Università degli Studi di Ferrara

DOTTORATO DI RICERCA IN
"Economia e direzione aziendale"

CICLO **XXVIII**

COORDINATORE Prof. **Massimiliano Mazzanti**

Transitions Towards Low Carbon Urban Mobility
How Italian Municipalities Affect Transition Pathway

Settore Scientifico Disciplinare SECS-P/07

Dottorando
Dott.ssa Moradi Afsaneh

_____
(firma)

Tutore
Prof.ssa Vagnoni Emidia

_____
(firma)

Anni 2013/2015

Dedicated to:

Omid

Who

support me to follow my dreams

Gave me Strength when I was tired

Gave me motivation when I was discouraged

Gave me hope when I feel disappointed

Thank you for coming to my life

And

Changing everything to a real Fortune

Acknowledgement:

First and foremost, I would like to express my deepest sense of gratitude to my supervisor, Professoressa Emidia Vagnoni who always accompanied and supported me with her valuable experience and deep knowledge, understanding and encouragement during the three years of research program. Thank you for being more than a supervisor; a kind sister, a real friend and a wise guide. I am hugely indebted to you and words never be enough to thank your kindness and endless supports during the research process.

I appreciate Dr. Henrik Gudmundsson, for being ever so kind to host me in Denmark Technical University (DTU), showing interest in my research and giving his precious and kind advices regarding the research process.

I am thankful to PhD coordinator, Professor Massimiliano Mazzanti, for providing me with the material and reports, introducing interviewees and suggestions during the annual hearings.

I express my gratitude to the committee members for their acceptance, time, comments, advices and considerations in evaluating this dissertation.

A special thank you to Dr. Andrea Chiarini for giving suggestions about the research topic.

A special thanks to my friends Dotoressa Caterina Cavicchi and Dotoressa Chiara Oppi, for their kindness, supports, motivations and helping me in translation jobs.

Many Thanks to Dr. Mehdi Heidari and his kind mom for accepting me like their family member in Italy.

Last but not the least I would like to thank my parents, for their supports, motivation and positive energies during the three years of my study abroad.

Abstract

In recent decades, there has been growing concerns about climate change challenge which is the resulted from the increasing trends of GHG and CO_2 emissions. There is a great emphasize in international society and specifically in Europe to reduce the level of emissions in different sectors. Transport sector is one of the main contributors of these gases that yet could not achieve the predicted targets of emission reductions, specifically in urban areas. low carbon urban mobility is chosen as the theme of this dissertation to find out how the urban mobility system could be managed, to be more sustainable; what factors affect emission reduction objectives of urban mobility and how local government can influence, manage or control these factors.

This study focused on the role of municipalities in sustainable urban mobility, the ways in which the transition from current mobility systems to low carbon sustainable systems are influenced by the *viewpoints and commitments* of policy makers to sustainability issue, how the transition process is managed by overcoming the *existing obstacles* through development of *strategies and plans* for improving current mobility system, *financing* and supporting projects and innovations related to clean mobility, and how other stakeholders participate and *cooperate* in such processes.

The dissertation, concludes by presenting a new conceptual framework that aims to inform such processes at local level, "five variables" mentioned above (attitudes, strategies, cooperations, finance and challenges) influence the success of emission reduction objectives. This framework used to evaluate the efforts of local government (municipalities) in transition towards low carbon mobility, the results showed that municipalities in Italy believe that only strategies and plans have a direct effect on the success of emission reduction objectives, and these plans and strategies are influenced by financial supports of higher authorities and cooperation with other stakeholder groups which is slightly affected by the viewpoints of policy makers. The research also revealed that municipalities who had long term strategic plan have better performance than other municipalities in the triangle of strategy, finance and cooperation.

Estratto

Negli ultimi decenni, la tematica del cambiamento climatico ha assunto progressiva rilevanza, anche a causa dei trend crescenti nelle emissioni di GHG e CO_2. Nella società internazionale e più specificatamente in Europa la sfida per la riduzione del livello di emissioni è tuttora di grande enfasi. Il settore dei trasporti rappresenta uno dei maggiori responsabili del rilascio di questi gas in atmosfera e attualmente, è ben lontano dal raggiungimento dei target di riduzione delle emissioni, soprattutto per quanto riguarda la situazione inerente le aree urbane. In questa dissertazione si affronterà il tema della mobilità urbana per capire quali strategie possono essere attuate per renderla sostenibile, quali fattori influenzano il raggiungimento degli obiettivi di riduzione delle emissioni e come i governi locali possono agire su questi fattori.

Questo studio esplorando il ruolo dei Comuni Italiani nella gestione della mobilità urbana sostenibile, vuole indagare come la transizione dai sistemi di mobilità corrente a sistemi *low Carbon* è influenzata dalla *visione* e dal *commitment* dei policy makers rispetto al tema della sostenibilità. Inoltre, si prefigge di discutere come la transizione può essere gestita attraverso il superamento degli *ostacoli* esistenti attraverso la *pianificazione* di *strategie* per la sostenibilità, la presenza di *fondi di finanziamento* ad hoc, l'adozione di progetti ed innovazioni relative alla mobilità sostenibile, e come può essere influenzata dal supporto e *collaborazione* degli stakeholder interessati dal sistema. La dissertazione conclude con la presentazione di un nuovo framework concettuale che possa contribuire a spiegare il fenomeno investigato: le "cinque variabili" identificate attraverso lo studio e presentate nel framework (le attitudini dei governi locali, le strategie, la cooperazione degli stakeholder, il finanziamento e le sfide) influenzano infatti il raggiungimento degli obiettivi di riduzione delle emissioni. Questo framework permette di spiegare gli sforzi dei Comuni nella transizione verso la mobilità urbana sostenibile. I risultati mostrano che i Comuni italiani ritengono le strategie e la pianificazione quali unici mezzi che possono avere effetto diretto sulla riduzione delle emissioni, e che l'attuazione di queste strategie siano influenzate dal supporto finanziario da parte delle autorità e dalla cooperazione con gli stakeholder che a sua volta dipende scarsamente dalla visione dei policy maker circa la sostenibilità. Lo studio ha anche rivelato che i Comuni che presentavano piani di lungo termine erano in grado di ottenere migliori performance rispetto agli altri, considerando il triangolo strategia, finanziamento e cooperazione.

Transition Towards Low Carbon Urban Mobility: How Italian Municipalities Affect Transition Pathways

Table of contents:

List of Figures:

List of Tables:

List of Charts:

Chapter1:

Introduction

This chapter provides a general overview of this dissertation. It describes the main motivations, problematic issues observed, aims, objectives and research questions, methodological structure of research and the experienced limitations. At the end an outline of dissertation structure and the main topics that will be discussed in each chapter will be presented.

Introduction:

In 2012, Italy was the fourth largest emitter of greenhouse gases (GHG) in the EU, with a share of 10% emissions (EEA, 2014). The climate change policies in Italy has been developed in the framework of EU climate policies which emphasize on the key role of local government in sustainable urban development, nevertheless multilateral environmental agreements influenced policy and legal developments which developed in the context of governance framework that involves a major devolution of responsibilities tolower levels of administration (provinces and municipalities) has been observed (OECD-Italy, 2013). Considering widespread agreement about the key role of municipalities in enabling urban sustainability, setting visions for sustainable cities and developing appropriate transport systems (Butera, 1998;ICLEI, 2012; Bulkeley and Betsill, 2007;UNCSD[1], 2012), this research develops a methodology to evaluate the role of local government (in this research, municipalities) in transition towards low emission urban mobility systems and the extent to what they utilize innovative solutions and strategies to achieve emission reduction targets.

The current chapter provides background information about the research including the study motivations and its significance, as well as problem statement, objectives, study context, methods and limitations. At the end, the dissertation outline is presented providing a summary of the main topics in each chapter and their arrangements.

1.1 Motivation

The strong policy focus on emission reduction as a challenge that requires subsequent actions at local, national and international level. The weak performance of transport sector and the role of local government (especially municipalities) in shaping transition context at local level (Rydin, 2010; Droege, 2008), present the main motivation of this study focusing on environmental sustainability and the role of municipalities in achieving emission reduction targets in urban areas. The main motivations of the research are related to:

Policy Focus on Emission Reduction

Climate change is one of the most significant long-term policy challenges in the world (Sprinz, 2009; Lempert et al, 2009; Huang et al, 2009) emerged as the consequence of

[1] United Nations Conference on Sustainable Development (UNCSD) Rio+20

widespread greenhouse gas emissions. Many countries set targets to reduce environmental emissions according to the international agreement of the UNFCCC[2] treaty.

Carbon emissions are increased with an accelerated pace after the emergence of automobility regime, As Banister (2011) argued these trends are affecting the global climate producing irreversible long term consequences. In EU there is strong policy focus on reducing GHG and Carbon emissions stated in "European environmental research and innovation policy", a set of strategies, actions and programs, aimed at defining and implementing a transformative agenda to greening the economy and the society as a whole, so to achieve a truly sustainable development. According to OECD (2015) the gap between current and desired GHG emissions trends demonstrates the need for strong policies to re-orient consumption, production and investment choices in our economies.

Performance of Transport Sector

Transport is the fastest growing source of CO_2 emissions and continued expansion of vehicle ownership and road traffic lead to high concentrations of air pollutants in the atmosphere, with serious respiratory and other health effects for the population, particularly in urban areas, it is crucial to support the transition toward low Carbon transport systems (Lee and Hine, 2008). In addition transport is the only sector where such a reduction in energy use and emissions is proving to be extraordinarily difficult to be achieved (Banister, 2011).

Transport activities are among the main contributors of greenhouse gas and specifically CO_2 emissions in world, Europe and Italy; in this regard they are expected to play key roles for achieving emission reduction objectives (Nakamura and Hayashi, 2012; Hickman et al., 2010). Among all transport forms, urban transport gained more attention from policy makers in the international society; the reason is that cities have higher emission rates and more transport related difficulties which are the main causes of environmental problems like GHG emissions. This dissertation focused on transition to sustainable low Carbon urban mobility, considering that one of the key strategies in Europe is to make cities low-Carbonized and more sustainable on an urban scale (EU commission, 2011). On the other side in order to move towards low Carbon sustainable transports in future, substantial transformations should be started now, which requires

[2] United Nations Framework Convention on Climate Change

new innovative solutions and effective management systems (see for example Geels 2012; TRIP 2012; GEA 2012).

Local Government's Contribution

Achieving sustainability in transport sector need comprehensive plans and strategies which should be applied by actors such as industries, local authorities, supply chain firms, universities and research centers and even citizens. These actors have taken different roles and responsibilities at local, regional, national and international levels. Litman (2015) emphasized the role of good governance and planning, and European Commission noted that this role mainly concerns local government and city authorities, because each city has its own particular characteristics and needs, and these require tailored policy responses that can best be designed locally. This position have been pointed out by a number of studies (Bell, 2002, Monteiro and Teixeira, 2006; Demerse, et al, 2008; Young and Dhanda, 2012; Clean cities report, 2011; Austin et al, 2012; Rashid and Khan, 2013; Gudmundsson et al, 2015). Also OECD report (2015) emphasizes the co-ordination between policy domains at the same level of government (i.e. horizontal governance) that highlighting the need for better governance related to transport planning and climate implications concerns systems transitions.

1.2 Problem Statement

The problem investigated in this dissertation is about managing the challenges of transitions towards low Carbon urban mobility at local level.

Transition is the process of broad changes not only in technological systems, but also in other sociotechnical systems. The role of government and specifically local government in steering modulating and controlling this change process is highlighted in transition management studies. Loorbach (2007) noted that while it is impossible to fully control, predict or direct the change process, the main aim of transition management is to manage the change process through influencing ongoing transition dynamics. This dissertation on three gaps in transition studies which pointed out the need for more research in urban mobility context, social dimensions of MLP, and the contribution of local government.

The problem that this study tries to investigate could be describes based on the gaps in addressing urban mobility in the framework of transition theory, addressing the non-technical dimensions of multi-level perspective and the role of government in affecting transition pathways. These gaps and related discussions are presented here briefly:

1.2.1 Urban transport sustainability in transition studies:

Urban transport sustainability is a shared challenge nowadays. In an extensive review of transport studies research on climate change mitigation, Schwanen et al. (2011, p. 1002) conclude: ‘‘there is a strong emphasis on mitigation via technology, economic instruments and infrastructure provision.” Transition literature focuses on the evolutionary process of mitigation through technological change. But technology and related development is not the sole driver of transition process. Socio-technical approach emphasizes the role of other social, political, behavioral, etc. factors in transition process. Within socio–technical research, “transition” refers to large-scale transformations during which the structure of the societal system fundamentally changes (Rotmans et al, 2001).

Understanding large-scale transitions to new transport systems requires analytical frameworks that encompass multiple approaches in ways that address interactions among them. The multi-level perspective (MLP), which will be discussed in this paper, is one such framework.

According to Geels (2011), the usefulness of the MLP has been illustrated with many historical case studies of transitions, such as in land transport (Geels, 2005a), shipping (Geels, 2002), cargo handling (Van Driel and Schot, 2005), clean water (Nastar, 2014, Geels, 2005c), aviation (Geels, 2006; Nakamura et al, 2013), highway systems (Geels, 2007a), and industrial production. But the MLP has also fruitfully been applied in studies of contemporary and future transitions to sustainability, e.g. in electricity systems (Verbong and Geels, 2007, 2010; Hofman and Elzen, 2010), biogas and co-combustion (Raven, 2004), organic food and sustainable housing (Smith, 2007). Many of these contemporary studies explain the ups and downs of ‘green’ niche-innovations by analyzing the learning processes, network dynamics, and struggles against existing regimes on multiple dimensions; however a few authors have addressed urban mobility and transport within the framework of transition theory (Köhler et al., 2009; Zijlstra and Avelino, 2011; Scheller, 2011 and Bertolini, 2011); although some research addressed the transition dynamics scenarios of mobility and ‘green’ cars (Nykvist and Whitmarsh, 2008; Van Bree et al., 2010; Geels et al., 2008, Marletto, 2013).

1.2.2 Socio-technical dimensions of MLP in transport studies

Addressing socio-technical dimensions of MLP applied in transport and mobility systems allows at observing one of the gaps. Genus and Coles (2007) argue that researches employing MLP has tended to over-emphasize the ‘technical’ transition process (like Geels, 5005 and 2012; Van Driel and Schot, 2005), whilst neglecting relevant socio-

technical and cultural phenomena contributing to system change. In this regard, the contribution of current research is to identify social, cultural, financial, political, etc. variables affecting the transition process need to be identified by analyzing the viewpoints of all stakeholders engaged in sustainable mobility plans and programs.

Scholars worked on sustainable urban mobility highlighted the importance of analyzing the interactions between industry, policymakers, consumers, and civil society and the ‘‘need to understand behavior [of all stakeholders], and to explore the means by which cooperation and support can be obtained, so that real change can take place’’ (Banister, 2008, p. 79 and Geels, 2012). The socio-technical approach and multi-level perspective was developed to analyze the role of these multi-actor processes in transitions. And as it suggested by Geels (2012), this research used MLP for making analyses of the possibilities, barriers and drivers of transitions towards sustainable low Carbon mobility.

The other aspect is the focus of current research on technological transitions, regarding this Morphy and Smith (2013) pointed out to the need for more research on socio-technical transitions criticizing MLP for having a limited understanding of society and politics compared to technology in emphasizing widespread long-term change. The cited authors believe that research in this field focused on technologies which constitute transitions rather than where transitions occurred, and argue that other aspects of MLP should be strengthened.

1.2.3 Contribution of local government

A number of studies emphasized the great potential of government and local authorities to promote, support and facilitate the innovation growth platform through policies, niche management strategies, incentives and knowledge transfer activities with other stakeholders (Taylor, 2006; Monteiro and Teixeira, 2006; Demerse, et al, 2008; Young and Dhanda, 2012;Austin et al, 2012; Gudmundsson et al, 2015). As Hillman et al (2011) argued, the literature about governance influence on innovation processes, and development and diffusion of sustainable technological innovations is still limited. They introduce a gap in the literature about the connection between governance arrangements and the functionality of the technological innovation system, and assumed that governance arrangements influence the functionality of technological innovations in different ways depending on the structure, stability and positioning of the innovations in relation to the regime. Despite the existing literature, some scholars believed that there is need for more researches on local governance framework regarding implementation of

sustainable planning tools and municipalities engagement in multi-level governance (Barrutia et al, 2013; Nash and Bray, 2014).

Since the early 1990s, municipalities and local governments have been active in local climate mitigation efforts, and some scholars believe that there is a need for more efforts now that climate change is the main priority of policy makers around the world (Rashid and Khan, 2010; Bulkeley, 2010; Allman et al., 2004; Bulkeley and Betsill, 2003; Collier, 1997). Some Authors like Baeumler et al (2012), noted need for more studies on the role of municipal efforts in promoting low Carbon urban growth, especially in terms of incentives and financial supports. Even recent studies stress the research need on the role of different actors (especially policy makers) in the transition process towards low Carbon systems (Lema et al, 2015; Pye et al, 2015).

This dissertation follows the need for an understanding via the complexity of local government's contribution in transition process. The researcher tries to face the problem from an original point of view: more and more detailed plans as well as sophisticated technologies are not enough (alone) to make transport system efficient and mobility management sustainable. Local stakeholders (and specifically local government) as a key-actors for the improving the context for niche development and regime transfers.

1.3 Aims, objectives and the study context

Some scholars emphasize the role of local authorities in setting environmental policies (Nijkamp and Pepping, 1998; Monteiro, 2006; Wildriver, 2006; Thomas, 2010). This planning role internationally recognized through Local Agenda 21 (United Nations, 1992).

The research aims to study the role of Italian municipalities (as the main representation of local government) are proposed in transition towards low Carbon urban mobility. So, the main research question is defined as follows:

How local governments (municipalities) affect the transition process towards low Carbon urban mobility?

The main research question is based on the assumptions that local governments and public authorities are the main actors in the field of sustainable mobility planning, since they have resources and capabilities available and they can take the leading role in transition toward low Carbon city transports.

Before analyzing the role of local government, it is essential to identify the dynamics of transition process and the factors that affect them, and then in order to know how

government can influence these dynamics, the government tools in managing the transition process should be identified. To do this, the following research questions formulated as the secondary research questions that need to be answered before the main question:

- **R1:** What are the dynamics of transition process and the main government tools for influencing transition pathways
- **R2:** What is the role of each factor as a driving force or restraining force of transition process,
- **R3:** How local government (in this case, municipalities) contribute in managing, controlling and influencing those dynamics and forces.

And in order to compare the effect of long term strategic and short term operational transport planning approach in municipalities another research question is considered:

- **R4:** What is the difference between two groups of municipalities (those who have PUT only, and the bigger municipalities that developed PUM in addition to PUT)

1.4 Methods and Tools

This dissertation has been developed in a way that avoids the problems with the case study method. It is not a case study of national processes, at most, it helps in understanding how local governments can direct, lead or affect the transition process. The research is relied on the mixed method approach which is a technique for gathering, analyzing and mixing both qualitative and quantitative analysis and procedures in a study to appreciate the research problem (Creswell, 2012). The research has been accomplished in two main steps:

The first step is an exploratory study conducted through the qualitative research methodology in order to identify the impediments to sustainable mobility in transport sector, and the role of local public authorities in fostering the transition process.

The key element in the methodology is to find the main variables which affect success of emission reduction targets based on the viewpoints of different transport stakeholders. For this aim a combination of different data collection methods was implemented, including literature reviews, secondary data analysis (document and website analysis, observations and recording), and semi-structured interviews. After reviewing the relevant literature and in-depth analysis of emission trends, strategies and the main objectives of emission reduction, a number of semi-structured interviews has been carried out to explore the

different stakeholder's viewpoint and opinion on "sustainable mobility strategies" and "local governance" contribution in transition process in Italy.

In order to have multi stakeholder viewpoints, at least one interviewee was selected from the following groups: industry (vehicle manufacturers and their suppliers), regional authorities, national decision makers (ministry), universities or research centers, agencies and regional public transport providing companies. Selection of interviewees from each group of stakeholders was based on identifying "the person most knowledgeable about the issue of interest" (Huber and Power, 1985, p. 174).

To ensure reliability of findings, all interviews were tape-recorded and transcribed. The interview notes where then categorized based on the challenges pointed out by interviewees and their role in the network.

The second step performs the quantitative methodology planned to measure the extent to what local public authorities are committed to sustainable mobility issue and their efforts in the transition towards low Carbon mobility systems. For this aim, a questionnaire was designed to identify how the mentioned variables affect emission reduction targets, are analyzed with statistical software (SPSS version 18.0 in order to find out the effect of different variables on emission reduction targets).

The abovementioned questionnaire was addressed to mobility managers or the transport responsible authorities in municipalities. Considering that the public authorities in Italy consist of ministries, administrative regions, agencies (in some provinces) and municipalities[3]. Municipalities are chosen as the main study population as the local regulatory agents that outline transport plans, and set the policy goals at urban level.

The questionnaire was distributed to 308 municipalities with more than 30,000 inhabitants. The reason for choosing cities with more than 30,000 inhabitants was that according to Italian law (Law Decree/D.Lgs. 285/92), only cities with more than 30,000 inhabitants must define and adopt a PUT (Piano Urbano del Traffico/Urban Traffic Plan) which is a classic urban transportation plan and is mainly devoted to managing city

[3] The Italian transport regulation authority was established on 17 September 2013 and became operational on 15 January 2014, but in this research it is not considered as the public governance body because as it is noted by Cambini and Perrotti (2015): "the Authority is fully independent from government, regulated businesses and infrastructure operators"

transport demand and supply issues, such as public transit, parking policies, and road safety measures (Velazquez Valoria, 2013; Percoco, 2007; Morrison et al, 2007)[4].

1.5 Limitations

The research tried to identify the main variables that can affect the achievement of Carbon reduction targets, based on the viewpoints of different stakeholders of transport sector, but it cannot and does not claim to provide a comprehensive assessment of all aspects of urban sustainability mobility or identify all affecting variables. Other variables affecting urban mobility context exist that are not mentioned or considered important by the interviewed stakeholders. The dissertation primarily address issues concerning local governance participation (mainly municipalities) in transition process, and only with regard to affecting pathways of transition.

Part of the research limitations was related to practical aspects the existing literature, some papers related to the study context (Italy) was in Italian, also data gathering and respondent's participation was one of the main difficulties of the current research. Occasionally consultants have published summaries of their studies in journals or presented results at conferences, (Kirby, Tagell, and Ogden, 1986; Mogridge, 1983; 1992 and 1997).

Another limitation refers to the difference of response rate between big and smaller cities. The questionnaire was translated to Italian, and posted to Italian municipalities, to the attention of mobility managers or transport service responsible; the response rate was below the expected value, yet the participation of 50 bigger cities was much higher than the rest of the sample. Whilst it is often desirable to pursue deeper, wider or more comprehensive studies, in each research there are practical impediments that affect the research feasibility.

1.6 Dissertation Outline

This research consists of two separate phases of qualitative and quantitative study. Phase one examines the key variables affecting the transition process towards low Carbon mobility at urban areas by examining the theoretical considerations and exploring the transport sector stakeholders' insights. It outlines the key concept underpinning theories of socio-technical transitions in identifying variables affecting low Carbon transitions at

[4] Urban transport policy actions in Italian cities are largely considered in two types of urban plan, another type of plans is Piano Urbano della Mobilità (henceforth PUM) and is obligatory for cities with more than 100,000 inhabitants that would be a subsidiary of selected sample

urban level and how those variables are related to each other according to theoretical perspectives. Phase two is empirical oriented, in which through an administrated questionnaires, local public authorities addressed how and to what extent those variables affect the role of local public authorities in undertaking transitions for low Carbon urban mobility in practice. The following chapters have been organized:

Chapter two reviews the current state of emission and mobility trends. The aim is to map the existing situation and present a general view of current systems. The chapter consists of two sections: the first section present GHG and CO_2 emissions trends at global and national levels as well as sectoral emissions (transport sector GHG and CO_2 emissions in world and in Italy); the second part presents the current mobility trends in the selected study context (Italy) and it includes urbanization, sub-urbanization and private vehicle trends.

Chapter three presents the desired state of urban mobility, introduced in terms of sustainable and low Carbon mobility system; then the policies, actions and strategies for achieving low Carbon mobility is presented in global and national contexts.

Chapter four refers to the theoretical foundations of this dissertation. The main theoretical approach is the literature about transition theory, dynamics of transition process and transition management which is focused on the role of governments at different levels. Then the socio-technical system theory and multi-level perspective are presented, considering transition as a process occurred in different levels involving different social systems as well as technical system. The last issue of theoretical consideration is introduced as the co- evolutionary approach that considers the co-evolution between different dynamics of transition process.

Chapter five describes the details of research methodology and methods used to gather data, it also describes the way in which the combination of quantitative and qualitative methods were selected and used in this dissertation. Identifying the main variables which affect the transition toward low emission mobility is performed by qualitative methodology, presenting different stakeholder's viewpoints through semi structured interviews. Furthermore a quantitative approach is used to evaluate local government efforts and practical actions in managing the transition process.

Chapter six**,** presents the results obtained during the research process and answers the research questions through qualitative and quantitative analysis methods.

Chapter seven provides a discussion of the lessons learned, the contribution, limitations of this research, and the suggestions for future researches which are followed by a list of references and the annex.

Chapter2:

Emission and Mobility Trends: Current State

This chapter of dissertation reviews the current state of emission and mobility trends. The aim is to map the existing situation and present a general view of current systems. The chapter consists of two sections: the first section present GHG and CO_2 emissions trends at global, sectoral and national levels; the second part present the current mobility trends in the selected study context (Italy).

2.1 Emission Trends

Global warming is defined as the long-term changes in earth's climate, especially changes due to the average atmospheric temperature increase. It is very likely that the number of cold days and nights has decreased, and the number of warm days and nights has increased on the global scale (IPCC, 2013) which is usually accompanied by the ecological changes like more floods, storms, tornados and droughts, dust and major atmospheric instabilities or abnormal weather events. NASA[5] states that climate change effects that scientists predicted in the past are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves.

Climate change is usually considered to be caused by increased concentrations of greenhouse gases (GHG) in the atmosphere. Some scientists argued that atmospheric CO_2 concentrations and global temperature are correlated to one another and there are even efforts to present models for describing and forecasting these changes. This means that increased GHG and specially CO_2 concentration affect the earth temperature; and on the other side higher temperatures may lead to increased release of CO_2 (Scheffer, 2006; Carter and Ockwell, 2007; Annan et al, 2010; IPCC[6], 2014). Human activities produced large amounts of greenhouse gases, which directly affect the surface temperature of the earth. Although human activities are not the only cause of climate warming, it is recognized that they are among the main contributors. IPCC (2014) reported that scientists were more than 95% certain that most of global warming is caused by increasing concentrations of greenhouse gases and other human (anthropogenic) activities (IPCC, 2014).

