarding schemes there will be consultation before they are introduced in London (Mayor of London, 2018, p. 113).

Cooperation between the Mayor, industry and other partners aimed to find solutions to eliminate emissions which come ''from tyre and brake wear'' (Mayor of London, 2018, p. 116). It is estimated that by 2030 ''90 per cent of PM emissions from road transport'' will come ''from tyre and brake wear'' (Mayor of London, 2018, p. 116). ''If PM2.5 levels are to be improved', it is necessary to be significantly reduced'' (Mayor of London, 2018, p. 116).The first step to take in order to achieve this, is the ''reduction in total vehicle kilometers''. A shift from driving ''to walking, cycling, public transport and more efficient delivery and servicing'' will lead to the reduction of total vehicle kilometers'' (Mayor of London, 2018, p. 116). The promotion of eco-driving will also be helpful. '' New technologies, including the use of properly designed regenerative braking'', are able to contribute in the reduction of emissions (Mayor of London, 2018, p. 116).The Mayor in cooperation with the UK government, ''manufacturers and other partners will support and accelerate research into the development and uptake of technologies to tackle tyre and brake wear'' (Mayor of London, 2018, p. 116). This incorporates rejuvenating ''braking and providing advice on more efficient driving'' (Mayor of London, 2018, p. 116).

The measures of London were divided in the same categories with Athens measures-technological, regulative and communicative measures. The technological measures depended on new technologies which enable Londoners to monitor the air quality of their territory, to use vehicles which are friendly to the environment, to upgrade the vehicles which they already have and to check if their vehicles pollute the atmosphere. London regulative measures depend on the enforcement of rules which Londoners have to follow to

improve the air quality. These measures aimed to improve the air of specific territories, to make Londoners prefer vehicles which are eco-friendly in their new purchases, to eliminate the use of vehicles which run on fossil fuels and to prioritize ''action on diesel''. Lastly the communicative measures aimed to inform citizens ''during high or very high pollution episodes'', to protect children who are vulnerable to air pollution, to develop channels of communication in Britain media so citizens are constantly informed regarding the air quality in their city, to familiarize them with eco-driving (Mayor of London, 2018, pp. 66,78). Additionally, the communicative measures sought to motivate Londoners to use alternative means of transportation such as public transport, cycling and walking instead of their cars, to motivate the purchasing of eco friendly vehicles and to inform them in regard to the ''differential pollution emissions form vehicles at the time of purchase''(including used vehicles) (Mayor of London, 2018, p. 101).

It is worth mentioning that the context of the city played again an important role, as in Athens case. London administration introduced measures that depended on the newest technologies (e.g electric cars, charging infrastructure for electric vehicles). These measures required financial resources for the municipality and a good financial status for the citizens who would purchase these vehicles. This means that the local government introduced measures which the local community was able to adopt-since Britain does not deal with a financial crisis, in contrast with Greece. Furthermore, London administration created a strategy in which organizations, educational institutes, London boroughs and citizens could participate (Mayor of London, 2018). This means that the actions against transportation emissions were a common goal for the city of London.

4.3 : The comparison

In this chapter, a comparison of the Athens and London strategies will be discussed. In order to answer the last research question- regarding the similarities and differences between the two action plans, the theory of Borras and Edler was used. The comparison starts with the context of the two cities and the policy instruments each local government allocated to achieve its aim. Hereupon the measures of the action plans and the actors who participated in the efforts against transportation emissions will be compared.

Context and instruments of the two cases

The first pillar of the theory helped to compare the contexts of the two cities and the instruments which Athens and London administrations allocated to deal with transportation emissions. As priori mentioned, the context of each city is directly connected with the action