Greenhouse gases are important because they can trap heat in the earth's atmosphere for a long time. This causes a significant raise in the earth's temperature whose some consequences are known as global warming effect. Although specific amount of these gases are essential for living on the earth and if they didn't exist another ice age may occurred, exceeded amounts of GHGs can cause serious environmental problems. Some impacts of the increased GHG concentrations may be slow to become apparent since

[5]The current and future consequences of global change; http://climate.nasa.gov/effects

[6]Intergovernmental panel on climate change

stability is an inherent characteristic of the interacting climate, ecological and socio-economic systems (OECD/IEA[7], 2013).

Regarding the growing concerns of climate change and global warming, and introducing GHG emissions as one of the contributing factors, it is important to monitor emission trends at national and global level in order to identify the share of different sectors and industries and understand the changes over the years which will help decision makers to adapt better policies and measure the effectiveness of current strategies and policies. Considering environmental sustainability, it is essential to notice the environmental damage caused by human activities.

2.1.1 GHG and CO_2 emissions

Increasing emissions of greenhouse gases worldwide have led to a substantial increase in atmospheric concentrations of long-lived greenhouse gases. According to US environmental protection agency[8], between 1990 and 2010, global emissions of all major greenhouse gases increased. Countries and regions have different emission potential based on their economic activities, technologies, population, and climate conditions. **Figure 2-1** shows GHG emissions in different countries around the world in 2009.

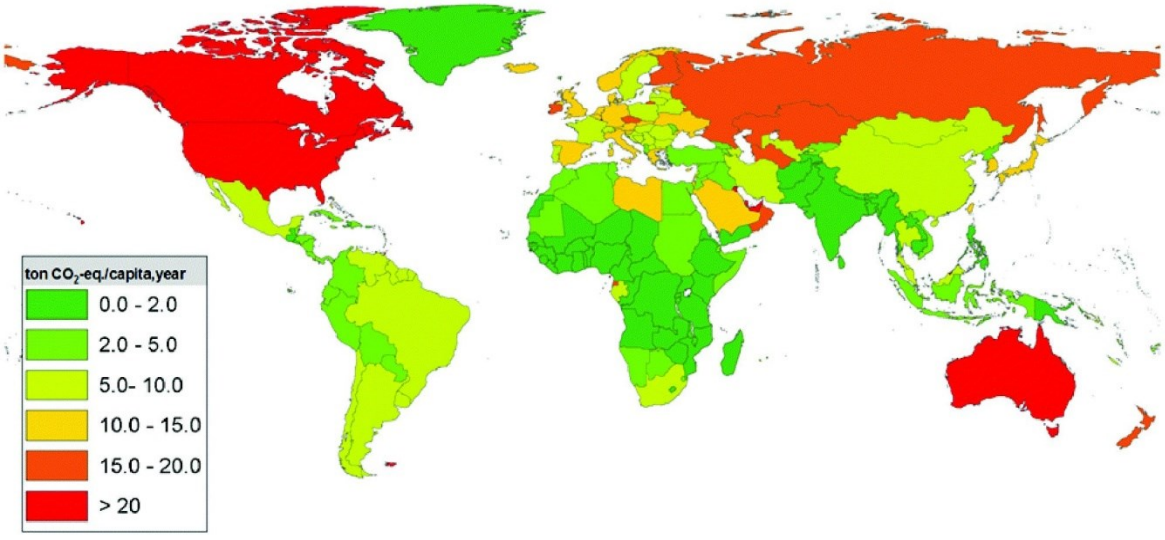

Figure2-1: Global GHG emissions (2009), Source: EC-JRC/PBL.EDGAR. Version 4.0[9]

Reported greenhouse gas (GHG) emissions estimates are based on an internationally agreed basket of gases covered by the Kyoto protocol: Carbon dioxide (CO2), methane,

[7]International Energy Agency
[8]EPA: US environmental protection agency: www.epa.gov
[9]http://edgar.jrc.ec.europa.eu/ , 2009

nitrous oxide, hydro-fluoro Carbons, per-fluoro Carbons and sulphur hexafluoride. Some gases have a greater impact global warming potential than an equivalent amount of others, for example so greenhouse gas emissions are expressed in terms of the equivalent million tons of Carbon dioxide (MtCO2e)[10].

Carbon Dioxide (CO_2) is the most common gas contributing to global warming. What makes CO_2 more important is the longer time scale for removing it from the atmosphere (in comparison with other GHGs). Considering long lifetime[11] of CO_2 in the atmosphere, stabilizing concentrations of greenhouse gases at any level would require large reductions of global CO_2 emissions from current levels. Even after stabilization of the atmospheric concentration of CO_2, anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks. It should be also considered that some changes in the climate system would be irreversible in the course of a human lifespan (OECD/IEA, 2013).

Climate scientists have observed that Carbon dioxide (CO_2) concentrations in the atmosphere have been increasing significantly over the past century, compared to the rather steady level of the pre-industrial era (about 280 parts per million in volume, or ppmv). The 2013 concentration of CO_2 (396 ppmv) was about 40% higher than in the mid-1800s, with an average growth of 2 ppmv/year in the last ten years. Significant increases have also occurred in levels of other GHGs like Methane (CH_4) and Nitrous oxide (N_2O) (OECD/IEA, 2014).

The Fifth Assessment Report from the IPCC (Working Group I) states that human influence on the climate system is clear (IPCC, 2013). Since the Industrial revolution, annual CO_2 emissions from fuel combustion dramatically increased from near zero to almost 32 $GtCO_2$ in 2012 (OECD/IEA, 2013).

One way to study CO_2 emission trends is the analysis of entrapped air bubbles in polar ice cores which is also known as the most reliable assessment to reconstruct the atmospheric concentrations of greenhouse gases and their variations for past climatic epochs (Neftelet al, 1985; Sowers and Bender, 1995; Alley, 2000; and Stauffer et al, 2002). Ice cores are unique with their entrapped air inclusions in providing direct records of past changes in atmospheric trace-gas composition (Petit et al, 1999). Air bubbles trapped in polar ice cores show that mean atmospheric CO_2 concentration started rising sharply at the

[10] UK transport greenhouse gas emissions factsheets

[11] The atmospheric lifetime relates emissions of a component to its atmospheric burden (Prather et al., 2001).

beginning of the nineteenth century (Neftel et al 1985) and more drastically from 1960, as it is clearly shown by Keeling curve (**Figure 2-2**). Keeling (1960) claimed that the observed rate of CO_2 increase at the south pole is compatible with what expected from the combustion of fossil fuels (Keeling, 1960), it is later proved by more than five decades continuous measurements conducted at the Mauna Loa Observatory, Hawaii. Keeling curve is now considered as the evidence of the man-made increases in greenhouse emissions that are believed to be the cause of global warming (Somerville, 2011; ATPS 2013; Libertini, 2014).

In this regard, moving toward low Carbon economy or low Carbon development which could be achieved through promoting low emission development strategies (LEDS) is a policy focused concept addressed by different international organizations in the world and in Europe (Parliament, EU., and Council, EU., 201212; OECD/IEA, 2010; EU climate foundation, 2009; UNCTAD, 2010; UNDP, 2011; World Bank, 2010).

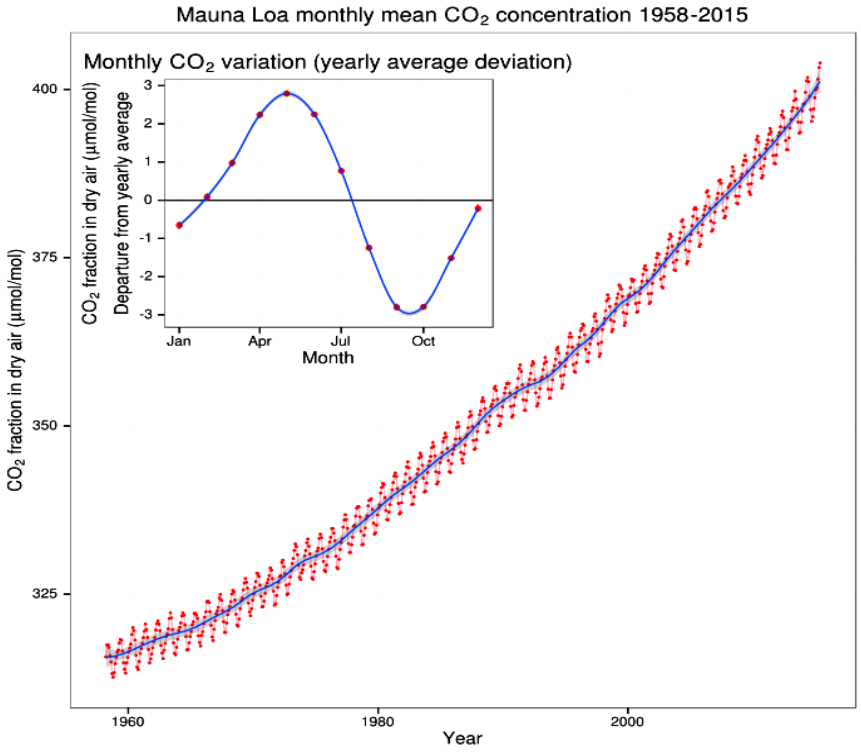

Figure 2-2: Keeling curve (1958-2015), Data from Dr. Pieter Tans, NOAA/ESRL and Dr. Ralph Keeling, Scripps Institution of Oceanography

[12]Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions

In order to better understand the effects of human activities and more specifically industrial revolution on CO_2 emission rates, six set of different ice core[13] data were combined together to show a complete history of CO_2 emission variations during a time scale about 800,000 year (**Figure2-3**). The vertical red line shows the Law Dome ice core data; more detailed data analysis of Law Dome ice core revealed that atmospheric CO_2 concentrations have increased from a pre-industrial value of 280 parts per million (ppm)(around 1800s) to 385 ppm in 2008 (keeling curve)which is still growing at an accelerated pace (OECD/ITF 2009).**Figure 2-3** clearly shows that the current level of CO_2 concentration in the atmosphere significantly exceeds the natural range for the past 800,000 years (180-300 ppm).

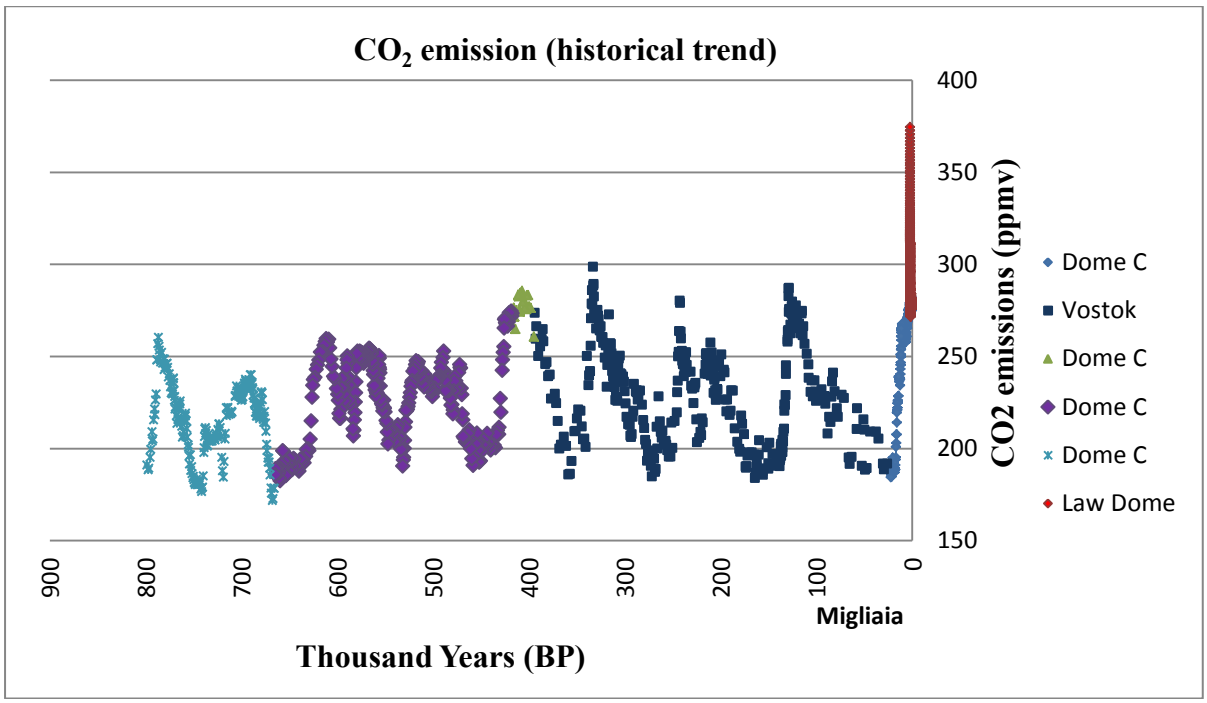

Figure2-3: Atmospheric CO_2 concentration based on Ice core data sets
Data obtained from[14]CDIAC[15] based on Law Dome, Vostok and EPICA[16] Dome C, ice core measurements

[13]The measurement of CO_2 in the atmosphere is made by the "ice core" method. Ice cores are unique with their entrapped air inclusions enabling direct records of past changes in atmospheric trace-gas composition
[14]Original data sources:
0 to +2004: Law Dome (MacFarlingMeure, C. 2004)
*-22 to 0 kyr: EPICA Dome C (Monnin et al. 2001) measured at University of Bern
-393 to -22 kyr: Vostok (Petit et al. 1999; Pepin et al. 2001; Raynaud et al. 2005) measured at LGGE in Grenoble
0416 to -393 kyr: EPICA Dome C (Siegenthaler et al. 2005) measured at LGGE in Grenoble
-664 to -416 kyr: EPICA Dome C (Siegenthaler et al. 2005) measured at University of Bern
-800 to -664 kyr: EPICA Dome C (Luethi et al. (sub)) measured at University of Bern

Looking at the short term variations, global CO_2 emissions raised by 4.6% in 2010, after have been declined in 2009 due to the impact of the financial crisis, in particular on Western economies. In absolute terms, global CO_2 emissions increased by 1.3 $GtCO_2$ between 2009 and 2010 (OECD/IEA, 2012). In 2012, global CO_2 emissions were 31.7 $GtCO_2$.

This represents a 1.2% year-on-year increase in emissions, about half the average annual growth rate since 2000 and four percentage points less than in 2010, year of initial recovery after the financial crisis (OECD/IEA, 2014). Growth rates by region varied greatly: emissions in Latin America, Asia, Middle East, Africa and China grew strongly (3.6% to 5.6%) while in most European countries emissions start to decrease (-0.5%), (OECD/IEA, 2014).

2.1.2 Focused Area: Transport Sector Emissions

Transport system is a main contributor to economic growth as a prerequisite to maintaining and developing the productivity of other sectors of society (Gudmundsson and Hojer, 1996). Transport systems are introduced as the backbone of twentieth century's economic and social progress (Gudmundsson et al, 2016), but beside all positive functions, transport activities have several negative impacts including traffic congestion, pollutions, greenhouse gas emissions, fatalities and injuries, energy consumption and other environmental impacts. OECD (1999) noted that the negative effects of the transport sector on the environment are growing faster than the negative effects caused by any other economic sector. One of these negative impacts is transport GHG emissions, which is increasing at a faster rate than any other energy using sector, as a result of increasing transport and mobility demands especially in urban areas according to the report of intergovernmental panel on climate change (2014).

Like any other sector, it is important to measure the level of GHGs and monitor the emission trends in order to find out if the applied policies and strategies in transport sector were effective enough or there is still a need to improve the strategies and the infrastructures of transport sector.

The European Commission[17] states that transport is the second biggest greenhouse gas emitting sector which is responsible for around a quarter of EU greenhouse gas emissions.

---

* (minus(-) sign shows the years before present (BP))

[15]CDIAC : CarbonDioxide Information Analysis Center

[16]EPICA: European Project for Ice Coring in Antarctica

17http://ec.europa.eu/clima/policies/transport/index_en.htm

Also road transport alone contributes about one-fifth of the EU's total Carbon dioxide (CO_2) emissions.

The European Federation for Transport and Environment (T&E) states that transport sector is the worst performing sector under 'Kyoto protocol' that seriously jeopardizes Kyoto target achievements (T&E, 2006) mainly because:

- Emissions from transport activities are increasing at a faster rate than any other energy using sector, as a result of increasing transport and mobility demands especially in urban areas (IPCC reports, 2007 and 2014);
- Transport sector is highly energy intensive and yet depended on fossil fuels and petroleum products. In fact, a large part of Carbon emissions in transport sector is resulted from burning fossil fuels (EU commission, 2012: OECD/IEA, 2009, Sorrell and Speirs, 2009; Cherp et al., 2012).

Burning fossil fuels is known as the main source of CO_2 emissions in the world. According to OECD/IEA report (2014), two sectors (electricity and heat generation, and transport sector) produced nearly two-thirds of global CO_2 emissions in 2012, electricity and heat generation which is heavily relied on coal burning accounted for 42% while transport produced 23% of Global CO_2 emissions (Figure 2-4), (OECD/IEA statistics report, 2014)

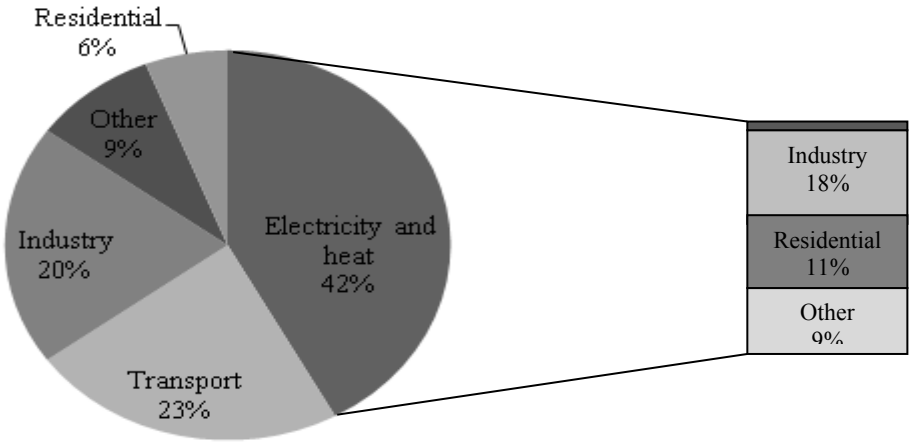

Figure2-4: World CO2 emissions by sector in 2012

Source: OECD/IEA statistics report, 2014

The European Commission states that: "Despite significant efforts to reduce emissions, transport has not yet achieved its de-Carbonizing targets. If this trend continues, transport is expected to contribute 50% of all CO_2 emissions in the EU by 2050, if not within the

next two decades"[18]. Thus, transport systems are expected to play key roles in transition toward low-Carbon economies (Nakamura and Hayashi, 2012; Hickman et al., 2010).

2.1.3 Study Context: Emissions in Italy

According to the report of EEA[19], the GHG emissions in Italy increased from 1990, primarily due to increases in road transport, electricity and heat production, and petroleum refining. The report noted that, the emissions in Italy decreased from 2004 with significant drops in 2009 and 2012, which were mainly due to the economic crisis and reductions in industrial output during these years (EEA, 2014).

Italian greenhouse gas inventory report (2014), shows that total greenhouse gas emissions, in CO_2 equivalent, excluding emissions and removals from LULUCF[20], have decreased by 11.4% between 1990 and 2012, varying from 519 to 460 CO_2 equivalent million tons (Mt), whereas the national Kyoto target is a reduction of 6.5%, as compared the base year levels, by the period 2008-2012. Considering the variation between the average of emissions in the 2008-2012 period and the emissions in the base year, the level of emissions decreased by 4.6%. It is noted that the economic recession has had a remarkable influence on the production levels affecting the energy and industrial process sectors, with a consequent notable reduction of total emissions, especially after 2010 (ISPRA[21], 2014). **Figure 2-5** shows the regional map of GHG emissions and the corresponding values for each region in Italy, (ISTAT data, 2010).

[18]EU commission report: towards low Carbon transport in Europe, 2012
[19]European Environmental agency
[20]Land use, land use change and forestry
[21]Istituto Superiore per la Protezione e la Ricerca Ambientale

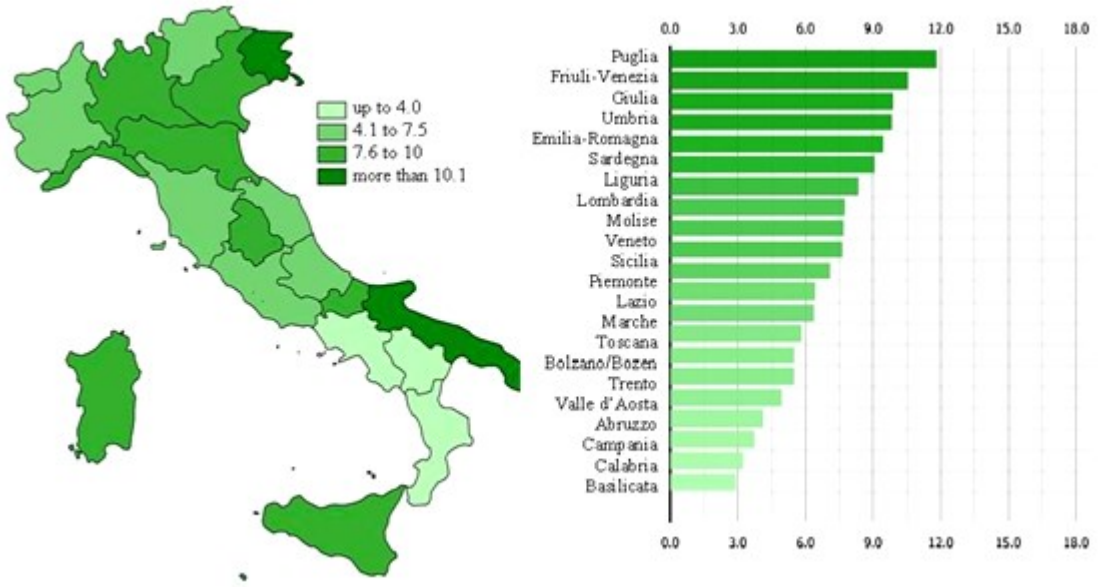

Figure 2-5: Regional GHG emissions in Italy, (CO_2 equivalent tons per capita)
Source: (ISTAT, 2010)

Chart 2-1 and 2-2 respectively show Italy's GHG emissions and CO_2 emissions at 2012 (latest available data at the time of writing this dissertation) in comparison with EU28 countries.

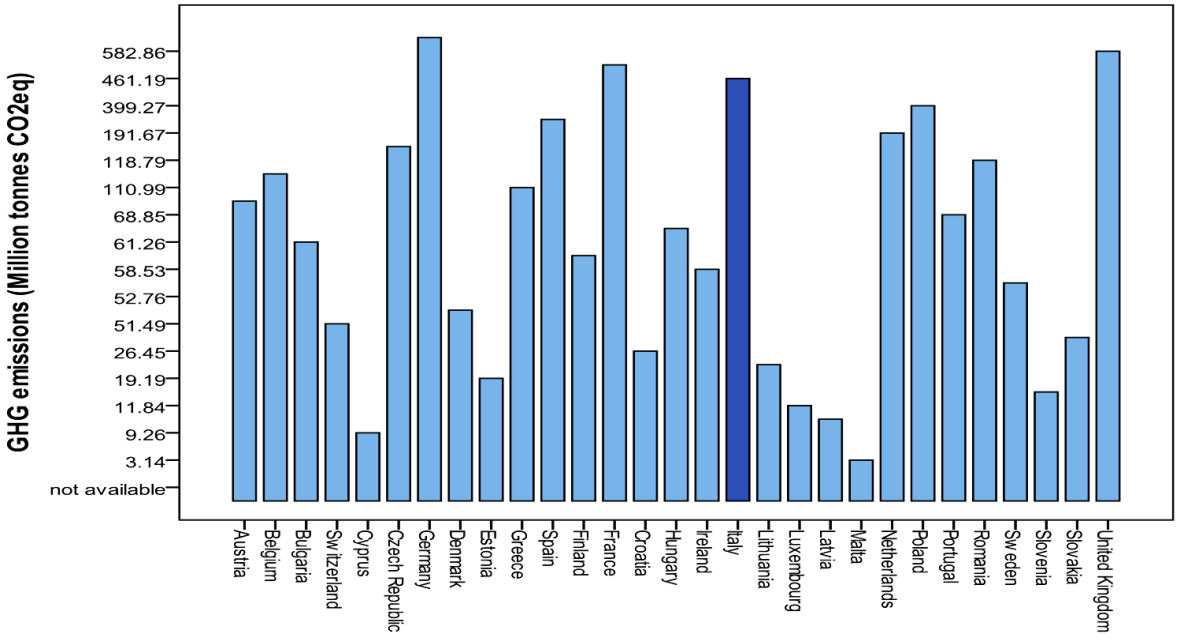

Chart 2-1: EU 28 GHG emission 2012, data from Eurostat-EEA statistics

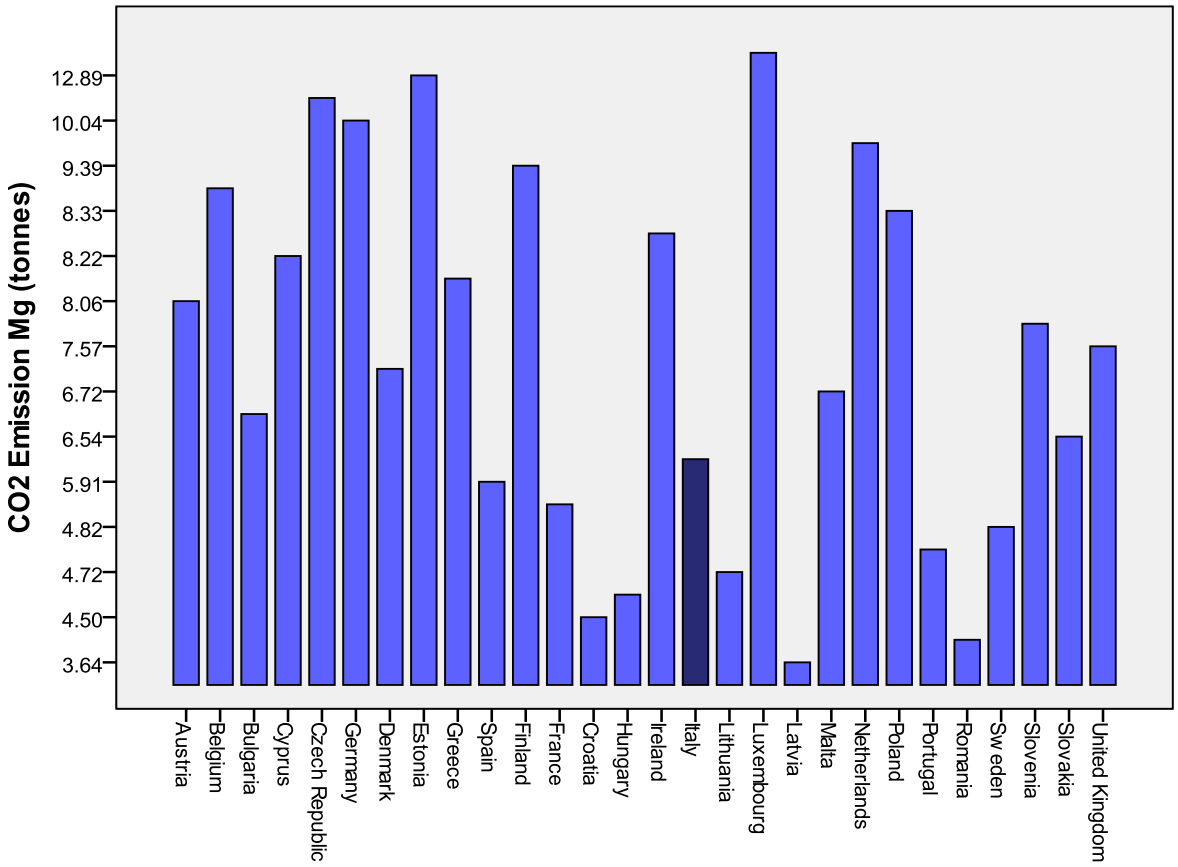

Chart 2-2: EU 28 CO_2 emission 2012, data from Eurostat-EEA statistics

The great part of emissions belongs to energy industries (32.5%) and transportation (27.1%). Non-industrial combustion accounts for 21.2%, and manufacturing and construction industries share is 13.9%, while the remaining emissions derive from industrial processes (4.4%) and other sectors (0.9%), as it can be seen in the pie chart (ISPRA, 2013).

Transport emissions in Italy

In Italy, the main sectors responsible for the increase in CO_2 and other GHG emissions are transport and energy industries due to an increase in the number of vehicles and mileages driven in the road transport sector and to increased production of energy; Saija et al (2000) noted that based on estimates at national level, transport has been the main source of pollution in urban areas with regard to different pollutants, such as NO*x*, CO and PM (particular matter), (Saija et al., 2000).

Emissions from transport have increased by 15.0% from 1990 to 2011 and the transport sector is responsible for 28.1% of GHG emissions (ISPRA, 2013). It should be noted that from 1990 to 2012 the most significant increase, in terms of total CO_2 equivalent, is observed in transport compared with other sectors (ISPRA, 2014), although since 2007

road transport emissions slightly decreased. **Chart 2-3** shows the relevant trends of road transport GHG emission between 1990 and 2012 (ISPRA, 2014).

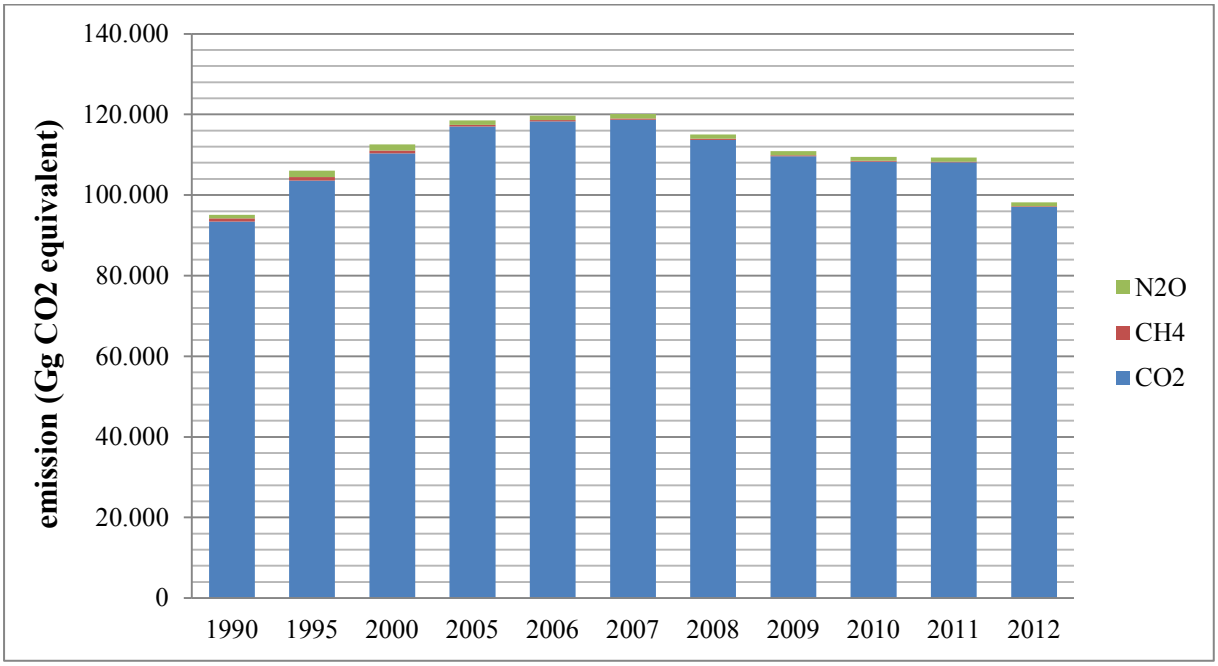

Chart 2-3: Road transport GHG emission trends between 1990 and 2012,

Source: ISPRA, 2014

Like the existing global trends, transport sector is the second CO_2 emitting sector after energy industries. **Chart 2-4** shows the share of transport sectors CO_2 emissions in comparison with other sectors in Italy at 2014.

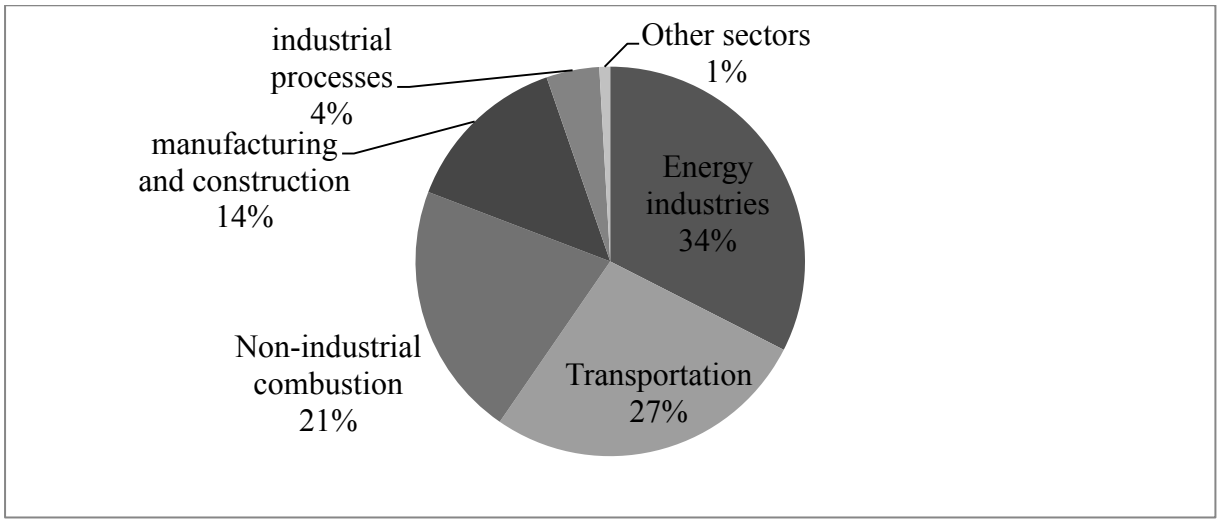

Chart 2-4: Transport CO_2 emission share in comparison with other sectors,

Source: ISPRA, 2014

This statistics show that despite mitigating efforts based on Kyoto protocol, the emissions from transport sector still has an increasing trend. It is noted in ISPRA report (2013), that

the increasing trend in emissions reflects the huge fuel consumption in transport sector (ISPRA, 2013). The reason behind the above fact is the increased mobility demand and the fossil fuels consumptions in this sector. According to the report published by Ministry for the Environment, Land and Sea (2009), in Italy the increase of vehicles fuel efficiency is not able to balance the increase of transport demand and car displacement. However, efforts undertaken by car industry subsequently to European regulations in order to reduce car's CO_2 emissions, will contribute to reduce these tendencies.

2.2 Mobility Trends

Urban mobility is an environmental issue, not only for local interventions, but also in international guidelines (CEC, 2006 and 2007; ECMT, 2002a and 2002b) and in national legislations, is the case of French and Italian laws on Urban Mobility Plans, and of the last generation of UK Local Transport Plans, among other countries.

Italy is a relevant case to study urban mobility, not only because of its high population density, economic activities, and urbanization, but also because of a lifestyle and mobility patterns which is largely based on the private car, as well as for its frequent breaches of the European Union's (EU) rules and laws, which have progressively emphasized the integration of environmental issues with economic and social ones (Dansero and Bagliani, 2011).

Regarding the environmental problems, air pollution is among the most important environmental problems of Italy, especially in some cities which suffer pollution caused by industrial activities in addition to transport emission and pollutions. The reports of Legambiente on pollution in the Italian cities (2010) showed that the pollution levels are increasing in big cities year by year. The comparison based on 125 environmental parameters among the Italian cities places the big cities in the lower positions of the classification[22] (Gargiulo, 2011). One of the main environmental causes of air pollution is car traffic which is due to vast use of private vehicles. The increasing number of cars registered in Italy shows the preference towards private means of transportation (motorization index in Italy 60.6 motor vehicles per 100 people vs. 47.3 in EU27) mainly because of the inefficiency of Local public transport (Perretti, 2014).

Brown et al (2003) introduce the main trends occurring in relation to mobility as follows:

[22] 2010 Legambiente Report, carried out with the scientific support of Ambiente Italia and the collaboration of the Sole 24 Ore

- **Urbanization Trend** has increased dramatically up to 50% in developed countries in the last 50 years (UNPD, 2002) and that means more cars in the urban area.
- **Sub-Urbanization Trend** in the big cities (the reduction in population density of urbanized areas) is 30% down in the period 1960 - 1990 (UNPD, 2002). It means that though people move to the big cities, they choose to leave in the suburb area. The effect is the increase of the car use to go to the city centers and back;
- **Vehicle ownership Trend** that increased according to the income. In Italy, for example there were 3 cars per 10 persons in 1980; while in 1995 the ratio was 6 cars per 10 persons (Schafer and Victor, 2000).

2.2.1 Urbanization Trends:

In a normal weekday in the year 2013, the total trips of adult Italians (aged between 14-80) is about 100 million trips which shows an increase about 2.8% compared to 2012, and the volume of passengers-km (total distance travelled) shows more significant increase, of about + 9.6% (from 1.26 billion in 2012 to 1.38 billion in 2013). But looking at the longer period revealed that after the increasing trend between 2000 and 2008, the number of urban trips as well as total passenger-km travelled decreased between 2008 and 2012, and mainly after 2010, maybe because the economic crisis has changed the mobility patterns by affecting the economic and industrial activities. **Table 2-1** shows the dynamic trend of mobility demand between 2000 and 2013 (Asstra and Isfort, 2014).

	2000	2008	2009	2010	2011	2012	2013
Number of total trips	126.2	128,1	125,4	123,8	106,6	97,5	100,2
Total Passenger-km	1216.2	1561.0	1432.8	1381.4	1302.2	1261.2	1381.8

Table 2-1: Dynamic trend of mobility demand (2000-2013), values in million trips

Source: Isfort, Osservatorio "Audimob" sulla mobilità degli italiani

By going further back, to analyze the trends of 1980s to 2000, the trends show the significant raise of passenger transport demands which represents the actual demand increase formed during 80s and 90s. The same trend, with a smooth slope, can be observed for freight transport demands (**Chart 2-5**).

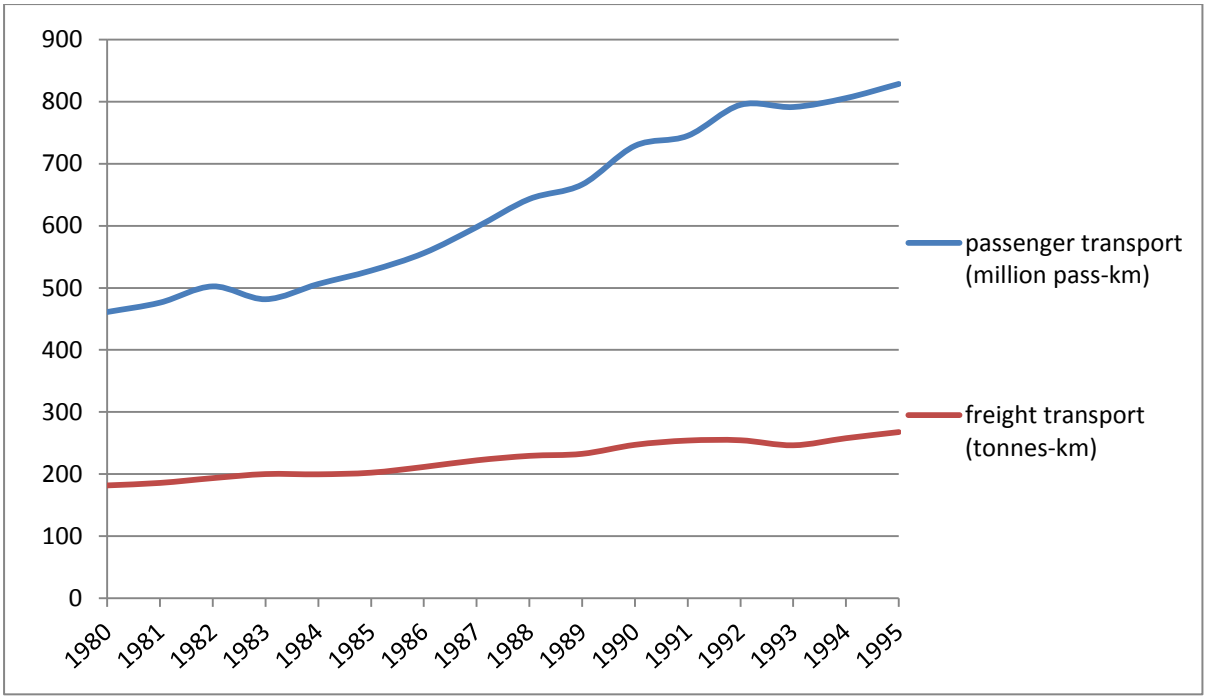

Chart 2-5: passenger and freight transport demand (1980-1995)

Source: Conto Nazionale dei Trasporti (1997)

2.2.2 Sub-urbanization Trends:

Although the archetypical European (and Italian) city structure presents the characteristics of the compact city which is densely inhabited, with a rather strong urban identity and a high "relational density" that cause the traffic congestion in city centers (Camagni et al., 2002), major Italian cities have experienced a process of sub-urbanization and decentralization that has gradually led to the formation of many dispersed urban areas (Sforzi, 1997). Thus causes the increasing trends of extra-urban trips (**Table 2-2** shows these variations). Sub-urbanization and decentralization accelerated by the economic crisis that pushes parts of the population to the suburbs and extra- urban areas in search of less expensive housing and living conditions (Asstra and Isfort, 2014).

	2008	2011	2012	2013	% of variations	
					2012-2013	2008-2013
Number of urban trips	80.2	69.9	58.6	59.1	-16,2	-22,9
Number of extra-urban trips	46.6	34.1	37.9	39.7	-4,7	-14,8
% urban trips to total trips	59.0	60.1	65.6	62.6	(-1,1)	(-3,6)
% extra-urban trips to total trips	41.0	39.9	34.4	37.4	(+1,1)	(+3,6)

Table 2-2: Share of urban and extra-urban mobility, Source: Asstra and Isfort, 2014

Although the number of extra-urban trips decreased between 2008 and 2013, the share of those trips increased in the same period. These trends are confirmed by comparing the share of short distance trips (inter-city mobility) to medium and long distance trips (which is usually in greater urban areas) (**Table 2-3**). The suburbanization patterns become more clear while comparing two main categories of short distance mobility statistics, intra city (10-50km) and intercity (up to 10 km) transport, where the public transport systems seem not to be able to provide the needs of the extra-urban inhabitants (Brown et al, 2003). **Table 2-3** clearly shows that the share of intra-city transport significantly increased during the period 2000-2013, comparing the share of intercity transport at the same period.

	2000	2008	2011	2012	2013	% of Variation (2000-2013)
Share of urban trips (up to 10 km)	79.8	73.2	72.5	70.4	68.9	-10.9
Share of medium distance trips (10-50 km)	18.1	26.6	24.6	26.6	27.7	+9.6
Share of long distance trips (over 50 km)	2.1	3.3	2.9	3.0	3.3	+1.2

Table 2-3: Share of short, medium and long distance trips.

Source: Asstra and Isfort, 2014

Also the average trip length which has almost doubled (from 7,7 km to 13,8 km) from 2005 to 2013 confirms the process of distance expansion due to sub-urbanization.

2.2.3 Private vehicle Trends

Increasing travel needs in urban areas caused the increasing rate of motor vehicle and especially private car ownership (Ingram and Liu, 1997; Chin, 2000; Dimitrov, 2004; Hayashi et al, 2004, Beirão and Cabral, 2007). The extensive and intensive use of cars as the main means of transport is one of the main reasons for socio environmental concerns. Though the CO_2 emission per vehicle has been decreased in the last years in consequence of better combustion engine technologies, the increase of cars used and sold negatively compensate these technical improvements.

Nowadays private cars account for around 80% of total inland passenger transport trips, both in Europe and in Italy, which is a considerable amount comparing to the share of public transport (**Chart 2-6** represent these trends between 2000 and 2013). The fact that private vehicles currently are more than a transport mean (Steg, 2005), represent a social status rather than a mobility need, along with other advantages such as flexibility,

freedom of movement, and low operational and maintenance costs, brought them to become the preferred means of transport (Mackett and Robertson, 2000; Rietveld, 2000; Thorson and Robusté, 1998). So, it is difficult to convince people to abandon this commodity, especially in cities where public transportation is deficient (Hiscock et al., 2002).

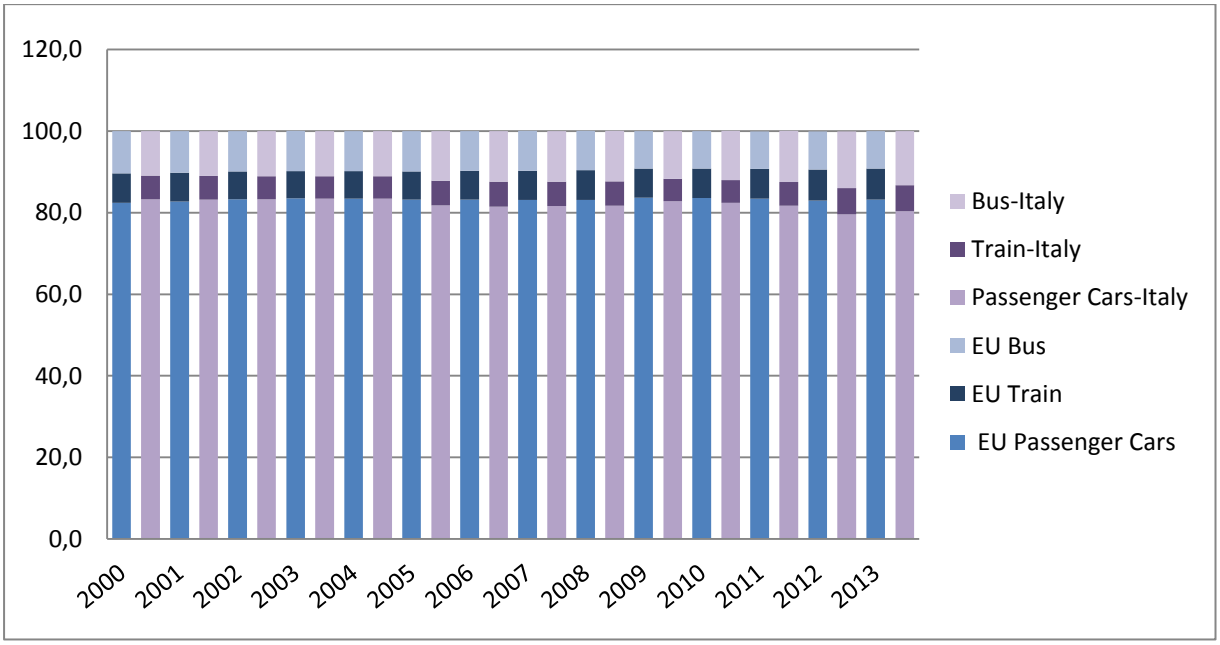

Chart 2-6: Inland passenger transport trends based on different modes (2000-2013)
Data source: Eurostat, 2014

Increasing rate of private vehicle ownership caused the concentration of air pollutants in urban areas and urban traffic is responsible for 40% of CO_2 emissions and 70% of other emissions from road transport in the EU (European Commission, 2013).

Among the strategies adopted to reduce Carbon emissions, one of the main strategies is prohibiting the cars to enter the historic centers of cities, with the creation of limited traffic zones (ZTL, zona traffic limitato). Thus greatly helped in reducing emissions, as reported in a study carried out in Milan metropolitan area (Invernizzi et al. 2011). Still, further policies, strategies and plans are needed to find ways and means to reduce the tendency to use private vehicles especially in central and southern cities, where there are not enough bicycle tracks and walking paths (ISPRA 2012, p. 322–323).

The strategies and experiences of local governments will contribute to the discussion in chapter seven, while discussing the research findings. Before that, in the next chapter, the image of future sustainable mobility systems and efforts for achieving sustainability will be reviewed.

Chapter3:

Desired System Scheme

The previous chapter described the current state and existing problems of urban mobility system, in the world and in Italy, being the latter the study context. This chapter focus on sustainable urban mobility defining the desired state of urban mobility in future; so in the first section a review of sustainability literature, its application and defined objectives in transport sector and urban mobility context will be analyzed. Then, the institutional policies and plans to reduce the emissions of urban mobility system will be reviewed both at global and national level. The last section introduces two main actions and strategies for achieving sustainable low Carbon mobility: mobility management (focused on demand management) and transport planning. these two strategies aimed at mapping the future state of sustainable urban mobility and how they could be achieved.

3.1 Sustainable Development

Sustainable development concept gained the attention of international society with a report published by the World Commission on Environment and Development in 1987, named "Our Common Future", which is also known as the Brundtland report. Nevertheless, before that, sustainability had been discussed in some events like UN Conference on the Human Environment in Stockholm (1972), in some reports (key report to the Club of Rome, by Meadows et al. (1972) or in academic studies (e.g. Solow1974; Hartwick 1977; Caldwell, 1984; Thompson, and Warburton, 1985).

In the Brundtland report, sustainable development is defined as the development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED[23], 1987, paragraph 27). This definition emphasize on applying solutions that protect the interests of future generations (Goldman and Gorham, 2006).

Daly (1991) defines sustainable development as an approach that satisfies three basic conditions:

A. The use of renewable resources does not exceed the rates of regeneration;
B. The use of non-renewable resources do not exceed the rate at which sustainable renewable substitutes are developed; and
C. The rates of pollution emission do not exceed the assimilative capacity of the environment.

By 1992, sustainable development hits center stage, when the United Nations convened the Conference on Environment and Development in Rio de Janeiro (often referred to as the "Earth Summit") – organized around the principal themes "environment and sustainable development". The idea of sustainable development then begins to take on a broader perspective than simply one of environmental concerns, and by the 1990s the "three dimensions" of sustainability come to the fore: environmental, economic, and social (or equity) - the so called three E's of sustainability which is described by Elkington (1997) as Triple Bottom Line (TBL) theory. In the last two decades, sustainable development is commonly seen inside three main dimensions of TBL theory.

[23] World Commission on Environment and Development

3.1.1 Sustainability in Transport Sector

In 1996, Gudmundsson and Hojer highlight the concerns about the environmental impacts of transport activities and highlighted the environmental impacts generated by the transport systems, due to their large-scale and diversity. The cited authors articulated the sustainable development goals in four different principles that they consider as equally important:

1) Preserving natural resources for future generations,
2) Preserving the option value of a productive capital base for future generations,
3) Improving the quality of life for individuals,
4) Ensuring a fair distribution of life-quality (Gudmundsson and Hojer, 1996).

Nijkamp et al. (1997) studied sustainability of transport sector, and based on the transport data trends, argued how transport sector is diverging from sustainability; thus, a lot of changes are needed to make the transport system more compatible with environmental sustainability (Nijkamp et al., 1997).

The definition by the UNEP (2011) on "green transport" presents a comprehensive perspective of "sustainable transport systems", which clearly refer to urban transport systems that supports:

1) Environmental sustainability through the protection of the global climate, ecosystems, public health and natural resources;
2) Economic sustainability through an affordable, fair and efficient transport system that promotes a sustainable competitive economy as well as balanced regional development and the creation of decent jobs, and;
3) Social sustainability by allowing the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health, while promoting poverty reduction and equity within and between successive generations (UNEP, 2011).

Some scholars who studied sustainable development believe that in order to achieve more sustainable development patterns, the economic approach should be shifted to the environment and social problem solving approach (e.g. Jacobs 1991; Common, 1995; and Roodman 1998). However, some others scholars believe that sustainable transportation need to be framed as a tripartite framework that balances all different dimensions of sustainability (WCED 1987; OECD 1997; Litman, 2005; Isfort, 2006; Nicolas et al., 2003). Among them, Litman (2011) defined the goals of sustainability in transport sector applying TBL dimensions (**Figure 3-1**).

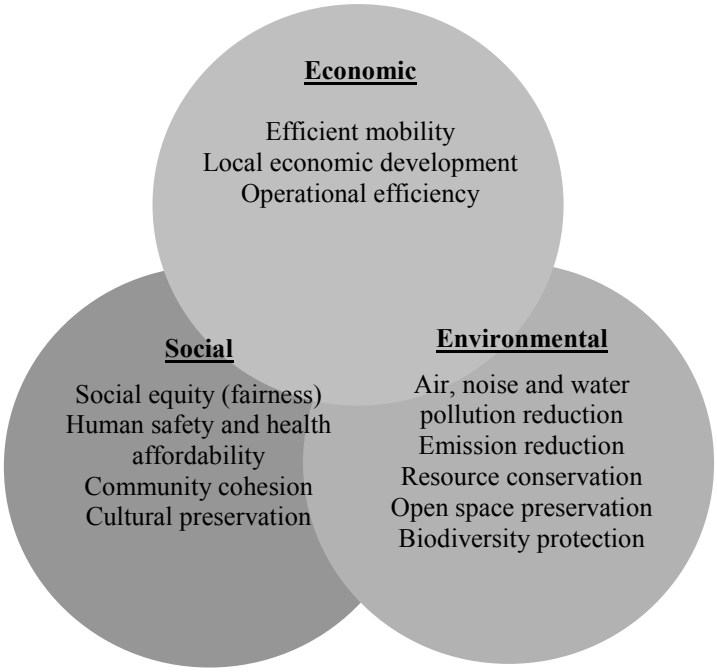

Figure 3-1: Sustainable transport goals (Source: Litman, 2011, p. 3)

In his work, Litman (2011) mainly focused on environmental sustainability dimension, in which climate change challenge highlights the need to reduce GHG and Carbon emissions from transport sector. However, the author considers that it is impossible to neglect the social and economic aspects, whose dimension and implications will be discussed where it is needed.