plans each administration chose to apply. The Greek economic crisis which started on 2009 affected both public and private domain. Due to the fact that Greece was not able to take funds from the ''financial markets, the Greek government made an official request'' for help to Eurozone (Katsikas, 2014, p. 5). The member states of Eurozone accepted the request and the help came in the form of memorandum (Katsikas, 2014). The memorandum aimed at the reduction of the Greek public debt and the creation of a framework which would provide ''stability and growth'' to the Greek economy (Kouretas G.P., 2010).The memorandum were supervised by Troika which is constituted from the European Commission, the International Monetary Fund(IMF) and the European Central Bank (ECB) (Katsikas, 2014). The austerity measures which were introduced by the memorandum exhausted Greek resources and led to bigger recession (Kouretas G.P., 2010). The inability of the national banking system to provide liquidity to the market led the national government to borrow again from Troika (Kouretas G.P., 2010). The new memorandum which was signed led to the decrease of the Greek public debt but it also led the Greek people to poverty and disorder of the social cohesion(Kouretas G.P., 2010). National resources were appreciably decreased. The financial status of Greek people changed completely. This change is also reflected in the climate action plan of Athens. More specifically, it is reflected in the aim of the climate action plan of the city. Despite the aim of the plan to improve the air quality of Athens, the local administration aimed to save resources (fuels, energy) and to open new job positions for Greek people (Municipality of Athens, 2017).

Examining the four instruments of the Athens plan and TREMOVE model it is worth to mention that three of them (GPC-Scale GHG emissions, GHG emissions inventory, ''standard emission factors'') depend on international guidelines such as the IPCC and GPC. The fourth instrument (TREMOVE model) is also based on the model which was developed in the University of Leuven (Municipality of Athens, 2017). This attitude of the local administration to prefer international initiatives shows that the creation of environmental actions on local level might not be a usual event. Furthermore, the instruments depend on guidelines for the inventory and directives for the calculation of GHG emissions. None of these instruments was based on technological developments like the Low- Cost Sensors for PM or clean air route finder, which form examples of London instruments (Mayor of London, 2018, pp. 18,80).

On the other hand, London administration has nine instruments. One of them is national and eight of them are local. London seems to follow a different tactic- compared to Athens

preferring national and local instruments such as the National diffusion tube bias or the London Local Air quality management framework (LLAQM). Furthermore, London administration depended on technology for its efforts against air pollution. More specifically, local authorities deployed technological developments, which contribute in the reduction of transportation emissions. Such instruments form the diffusion tubes, the low cost sensors for PM, the infrastructure for electric vehicle charging points (Mayor of London, 2018). The ability of London administration to prefer such technologic developments might be connected with the financial status of the municipality which had the economic ability to invest money for the implementation of their environmental strategy. The opposite happens with Athens case where the financial crisis did not enable the local authorities to invest money on their climate action plan, since the municipality did not have enough resources.

Measures of the two cases

The comparison between the measures of Athens and London was based on the second and third pillar of the Borras and Edler theory. The second pillar reflects the measures of the local authorities, which aim to motivate citizens to act against transportation emissions (Borras, 2014). ''The third pillar refers to the popular views and support of the socio-technical system (or lack thereof)'' (Borras, 2014, p. 24). In other words the third pillar is connected to the actors who cooperate to regulate the issue with the support of the local environment.

The measures in Athens are divided into two categories. The first one is the measures which referred to the municipality fleet and its fuels consumption and the second category referred to private transportation. Athens administration implemented thirteen measures in total. Three of them referred to municipality fleet and ten of them referred to private transportation. In contrast to Athens, London implemented thirty-three measures. Fifteen of them referred to the municipality fleet, twelve of them were connected to private transportation and six of them appertain to a general category which is consisted of various measures.

Another difference between the two action plans forms the character of the measures. The local administration in Athens implemented two technological measures, one communicative and ten regulative measures. Through the technological measures which were applied on the municipality fleet, the local authorities of Athens aimed to achieve reduction in GHG emissions and in fuels consumption. The communicative measures which were applied in Athens aimed to inform and sensitize all drivers regarding the benefits of

eco-driving and motivate them to adopt habits that make their transport friendlier to the environment. The regulative measures motivated Athenians to adopt eco-friendly habits and respect more the environment they live in. Characteristic examples of the regulative measures formed the institutionalization of speed limits and the abatement of the mobility of heavy transport (Municipality of Athens, 2017, p. 92)