3.1.2 Sustainable Urban Mobility: Incumbency and Objectives

More than 50 percent of the world's populations currently live in urban areas in Europe, this amount is more than 70 percent that is expected to be over 80 per cent urban by 2050 (UN, 2014);. For many cities, traditional transport comprises a sizeable percentage of total Carbon emissions. It also contributes to air pollution, poorer health, and resource inefficiencies in the form of higher oil prices, traffic jams, etc. Until the end of the 1970s, the concept of mobility was predominantly seen as a matter of transportation services provision. Thus, the main problem faced by transportation planners was to match infrastructure supply with transportation demand, for both goods and passengers. In recent time, the new approach to mobility is based on the assumption that the mobility problems are not only a consequence of a limited physical access to the transportation modes. On the contrary, they involve complex environmental, economic, social and behavioral issues. These are directly connected to the urban planning of the city, to

financing issues, and to a managerial system approach to deal with mobility issues (Da Silva et al., 2008).

From the economic perspective, urban mobility is an important contributor of economic growth, considering the role it plays in business activities. While transport is considered a condition that enable the economy to grow, if not well managed, it can also retard both growth and effectiveness and efficiency of essential services' delivery. The rapid increase in urbanization's rate and the increasing number of daily trips caused many transport related problems in urban areas (congestion, pollution, noise and emissions). These problems deeply contribute to determine high socio economic costs that severely impair the economic prospects of cities; so, sustainable mobility is considered as the major obstacle to a sustainable economic development (Shell report, 2012).

Regarding sustainability issue, cities highly affect world's sustainability (Wittmayer et al., 2014) and are considered as the key context for applying sustainable development and climate change policies and strategies. Cities are the origins of economic and cultural wealth, and the source of dynamic development that provides opportunities for technological, organizational, and social innovation (Sukhdev, 2009). The importance of cities is also expected to increase due to the role of metropolitan areas as growth centers of the emerging global service economy (McCormick et al., 2013). In this regard, urban development is the main topic at the center of political and scientific debates on environmental degradation and sustainability (Allegrini and De Santis, 2011).

Scholars and policy makers agree on the fact that effective and integrated solutions for sustainability can only be found - and efficiently implemented - through cities and urban areas (Dodman, 2009; UNHabitat, 2010; ICLEI[24], 2011; Wheeler and Beatley, 2010; Roseland, 1997). Many cities recognize this statement as relevant, and have adopted ambitious sustainability targets and agendas (Wittmayer et al., 2014). Different organizations published aims and objectives to be achieved to fulfill sustainable mobility. The World Business Council for Sustainable Development's (WBCST) "Sustainable Mobility" program refrains from providing a definition or specific policy vision, with defining a set of seven 'goals' to 'improve the outlook' sustainable mobility for before and after 2030.

[24] International Council for Local Environmental Initiatives: is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development.

1) Ensuring that the emissions of transport-related pollutants do not constitute public health concern anywhere in the world
2) Limiting transport related GHG emissions to sustainable levels
3) Significant reduction of the number of road vehicle-related deaths and injuries
4) Reducing transport-related noise
5) Mitigate congestion
6) Narrowing the "mobility opportunity divides"
7) Preserving and enhancing mobility opportunities (WBCSD, 2004).

Banister (2005) emphasizes the identified problems of urban mobility and the need to assess their priorities. Furthermore, Banister introduces seven key issues to be addressed for achieving principles of sustainable development in transport sector: growing congestion, increasing air pollution, traffic noise, road safety, degradation of urban landscape, use of space, and global warming. Then, he adds three land use and development factors to those listed above: decentralization of cities, development pressures, and globalization and the relocation of industry. Finally, Banister (2005) suggests seven basic objectives to be met for achieving sustainable transport systems:

1) Reducing the need to travel
2) Reducing the absolute levels of car use and road freight in urban areas;
3) Promoting more energy efficient modes of travel for both passenger and freight;
4) Reducing noise and vehicle emissions at source;
5) Encouraging a more efficient and environmentally sensitive use of the vehicle stock;
6) Improving safety of pedestrians and all road users;
7) Improving the attractiveness of cities for residents, workers, shoppers and visitors.

In their work, Mameli and Marletto (2009) aligned the objectives of sustainable urban mobility to the dimensions of TBL; the resulting framework is summarized in **Table 3-1**.

Dimensions	**Objectives of Sustainable urban mobility policies**	
Social sustainability	Accessibility	Increasing the alternatives to mobility
		Easing non–motorized mobility
		Easing private motorized mobility
		Easing public transport
	Livability	Reducing public space occupied by motorized vehicles
		Reducing noise generated by mobility
		Reducing air pollutants generated by mobility
		Increasing transport safety

Environmental sustainability	Reducing greenhouse-gasses generated by mobility
	Reducing waste generated by mobility
	Reducing land consumption generated by mobility
Economic sustainability	Reducing public mobility costs
	Reducing private mobility costs

Table 3-1: Objectives of sustainable urban mobility policies

Source: Mameli and Marletto (2009)

Nowadays, one of the main challenges for achieving sustainability at urban level is the growing concerns about global climate change and ecological, environmental and resource problems (environment sustainability) (McCormick et al., 2013). These challenges are enhanced by the nature of cities themselves (Ernst, 2016), but transport activities are the main causes of un-sustainability patterns as they have a big share in producing such environmental impacts and yet not achieved the predefined sustainability objectives. Banister (2011) noted that ‘‘the empirical evidence may be limited’’ in proving that cities are moving towards a sustainable mobility paradigm. The considerable potential for reducing the Carbon use in cities is not (yet) exploited because of a ‘‘lack of clear vision and the seductiveness of following the high mobility option’’ (Banister, 2011, p. 1544).

The literature allows at arguing that in order to achieve sustainable urban mobility in the near future, the current mobility system should be changed into a more efficient, more reliable and less environmentally harmful one.

The Declaration towards Sustainable Transport in the CEI [25] Countries (UNEP/OECD/Austria, 1999) recognized that the need for developing policies towards sustainable transport has to be urgently addressed and that a new approach to that task is necessary. In particular, the call is for a new approach that places environment and health issues among the top priorities of the transport agenda, to ensure the full integration of environmental and health implications into transport development. However, after ten years from the declaration’s presentation, Raeva (2007) argued that there was still poor evidence of walking the talk towards sustainable urban mobility.

To achieve the sustainable mobility related objectives, detailed policy goals, specific targets, strategies and actions are needed. Considering the complexity of the context, this dissertation focused only on emission reduction context, in this regard, a review of

[25] Central European Initiative

international and national political plans and strategic actions for future low Carbon mobility paradigm will be presented in the next section.

3.2 Policies and actions on low Carbon urban transport

Carbon emissions are increased with an accelerated pace after 1990s. As Banister (2011) argued these trends are affecting the global climate with irreversible long term consequences. Some authors (Sprinz, 2009; Lempert et al, 2009; Huang et al, 2009) referred to it as the most significant long-term policy challenges in the world. Many countries set targets to reduce environmental emissions according to the international agreement of the UNFCCC[26] treaty.

Considering the climate objectives defined by EU, sustainable mobility policies and planning approaches emerged as an interesting policy platform suggested by European Commission. European Union emphasized on Sustainable Development as a priority political action (Euro- Cases, 1998). Different guidelines and strategy framing documents have been delivered by the European Commission to present the framework for strategic actions at urban level, such as the Transport White paper and the Green paper series.

3.2.1 International policy approach

The international society has a serious intention for reducing GHG emissions and specifically reduce CO_2 emissions from burning fossil fuels. To this regard, a number of reports and calls have been published by international committees which set targets to reduce environmental GHG emissions. Among them, UNFCC[27] treaty (1992) provides a structure for intergovernmental efforts to tackle the challenge posed by climate change. It is the first effort and its ultimate objective is to stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Others calls came from the IPCC assessment reports (1990, 1995, 2001, 2007 and 2014), the Conference of Parties (COP), and the most famous one, from Kyoto protocol (1997) under which certain industrialized countries agreed to define a cap on their emissions of CO_2.

The EU committed to reduce its collective GHG emissions by an average of 8% below 1990 levels by the period 2008-12 (EEA, 2009, p. 9). The transport white paper[28] (2001) presents European transport policies for 2010 that suggest specific measures for transport

[26] United Nations Framework Convention on Climate Change
[27] United Nations Framework Convention on Climate Change
[28] European transport policy for 2010: time to decide

sector at EU level. Green papers are another group of documents published by the European Commission that invite the relevant parties (institutional bodies or individuals) to participate in a consultation process and debate to stimulate discussion on defined topics at the European level. OECD/Italy (2013) recommended comprehensive strategies to speed up tge implementation of plans for investment in urban public transport infrastructure and multimodal freight networks (OECD/Italy, 2013).

Among the policy documents, the green paper entitled "Towards a new culture for urban mobility" specially focus on urban mobility and promotes greener cities, smart mobility and accessibility, safety and security in urban transport (EC, 2007). In 2009, the European Commission adopted the Action Plan on urban mobility (COM, 2009. 490/5). After that a newer version of Transport White Paper was published, entitled "Roadmap to a Single European Transport Area- Towards a competitive and resource efficient transport system"; it presented the European transport vision for the future, until 2050. The transport white paper recommended profound changes in the strategic planning, and proposed a series of objectives and real measures that focused on transport integration (EC, 2011).

One of the main framework proposed for strategic actions is the so-called "Avoid-Shift-Improve" approach, introduced by Dalkmann and Brannigan (2007), and applied by many other scholars (Bongardt, 2010; GIZ[29], 2011; Lindfield and Steinberg, 2012; Nakamura and Hayashi, 2012; Bakker et al., 2014). The "Avoid-Shift-Improve" approach states that infrastructure should be provided in such a way that: unnecessary travel demand is reduced or avoided, then travel is shifted to more economic and environmentally-friendly low Carbon modes, and finally the intensity of transport-oriented emission (vehicle fleet and fuels) improved by technological measures.

In 2007, the EU Member States agreed on the "20-20-20 targets" which is adopted through smart cities plan. The recent adoption of the EU Smart Cities and Communities initiative aims at reducing Carbon emissions and improving the energy efficiency performance of the city. It is touting a number of initiatives, in view of the objectives that EU has set in relation to the Strategy 20–20–20 to be achieved by 2020 (−20% in greenhouse gas emissions compared to 1990, at least 20% of energy consumption from renewable sources, and −20% of energy consumption) (Malik et al., 2013).

[29] Deutsche Gesellschaftfür Internationale Zusammenarbeit

The Smart Cities strategy seeks to create virtuous circles for Europe to be regarded as an outpost of the world in terms of clean, efficient, and low-Carbon technologies, generating new lifestyles, integrated projects, and positive effects in terms of employment and sustainable economic growth. While in the short term the Smart Cities strategy can result useful in promoting the transition to a society with low environmental impact, in the long run different ways of thinking about mobility, production, and consumption have to be made, starting from the energy sources and the methods of production and consumption of materials.

Another policy target for emissions' reduction is the "2030 targets" of the EU, based on which the EU-wide CO_2 emission volume has to be reduced by 40% as compared to 1990 levels[30]. The share of renewable energy is expected to be increased to 27% across the EU. Finally, the so called "2050 objective" of the EU prescribe the reduction of greenhouse gas emissions in the EU by 80% to 95% versus 1990[31].

3.2.2 National Approach (in Italy)

Policies and plans for growth and sustainable development in Italy are based on European strategies (Europe 2020 and Europe 2050) which includes programs, directives and regulations for the protection of the environment, and they also represent the drivers for competitiveness and growth of the Italian economy (EPOMM[32], 2013; KpVV[33], 2012).

The Environmental Strategy for Sustainable Development (ESSD), adopted in 2002, was the key strategic document defining Italy's priority areas for the 2000s. It was approved by the Inter-Ministerial Committee for Economic Planning[34], Italy's main body responsible for co-ordination and horizontal integration of economic policies. ESSD included specific objectives, targets, indicators, monitoring and participation procedures for climate change and ozone layer protection; sustainable management of nature and biodiversity; improving the quality of the environment and life in cities and rural areas; and sustainable management of natural resources (OECD-Italy, 2013). The role of the ministries is to fix and implement the national policies, regulations, incentives, etc., for environment and the climate change through grants, incentives, specifically for the automobile market and cleaner fuels.

---

[30] 2030 climate & energy framework, http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm
[31] http://ec.europa.eu/clima/policies/strategies/2050/faq_en.htm
[32] European Platform on Mobility Management
[33] Kennis platform Verkeer en Vervoer
[34] Comitato Interministeriale per la Programmazione Economica, CIPE

Italy's national strategy for reducing GHG emissions from transport sector focused on measures aimed at three main goals:

- Reducing average CO_2 emissions from the vehicle fleet;
- Increasing the use of biofuels; and
- Developing local public transport infrastructure and services, as well as infrastructure for long distance rail and sea shipping (OECD-Italy, 2013).

According to OECD environmental performance report, Italy lacks a comprehensive transport strategy aimed at rebalancing the modal split of both passenger travel and freight haulage, although many national transport infrastructure plans have been developed up to now (OECD-Italy, 2013)

There is no single solution for achieving sustainable transport systems and a wide range of possible options should be implemented from which cities may be inclined to choose one or a combination of them depending on the particular situation of each city. The choice of strategies depends on the community's demographic, geographic and political conditions. Litman (2003) argues that it is usually the best to implement a variety of strategies, where most individual strategies have a modest effect on total vehicle travel; it is the cumulative and synergetic impacts[35] that generate the improvement in the urban transport (Litman, 2003).

3.3 Actions, Strategies

The climate change policies refers at decisions mainly at international and national level, and fix the general targets and objectives. Strong international policies focusing on emission reduction requires subsequent actions at local, national and international level. This section briefly reviews the future policies for reducing Carbon emissions.

While a policy refers to a guide of thinking and action for making decisions, the strategy is more related to the direction in which human and physical resources will be deployed and applied with the aim of maximizing the chance of achieving defined targets. Strategies are mainly used by lower management levels (national, local and organizational authorities), while policies are set at the international level, by international institutions. Focusing on strategies, the following sub-sections present two broad strategic approaches used for achieving sustainable mobility systems: mobility management and mobility systems.

[35] The cumulative impacts of a set of strategies are greater than the sum of their individual impacts

3.3.1 Mobility Management

One of the main challenges of transport and mobility management is to meet the increasing mobility demands in cities while reducing traffic congestion, environmental and social impacts of transport system (IPCC, 2014).

Until the early 1990s, the main approach to deal with negative impacts of transport was large-scale infrastructure investment such as the building of roads or parking spaces, or the construction of tramways or subways. It was generally supposed that a growth in the volume of traffic is linked to economic growth. Particularly, in the late 20th century, the expectation of transport infrastructure was accompanied by a continual growth in demand, which has failed to reach saturation point and led to the considerable overloading and impairment of urban road and public transport systems. Even the introduction of intelligent transport systems (ITS), particularly in the last few years, has not fundamentally changed traffic conditions in cities. Traffic planners realized that hardware and supply oriented approaches are not the best ways to address the continually increasing demand for transport. This coincided with the need to reduce the expenditures on transport infrastructures because of growing budget constraints, so new solutions to the problems associated with the perpetual growth in transport demand had to be found, and the idea of influencing the demand itself emerged as a new element in transport science (Gronau and Kagermeier, 2004).

Mobility management is an approach oriented to the management of transport demand, which develops and implements strategies to ensure the mobility of people and the transport of goods efficiently, with regard to social aims, environmental and energy saving. Litman (2003) addressed mobility management as the management of transport demand which emphasize on the movement of people and goods, not just motor vehicles, and so gives priority to public transit, ridesharing and non-motorized modes, particularly under congested urban conditions. It is made up of different approaches and techniques that change travel behavior in the increasing and growing number of transportation system performance.

Therefore, the purpose of mobility management is to adapt the procedures for identifying the measures and actions planned to change mobility needs, such as elements of strategic value and the techniques commonly used for the market introduction of goods or services. Any new transport service, traditional or alternative, goes through the stages of market segmentation and identification of the different target groups and aims to affect the choice of citizens toward more efficient, environment friendly transport modes.

According to OECD/ITF report, mobility management is a short term demand oriented approach to promote and enhance sustainable mobility. It aims at encouraging the citizen's behavior toward more sustainable transport modes and alternative travel choices through the actions which are based on information, communication, motivation, organization, coordination and promotion (OECD/ITF, 2010[36]).

As Litman (2003) pointed out, there are many potential mobility management strategies with different impacts. Some of them improve transportation diversity (travel options available to users); others provide incentives for users to change the frequency, mode, destinations, route or timing of their travel. Some reduce the need for travel; some involve policy reforms to correct current distortions in transportation planning practices. In literature, the researchers who support a mobility management strategy argue that the effect of mobility management on energy conservation and emissions reduction is more economical and efficient (Burbank and Brinckerhoff, 2009; USDOT, 2010; Gross et al., 2009).

It could be concluded that the ultimate goal of mobility management is to influence travellers' behavior through decreasing private car travels and promoting public and clean transport modes like walking, cycling and rail transport. This emphasizes that mobility management does not intend to eliminate car travel, but rather, to considerably reduce the (still increasing) amount of personal vehicle travel, particularly in urban areas.

In order to implement the mobility management strategies, establishing a solid partnership among all the relevant stakeholders is very importance. This is especially applicable when setting up of a mobility center, which works as a common platform for coordinating mobility measures and services while also securing communication and information flows.

Mobility management in Italy:

Italy's climate change policy has largely been developed in the framework of EU climate and energy policies, and the central government has overall responsibility for climate policy (OECD, 2013). The Ministry of the Environment, Land and Sea (MATTM) is the highest level authority with regard to environmental policies. Its operational objectives are related to the publication of national legal acts, the participation in the international initiatives dealing with environmental protection and the implementation of EU

[36]Effective Transport Policies for Corporate Mobility Management, By OECD, International Transport Forum

environmental policies. Since 2011, the MATTM has reported annually on Italy's progress in meeting international GHG emission reduction commitments in the "Economy and Finance" Document. In 2012, the MATTM presented a draft plan for achieving the EU-related target to 2020. This plan overcomes the weaknesses of previous plans and integrates the measures foreseen in the national plans for renewable and energy efficiency, as well as regional actions supported by EU and national funds for regional development (OECD, 2013).

Mobility Management starts to became popular in Italy from "Ronchi Decree" on "Sustainable mobility in urban areas", enacted by the Ministry of Environment, land and sea, at 27 March 1998. The Decree is one of the first initiatives established by Italian government in accordance with the commitment to Kyoto Protocol on climate change. This Ministerial Decree made it compulsory to formally define a company head of mobility in all those organizations with over 300 employees in one single unit, or more than 800 employees spread across a number of local units. The aim of the decree is to engage business and workers in identifying alternative measures to the use of private vehicle and the responsibility of mobility manager is to optimize the trips of employees with the aim to reduce private car use, and adopt the "Plan of Home-to-Work" (Bertuccio et al., 2001).

The mobility management strategy is able to coordinate the demand on different transport modes and the different services provided both to private and public mobility (focus on walking, cycling and disabled people), that is exactly what the EU asked for: a balanced development of all relevant transport modes[37]. At the organizational level, as defined by the Ronchi Decree, the mobility manager has the simple task to facilitate the movement of employees through systematic trip home to work using low impact measures. In this regard, the mobility manager is supported by the mobility manager of area, who works at municipal or provincial level to support wider management of sustainable mobility, promoting sustainable transport and changing travelers' attitudes and behavior to all citizens (Bertuccio and Cafarelli, 2011). A second decree enacted at 20 December 2000, by the Ministry of Environment, promotes a series of programs to assist municipalities and public institutions, for co-financing projects in order to promote policies on mobility management. They provides structural funding for mobility management and expanded the scope to school travel, travel plans for all highly-frequented sites, and mobility

[37] http://www.newslettereuropean.eu/sustainable-urban-mobility-new-metropolitan-lifestyle/

managers for entire areas (EPOMM, 2013, and KpVV, 2012). Also, the mentioned decree consider incentives for implementation of mobility management strategies through funding municipalities or group of municipalities. Developing urban transport systems in Italy is the responsibility of regional and local authorities (OECD, 2013), in this regard mobility management predominantly understood and carried out as a local activity. The policies of the Ministry of Environment have been included in a framework of actions to govern the demand of mobility, aimed at gradually discouraging private transport, promoting the use of fuels with low environmental impact, and the improvement and diversification of the offer of transport (EPOMM, 2010).

Once the strategies have been defined, there is a need for plans to describe how they should be implemented. The Mobility plan, that is introduced as the comprehensive guidance document, indicates how a mobility management scheme in a specific context should be implemented. The mobility plan is based on an analysis of the practical experiences about city's travel patterns and transport situation, and leads to the elaboration of specific goals, setting of a time plan and detailing of exact measures and methods of implementation (TRT[38], 2009).

3.3.2 Transport Planning

Any change to transport and mobility systems should be made after exploring all aspects of the problems and solutions or possible alternatives. While strategies often express long term or short term objectives, and the desired view of the system, plans have more detailed expressions about the goals, actions, and assessment methods. Mobility plans integrate quantitative tools with specific policy objectives, in order to develop strategies for shifting the mobility patterns toward cleaner, safer and more convenient systems.

Transport planning emerged as a central component of policy discussions at national and sub-national levels and the efforts to tackle climate change are discussed widely in urban sustainability debates (EC, 2010; Lundqvist and Biel, 2007). European Commission highlights the role of effective urban transport systems as a facilitator for growth in achieving sustainability objectives[39] (e.g. UN-Habitat, 2011; UN, 2010).

Traditional transport planning mostly focused on improving mobility and rarely considered wider impacts (Litman, 1998). These days the new paradigm of "green

[38] Trasporti e Territorio

transport planning" gained the attention of international society, which aims at reducing traffic congestion, environmental pollution, promoting social equity and save construction costs by modifying existing transport services and introducing innovative green transport options. This new concept has an important role in guiding for transport development in urban areas and is an effective mean to achieve the sustainable development of urban transport (Pan, 2012).

The Mobility Plan is a comprehensive and guiding document that indicates how to implement mobility management scheme in a specific area. It sets out the aims to be reached and the measures to be taken; identifies how will the measure be put into practice and who is responsible for their implementation within a certain time period. The explicit character of the document is motivating and convincing for prospective financiers and provides a base for later evaluation (Wilhelm and Posch, 2003).

Urban Mobility Plans in Italy

Urban transport plan, according to the Italian national Law n.340/ 2000, have the specific aim of improving the traffic situation in the cities. Mobility plans consider all modes of transport planned towards a sustainable urban development approach. The measures implemented are a mixture of material and immaterial interventions with the aim to reach a better traffic environment with reduced traffic volumes and emissions, increased accessibility and safety, and an increased quality of life for all citizens (Papa and Battarra, 2010).

The National Government has direct competence on the national roads and public transport networks (planes; inter-city, inter-regional and high speed trains; inter-regional buses; navigation). In the previous order the national Government was fully in charge of the railway network, while the reform transfers the functions related to local service to the regional administration, in accordance with the subsidiary principle.

National level consists of ministries, who are responsible for fixing and implementing the national policies by means laws, regulations, incentives, etc.). Mainly the ministries of transport, environment land and sea, infrastructure and economic development are engaged in transport and environment related policies.

According to European platform of mobility management, the actions enclosed in Italy's national guidelines aim to:

- Meet mobility needs of the population;
- Decrease the levels of air and noise pollution in accordance with the international agreements and national rules;

- ❖ Reduce energy consumption;
- ❖ Increase the level of safety of the transport;
- ❖ Minimize the use of private vehicles and moderate traffic;
- ❖ Increase the capacity of transport system;
- ❖ Increase the percentage of people transported by public systems, with solutions like carpooling, car sharing, taxis, etc..;
- ❖ Reduce congestion in urban areas characterized by a high density of traffic through the implementation of integrated transport system and infrastructure that are capable of fostering better regional planning and urban systems;
- ❖ Encourage the use of alternative means of transport with the lowest possible environmental impact (EPOMM website)[40].

The institutional structure in Italy assigns a relevant role to the regions. The authorities of the central government were partially transferred to the regions, whose role was implemented, one by one, after 1970[41]. Italy is divided in 20 regions and each of them has its own structure; the competences differ from Region to Region, especially in the Regions with special status (Friuli-Venezia Giulia, Sardegna, Valle d'Aosta, Trentino-Alto Adige, Sicilia). Regions are in charge of regional trains (regional services by train or sometimes coach), while the 110 Provinces[42] usually are engaged with coordinating municipalities in their area and are in charge of transport by road and coach (i.e. non-urban transport) (Emilia, 2011). They mainly host the mobility manager of the area. Normally, regions participate in the adoption of the general transportation plan, which is the responsibility of the inter-governmental Committee for economic planning; planning agreements among the Minister of Transportation, the regions and the interested local governments specify the project to be implemented and the required transportation's means, in order to achieve a better coordination between national and local systems.

Regions are responsible for planning, policy-making, regulating and financing the entire system of regional and local public transportation. Depending on the case, this involves both projects aimed at implementing or enhancing state projects as well as those requiring further participation of the local governments; this also includes autonomous regional decisions or decisions for which consultations are required, or even joint decisions with

[40] http://www.epomm.eu/endurance/index.php?id=2809&country=it
[41] http://www.mlit.go.jp/kokudokeikaku/international/spw/general/italy/index_e.html
[42] The provinces are sub-division of the Region. However, a 2014 law abolishes the provinces level of government. Thus, for the next future, roles and competences will have to be redesigned.

local governments and their representatives (Vesperini, 2000). The Regional Administration has competence on planning, financing and managing the regional train service; money transfers to Provinces and to the eleven Municipalities to subsidies bus services; planning, financing and managing the regional road network (Burla et al., 2001). At local level, **provinces** have competence on: planning and financing the inter-urban and urban bus network, outside the large conurbations; planning, financing and managing the local road network. With the reform Provinces are no longer solely in charge of administrative functions related to bus services but also of the planning ones, which were assigned before to the regional body. At the urban policy level the main Municipalities have competence on planning, financing and managing urban public transport by bus, tram and underground (Burla et al., 2001) different levels of government transport planning in Italy are presented in **Table 3-2**.

In line with decrees on mobility management and the policy of the Ministry of Environment, Local Authorities have the competence to promote mobility management measures and a local mobility management policy. By the decrees it is possible to establish an office of the mobility manager of area and encouraging companies to appoint a mobility manager and adopt a mobility plan. Since 2000, in application of Ministerial decrees, local authorities promoted municipal and provincial office of Mobility Manager of area (actually they are 67). Furthermore, some local authorities committed to offices of the mobility manager of the area the management of some mobility management measures (e.g. bike sharing, car sharing, cycling...) (Bertuccio and Cafarelli, 2011).

Level	Instrument	Objective	Territorial and Urban Planning
National	General Transport Plan	❖ Defining a common strategy for Italian transport policy ❖ Coordinating the tasks and implementing interventions between different levels of government	
Regional	Regional Transport Plan	❖ Defining a plan for integrated transport service; identifying new transport infrastructure that are required	Spatial plan with province coordination
Province/ Municipal	Urban Mobility Plan	❖ Defining long and medium term strategies aimed at redesigning transport supply between one or more municipalities	Spatial plan with province coordination
Municipal	Urban Traffic Plan	❖ Defining a set of coordinated initiatives to improve the condition of the road, pedestrians, public transportation and private vehicles in urban areas	municipal development plan
	Urban Parking Program	❖ Rationalization urban parking supply ❖ Meeting the parking demand without affecting the environmental quality	

Table 3-2: Levels of transport planning in Italy

(Source: La Rocca, 2011)

A) Planning at national and regional level: General transport plans (PGT)

The General Transport Plan (in Italian, Piano Generale dei Trasporti)[43] sets out national transport policies and defines the national guidelines for those policies. This plan also provides the improvement of rail transport, rationalization of road transport, privatization of the fleet and the adaptation of infrastructure to support the development of the sector and integrated logistics. The plan is revised every three year and a newer version was presented in 2000; it produces a review of the PGT after Europe leads the drafting of the White Paper and is known as PGTL (Piano Generale dei Trasporti e della Logistica-General Transport and Logistic Plan). The most important aspects of the new PGT are mostly related to the identification of targets that will remain fixed in time and the possibility of renegotiating the interventions on the basis of the financial resources that are made available each year. The review of the PGT put in the content of the plan is that of the regional changes as the national wording is called: **PRTL:** (Piano Regionale dei Trasporti e della Logistica-Regional and Logistic Transport plan). It is also upgraded according to White paper on transport, but present new concepts.

According to the National Account for Infrastructure and Transport (2001)[44], Italy's mobility management monitors addressed the actions supported by national mobility plans as follows:

- Mobility plans home to work and home to school
- Training on mobility management
- Discounts on public transport subscriptions reserved to employees
- Business transport services reserved to employees
- Purchase of vehicles with low environmental impact for public administration
- Carpooling
- Teleworking
- Survey on mobility demand

B) Planning at Local level: Urban Mobility plans

[43] It also defined the SNIT (Sistema nazionale integrato dei trasporti - national integrated system of transport) that defines national interests of entire transport network.

[44] Conto Nazionale delle Infrastrutture e dei Trasporti: Ministry of infrastructure and transport website: http://www.mit.gov.it/mit/site.php?p=cm&o=vd&id=1947

The national legislation on the issues of transport planning has introduced Urban Mobility Plan (PUM[45]) as an instrument in order for planning in greater urban areas with regard to medium and long time frames. The article 22 of the Law n. 340/2000 states that single Municipalities or group of Municipalities with more 100,000 inhabitants can receive a state funding up to 60% of the whole investment required by their Urban Mobility Plan (PUM).

The General Transport and logistics Plan (PGTL) introduces PUM as a "systematic project" based on the combination of investments and organizational management innovations to be implemented in different phases of a defined time period (ten years), that enables the local governments to manage the issues of mobility more effectively. It addresses the typical problems of densely urbanized areas with a high number of movements, which is usually caused the reduced commercial speed (Veneto Regional transport plan).

Another tool for planning at urban level is the Urban Traffic Plan (PUT); that is more regulatory and operational plan and is made compulsory for municipalities with more than 30,000 inhabitants since 1996. The Urban traffic Plan aims at enforcing regulations on private traffic issues, such as congestion or parking management, pedestrian, public transport and private vehicles, usable and feasible in the short term and in the case of equipment and transport infrastructure largely unchanged. According to the Ministerial Directives '95[46], PUT consists of three levels of design:

PGTU: which is intended as a preliminary for the entire town (main roads and local);

PPTU: that stands for the detailed plan, seen as the most complex areas of project;

PETU: which is going further to the executive actions, and is the executive plan for projects prescribed in the previous phases[47].

PUM is an evolution of former regulatory tools, the urban traffic plans (PUT[48]). PUM is not mandatory and municipalities with more than 100,000 inhabitants are suggested to define it, while PUT is compulsory for municipalities with more than 30,000 inhabitants since 1996.

---

[45]Piano Urbano della mobilita

[46] Direttive Ministeriali del 1995.

[47] "Nuovo codice della strada", Decreto Legislativo 30 aprile 1992 n. 285*, G.U. 18 maggio 1992, n. 114, S.O*

[48] Urban Traffic Plan is our translation of the document called in the Italian legislation Piano Urbano del Traffico (PUT).

In addition, the scope of the PUM is broader than the PUT's one, and it includes the provision of long-term strategies to manage private traffic, transit and parking, to develop infrastructure, to implement intelligent transport systems, to support 'niche' measures such as carpooling/sharing in a comprehensive way (see Figure 3.3). The PUM provides decision makers with the opportunity to manage all the mobility-related issues using just one planning tool. According to this approach, PUT becomes a mere regulatory tool to manage roads and private traffic, coherent with the general goals stated in the PUM (López-Lambas et al., 2013).

The Italian legislation (article 22 of the Law n. 340 of 2000) states that PUM is an integrated project on urban mobility including infrastructural measures on public and private transport as well as on demand management by means the network of the mobility manager. PUM is a strategic plan for the medium to long term, facing mobility problems whose solution requires "investments" and therefore financial resources and time required for implementation. The objectives substantially are in the same level of those provided by PUT and are pursued "to change infrastructure assets".

PUT, however, is a short-term tactical (operational) plan and it assumes "infrastructure assets unchanged" and organizes the most of the existing. It is, therefore, essentially a management plan. In this context, it is clear that the actions provided by PUM often arise from analyzing the criticalities unsolvable with PUT, and once implemented those PUM's actions, PUT must be reviewed since the entire infrastructure available is changed.

In the national planning document it is observed as the PUM has to find a synergistic integration with the programs of urban regeneration and sustainable development of the territory. Moreover, with regard to urban aspect, the PGT is noted that it is "essential that interventions under the PUM have the strength of variation of urban plans (PUM integrates them for its share of competence), the General Plan (PRG) and other plans (PRUSST, Integrated Plans, etc.).

In addition, the PUM – joint to mobility policies and forecasts - constitutes one of the elements relevant to the preparation of planning instruments and their implementation: the issue of mobility (even according to its environmental aspects), revised in the light of the issues of land use planning, can assume the value of "Standard" quality. This concept should be extended to the wide planning process, also based on the definition of the beneficiaries of the funding for mobility goals (Veneto Regional transport plan).

It can be concluded that, PUM is a long term strategic plan that forecast the required changes, but PUT is an operational plan that considers the existing infrastructures. Based

on its nature, PUT requires to go through frequents revisions; the implementation of the infrastructures brings at the PUT's update.

Currently, many municipalities entitled to implement such plans, show an asymmetric situation: they have the PUM already being enforced, whereas PUTs are still in the making. That situation could be the consequence of the nature of the plans; being the PUM just strategy setting, it does not require to be operational, while the PUT should have operational plans for the implementation of strategies. Thus, PUT is really relevant to the strategy implementation, consider that generally most of the strategies fails because of the weakness of the implementation phase. A comparison between PUM and PUT is represented in **Table 3-3**.

Differences	PUT	PUM
Size	Municipalities with more than 30,000 inhabitant	Municipalities or group of municipalities with more than 100,000 inhabitant
Type	Operational	Strategic
Level of obligation	Mandatory	Voluntary
Goals	Short term	Long term

Table 3-3: The differences between PUT and PUM

Based on the above institutional context and literature, the local level efforts is relevant in achieving low Carbon transport objectives, as well as how municipality's plans and strategic visions shape or change the transition pathways towards low Carbon urban mobility.

For this aim the theoretical considerations of change process (Transition Theory, Sociotechnical Approach, Multi-level Perspective and related remarks) will be explained in the next chapter and after describing the research methodology (in Chapter Five) the analysis of Italian municipal efforts will be presented in Chapter Six.

Chapter4:

Theoretical Framework

This chapter presents the theoretical background of the current research, shifting from existing mobility systems to more sustainable and less Carbon intensive ones. To this end, changes are needed not only in technologies, but also in policies, organizations, cultural patterns that are explained by the socio-technical system theory. Transition theory concept and related approaches are used to describe this change's process. One of the most used approaches in transition theory is the multi-level perspective that describes the transformation process in three hierarchical levels that have different pace, actors, and dynamics of change. Transition occurred in specific pathways that are the results of different transformative mechanisms, forces, resources and interactions among actors. Transition management is a framework that aimed at influencing the direction and speed of transitions arguing that it is not possible to fully control the transition process and pathways. At the end, the contribution of local government and the tools they use to affect transition process and pathways are analyzed.

4.1 The Change Process: Socio-technical Transitions towards low Carbon mobility

In order to move toward more sustainable systems and societies (emphasizing Carbon emission reductions), different initiatives and interventions upgrade infrastructure networks to reduce Carbon emissions and stimulate economic development (McLean et al, 2015); but structural changes are necessary in societal systems in order to achieve sustainable development goals (Kern, 2012). Skippon et al. (2012) argued that, even though essential for emission reductions, technological developments will not be enough on their own to enable sufficient reductions in cumulative CO_2 emissions from the road transport sector. The authors conclude that it is necessary to think beyond technological innovation borders, and consider other social, cultural, political factors in studying less Carbon intensive transport systems.

Scholars of Science and Technology Studies (STS) and Innovation Studies have developed a "quasi-evolutionary" approach to studying technological change based on insights from evolutionary economics (Van Den Bergh et al., 2011). In this model, the innovation process is characterized as a coupled dynamic of selective pressures and adaptive capacity in the dominant system "regime", in which a technology is embedded (Rip, 1992; Smith et al., 2005).

This mental change of current socio-technical systems toward more sustainable future planned configuration of "socio-technical regimes[49]" are described as "transitions toward sustainability" (Elzen et al., 2004). According to Geels and Schot (2010), it is important to distinguish transitions from (incremental) general change processes.

The concept of "socio-technical transitions" is defined as "a shift from one socio-technical system to another"; a radical shift (regarding the scope and not the speed of change), a long-term process that require multiple changes, involving multiple actors (Grin et al., 2010, p.11) and co-evolutionary perspective on changes in both supply and demand at the system level (Elzen et al., 2004). In transition studies, the term "socio-technical" emphasizes the co-evolution of social and technological relationships, while "transitions" refer to the dynamics by which fundamental change in these relationships occur (Graugaard, 2014). Based on socio-technical approach this change or transition

[49]This "regime" concept and definitions will be described later in this chapter

process is not driven only by technological innovations and requires combinations of new technologies, new organizations and institutional arrangements, together with changes in use patterns and culture (Vergragt, 1988).

Acknowledging that these processes take place in a multi-dimensional space - comprising institutional rules, economic requirements, political negotiations as well as social and cultural rules and expectations –the (re)configuration of social and technical elements by new innovations need to be analyzed. Socio-technical relationships that have become 'locked-in' to stable configurations are referred to as 'socio-technical regimes'. At this level, innovation processes tend to be incremental, i.e. new innovations are consistently adapted to suit the existing socio-technical configurations of the regime (Schot and Geels, 2008).

Multi-level perspective (MLP) is one of the most used frameworks that describes the process of these changes when radical innovations (that are called niches, in MLP) are nurtured and experimented in protected spaces, then transferred, diffused and translated into the new systems that exert pressure on various aspects of regimes. And in this way radical innovations shape their trajectory to replace, align, reconfigure or transformed[50] into new systems (regimes) that are expected to be more sustainable than the existing ones. The whole process is occurred in the context of broader evolutionary landscape that exerts pressure on the existing regimes and creates windows of opportunity for niches to new regime transformation. These concepts and related theories will be deepen in the current chapter.

4.2 Socio-Technical System Theory

In organizational development, socio-technical systems (STS) is an approach that recognizes the interaction between people and technology, while "Technical" is a term used to refer to structure and a broader sense of technicalities. Socio-technical refers to the interactions of social and technical aspects of an organization or the society. It provides meanings to assist the prediction and understanding of the interplay of technology systems with social systems. In fact, it may be more preferable to view the systems as one holistic system but with different technology and social perspectives (Hall and Clark, 2010). Cooper and Foster (1971) argue that socio-technical theory is about joint optimization, designing the social system and technical system in a way that

[50] the possible pathways of transition that will be described later in this chapter

they work smoothly together. As distinct from socio-technical systems, socio-technical theory proposes a number of different ways of achieving joint optimization.

Socio-technical systems theory has been used for decades as a framework to design and understand organizations, and has been applied in practice as a framework for organizational change. In the definition of socio-technical systems, every organization is made up of a "social subsystem (the people) using tools, techniques and knowledge (the technical subsystem) to produce a product or service valued by the environmental subsystem (of which customers form a part)" (Shani et al., 1992, p. 92). This framework divides the organization into three interdependent subsystems: social, technical, and environmental. Each of them must be aligned and work together to allows the organization at functioning optimally.

Considering transport and mobility systems, scholars have explored ways through which the integration of technologies, infrastructures, scientific knowledge, strategies, consumer practices, governance and markets, can change the operation of urban mobility in a more sustainable way (Elzen et al., 2004; Geels, 2004; Kemp et al., 1998; Smith, 2007; Geels et al, 2011; Kent and Dowling, 2013; Hodson and Marvin, 2010; Brown et al., 2003; Carmien et al., 2005).

In transition studies, Geels (2004) defines Socio-technical systems as an abstract, functional sense which makes a linkage between elements that are necessary to fulfil societal functions (e.g. transport, communication, nutrition). While existing innovation system approaches mainly focus on the production side where innovations emerge, socio-technical systems (ST-systems) encompass production, diffusion and use of technology. This approach allows at widening the analytic focus and incorporating the user side explicitly in the analysis.

4.3 Transition Theory

Transition studies have emerged in the last decades as a new field of research in order to explore, understand and explain the dynamics of fundamental, long-term societal change. From a transition perspective the sustainability ambitions of European cities do needs fundamental changes that are to incur in institutional frameworks, mind-sets and practices (Wittmayer et al, 2014).

The theoretical concept of transition refers to a transformation process in which society changes in a fundamental way (Geerlings et al., 2012). It involves the development of technical innovations (by scientists or entrepreneurs), their organization (manufacturing,

financing), their use (selection, adoption), and the broader societal embedding (regulations, markets, infrastructures, cultural symbols). Since several of these societal elements co-evolve, it implies that in a transition, the structures, cultures and practices of a societal system are fundamentally changed, so that the way the societal system functions is profoundly altered (De Haan and Rotmans, 2011).

Bulkeley et al. (2011) states that there are many different ways in which concept of transition might be understood. For example, Rotman (2003) believes that transition can be understood as a gradual transformation process, as a result of simultaneous development in different societal domains and combined actions of macro, meso and micro level developments. Geels and Schot (2010) noted that transition is different from incremental change process. The main differences in the following aspects:

- Co-evolution: Transitions require multiple changes in societal systems
- Multi actor process: Transition requires interactions between different societal groups such as businesses, users, scientific communities, policymakers, social movements, etc.
- Radical: Transition is radical shifts, regarding the scope of change, (not the speed)
- Long-term processes: Long time intervals (40-50 years), break-through may be seen in shorter periods (e.g. 10 years)
- Macroscopic phenomenon: transition affects the whole "organizational field" (aggregation of suppliers, consumers, regulatory agencies, etc.) (Geels and Schot, 2010).

Kemp et al. (2007) argue that tackling the persistent problems requires structural changes in technical systems, change in beliefs and values, as well as governance structures; as a result, transition processes fundamentally change both the structure of the system and the relations between societal actors.

The researches related to transitions and system change has expanded under different transformation terms, e.g. regime transformation (Vande Poel, 2003), technological revolutions (Perez, 2002), technological transitions (Geels, 2002), system innovation (Elzen et al., 2004; Geels, 2005a) and transition management (Rotmans et al., 2001).

Transition theory has been used to analyze the experienced transitions process that have been occurred in the present or past (Geels, 2005a and b), or to forecast future transition pathways by designing and developing scenarios or future efforts (see for example, Marletto, 2014; Spickermann et al., 2014, Crozet et al., 2013; Silvester et al., 2013; Dhar and Shukla, 2015). Lachman (2013) believed that the most used transition approaches are:

Multi-Level Perspective, Strategic Niche Management, Transition Management, Innovation Systems, Techno–economic paradigm, and Socio–metabolic transitions. In this dissertation, the transition management and multi-level perspective approaches are mainly focused. The first one (transition management) have been chosen because of its managerial efforts believing that it will help the society to gain more from existing capabilities in transition process, and the second one (multi-level perspective) is chosen because of considering all macro, meso and micro level factors.

4.4 Multi-Level Perspective (MLP)

Multilevel perspective is an attempt on socio-technical transitions to take account of the processes of mutual shaping and the cumulative nature of change which have been developed to describe and analyze the transition process. Geels (2011) argues that multi-level perspective (MLP) is a middle-range theory that conceptualizes overall dynamic patterns in socio-technical transitions. The analytical framework combines concepts from evolutionary economics (trajectories, regimes, niches, speciation, path dependence, and routines), science and technology studies (sense making, social networks, and innovation), structuration theory and neo-institutional theory (Geels, 2011). These theoretical micro-assumptions have been articulated elsewhere (Geels, 2004; Geels and Schot, 2007; 2010).

The basic idea of the MLP is that there is no single driver of transitions. Instead, MLP views transitions as non-linear processes that results from the alignments of developments at three analytical levels:

1) Niche-level, where radical innovations (novelties) emerge,
2) Socio-technical regime level, which refers to the rules that enable and constrain various incumbent actors, who reproduce existing systems,
3) Socio-technical landscape, which forms an exogenous context.

Each “level” refers to a heterogeneous configuration of elements; “higher” levels are more stable than “lower” levels in terms of number of actors and degrees of alignment between the elements. Processes on these levels differ in structuration and are placed in a nested hierarchy (Geels, 2011). Different types of interactions between these levels lead to different transition pathways (Rip and Kemp, 1998; Geels, 2002, 2005a; Geels and Schot, 2007). The most used graphical presentation of the three levels is introduced by Geels (2002) as from **Figure 4-1**.

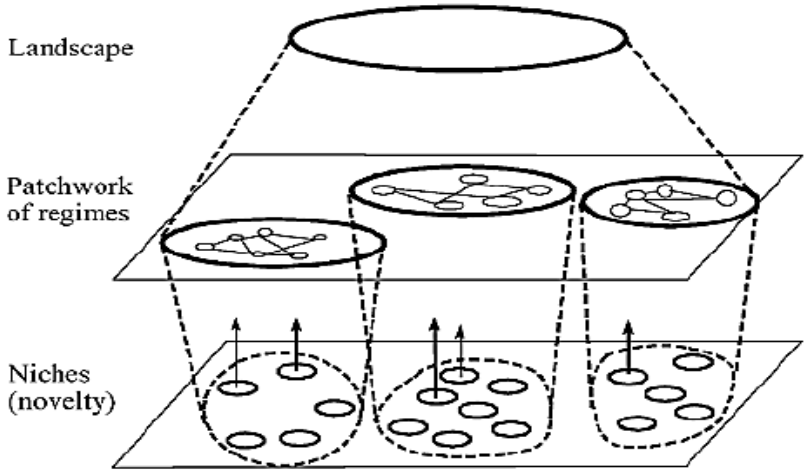

Figure 4-1: Multiple levels of MLP as a nested hierarchy

Source: Geels (2002, p. 1261)

Niches are mainly introduced as novelties and radical innovations in transition literature. The niche level is the one in which new technologies are initially developed within the old framework; they are produced on the basis of knowledge and capabilities and geared to the problems of existing regimes (Freeman and Perez, 1988). Novelties emerge in niches, in the context of existing regimes and landscapes with its specific problems, rules and capabilities (Geels, 2002) and they are often carried by experimental or demonstration projects, which allow niche actors to learn about innovations in real life circumstances. Niche actors hope that their promising novelties are eventually used in the regime or even replace it (Geels, 2012); but these novelties are characterized by uncertainty, because innovative practices have not yet resulted in best practices, rules of thumb, and stable routines. The niche level provides the "area" where the space is provided for radical innovation and experimentation. Niches are protected, nurtured and empowered to realign existing regime as initial niches cannot threaten the regime (Smith and Raven, 2012). Niche-innovations that are supported by more actors and receive more resources have higher degrees of momentum. Most innovations remain "niche" at this level, and do not get enough support to be transferred to upper level but some niche innovations grow to become adopted by the regime and the journey from niche to regime started[51]. Successful niches exert pressure on various aspects of regimes and thereby shape their trajectory against the background of broader evolving landscape. In this sense, transitions research is interested in uncovering how socio-technical configurations that

[51] for more information about niche –regime interaction see: Raven and Verbong, 2009

might work become configurations that do work among a plurality of transition pathways (Smith et al., 2004).

Kemp (2010) describes socio-technical regimes as the heart of transition scheme, where the transition process occurs. Regime refers to the dominant practices, search heuristics, outlook or paradigm and ensuing logic of appropriateness pertaining in a domain (a sector, policy domain or science and technology domain). According to Geels (2004), regime consists of three interlinked elements: network of actors and social groups, the set of formal and informal rules, and the material and technical elements.

The 'socio-technical landscape' is the environment in which a regime is embedded; landscape characteristics mark broader structuralizing processes that influence niche-regime dynamics (Smith et al., 2004). It includes the physical environment and material infrastructures that can perform their function in an active or dormant way for decades or centuries, but also societal values and concerns, the media landscape, macroeconomic trends, and long-term geopolitical dynamics (Geels et al., 2011).

Kemp et al. (2011) believes that MLP unites the various transition approaches, in MLP transitions are viewed as the outcomes of developments at the micro, meso and macro level. The micro level situated in a context of product regimes, regulatory regimes, science and research regimes (conceptualized as meso structures), and the overall macro landscape of values, infrastructures governance systems, media, etc. as the broader context (Geels, 2002, 2005; Rotmans, 2005; Grin et al., 2010). This means that the niches are embedded within the regimes, and regimes in the landscape (Geels, 2002). In this hierarchy, MLP is applied specifically in the following manner: how new technology becomes the dominant technology (regime), through observing interaction at multiple levels – niche, regime and landscape – over time (Rip and Kemp, 1998; Geels 2002; Geels and Schot, 2007)

Kemp et al. (2011) noted that MLP considers transitions as the outcome of pressures on product regimes (cultural criticisms, regulations) and the development of alternative systems, elements of which are originating in niches, breaking out, support from various actors (including incumbent companies, politicians, civil society) and various processes of alignment. It focuses on stability and change. To explain stability the notion of regime is used, which says that we are locked in car-based modes of transport since societies have adapted themselves to their use in terms of car ownership, infrastructure, training and knowledge, regulations, practices and cultural acceptance (Kemp et al., 2011).

According to Geels (2012), MLP has the following characteristics:

A) Co-evolutionary and 'systemic' approach. Transitions are not driven by single factors (such as prices or technological change), but involve co-evolutionary developments among multiple dimensions (technology, industry, markets, consumer behavior, policy, infrastructure, spatial arrangements and cultural meaning).

B) Actor-based approach. The MLP focuses on strategies, perceptions, actions and interactions among car drivers, transport planners, car manufacturing firms, and public opinion.

C) Complex dynamics. The MLP does not employ linear cause and-effect relationships or simple drivers. Instead, it emphasizes mutually reinforcing developments, alignments, co-evolution, innovation cascades, knock-on effects, and hype-disappointment cycles (Geels, 2012).

D) Stability and change. The MLP encompasses stability, lock-in and resistance to change on the one hand, and (seeds for) radical (systemic) change on the other hand.

The above listed characteristics will be briefly explained in the following sub section, as they are used in current research process.

4.4.1 Co-evolutionary Approach

The notion of transition is firmly rooted in traditions of system thinking that highlight the co-evolution of the sociotechnical systems and seeks to understand and analyses the emergence, transformation and decay of socio-technical systems (Shove and Walker, 2007).

The co-evolutionary approach holds that technology and society codetermine each other, and that the interactions give rise to irreversible developments and path dependencies (Kemp, 2009). Scholars used co-evolutionary approach to determine the dynamics of stability and change process, by causal influences between mutually evolving systems. For instance, Freeman and Louca (2001) seek to explain long-term changes in techno-economic systems through the interactions between five evolving systems relating to science, technology, economics, politics and culture.

Kemp et al. (2007) noted that the term co-evolution is frequently used in sustainability discussions. They argue that co-evolutionary view is important for sustainable development's governance for two reasons[52]:

First, it accepts cause-effect-cause loops across different scales and systems, with effects becoming causes of other developments ('positive feedback' in systems terms). The

[52]This consideration shape the fundamental basis of this dissertation's analytical framework

example in mobility system is the use of cars that facilitates travel and urban sprawl and in turn causes increasing demand for cars. This simple example also shows that people's needs are partly endogenous to other developments. The same is true for environmental policies, which is not independent from economy but is a response to problems (for instance emissions and climate change problems, with the policies giving rise to new problems (high costs or waste).[53]

Second, co-evolutionary perspective considers developments in different subsystems as partially independent. Co-evolution is a special type of interdependency: *A* influences but not determines *B* and *C* that in turn influence, but do not determine A; although all A, B and C change irreversibly. The different units of evolution enjoy relative autonomy in development. Technical change coevolves with institutional change (within systems of governance and organizations and culture), they are shaping but not determining each other (Kemp et al., 2007).

In this research used co-evolutionary approach applied in analyzing the relations between variables affecting transition pathways, in which dynamics are determined by interactions between mutually evolving variables relating to different systems.

4.4.2 Actor-Based Approach

Grin et al. (2011, p. 232) argue that there is a lack of a systematic understanding of actors involved in the 'distributed agency' in transition processes. In recent years, a few authors point out to a conceptual uncertainty regarding the individuals or individual organizations participating in transition process and focused on studying the actors in transition process (e.g. Brown et al., 2013; Farla et al., 2012), although other authors highlighted the need for more studies in this context (e.g. Frantzeskaki et al., 2012; Loorbach, 2010a). Avelino and Wittmayer (2015) argue that understanding the politics of sustainability transitions requires a definition of the actors involved in sustainability transitions.

In transition studies, socio-technical transitions involve alterations in the overall configuration of socio-technical systems, including technology, policy, markets, consumer practices, infrastructure, cultural meaning and scientific knowledge (Elzen et al., 2004; Geels, 2004). These elements are reproduced, maintained and transformed by different actors with different powers, influence and authorities (Avelino and Wittmayer, 2015).

[53] This self-confrontation of development with its consequences, sparking policy responses, is called reflexive modernization (Beck, 1994)

For example Geels (2011b) linked the diversity of these actors to the levels of MLP, arguing that: “Each ‘level’ in MLP refers to a heterogeneous configuration of elements; ‘higher’ levels are more stable than ‘lower’ levels in terms of number of actors and degrees of alignment between the elements”. Regarding the influence and authorities, the actors does not have equal roles and power in transition process; private actors have limited incentives to address sustainability transitions, because the goal is related to a collective good (‘sustainability’). In this context, public authorities and civil society will be crucial to address public goods and internalize negative externalities, to change economic frame conditions, and to support ‘green’ niches (Elzen et al., 2011).