On the other hand the administration in London implemented twenty-one technological measures, seven communicative and five regulative measures. In contrast with Athens, the local administration of London chose to apply a limited number of regulative measures. More specifically they tried to achieve change through the technologic measures which provide means for the reduction of transportation emissions and through communicative measures which stimulate citizen's participation. The technological measures which were applied in London made easier the inventory of GHG emissions and facilitated the purchase of electric cars from Londoners, since charging points for electric vehicles were installed in many locations in the city. Furthermore, it made citizens part of the strategy. Some of the measures which verify the motivation for citizen's participation are the ''low cost sensors'' which enable Londoners to participate in the actual measurements of air quality in their cityand the ''cleaner vehicle checker'' which gives Londoners the opportunity to check the impact of their cars to the atmosphere (Mayor of London, 2018, pp. 18,80). Regarding the communicative measures, London administration invested in the communication between the local authorities and citizens. This way Londoners understood the importance of this strategy and acted to contribute in the reduction of transportation emissions. In addition, communicative measures contributed in the protection of citizen's health (Mayor of London, 2018). Characteristic measure forms the ''broadcasting information'' in various locations in the city (e.g ''bus shelters'') which informs Londoners for the air status of their city (Mayor of London, 2018, p. 65).

Another difference is that taxis fleet in London form also part of the strategy. According to the Mayor of London, ''all newly licensed taxis have been required to be zero emission capable'' (Mayor of London, 2018, p. 78). On the contrary, Athens administration did not include taxis fleet in the actions against transportation emissions.

Furthermore, the Athens administration included the municipality garbage trucks in the actions through the sensors and the gas counters which were placed on bins waste and dustcarts respectively (Municipality of Athens, 2017). London administration did not introduce measures for garbage trucks.

Actors of the two cases

The last difference refers to the people who cooperate for the climate action plans in the two cities. The Athenian climate action plan is implemented by the local government, and the municipality services. Citizen's participation is limited since they participate only through the ''e-drive academy'' (Municipality of Athens, 2017, p. 87). On the other hand, the efforts against air pollution in London are the result of collective action between the local government, the national government, King's London college, London boroughs, non-governmental organizations and citizens.

Despite the differences, the two action plans have also similarities. Firstly, both administrations implemented measures which promoted the use of public transport, cycling and walking as alternative means of transportation. Secondly, drivers were motivated to shift to eco-driving. Arranged in the table below are the differences between the two action plans according to (Municipality of Athens, 2017), (Mayor of London, 2018).

Table 10: Differences between the two action plans

Borras&Edler theory	**Athens plan**	**London plan**
	1st Pillar	
Context:	**Low Financial Ability**	**High Financial Ability**
Policy Instruments:	➢ 4 instruments ➢ Based on international guidelines ➢ Depend on guidelines for the inventory and for calculation of GHG emissions	➢ 9 instruments ➢ Based on national and local initiatives ➢ Depend on technological developments
	2nd Pillar	
Actions:	➢ 13 measures ➢ 10 regulative measures, 2 technological measures, 1 communicative measure ➢ Exclusion of the taxi fleet from the actions ➢ Inclusion of the dustcarts in the actions	➢ 33 measures ➢ 21 technological measures, 7 communicative measures, 5 regulative measures ➢ Inclusion of the taxi fleet in the actions ➢ Exclusion of the dustcarts from the actions
	3rd Pillar	
Actors	➢ local government ➢ and the municipality services	➢ local government, ➢ national government, ➢ educational institutions, ➢ London boroughs, ➢ non-governmental organizations ➢ citizens

Chapter 5. Conclusion

Air pollution is a serious environmental problem that causes death and disease to people all around the world (WHO, n.d). In the light of WHO, ''4,2 premature deaths globally'' are connected to air pollution. Air pollutants come from ''both man-made and natural sources'' (European Environment Agency, 2019). ''Burning of fossil fuels'' for the production of electricity, transportation, ''industry and households'', agriculture, ''volcanic eruptions and windblown dust'' form some of the sources which are responsible for air pollution (European Environment Agency, 2019).

Governments on local, national and international level work to improve the air quality people breath and to protect our planet. The present thesis examined the way Athens and London administration deal with transportation emissions and aimed to find the differences between their action plans.

This became possible through qualitative research. All the information was collected from policy documents, academic articles, the web pages of the two municipalities, from journals and from web-sites with environmental content. The comparison between the two action plans depended on the theory of Borras and Edler. More specifically, the policy instruments each local government allocated, the context of the two cities, the measures which aimed at the reduction of transportation emissions and the actors who cooperated for the implementation of the plans were categorized in accordance with the three pillars of Borras and Edler.