The behavior of each actors in the system may be characterized by the values they hold and the strategies they choose to follow. In turn, these are influenced by the institutional factors of national policies, market rules, and regulatory structures (Hughes, 2009). In socio-technical perspective on transitions, power is primarily associated with regulative rules underlying socio-technical regimes, and the ‘power struggles’ between incumbent socio-technical regimes and upcoming niches. Geels and Schot (2007, p. 415) argue that power is one ‘foundational paradigm’ that revolves around actors and social groups with ‘conflicting goals and interests’, and that views change as the outcome of ‘conflicts, power struggles, contestations, lobbying, coalition building, and bargaining’ by and between these actors and social groups. In a more recent study, Geels (2014, p. 9) argues that incumbent industries and policy-makers have more power than other actors, and even though ‘social movement organizations, citizens, labor unions and other groups try to shape “public discourses”, it is the coalition of “policymakers” and incumbent “firms” that is most powerful (Geels, 2014, p. 29). Therefore, as Geels (2011b) concludes transitions are complex and long-term processes, comprising multiple actors.

Based on the levels of authority, power and structure, the actors of transition process are classified in broad categories. Contributions in transition studies mostly use the common distinction among “market (business)”, “state (government)” and “civil society” (cfr. Durrant, 2014; Walzer, 1998). Other common distinctions are the “triple helix” that gives an articulation based on state, market and science, or the “quadruple helix” that adds the category of ‘civil society’ (cfr. Farla et al., 2012; Grin et al., 2011; Pesch, 2014). The category of ‘civil society’ includes both formal entities such as trade unions, and informal entities such as families, although it is generalized for civil society as a whole (Avelino and Wittmayer, 2015).

The Multi-Actor Perspective presented by Avelino and Wittmayer (2015) distinguishes four actor categories along the following three axes, namely (1) informal—formal, (2) for profit—non-profit and (3) public—private and the Third Sector. The latter is conceptualized as an intermediary sector in between the three others and includes the 'non-profit sector' that is formalized and private, but also many intermediaries, i.e., organizations that cross the boundaries between profit and non-profit, private and public, formal and informal. In this classification, for example, the "State" is characterized as nonprofit, formal and public organizations.

4.4.3 Dynamics of Transitions

Transition in any socio-technical system involves dynamics between multiple actors on multiple levels, and transitions research aims to understand and capture these dynamics. The diffusion of a technological innovation into society can be considered in distinct phases (Rotmans et al., 2001). Well-known scholars present models in order to describe this phases and process (among them: Rip and Kemp, 1998; Kemp et al., 2001; Geels, 2002; Geels and Schot, 2007). Kemp (2009) describes the transition process in three phases linked to the levels of MLP:

1) Creation of novelties at the micro level against the backdrop of existing (well-developed) product regimes,
2) Evolution of the novelties, exercising counter influence on regimes and landscape,
3) Macro landscape which is gradually transformed (Kemp, 2009).

The transition literature that aimed to identify factors affecting transition process or pathways are mainly focused on studying the energy related transitions; although some well-known authors like Geels (2011) wrote about historical transitions in transport sector, there is still need for more studies to present new analytical framework for analyzing the dynamics of transition process (Geels et al., 2011).

Transition pathways describe how technological innovations matured and developed by different social actors and how they help in shifting the current regimes to the desired regimes, or healing the regime cracks and incumbencies. So, in this section the dynamics of path creation in transition process will be analyzed based on previous research findings and current research results.

Thus, a review of a few models that aim at describing those pressures and the forces that affect them. One of the first models to describe transition process dynamics is presented

originally by Rip and Kemp (1996) and is modified then by Kemp et al. (2001)[54]. In this model, landscape and niches put pressure on the regimes and determine if a regime shift will occur (Kemp et al., 2001). This process is shown in **Figure 4-2**, in which the grey bold arrows show the local practices including those that involve novelty creation occurred in the context of regimes and the socio-technical landscape, the dotted arrows indicate that the emergence of niches is strongly influenced by existing regimes and landscape.

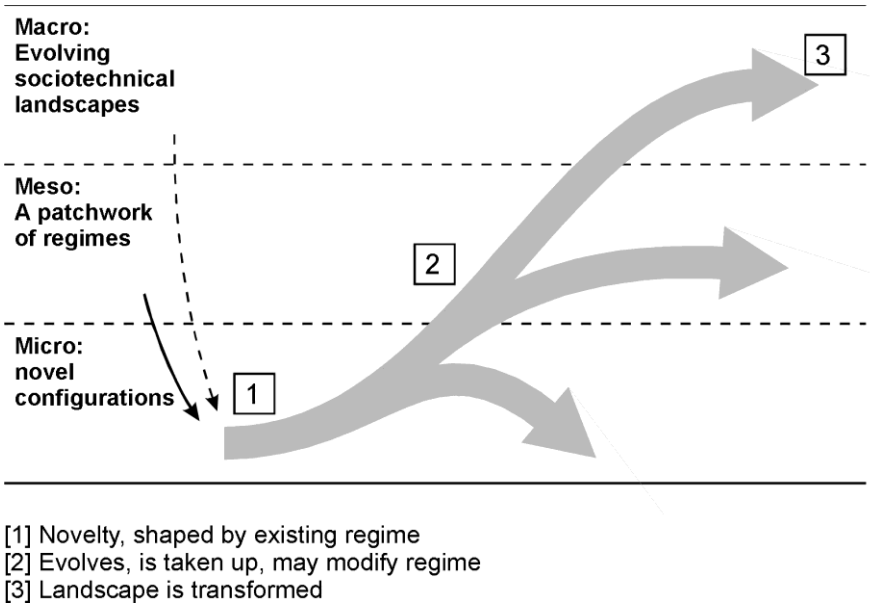

Figure 4-2: The dynamics of socio-technical change

Source: Rip and Kemp (1996) and Kemp et al. (2001).

Geels (2002) modified this model by focusing on the ongoing processes at the regime and landscape level to counter the bias in Rip and Kemp model, and considering the incremental processes pointed out by Clark (1985) as 'down the design hierarchy'. The transition of technological innovations occurs as the outcome of linkages between developments at multiple levels, represented with vertical dotted arrows. Radical innovations break out of the niche-level when ongoing processes at the levels of regime and landscape create a 'window of opportunity'. These windows may be created by tensions in the socio-technical regime or by shifts in the landscape that puts pressure on the regime.

[54]Here we don't enter the literature about path dependency and related models that describe the technology adoption processes and industry evolution, to keep concentration on transition literature (different models presented by authors like David, 1985; Arthur, 1989; Altman, 2000; Taylor, 2007 and others)

On the landscape level, changes usually take place slowly [55]. Using fat long arrows, **Figure 4-3** represents these evolving landscape developments. As mentioned before, landscape changes may put pressure on the regime (Geels, 2002). Changes in landscape dynamics lead to re-framings of norms and rules can open up windows of opportunity for the niche by destabilizing the capability of a regime configuration to perform well according to those norms and rules (Schot and Geels 2008). These dynamics are important for understanding how and why broader societal developments affect the evolution (or break down) of 'possible would-be regimes' (Smith et al. 2010).

At regime level, Geels (2002) introduces seven dimensions in the socio-technical regime (technology, user practices and application domains (markets), technology, infrastructure, industry structure, policy and techno-scientific knowledge) that are linked and co-evolve, while also having internal dynamics. The model is represented in **Figure 4-3**; the regular ongoing incremental processes are represented with relatively long arrows. The interaction among different dimensions may result in 'tensions' visualized in the figure with shorter diverging arrows, indicating uncertainty and differences of opinion. Tensions may lead to periods in which linkages are weakening (Geels, 2002).

On the niche level, actors in precarious networks work on radical innovations. Because a dominant design has not yet stabilized, the efforts go in all kinds of directions, leading to variety; represented by small arrows going in different directions in **Figure 4-3**. Although radical innovations may seem promising for a while, there is no guarantee for success. Radical innovations may also gradually stabilize into a dominant design, represented in Figure 4-3 with arrows growing longer and fatter (Geels, 2002).

[55] E.g. cultural changes, demographic trends, broad political changes.

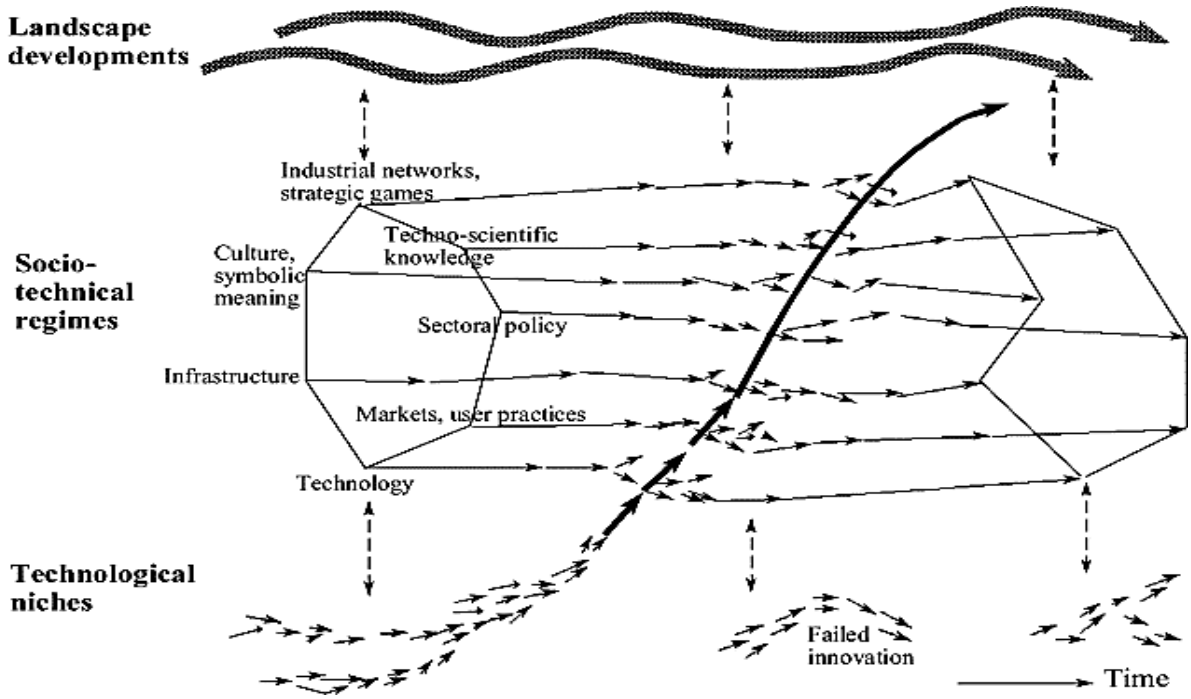

Figure 4-3: Dynamic MLP on technology transitions.

Source: Geels (2002)

Geel's model is one of the first and most cited theories for transition process dynamics that shapes transition pathways (path creation) based on MLP; in 2012, Geels presented the updated version of this model, introducing the general dynamic of transitions through the interaction between processes at different levels:

A) Niche-innovations build up internal momentum,
B) Changes at the landscape level create pressure on the regime, and
C) Destabilization of the regime creates windows of opportunity for niche-innovations.

The last model which is introduced in this section is the framework presented by Foxon et al. (2010) for developing transition pathways for a low Carbon electricity system in UK, in a time span between 2010 and 2060. The framework is built based on the multi-level perspective (MLP) for analyzing the dynamics of transitions and is represented in **Figure4-4**. In this model, the different shadings represent different configurations at the start and end of the transition that are more or less same as the dimensions introduced by Geels (2002), four pathways are introduced as: Market rules, Central Co-ordination, Thousand flowers (bottom up delivery of solutions) and the forth pathway that explore variations and combinations of the three basic pathways. The factors affecting transition

pathways are classified in groups of international, environmental, cultural factors, alternatives and options, social experimentation and the related sectoral innovations.

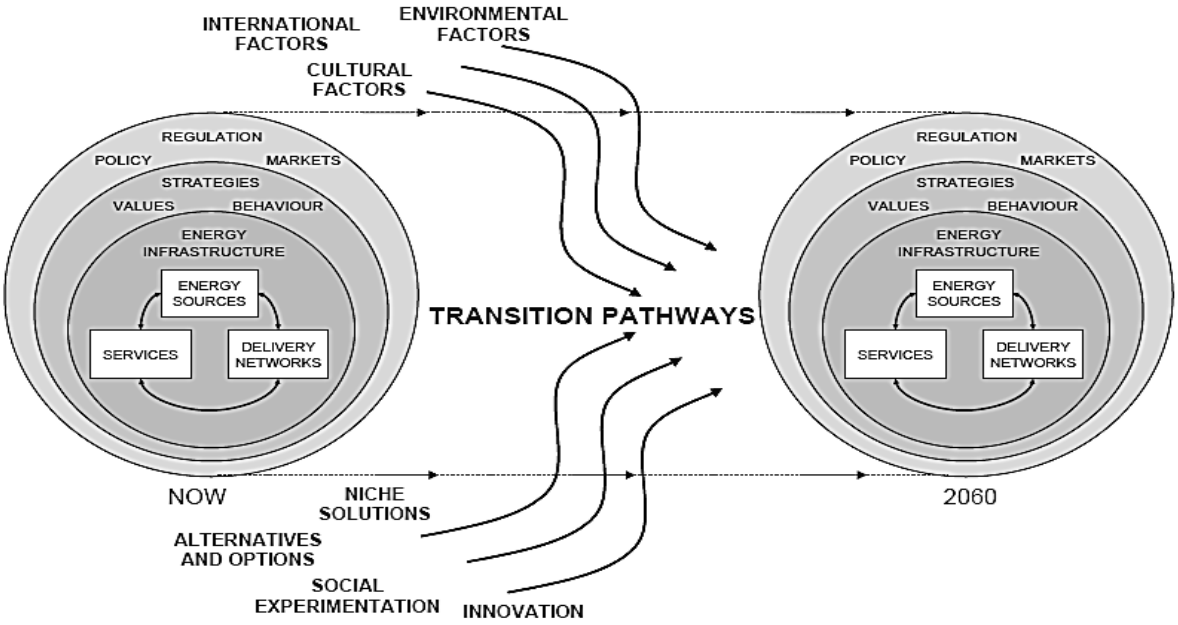

Figure 4-4: The factors influencing transition pathways

Source: Foxon et al. (2010)

Geels (2005a) argues that these dynamics are complex, because they are not mechanical, but socially constructed. The dynamics are not linear, because perceptions and strategies of actors change over time. Transitions are complex processes that cannot be overseen, or steered, from one viewpoint. They are emergent outcomes of interactions between social groups with myopic views and differing interests, strategies and resources. Based on that, to build a more comprehensive view, the literature evidence about identifying the dynamics of transition towards low Carbon mobility is presented (in the next subsection and upcoming sections). The factors that affect transition pathways are identified and introduced based on different regime dimensions.

4.4.4 Stability and Change Process

According to Geels (2012), MLP provides a way of addressing the core analytical puzzle of transitions, namely stability and change; in which, existing systems are characterized by stability, lock-in, and path dependence, which give rise to incremental change along predictable trajectories. On the other hand, radical alternatives (at niche level) are being proposed, developed and tried by pioneers, entrepreneurs, social movements and other relative outsiders (to the existing regime). These alternatives typically face an uphill struggling against existing systems, because they are more expensive (since they have not

yet benefited from economies of scale and learning curves), require changes in user practices, face a mismatch with existing regulations, or lack an appropriate infrastructure. The core puzzle in transitions thus centers around (dynamic) stability and (radical) change, and how the interactions are played out on multiple dimensions (Geels, 2012).The changes occur on a regime level, where firms and technologies are embedded in their social, institutional and economic context. Based on MLP, socio-technical regime is embedded between broader landscape and niche level. Based on multi-level perspective, transitions come about through interactions between processes at different levels:

1) Exogenous changes (at the so-called 'landscape level') create pressures on the regime;
2) Destabilization of the regime (cracks and tensions) creates windows of opportunity for wider diffusion of niche-innovations;
3) Niche-innovations gradually build up internal momentum (through positive interactions between learning processes, vision articulation, and social network building) (Geels, 2015).

When considering the dynamics of transition towards low-Carbon urban mobility systems, regarding the levels of MLP, the dynamics are classified based on the pressures they exert on different regime dimensions, introduced by Geels (2012) as: market and user practice, industry, policy, technology, science and culture.

Landscape Factors

Following the multi-level perspective, the regime is influenced by wider landscape factors and niche alternatives (Rip and Kemp, 1998; Geels, 2002, 2005a). Changes that occur in the landscape are much slower than regime and niche level, and determine the stabilization and destabilization of regimes. These may gradually put pressure on the regime, creating 'cracks', and causing the realignment of some of its elements (Geels, 2004). If these forces applied to the existing cracks in regimes, windows of opportunity for sustainability transitions will be opened for a limited time.

In transition literature different factors introduced as landscape changes that affect regime and niche transfers, for instance increasing environmental awareness (Smith et al., 2010) is a socio-cultural process which puts pressure on numerous regimes (aviation, mobility, energy, agriculture etc.), whilst providing opening windows of opportunity for new technologies to establish themselves. Regarding transport sector and environmental

problems, climate change is putting pressure on transport sectors, causing changes in technical search exploration and public policies. Furthermore, broad cultural changes in values and ideologies, or change in political coalitions may also create pressure (Geels, 2004).

Table 4-1 summarizes the literature about landscape factors that affect transition pathways; landscape dynamics may result in stabilizing or destabilizing the existing regimes by putting pressure on different incumbent regimes.

Regime dimensions	Stabilized by:	Destabilized by:
Market and user practice	• Freedom (speed, convenience, time saving, etc.) (Geels et al, 2011 and 2012) • Increasing demand for mobility (Geels, 2012; Castells, 1996-1998) • Process of globalization and economic growth (Geels, 2012; Freund and Martin, 2000; Sperling and Gordon, 2009) • Economic crisis (Hodson et al, 2015) • Rapidly growing international tourism (Geels et al, 2011) • Growingwealth and the rise of second and third cars in households (Geelset al, 2011) • Shift towards network society (Geels et al, 2011) • Demand specificity (Floricel et al, 2009)	• Energy security and affordability (Geels et al, 2011 and 2012, Foxon et al, 2010) • Ideological commitments to liberalized energy markets (Foxon et al, 2010) • Physical disruption of external supplies (war, terrorism, etc.) (Foxon et al, 2010) • Changes in international economic financial situation (Foxon et al, 2010) • Fuel price (Rip and Kemp, 1998;Hillman and Sanden, 2008; Hodson et al, 2015) • Carbon trading (Hillman and Sanden, 2008) • Financial-economic crisis- declining sales(Hodson et al, 2015)
Industry	• Industrial development strategies (Rogge et al, 2015) • Government-led growth strategies (Mah et al, 2012)	• Rise of digital society (Geels et al, 2011) • Industrial dynamics (Rip and Kemp, 1998) • Industrial structure (Rogge et al, 2015) • Government-industry linkages (Geels et al, 2011)
Policy	• Institutions, and distributions of resources and human capital in existing regimes (Rock et al, 2009) • Lack of effective environmental policy management (Rock et al, 2009) • Political system (Geels et al, 2011) • Land development and urban planning policies (Elzen et al, 2002)	• Climate change (Geels et al, 2011 and 2012; Rip and Kemp, 1998; Hillman and Sanden, 2008; Hodson et al, 2015) • Promotion of low Carbon energy sources (Foxon et al, 2010) • Governmental commitment to national and international targets (Foxon et al, 2010) • External factors leading to high oil and gas prices (Foxon et al, 2010) • Financial and trade openness,

		combined with the right kinds of institutional setting (Rock et al, 2009) • Macro-political developments (Rock et al, 2009, mah et al, 2012)
Technology	• Preexisting technological strengths (Mah et al, 2012) • Manufacturing base (Rogge et al, 2015) • Structuring potential (Floricel et al, 2009) • Physical infrastructure (Geels et al, 2011 and 2012)	• Manifest in investment, trade, and knowledge flows (Rock et al, 2009) • Diffusion of ICT (Geels, 2012, Hodson et al, 2015) • Enabling technologies (Elzen et al, 2002) • Electrification of mobility and heat (Rogge et al, 2015) • Green ICT (smart technologies) (Rogge et al, 2015)
Culture	• Individualization (Geels, et al 2011) • Cultural values (ownership, privacy, choice, progress) (Geels, et al, 2011 and 2012, Sheller, 2004) and perceptions (Elzen et al, 2002) • Demographic factors (Elzen et al, 2002)	• Public awareness of climate change (Elzen et al, 2002) and willingness to accept and undertake changes (Foxon et al, 2010; Smith et al, 2010) • Changes in values and ideologies (Geels et al, 2011)

Table 4-1: Landscape pressures at different regime dimensions

Source: Own work based on different resources

Those presented in **Table 4-1** are the factors related to the macro-level (landscape) affecting the existing niches and regimes and how they transfer during the transition process. The next section will represent the literature analysis on identifying dynamics and affecting factors at meso level (socio-technical regimes), in transition literature, introduced as lock in (stabilizing factors) and cracks (tensions or problems in the existing regimes-destabilizing factors).

Regime Lock-ins and Cracks

Socio-technical regime refers to the set of rules and institutions that shape the perceptions and actions of the incumbent actor groups who reproduce or change elements of socio-technical systems (Rogge et al., 2015). The regime is stabilized by the interactions between its constituent technologies, institutions, business strategies and user's practices, and can be reinforced or destabilized by influences from wider landscape factors and niche alternatives (Foxon et al., 2010). Incumbent actors tend to be 'locked in' to existing regimes and systems (Unruh, 2000) because of sunk investments (in skills, factories, infrastructures), economies of scale, increasing returns to adoption (Arthur, 1988),

favorable regulations, cognitive routines that make 'blind' (Nelson and Winter, 1982), social norms and behavioral patterns. The dominant rules or modes of thinking which guide approaches and actions effectively exclude radically alternative innovations, and the regime is thus path dependent, or in a situation of lock-in (Kemp et al., 1998). This lock-in occurs both in institutions, social practices and technological infrastructures (Raven et al., 2010). Lock-in mechanisms stabilize the existing regime, leading incumbent actors to prefer incremental changes that stay within the bounds of the existing regime (Geels, 2012). In this situation is mostly incremental, aimed at elaborating existing capabilities and protecting vested interests (Rogge et al., 2015).

Besides the lock-in issue, other problems that encircle steering to sustainable development are dissent about long-term goals, dealing with uncertainty, distributed control, political myopia and the determination of short-term steps for the long-term change (Kemp et al., 2007 and Meadowcroft, 2009).

In the context of urban mobility, different regimes are interacting, affected by landscape pressure and niche developments and affecting each other. Generally, socio-technical land based passenger transport (which includes urban mobility regime) consists of three separate regimes: private car based regime (automobility); public transport regime including rail (subway regime, in urban mobility), bus, cycling sub-regimes and non-motorized transport (walking and cycling). Lock-ins, cracks, and tension forces introduced in these regimes and related sub-regimes are summarized in **Tables 4-2, 4-3 and 4-4**, based on pathway project findings and other individual studies.

Automobility	**Lock-in (stabilizing forces)**	**Cracks and Tensions (destabilizing forces)**
Market and user practice	• Car embedded in lifestyles and mobility patterns (shopping, commuting, bringing children to school) (Hodson et al, 2015) • Socio-cultural preference for the car (Hodson et al, 2015, Turnheim et al, 2015) • Taxes as large source of income for government (Van der Eerden, 2013) • Economies of scale (Arthur, 1988) • Increasing returns to adoption (Arthur, 1988)	• Depressed car sales after crisis (Hodson et al, 2015) • Market saturation (Geels, 2012) • Dis-satisfaction about fuel prices (Hodson et al, 2015) • Congestion and parking problems(Hodson et al, 2015, Turnheim et al, 2015) • Concerns about road and car safety (Hodson et al, 2015) • Environmental awareness (Hodson et al, 2015) • Health concerns (Hodson et al, 2015) • Increased fuel taxes (Elzen et al, 2004) • Road pricing schemes (Elzen et al, 2004) • High parking rates (Elzen et al, 2004)

Industry	• Great Market segment (Turnheim et al, 2015) • Diversity of models and prices (Turnheim et al, 2015) • Powerful (global) automobile industry(Turnheim et al, 2015; Van der Eerden, 2013) • Sunk investments in machines, manpower, factories, knowledge (Hodson et al, 2015, Arthur, 1988) • Commitment to internal combustion engines (Hodson et al, 2015) • Car industry innovation strategies (Geels, 2012)	• Pressure from local policymakers, who introduce some car-restraining measures and stimulate alternatives (bus, cycling) (Hodson et al, 2015) • Economic problems (Hodson et al, 2015, Geels, 2012) • High level of competition (Geels, 2012) • Awareness of climate change and peak oil (Hodson et al, 2015; Geels, 2012) • Shifts from the expansion of the car-based system to its transformation to address the various problems and externalities (Geels, 2012)
Policy	• Policymakers are constrained by lobby groups, and economic importance of car industry (Hodson et al, 2015) • Policies to tackle congestion problem (Turnheim et al, 2015) • Plans and programs(Rogge et al, 2015) • Favorable regulations(Nelson and Winter, 1982) • Cognitive routines that make 'blind'(Nelson and Winter, 1982)	• Climate change pressure from EU and national policy makers (Hodson et al, 2015; Turnheim et al, 2015; Geels, 2012) • Pressure from local policy makers (car restraining measures) (Hodson et al, 2015; Turnheim et al, 2015, Geels, 2012) • Environmental policies (Turnheim et al, 2015) • De-Carbonisation objectives (Turnheim et al, 2015) • CO_2 labeling scheme for cars(Turnheim et al, 2015) • High fuel taxes(Turnheim et al, 2015) • Parking and driving restrictions in urban areas(Turnheim et al, 2015) • Zoning policies(Elzen et al, 2004) • Weakening in the commitment of policymakers (Geels, 2012)
Technology	• More efficient vehicles (Turnheim et al, 2015) • Better environmental performance of new vehicles(Turnheim et al, 2015) • User interface and convenience (Turnheim et al, 2015) • Entertainment (Turnheim et al, 2015) • Safety and comfort improvements(Turnheim et al, 2015)	• Development of technical alternatives(Hodson et al, 2015, Turnheim et al, 2015) • Substantial CO_2 tax on fossil fuels(Elzen et al, 2004) • Real-time information (Kim, 2015) • Development of ICT(Geels, 2012)
Culture and believes	• Positive cultural believes about cars (Hodson et al, 2015; Van der Eerden, 2013)	• Anti-car discourse (Hodson et al, 2015) • 'Sustainable mobility' debates(Hodson et al, 2015)

Table 4-2: Dynamics of private car based regime (automobility)

Source: Own work based on different resources

Public Transport	Lock-in (stabilizing forces)	Cracks and Tensions (destabilizing forces)
Market and user practice	• Students make up a large percentage of public transport users (Turnheim et al, 2015)	• Multiple service operators at local level user dissatisfaction (Turnheim et al, 2015)
Industry	• Shared infrastructure elements with cars (for buses) (Turnheim et al, 2015) • The level of privatization in the industry (Hodson et al, 2015) • Optimized organizational set-ups and capacity	• Public transport fleet age (Turnheim et al, 2015) • Few international NGOs (Van der Eerden, 2013)
Policy	• Financial incentives to encourage public transport (Turnheim et al, 2015; Van der Eerden, 2013) • Need for support and continuity in service (Turnheim et al, 2015) • Policies for improving accessibility (Turnheim et al, 2015) • Efforts to increase reliability (Turnheim et al, 2015) and • Frequency of service (Turnheim et al, 2015) • Geographic network coverage (Turnheim et al, 2015) • Zoning policies(Elzen et al, 2004)	• Spatial planning strategies (compact city; network of cities) (Turnheim et al, 2015) • The tension between competition law and a greater role for local policymakers (Hodson et al, 2015)
Technology	• Simplified ticketing (Turnheim et al, 2015) • Real-time travel information (Turnheim et al, 2015) • Flexibility in planning and operation (Turnheim et al, 2015) • Alternative engines and fuels (Turnheim et al, 2015) • Intelligent Transportation Systems (Van der Eerden, 2013) • Integrated public transport (Turnheim et al, 2015)	• Lower quality of service (compared to cars) (Turnheim et al, 2015) • Clean vehicle technologies (Kim, 2015)
Culture and believes	•	• Negative cultural representation: 'people transport', slow, infrequent, etc. (Van der Eerden, 2013; Turnheim et al, 2015; Hodson et al, 2015) • Negative or challenging public debates and opinions (Turnheim et al, 2015)

Table 4-3: Dynamics of Public Transport Regime (mainly bus system)

Source: Own work based on different resources

Non-motorized	Lock-in (stabilizing forces)	Cracks and Tensions (destabilizing forces)
Market and user practice	• Trend of cycle usage (Hodson et al, 2015)	• Inadequate time for pedestrians (Litman, 1994) • Bike theft (Replogle and Mundial, 1992)
Industry	• Growth of a wider cycling industry of associated products (clothing, accessories)(Hodson et al, 2015)	• Inadequate lane space for cyclists (Litman, 1994) • Poorly designed infrastructure(Kim, 2015) • Non-existent, incomplete, and poor quality sidewalks and crosswalks (Litman, 1994)
Policy	• Policy-push around cycling and associated infrastructure (Hodson et al, 2015) • Smart urban planning regulations (Climate Works 2011; De Oliveira, 2012)	• Under-supported by transportation agencies (Litman, 1994) • Lack of participation in policy design(Kim, 2015)
Technology	• Innovative technologies (like E-bikes) (Hodson et al, 2015)	
Culture and believes	• Views that people hold of cycling are often ambiguous and sometimes contradictory (Hodson et al, 2015) • Cycling remains a marginal activity (Hodson et al, 2015) • Health benefits (Litman, 1994)	• Perceived Accident Risk (for cyclists) (Litman, 1994) • Walking and bicycling considered travel modes of last resort (Litman, 1994) • Lack of awareness and negative attitudes (Kim, 2015)

Table 4-4: Dynamics of Non-Motorized Transport Regime (walking and cycling)

Source: Own work based on different resources

These tables clearly show that stabilizing factors for one regime could destabilize the other ones, and the transition towards low Carbon urban mobility aimed at replacing the current non-sustainable regimes by the sustainable less Carbon intensive ones. In this sense, the dominant regime of private cars should be substituted by, or transformed, to more sustainable regimes that are related to cleaner features of urban mobility, like public transport regimes, non-motorized transport regimes (cycling, walking, etc.). In some cases, the current regimes re-align with the prospective changes, like the technological developments in automobility regimes that aimed at reducing the emissions of cars by improving the engine and fuel technologies. The transition pathways are explained in the next sessions.

Promising Niches

Various "green" niches have emerged and resulting to participate in transitions process to achieve low Carbon mobility systems. These innovative practices deviate in one or more dimensions (e.g. technical, cultural, behavioral, policy, infrastructure) from the established regime(s). Niche-innovations that are supported by more actors and receive more resources have higher degrees of momentum (Geels, 2012), and in this regard, they can have more chance to be nurtured and emerged as the new regimes of mobility. In this section, we mention some of the niches that have the potential to change the current urban mobility regimes. **Table 4-5** shows niche innovations, related examples and applications, and driving forces that can help them to grow and develop.

Niche innovations	Driving Forces	Problems, barriers
Integrated transport – Train-taxi – Bus rail – Bike-rail – Intermodal tickets	• Governance and policy support (Geels, 2012) • Presence of policy entrepreneurs or particular coalitions of actors (Geels, 2012)	• Time losses of transfers; • Low support from regime players inter-modal travel as add-on activity, not as core business, • The absence of powerful advocacy coalition speaking • Low level of economic interest (Geels, 2012)
Sustainable urban Planning – Compact cities – Smart growth – Clustering[56] – Transit Oriented Development – Livable streets	• Social movement networks and community organization support • Contemporary visions of new and 'retrofitted' cities (Geels, 2012) • Transport and land-use regimes interaction • Spatial planning innovation rather than technological focus • Political support(national and local planning regulations and practices) • Powerful private regime actor (Turnheim et al, 2015b)	• Unexpected and often counterproductive results on sustainable mobility: no lasting improvement, but halting more negative development (Turnheim et al, 2015b) • Very low techno-economic momentum (Geels, 2014; Turnheim et al, 2015b)
Sharing schemes – Car sharing – Bike sharing	• Fast developing urban markets • Embeddedness in existing automobility networks • Positive cultural and symbolic meanings	• Requires significant reconfiguration in conceptions of users, business model, tracking, monitoring and payment infrastructure

[56] Clustering important destinations around public transport hubs

	• Policy visions as integral part of future mobility systems • Different role in a variety of pathways (Turnheim et al, 2015b) • Social movement networks and community organization support • Contemporary visions of new and 'retrofitted' cities (Geels, 2014) • Alignment with visions of multi-modal transport (Turnheim et al, 2015b)	and a mix of new and incumbent actors (Geels, 2014)
Demand management – Mobility management – Transport and travel planning	• Voluntary nature • Zero costs • Attractive to policy makers (Geels, 2012)	• Still in the early stages • Limited momentum Dependent on good intentions (Geels, 2012)
Public transport innovations – Special bus lanes – Real-time information panels – Short-distance radio systems – Green propulsion technologies	• Increasing political support (Harman et al., 2012) • Modal shift (Geels, 2012)	• Expensive and unattractive in low density areas • Require greater focus on spatial planning strategies • Significant alterations to regulations and taxes(Geels, 2012)
Information and communication technologies –Intelligent transport systems (ITS) –Tele-working, tele-shopping, etc.	• Supported by policy makers, highway engineers, transport planners, and traffic managers • Commercial interests-economic potential • integration into cars or public transport (Geels, 2012)	•
Green propulsion technologies	• Support by CO_2 regulations (in Europe) and • Government subsidies for R&D programs and adoption • Joint ventures between incumbent car companies and component suppliers (Orsato et al., 2012)	• Experienced several ups and downs (hype disappointment cycles) (Geels, 2012) **Depend on :** • taxes or subsidies, • Tougher CO_2 regulations • Technical improvements • Public investments in infrastructure (Geels, 2012)
–Plug-in Hybrid Electric Vehicles	• Mass commercialization, important market share, stable design features (Turnheim et al, 2015b)	• Technical compromise (Turnheim et al, 2015b)

–Battery Electric Vehicles	• Policy support for progress towards charging • Involvement of fleet operators • Increasing public exposure (Turnheim et al, 2015b)	• multiple hype/ disappointment cycles • Need for interoperability of charging opportunities (Turnheim et al, 2015b) • Issues of vehicle range and cost (Geels, 2014)
–Hydrogen Fuel Cell Vehicles	• Technologically at an experimentation stage • Precursor market experiments just emerging • High costs • Considered as option for the medium and long term (2030 and beyond) (Turnheim et al, 2015b)	• Repeated hype cycles (Turnheim et al, 2015b; Geels, 2014) • Technical and cost difficulties (Geels, 2014)
–Biofuels	• Developments driven by EU policy (obligations) • Technological diversity • Innovative sector (Turnheim et al, 2015b)	• Traceability and scope for sustainably scaling up (Turnheim et al, 2015b) • More expensive than fossil fuels (Geels, 2014)

Table 4-5: Promising niches in transition towards low Carbon mobility

Source: Own work based on different resources

Beside these regimes, urban form and structure is another factor that influence transport options and mobility patterns in cities. Makinen et al. (2015) noted that the development of urban form is a slow dynamic process in which existing structures determine present and future courses or action. In this sense, land use characteristics and structural organization of urban areas influence, for example, how public transport service could be offered and developed (e.g. the quality or access to transit stops), and this consequently affect the viability of public transport as an alternative to private car use (Gori et al., 2012).

4.5 Transition Pathways

Following the multi-level perspective, transition pathways are defined by the interactions between activities and structures of internal regime dynamics, wider landscape factors, and niche alternatives. These dynamics destabilize the incumbent regime and give rise to changes in dominant socio-technical regimes, these changes result in emergence of new regime. Foxon et al. (2010) propose two categories to characterize how differences in the timing and nature of multi-level interactions can give rise to different norms in which transitions from one regime to another can occur. In the first category those authors who are interested in issues of transition governance (Smith, Stirling and Berkhout) in which

different actors within and outside current regimes are able to take action (referred to as agency) and to influence others to take action (referred to as power) in relation to affecting the rate and change of a transition. In this category the regime changes as a function of two processes:

1) Shifting selection pressures on the regime, coming from social and economic pressures on firms within the regime, and from broader landscape developments and niche innovations (internal or external resources);
2) Co-ordination of resources (e.g. skills and capacities, as well as physical resources): including planned vision-driven coordination or unplanned emergent coordination (Berkhout et al., 2004).

These process gives rise to following transition pathways that are represented in **Figure 4-5**.

- **Endogenous Renewal** (coordinated response, internal adaptation): arises in the context of regime members (firms, supply chains, customers and regulators) making conscious efforts to find ways of responding to perceived competitive threats to the regime, by drawing on internally available resources, such as existing capacities.
- **Re-orientation of Trajectories** (uncoordinated response, internal adaptation): shape through the conjunction of a series of uncoordinated responses, relating to changes in technologies, institutions, business strategies and user practices, but mainly drawing on internally available resources.
- **Emergent transformation** (uncoordinated response, external adaptation): arises largely from uncoordinated pressures for change and responses based on through resources and capacities lying outside the incumbent regime, such as previous energy transitions between dominant fuel sources, e.g. from wood to coal burning.
- **Purposive Transitions** (coordinated response, external adaptation): This type of transition draws on external resources, but has been deliberately intended and pursued from the outset to reflect an explicit set of societal expectations or interests, such as the promotion of civil nuclear power.

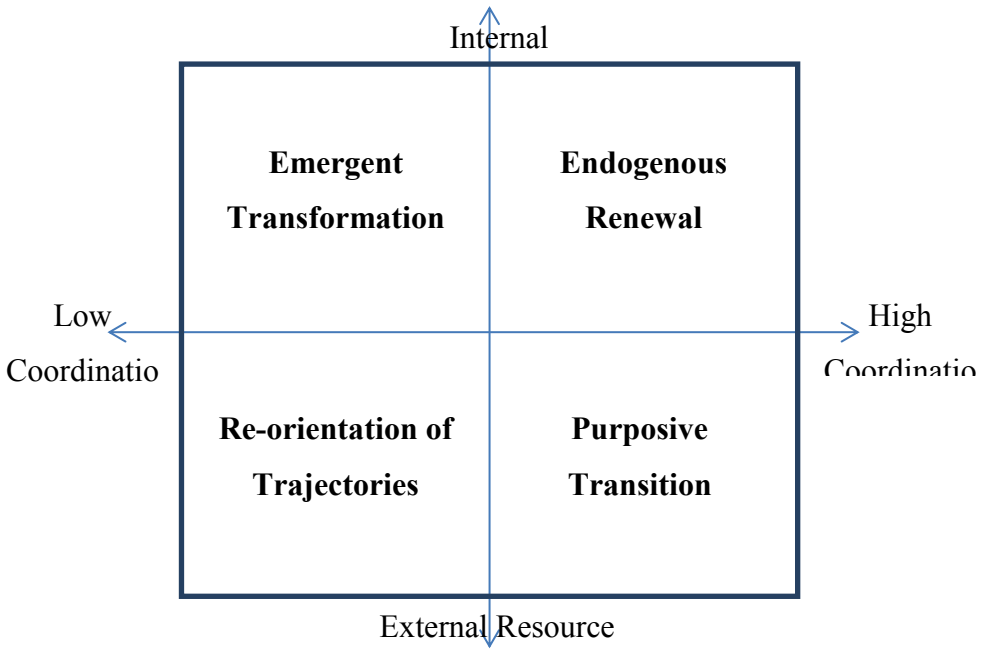

Figure 4-5: Four transition contexts and transformation processes

Source: Berkhout et al., 2004

Geels and Schot (2007) criticized the typology of transition pathways presented by Berkhout et al (2004), believing that coordination arises through the alignment of the visions and activities of different groups, and hence cannot be regarded as lying on a single axis to characterize transitions. Instead, they propose different pathways, based on differences in the timing and nature of multilevel interactions:

- **Technological substitution**: niche innovations emerge and replace existing regimes, new core-actors emerge after a battle with old core-actors.
- **Reconfiguration:** niche-innovations are adopted into the existing system/regime, and subsequently lead to changes in the system architecture; it is based on integration of new non-core actors.
- **Transformation:** incumbent actors change regime elements (beliefs, search heuristics, investment patterns, regulations etc.) to solve problems and accommodate external pressures, and
- **De-Alignment and Re-Alignment**: strong landscape changes lead to regime breakdown (de-alignment), followed by a prolonged period of niche-experimentation with multiple novelties, and gradual re-alignment around a 'winner' (Geels and Schot, 2007).

Foxon et al. (2009) introduce another type of transition pathways in their study of low Carbon energy systems, focusing on alternative plausible governance patterns and how

they could affect technological, institutional and social changes in those systems. They introduce four possible pathways:

- **Market Rules:** envisions the broad continuation of the current market-led governance pattern,
- **Action/Reaction:** may be interpreted as a bifurcation of Market Rules that envisions the continuation of the current governance pattern in the short term
- **Central Control:** envisions greater direct governmental involvement in the governance of socio-technical systems,
- **Thousand Flowers:** considers sharper focus on more local, bottom-up diverse solutions ('let a thousand flowers bloom'). These developments are driven by innovative local authorities and citizens groups (Foxon et al., 2009).

More recently, Marletto (2014) conducted a study to introduce the socio-technical pathways toward sustainable low Carbon urban mobility regarding 2030 targets. Three pathways emerged as the result of different transformative mechanisms, as follows:

AUTO-City: It is similar to "Reconfiguration" pathway (introduced by Geels and Schot, 2007) and is the result of interventions for the greening of urban mobility which, at the same time, do not destabilize the dominant position of the "individual car". In this scenario, transport policy is influenced by the car industry and the niches are mainly Hybrid and Electric cars.

ECO-City: Multilevel transport policy is necessary to ease the diffusion of integrated urban transport systems result in the emergence of 'ECO-city' scenario where electric cars will play a secondary role. In this scenario, an integrated and multilevel urban policy is influenced by a coalition of NGOs, local governments and industries and a coalition of new core actors support a new vision of urban mobility. The important niches are those that are related to New urbanism (dense and multifunctional cities) and "3Bs" (Buses, Bicycles, and Batteries). It represent "De-alignment and Re-alignment" pathway in Geels and Schot (2007) typology.

ELECTRI-City: Certain industrial policies create the conditions for the establishment of this scenario, in which the electric car will be nothing but an element of an "Energy+ Transport" system. In this scenario, transport and energy policies are influenced by the electricity industry and new core-actors emerge after a battle with old core-actors. The important niches are electric car and smart grids. This pathway is similar to substitution pathway in Geels and Schot (2007) study.

4.6 Transition management

Shove and Walker (2007) argue that transition literature desired to conceptualize system dynamics, through retrospective analyses of the rise and fall of selected socio-technical systems and regimes (e.g. from sail to steam ships, from horse to car, or from coal to gas (Geels 2002; Correlje and Verbong 2004). According to them, studies of systems in transition are typically distanced, making few claims about how individuals and organizations can, might or should act to affect the processes in question or to steer trajectories towards pre-defined, normative goals. Transition management is an alternative model of environmental governance that is concerned with how to govern transitions to more sustainable socio-technical systems. It seeks to guide the gradual, continuous process of transformation of socio-political landscapes, socio-technical practices and "the structural character of society" from one equilibrium to another (Rotmans and Kemp, 2001; Foxon et al, 2010; Meadowcroft, 2009).

A number of theories consider that the sociological aspect of transition rooted within population dynamics and the evolution of society from high birth rate/high death rate to low birth rate/low death rate (Davis, 1945). Other theorists agree on the fact that transition management is based on systems theory and the co-evolution of social and technical factors within the system (Shove and Walker, 2007). In this approach, the shift in the political landscape, from a centralized government to a more liberal one, market-based structure, creates new forms of bottom-up governance styles (Loorbach, 2010).

Transition management is considered a deliberate approach to putting hands on the systems' inherent dynamics: to "influence the direction and speed of transitions by coordinating and enabling the processes that occur at different levels in a more systemic and evolutionary way" (Kemp and Loorbach 2006: 109). It aims at facilitating a more fundamental and long-term reflection on socio-technical system dynamics in order to overcome the myopic orientation of established policy-making processes (Rotmans et al. 2007). However, transition management is claimed to be fundamentally different from traditional political planning. Referring to the concept of "incremental politics," Kemp and Loorbach (2006: 109) define transition management as an "attempt at goal-oriented modulation, not an attempt to achieve predefined outcomes through planning and control." Rotmans et al. (2007) situate transition management more precisely in the middle ground between planning and incrementalism. Asserting that it combines the best

of both worlds, they characterize transition management as a "perspective incrementalism for sustainable development" (Rotmans et al. 2007: 25).

Transition management highlights the policy dimension at a local level, and is concerned with creating variety informed by visions and experiments for sustainability, as well as shaping new pathways and gradually adapting existing institutional frameworks and regimes (Kemp and Loorbach, 2006). According to Loorbach (2007), the key principles of transition management as a form of governance are:

- Seeks to widen participation by taking a multi-actor approach in order to encompass societal values and beliefs
- Takes a long-term perspective (between 1-3 generations) creating a basket of visions in which short-term objectives can be identified
- Focused on learning at the niche level, experiments are used to identify how successful a particular pathway could be and uses the concept of "Learn by doing, doing by learning" (Loorbach, 2007).
- A systems thinking approach which identifies that problems will span multiple domains, levels and actors (Rotmans and Kemp, 2001).

Loorbach (2004) introduced three different types of governance activities in transition management process[57]:

Strategic activities: According to Loorbach (2010) these are long term activities (in scale of 30 years) that leads to changes in the 'culture' of the societal system at the landscape level Strategic activities includes the process of vision development; the collective action of goal and norm setting.

Tactical activities: Relates to the interaction between actors in the landscape level and socio-technical structures at the regime level. In this process, the regime is aligned with the long term goals, and transition is conducted in a certain direction (Rotmans and Loorbach, 2009). It includes the processes of agenda-building, negotiating, networking, coalition building, etc. (Grin et al., 2010).

Operational activities: Actions have a short-term horizon and are often carried out in the context of innovations[58] that often emerge at niche level, and are driven by individual ambitions, entrepreneurial skills, or promising innovations (Loorbach, 2010). In this level

[57] The author used this framework in an article co-authored by Kemp and Rotmans (2007) for developing multi-level governance model. In that work, the relation and interaction among the mentioned three levels were included.

[58] In this context, innovation includes innovation projects and programs, in business and industry, in politics or in civil society. (Loorbach, 2010).

of activities, transition management is concerned with translating visions and transition paths into "transition experiments" (Laes et al., 2014) and includes processes of experimenting, project building, implementation, etc. (Grin et al., 2010). **Table 4-6** represents the comparison of these three levels of activities.

Level of activity	Focus	Problem/scope	Timescale
Strategic	Culture	Abstract/societal system	Long term (30 years)
Tactical	Structures	Institutions/regime	Midterm (5–15 years)
Operational	Practices	Concrete/project	Short term(0–5 years)

Table 4-6: Comparison of three levels of activities in transition management process

Source: Loorbach, 2007

After a few years, Loorbach (2010a) added another level of activities to the previous framework, named reflexive activities. **Reflexive activities** need to be an integrated part of the governance processes and are related to all other types of governance activities mentioned above. Reflexive activities relate to monitoring, assessments and evaluation of ongoing policies and ongoing societal change. They are necessary to prevent lock-in and to enable exploration of new ideas and trajectories (Loorbach, 2010a). In an another study, Loorbach (2010b) states that transition management offers governance principles and a set of governance instruments that can be applied to deal with major complex issues and highly uncertain, non-linear change. Foxon et al. (2010) describe transition management as a form of participatory policy-making that aims to steer or modulate the dynamics of transitions through interactive, iterative engagement among stakeholders' networks. One category of these stakeholders (or transition process actors) is the category, which is described as "State"[59] that includes different levels of government authorities.

4.6.1 Government Role in Low Carbon Transitions

Rotmans et al. (2001) highlighted the role of government in transition process in their famous article entitled "more evolution than revolution" stating that governments should bringing about structural change in a stepwise manner and be sensitive to the existing dynamics, and regularly adjust the goals to overcome the conflict between long-term ambition and short-term concerns.

Governance prescriptions in transition management mainly focus on facilitating evolution context for niches, especially where incumbent socio-technical regimes are under

[59] The actors categories were described before in actor based approach of MLP.

pressure to change (Smith and Stirling, 2008). Regarding to this, Loorbach (2010b) noted that it is impossible to predict or direct transitions, instead it should be possible to influence ongoing transition dynamics in terms of speed and direction. In other words, analyses in terms of transitions could help to identify dynamics (e.g., emerging innovations, niche-clustering, increasing landscape pressures, regime crises, lock-in or modulation) that could be influenced.

Moloney et al. (2010) noted the critical role of government at the national, state and local level in addressing climate change challenge by coordinating and better integrating current approaches in technical and social transitions. They believe that government role is important because they shape institutional and infrastructure systems and have more power in supporting community based organizations and practices.

With regard to emission reduction targets, although different stakeholders of transport sector should converge and develop close cooperation and partnership to solve the problems, many authors highlighted the role and contribution of public authorities - especially national and local governments - in developing emissions' reduction plans and policies, and providing financial and other kind of resources for transition toward sustainability (Bell, 2002, Monteiro and Teixeira, 2006; Demerse et al., 2008; Young and Dhanda, 2012; Clean cities report, 2011; Austin et al., 2012; Khan, 2013; Gudmundsson et al., 2015). Some scholars even go further and believe that public authorities should take the leading role in encouraging, and then supporting, private sector involvement, and coordinate the other stakeholders (Stern, 2006; EU INNOVA, 2011; Greene et al., 2011).

4.6.2 Governance Instruments

The main conceptual challenge in transition management is to translate the relatively abstract steering principles derived from dynamic complex systems into a practical management framework (Verborg and Loorbach, 2012). For this aim, there is a need to introduce government instruments that are mostly used for translating policy to practical actions. Elzen (2003) introduced those governance instruments in a framework of three different governance paradigms that are not only different in their basic philosophy, but also in their instruments:

1) Traditional top-down model, (also known as classic steering or command and control), consider the central role for (national) government and hierarchical relations,
2) Bottom-up or market model gives a large degree of autonomy for local actors,

3) Policy network model of shared rule-making and agreements between interdependent actors with diverging values and beliefs.

The **Table 4-7** shows a comparison of governance paradigms and their characteristics.

	Classic steering (Top down)	**Market model (Bottom up)**	**Policy Networks (processes and networks)**
Level of analysis	Relationship between principal agent	Relationship between principal and local actors	Network of actors
Perspective	Centralized, hierarchical organization	Local actors	Interactions between actors
Characterization of relationships	Hierarchical	Autonomous	Mutually dependent
Characterization of interaction processes	Neutral implementation of formulated goals	Self-organization based on autonomous decisions	Interaction processes in which information and resources are exchanged
Foundational scientific disciplines	Classic political science	Neo-classical economy (‘rational economic man’)	Sociology, innovation studies, neo-institutional political science (‘bounded rationality’, uncertainty, learning, interacting)
Governance instruments	Formal rules, regulations and laws	Financial incentives (subsidies, taxes)	Learning processes, network management e.g. experiments, demonstration projects, vision building at scenario workshops and foresight, network building, public debates

Table 4-7: Different Governance Paradigms

Source: Elzen (2003) based on: De Bruijn et al., (1993, 22)

Elzen (2003) noted that instructiveness and networks should be crucial constituents of transition management or transition policy. Thus, it seems that the third paradigm is most appropriate for transition management. Although, this does not mean that the other two can be abandoned.

Regarding the instruments, as it is shown in **Table 4-7**, formal rules and regulations are common instruments in the command-and-control paradigm, subsidies and taxes in the market model, and network management, learning processes, experiments, and interactive policy making in the third paradigm.

4.6.3 The Role of Local Government and City Authorities

Cities are vibrant, innovative and exciting places to live but they are also engaged in problems related to urban quality of life, transport and traffic problems and related consequences like air pollution, congestion, unplanned urban growth, rising living costs, and increasing demands on service delivery. These issues put pressure on local governments who act as community policy-makers and administrators, and are focused for community identity, provide services to meet community needs, facilitate and coordinates local efforts and resources in pursuit of common community goals (Van Staden et al., 2014). Wittmayer et al., (2014) argue that cities offer the opportunity for decisive local action to address sustainability issues both in terms of policy, and societal action.

Regarding the sustainability transitions, planning for sustainability mainly concerns local government and city authorities; each city has its own characteristics and needs, and these require tailored policy responses that can best be designed locally, as it is also pointed out in a number of studies (Bell, 2002; Monteiro and Teixeira, 2006; Demerse, et al., 2008; Young and Dhanda, 2012; Clean cities report, 2011; Austin et al., 2012; Khan, 2013; Gudmundsson et al., 2015).

Van Staden et al. (2014) argue that local government are important level of government because they are closest to the citizens, that give them a unique position to understand, inform, guide and lead local inhabitants, businesses and industries. In most cases they are democratically elected, and are a level of governance that represents their local community. They also have an important role in addressing non-technological barriers to support the transition process.

Considering the climate change adaption, Agrawal et al. (2009) state that local level organizations and institutions have the following advantages in climate change adaptation compared to higher level institutions:

A) Representing local perspectives in policy making and climate change planning area,
B) Bridging and promoting two-way communication between higher and local policy levels,
C) Assisting and guiding the implementation of climate change adaptation activities,
D) Mobilizing local participation; and finally
E) Handling the full adaptation and resilience cycle, at local level.