The present thesis contributed to cover the ''lack of knowledge'' which Rykkja, Neby and Hope found out that exist around the issue of governmental actions towards climate change (Rykkja, 2013, p. 106). Furthermore, using a public administration perspective and by comparing the actions which the administrations of the two cities took to reduce their transportation emissions, it also contributed to the lack of comparative researches between different countries. In this thesis, the cities of Athens and London formed the examined cases. Focusing on the measures the two administrations implemented and taking into account the contextual characteristics of the cities, the differences and similarities between the two action plans and the way each administration chose to approach the issue are evident. In practice the present research showed how two different cities deal with the same enemy, transportation emissions, displaying the effect of city's context on the measures each administration choose to implement. By finding the similarities and differences, the present thesis set the stage for future researchers to find how Athens and London could

adopt measures from each other and specifically the measures which each society is able to adopt.

To answer the research questions the climate action plans of the two cities were studied. Specifically, the parts that referred to the actions which aim to reduce transportation emissions were examined. In order to find the differences between the two action plans, the categories of context, instruments, measures and actors were analyzed. They were compared in regard to the number and the content of the measures, the number and the content of instruments and the number of the actors who participated in the implementation of each actions plan. In addition, in order to examine the context of the two cities newspaper articles and journal articles were studied. It is important to mention that the social forces which were considered during the research is financial status of the two cities but not other social forces such as the culture of Athens and London.

5.1 Comparison between the two cases

Regarding the answer of the main research question: '' What are the differences between the actions the two administrations use to fight transportation emission in their cities?'' the analysis showed that, Athens plan aimed to improve the air quality of the city and achieve environmental but also energy and economic benefits. London administration aimed to achieve environmental and health benefits.

Also, Athens administration depended its action plan on international guidelines, in contrast with the London plan which was based on local and national initiatives (Municipality of Athens, 2017), (Mayor of London, 2018). Moreover, the Athenian administration allocated four instruments for the implementation of the city's action plan. These instruments depended on guidelines for the inventory and calculation of GHG emissions. On the other hand London authorities allocated nine instruments which depended on technological development (Municipality of Athens, 2017), (Mayor of London, 2018). Athens administration chose to implement thirteen measures. Most of them were regulative. In contrast with London plan which applied thirty-three measures and most of them were technological. Another difference in the two action plans is the inclusion of the dustcarts in the Athenian plan, in contrast with the London plan where dustcarts were excluded. The same happened with the taxis fleet in London. More specifically London included taxis in the actions against transportation emissions in contrast with Athens where taxis fleet was excluded from the climate action plan. Lastly, an important difference is that the Athenian plan was implemented by the local authorities and municipal services. In contrast the

London plan was the result of broader cooperative action where the local government worked together with the national government, educational institutes, London boroughs, Non-governmental organizations and with the citizens (Municipality of Athens, 2017), (Mayor of London, 2018).

To conclude, Athens administration chose to implement an action plan which included more regulative measures than communicative ones. Citizens could participate to a limited degree. Additionally, the actions were organized by groups of people which appertained to municipal services and it depended on international guidelines (Municipality of Athens, 2017). On the contrary London authorities implemented a plan which depended on technological measures. The technological developments which London administration deployed, enabled Londoners to participate in the efforts against transportation emissions (Mayor of London, 2018). Also, London plan was the result of collective action between various actors.

It is worth to mention that the different context of the two cities is directly connected with the measures each administration chose to implement. The Greek financial crisis affected the resources of the Greek authorities of all levels (Kouretas G.P., 2010). On the other hand, London had better financial status. This enabled London authorities to expend bigger amounts of money in comparison to the local government of Athens (Mayor of London, 2018).The measures were well intended by both city administrations however financial limitations and economic difficulties differentiate the measures which can be implemented in different contexts.

Lastly the two action plans had some similarities. The promotion of public transportation, cycling, walking and the efforts to make drivers shift to eco-driving formed common measures between the climate action plans of Athens and London(Municipality of Athens, 2017), (Mayor of London, 2018).

5.2Recommendations for future research

Since, the present research compared the action plans of Athens and London focusing on the measures which aimed to reduce transportation emissions, future researchers could investigate to what extend the two action plans had the expected results, how effective where the measures the two administrations chose to implement.

Secondly, future researchers could study whether and how the two cities could learn from each other. More specifically, it would be an interesting topic to investigate if these

two cities which are characterized form contextual differences could be inspired from each other in order to adopt and/or adjust the measures their citizens were able to follow.

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