For Carbon emission reduction, Baeumler et al., (2012) argue that even with strong national leadership, cities will carry the bulk of responsibility for implementing the low-Carbon city agenda. They believe that the main roles of city authorities in Carbon reduction plans are:

Determining city's Carbon footprint: Knowledge of a city's footprint is critical to informing citizens and policy makers about the level and source of baseline emissions and conducting a citywide Carbon emission inventory that requires a consistent methodology, robust data collection, and transparency.

Developing a vision and set a low-Carbon target: Visions are some type of image of the future that shape the practices of today and therefore reproduce themselves tomorrow (Ryan 2002a; 2002b).This will require bottom-up analyses of options and a top-down articulation of a long-term vision from the city's officials.

Implementing low-Carbon city action plan: A low-Carbon city strategy and implementation plan needs to be developed and organized into a set of cross-sectoral and sectoral actions with each activity fully cost with financing identified. The low Carbon-city action plans should clearly address institutional integration. This is especially crucial given the strong interdependencies of many activities, particularly those for urban land use and transport.

Monitoring progress: Monitoring, verifying, and reporting Carbon emissions will ensure that the city is moving toward a low-Carbon growth path and is on track to deliver sustainable development. A measuring and reporting system should again use a nationally or globally recognized inventory methodology be based on a robust data collection system, and start with a solid baseline inventory that provides a benchmark for comparing subsequent inventories. Inventories should be conducted regularly, with results reported and verified (Baeumler et al., 2012).

Regarding all above mentioned actions, and due to the important role of local government in transition towards low Carbon urban mobility, this research focused on analyzing the role and contribution of local government in reducing Carbon emissions. In the next chapters this dissertation develops a methodology to analyze the role and efforts of local government, in order to get a better knowledge of the study context, to identify the dominant mobility regimes, the transition dynamics and how local government affect these dynamics, do they have special plans? Have they considered special targets for Carbon or more generally GHG emission reductions? What are the main strategies they applied in urban mobility context? Do they have any measurement system? Do they

publish the results of these measurements? And other questions like this will be asked to give us a better understanding of practical efforts in transition towards low Carbon urban mobility.

Chapter5:

Methodology

This chapter describes the research design and methods chosen for this dissertation. It has been constructed based on the concepts of transition toward low Carbon mobility and local governance, composing the theoretical background previously described, and the research theoretical framework designed, based on the current methodology that will be described in the next chapter. The project is an exploratory study about the contribution of local government in achieving low Carbon transport targets It is designed based on a mixed method approach; the methodology consists of a two phase research work and different methods, tools and populations are used in each phase based on the aims and objectives of the relevant work. This chapter is explaining the research design, methods and tools, study population and the motivations of choosing specific method, tool or population.

5.1 Overview of Research Process

The current research is a two-phase exploratory-descriptive study based on mixed method design, which is an integration of qualitative and quantitative methods. In the first phase the researcher tries to get a better picture of existing situation and providing the fundamental context for the second phase, which is a description of municipalities' efforts and viewpoints.

The main aim of this dissertation is:

Measuring the contribution of local public authorities [Italian municipalities in this case] in achieving low Carbon mobility targets.

Based on this aim, the primary research question is defined as it follows:

What is the local public authority's contribution in achieving low Carbon mobility systems?

In order to answer the main research question, secondary research questions have been pointed out:

- **R1:** What are the dynamics of transition process and the main government tools for influencing transition pathways
- **R2:** What is the role of each factor as a driving force or restraining force of transition process,
- **R3:** How local government (in this case, municipalities) contribute in managing, controlling and influencing those dynamics and forces.

The literature discussing the above questions has been reviewed in chapters 2 and 3, but in order to get a broad view of what actually is happening in Italy there is a need for better understanding of policies, strategies, challenges, available resources and the structure of transport and mobility planning.

The first phase of the current research is an exploratory study based on qualitative method; data gathering consists of semi structured in depth interviews with transport sector stakeholders in order to identify the main factors that affect the Carbon reduction targets or the related strategies in Italy. This exploration allows the researcher to better understand the study context, as well as to identify the key variables for building the conceptual framework that is going to be tested in the second phase of the research process. The conceptual framework shows the factors that affect the achievement of Carbon reduction targets for sustainable mobility and the estimated relations among them. Thus, using both the literature review and the first phase results the research hypothesis have been shaped, in order to answer to both secondary and primary research questions.

The second phase can be identified with the larger empirical action related to designing a survey and collecting data for testing the theoretical framework, the hypothesis and answer the secondary research questions formulated at the end of the first phase. The data were gathered through administered questionnaires to the municipalities that develop and adopt at least one kind of mobility plans (PUM or PUT) in Italy. The returned questionnaires then, are analyzed based on the quantitative analysis methods. A more detailed description of data gathering and analysis methods will be given later in this chapter.

In other words, the first phase deals with articulating the theoretical foundation that was described in Chapter 4 combined with the empirical finding presented in the following chapter 6 (while presenting the study results). In the second phase, the conceptual framework is used to develop a questionnaire for analyzing municipality's practices. These returned questionnaires are tested by quantitative data analysis methods. **Chart 5-1** shows the research methodological design and tools.

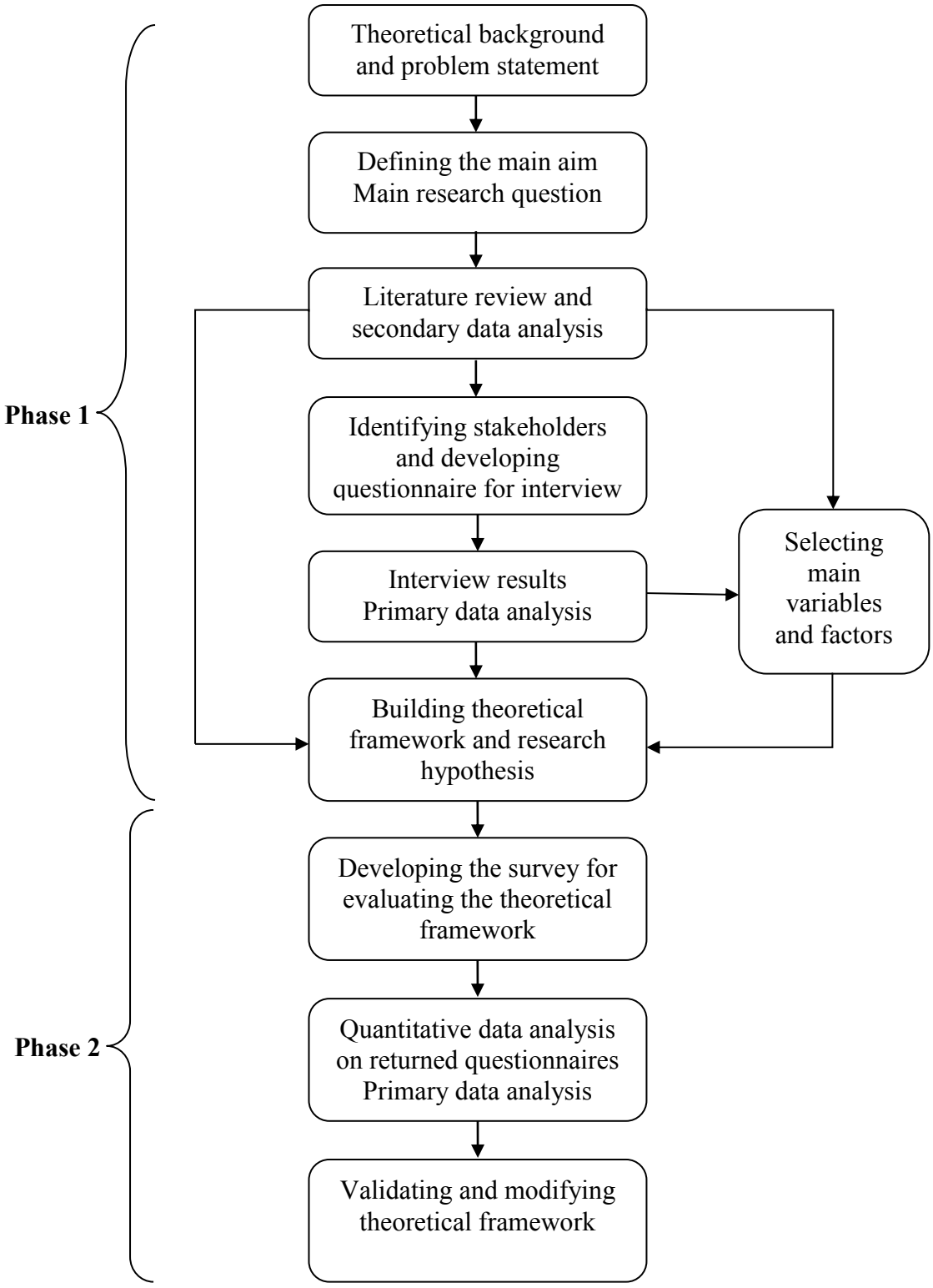

Chart 5-1: Research process and design, Source: own work

5.2 Setting up the Research Designs

Creswell (2013) introduce research designs as the types of inquiry within qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures in a research design. Others have called them strategies of inquiry (Denzin & Lincoln,

2011). The researcher not only selects a qualitative, quantitative, or mixed methods study to conduct; the inquirer also decides on a type of study within these three choices (Creswell, 2013).

Choosing the design, depend on the research methodology. While talking about the research design, we have to clarify whether the research is empirical or theoretical (conceptual). **Exploration, Explanation or Definition?**

Creswell (2013) categorized the main research designs based on the methodological approach which is shown in **Table 5-1**. Regarding those categories, approaches and procedure the current dissertation is an *Empirical Exploratory-Casual Comparative sequential study* which is going to be explained more in this section based on the approaches, purpose and procedures that are followed in this study, then the introduction and motivations of mixed method design will be presented under the methodological approach headline.

Quantitative	Qualitative	Mixed Methods
• Experimental designs • Non-experimental designs, such as surveys	• Narrative research • Phenomenology • Grounded theory • Ethnographies • Case study	• Convergent • Explanatory sequential • Exploratory sequential • Transformative, embedded, or multiphase

Table 5-1: Research designs, Source: Creswell (2013)

5.2.1 Empirical vs. Theoretical Approaches

The research has been conducted on an empirical base, because it aims at examining and analyzing the circumstances by collecting empirical data (Grønmo, 2006). The research derives knowledge from actual experience rather than just focusing on theories and beliefs (Penn State University 2013, P. 1) which means that the research is based on observation and measurement rather than theoretical reasoning. Although in the first phase a theoretical framework is developed, it should be noted that the aim is not just to develop a theory, but going one step further and collecting data to test the theoretical framework (Jones, 2014).

According to Flynn (1990), the initial step in conducting empirical research deals with articulating the theoretical foundation for the study (Flynn et al., 1990). In this regard, the empirical exploration at the beginning (phase1) fulfills the researcher's need for better understanding, testing the feasibility of a more extensive study, or determining the best methods to be used in a subsequent process. The objective of this exploration is to identify key issues and key variables (Pojasek, 2005).

Also, data collection methods should be depended on the research type which is going to be performed. In both phases of the research process, the search for empirical data has been planned and conducted, beyond analyzing the theories and building the conceptual framework. In phase one, the empirical data have been gathered based on the experiences and viewpoints of transport and mobility stakeholders, while in phase two the empirical data have been gathered based on the perceptions and practices of municipalities responders.

5.2.2 Research Purpose: Exploratory-Casual Comparative Design

The purpose of research could be exploratory, descriptive, explanatory, or policy oriented. As any research study will change and develop over time, more than one purpose may be identified (Pojasek, 2005). In term of purpose, this dissertation is an exploratory-experimental study: after conducting the exploration, the experiment of theoretical framework is performed.

The exploratory investigation conducted in phase one attempts to gain some familiarity with the appropriate concepts and looks for patterns or ideas without any preconceived view or explanation (Jones, 2014). The purpose is exploration since there is limited knowledge about the study problem (municipalities' efforts to achieve Carbon reduction targets) and no prior hypothesis could be defined at the beginning. As argued from many authors, researchers choose to use an exploratory design when they first need to explore a phenomenon qualitatively, before they can be able to measure or test it (Creswell, Plano Clark, et al., 2003; Morgan, 1998). Exploratory designs in this study begins with a qualitative in-depth exploration, of the key issues related to sustainable mobility in Italy; those initial qualitative results contribute then to build the quantitative study (Clark et al, 2008).

As from Campbell and Stanley (1963), the experimental study allows at testing the accuracy of the theoretical framework by determining if the independent variable(s) (the factors identified at Phase one) causes an effect on the dependent variable (in this study: emission reduction targets). This approach is described by Leedy and Ormrod (2001) as *Causal Comparative Research*, which provides the opportunity to examine the interaction between independent variables and their influence on dependent variables; the researcher examines how the independent variables affected by the dependent variables. The factorial design focuses on two or more categories with the independent variables as compared to the dependent variable (Vogt, 1999)

5.2.3 Research Procedure: Sequential Design

The data gathering process could be conducted at the same time (based on concurrent, simultaneous or parallel design) or organized in phases (based on a sequential or two-phase design) (Azorin, 2010). In his book entitled "Research Designs", Creswell (2003) introduced three general strategies for research procedure: sequential, concurrent and transformative procedures. In the sequential procedure the researcher seeks to elaborate on or expand the findings of one method using also another method. Concurrent procedure is focused on the researcher convergence of quantitative and qualitative data that aim at providing a comprehensive analysis of the research problem. Finally, in transformative procedure, the researcher uses a theoretical lens (such as a gender, ethnic/racial, or class perspective) as an overreaching perspective within a design that contains both quantitative and qualitative data.

Considering the characteristics of the context of study and the research aim, this dissertation is based on a sequential procedure to data gathering, in which the researcher firstly gather data to explore the context through the collection of data related to the views of participants. The outcome of the first empirical phase of analyses allows at identifying variables that are relevant in the context and that need to be investigated, thus considered into the follow-up quantitative study (Creswell 2013).

The empirical analysis conducted in the second phase, and based on the survey, brought at correlating the identified variables and their effect on dependent variable (that is the achievement of emission reduction targets, in this study). As described, the qualitative and quantitative analysis is performed in an ordinal sequence.

Two main factors that help researchers to design and conduct a mixed methods study are implementation of data collection and priority (Morse 1991; Morgan 1998; Tashakkori and Teddlie 1998; Creswell 2003). Implementation of data collection refers to the sequence that the researcher uses to collect both quantitative and qualitative data. In this dissertation, the qualitative data helped in building the analytical framework, which is used as the base for gathering and analysing quantitative data.

5.3 Methodological Approaches

General research strategy that outlines the way in which research is to be undertaken and, among other things, identifies the methods to be used in it. These methods, described in the methodology, define the means or modes of data collection or, sometimes, how a specific result has to be calculated (Howell, 2013). In fact, methodology is guidelines on

how the research ought to, and can be performed to make the research results acceptable as valid knowledge (Langeland, 2009). A method consists of rules and techniques on how to collect, adapt, analyze and present empirical evidence. Rationality is not only logical, analytical rationality, but it is also based on experience with aspects tied to the context and subjects intuition (Lysgård, 2000).

While thinking about choosing the research methodology, the competence of each approach with the goals and objectives of the research should be estimated. The method that aligns with the study goals is usually considered the best. Given the aims of this research and the available knowledge, there is a need for providing a better understanding of the study context that reflects the specific aspects of the country's current policy objectives, strategies, planning tools, main actors and challenges in transition towards low Carbon mobility. This exploration needs the collection and analysis of qualitative data. Based on co-evolutionary approach, the relation between dependent and independent variables should be examined, in this regard the second phase designed based on statistical analysis of a survey which is distributed between local public authority representatives (municipalities). Based on these explanations, the overall research design is mixed method-sequential that is an integration of qualitative and quantitative methods with an ordinal arrangement. Mixed method design and the related arguments are explained in this section.

5.3.1 Mixed Method Approach

Using a combination of methods to study a social phenomenon came to be accepted as a beneficial research practice during the 1980s. In a widely cited article, Johnson et al., (2007) attempts to define mixed method research as third major approach after quantitative and qualitative approach. The result of their survey showed that most researchers combine qualitative and quantitative research but some researchers mixed more than one form of qualitative research. Bryman (1988) argued for a `best of both worlds' approach and suggested that qualitative and quantitative approaches should be combined. Researchers have increasingly accepted the underlying assumption that biases are inherent in any one particular method of data collection or analysis (Rocco et al., 2003). Denzin (1989) advised: "by combining multiple observers, theories, methods, and data sources, [researchers] can hope to overcome the intrinsic bias that comes from single-methods, single-observer, and single theory studies" (p. 307). But even before 1980s scholars noticed the necessity of using multi method designs in order to minimize

the methodological bias; Jick (1979) believed that qualitative and quantitative methods should be viewed as complementary rather than rival camps. He pointed out the argument of Campbell and Fiske (1959) who stated that more than one method should be used in the validation process to ensure that the variance reflected that of the trait and not of the method. Therefore, researchers are turning to mixed methods to conduct stronger research. "The Handbook of Mixed Methods in the Social and Behavioral Sciences", Tashakkori and Teddlie (2003) noted the increasingly widespread use of mixed method approach.

Thus, mixed method approach is introduced as the "third movement" in the evolution of research methodology- following quantitative and qualitative approaches - and many scholars promoted it (Alford, 1998; Brewer and Hunter, 1989; Bryman, 1989; Cook and Reichardt, 1979; Giddens, 1976; King et al., 1994; Maynard and SchaeVer, 2000; Tashakkori and Teddlie, 1998; and 2002, Creswell and Garrett, 2008).

Although the research literature shows multiple ways to mix methods, and many levels of mixing both qualitative and quantitative elements in research projects (Rocco et al, 2003), mixed methods can be defined generally as the integration of more than one method or data source to investigate a phenomenon (Leahey, 2005). However, mixed method approach generally refers to the combination of both quantitative and qualitative methodologies, and the other types are mostly known as multi method designs. The journal of mixed method research defines mixed method as "research in which investigator collects and analyses data, integrates findings and draw inferences using both qualitative and quantitative approaches and methods in a single study or program of inquiry" (Tashakkori and Creswell, 2007, p.4). This is a broader definition of what has been previously introduced by Denzin (1978): Triangulation between methods, which are defined as "the combination of methodologies in the study of the same phenomenon" (Clark et al, 2008). Jick (1979) believed that by using triangulation, the weaknesses of one method would be offset by the strengths of another.

In this dissertation we follow the definition by Tashakkori and Teddlie, (2003, p.711) who define mixed method design as a type of research in which qualitative and quantitative approaches are used in forms of questions, research methods, data collection and analysis procedure.

5.3.2 Purposes of using mixed method design

Greene, Caracelli, and Graham (1989) identified and gave examples of evaluation projects that demonstrated five purposes for adopting mixed methods design strategies: *triangulation, complementarity, development, initiation and expansion* (Rocco, Bliss, Gallagher & Perez-Prado, 2003).

Triangulation is necessary in order to increase a study's validity and interpretability, while *Complementarity* increases a study's validity and interpretability by effectively managing overlapping, but different aspects of a phenomenon. *Development* uses results from one method to develop the other method. *Initiation* is used to add depth and breadth to inquiry mixed methods in order to deal with inconsistent results from qualitative and quantitative research findings. Finally, *expansion* approach helps to extend the scope of the study (Greene, Caracelli, and Graham, 1989).

The purpose of adopting the mixed method design in this dissertation is defined under *Development* category in which the result of the first phase which is a qualitative exploratory study is used for developing the quantitative analysis conducted in the second phase.

5.3.3 Motivations of using mixed method design

As mentioned earlier, the core assumption of mixed method design is that when researchers bring together both quantitative and qualitative research, the strengths of both approaches are combined, leading - it can be assumed - to a better understanding of research problems than either approach alone (Creswell and Garrett, 2008). This has been the historical argument for mixed methods research for more than 30 years (e.g., see Jick, 1979). A mixed method approach, therefore, presents a logical and intuitive appeal hence provides a platform for bridging the divide between qualitative and quantitative paradigms. This attribute, consequently, makes an increasing number of researchers to utilize mixed method designs in undertaking their studies (Onwuegbuzie and Leech, 2005). One of the main reasons behind using mixed method approach is to reduce the methodological bias.

Denzin (1988) contends that mixing methods permit more exact understanding or, in methodological terms, enhances validity (internal and external) as well as reliability. Other advantages include greater confidence in results; assistance in uncovering deviant or surprising dimensions of a phenomenon; enriched explanations, and theory integration or synthesis (Newman and Benz, 1998, p. 84).

According to Creswell (2007) the advantages of mixed method design are:

- ❖ Providing more evidence for studying a research problem than either quantitative or qualitative research alone.
- ❖ Enabling the researchers to use all of the tools of data collection available rather than being restricted to the types of data collection typically associated with quantitative research or qualitative research.
- ❖ Helping to answer questions that cannot be answered by quantitative or qualitative approaches alone
- ❖ Being "practical" in the sense that the researcher is free to use all methods possible to address a research problem and
- ❖ Solving problems using both numbers and words, combine inductive and deductive thinking.

In this regard, and considering that the mixed method approach give more opportunities to the researcher to search for information and data, and to analyze them, by using whatever methodological tools are required to answer the research questions, the mixed method approach has been selected for the research design behind this dissertation. Furthermore, the research process showed that either qualitative or quantitative methods are not able to answer the research questions if they are used solely. Finally, as previously described between different mixed methods designs this dissertation followed exploratory sequential design.

5.3.4 Critics to mixed method approach

Mixed methods research is an emerging methodological approach that became popular in business and management studies. Although mixed method research may offer a solution to the deficiencies of individual research paradigm, it is also subject to criticism. The first criticism is related to the definition of mixed method, as a third category of research methods (the approaches which is supported by well-known authors like Johnson et al., 2007; Alford, 1998; Brewer and Hunter, 1989; Bryman, 1989; Cook and Reichardt, 1979; Giddens, 1976; King et al., 1994; Maynard and SchaeVer, 2000; Tashakkori and Teddlie, 1998; and 2002; Creswell and Garrett, 2008). Critics argue that methods generate unique types of findings and knowledge that may not be merged (Zou and Sunindijo, 2015). For example, Greene et al. (2010) argue that methodological approaches based on fundamental philosophical understandings cannot be combined in one study; or Symonds and Gorard (2008) in an article named "The death of mixed methods" argue that

endorsing mixed methods as a 'third category', uphold paradigmatic separatism and thus create a world of limitation. They analyze mixed method's construct, content validity, and propensity for bias. The research findings suggest that, as a label grown out of two stereotypes, mixed methods is in danger of acting against its own aims by inhibiting new growth in research and by enforcing separation amongst methodologies and their practitioners (Symonds and Gorard, 2008). In an another study, Cameron et al. (2013) noted that a common criticism of mixed methods studies reported in academic journals is the lack of a justification or rationale for the use of mixed methods and how the study has integrated the data or findings from the study.

Responding to these critics Bryman (2012) noted that the notion of research methods carrying fixed philosophical assumption is difficult to sustain since each method could be used in a wide variety of tasks. Also, Symonds and Gorard (2008) who criticize the mixed method approach confess that there is a need for methods that better meet the purposes of research and quote and Hammersley (2005)'s argument that states: "individual researchers should be free to identify the most productive areas of inquiry and to determine the most effective means for investigating them" (Hammersley, 2005:144). So in order to respect researchers freedom in choosing the research method they finally suggest to use the word 'quantitative' to refer only to the activity of quantification, and 'qualitative' to describe that which is examined in depth – without being linked to a research paradigm.

A further criticism of mixed method research is the tendency of quantitative methods to be the primary driver of studies; but Greene et al. (2010) mention examples that regards qualitative and quantitative methods as equally important means to answer the research aims (Shaw and Holland, 2014).

5.4 Study Population, Data Collection and Analysis Methods

A variety of data sources is used in the presented research dissertation. As pointed out by Creswell (2013), the phases of the data collection and analysis vary according to the specific method of analysis selected. Then, Green (2012) argues that the type of data collection method depends on the research question or hypothesis, ethical considerations, and the type of analysis the researcher plan to conduct (Green et al., 2012).

At this stage, the study population, the data collection methods, and the analysis tools and the related considerations are going to be explained in the following subsections, as well

as the data reliability, motivations and reasons of choosing specific method for data collection or analysis.

5.4.1 Study Population and Sampling Strategies

The population under study is different with regard at the two phases of the research process, depending of the aims of the special phase. In research, sampling is the method for selecting people, events or objects for study. Non-probability and probability sampling strategies enable the researcher to target data collection techniques[60]. The data may need to be of a specific size (sometimes determined by a power calculation) or composition. After defining the sample special, techniques are used to collect the required data. This section describes the study population (the samples) and the motivations or reasons for choosing the specific samples. The next two sections aim at describing the data collections methods and analysis tools respectively.

A) Phase One: Selection of Interviewees

Phase 1 is conducted according to a qualitative study that seeks to explore meaning and perceptions of problem and challenges in order to gain a better understanding about the current situation and efforts, strategies and plans, and generate the research questions. For this aim, the researcher decided to explore the study context from different perspectives and viewpoints. The transport sector stakeholder groups were identified by literature review, considering previous studies and researches conducted even in Italy. The stakeholder's representative organizations and the viewpoints searched during the interviews are summarized in **Table 5-2**:

Stakeholder groups	Actor Category	Perspectives/aspects	Representation in Italy
National government	State	Political-Strategic	Ministries
Regional administration	State	Strategic- Planning	Regions- Agencies
Local authorities	State	Strategic- Planning Implementation	Municipalities
Public transport providers	Market	Infrastructure	Local bus and freight companies
Automotive industry	Market	Technological	Vehicle producers
Universities and research centers	Science	Scientific- knowledge	Universities and research centers
Civil society	End user	user	Customer association

[60] http://learntech.uwe.ac.uk/da/Default.aspx?pageid=1409

Table 5-2: stakeholder groups, viewpoints and representations

After identifying the stakeholders, the researcher needs to identify the interviewees from above mentioned groups for semi structured interviews, encouraging them to share rich descriptions of phenomena while leaving the interpretation or analysis to the investigators (DiCicco-Bloom and Crabtree, 2006). Selecting the interview participants is based on purposive sampling that seeks to maximize the depth and richness of the data to address the research question (Kuzel, 1999). The main goal of purposive sampling is to focus on particular characteristics of a population that are of interest, which will best enable the researcher to answer research questions. The sampling process involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest (Cresswell and Plano Clark 2011). In addition to knowledge and experience, Bernard (2002) and Spradley (1979) note the importance of availability and willingness to participate, and the ability to communicate experiences and opinions in an articulate, expressive, and reflective manner. In purposive sampling method, the sample being studied is not representative of the population, but for researchers pursuing qualitative or mixed methods research designs, this is not considered to be a weakness (Lund Research Ltd[61], 2012).

There are a variety of purposeful sampling designs, some of them are used to identify and expand the range of variation or differences, while other strategies are used to narrow the range of variation and focus on similarities (Palinkas et al, 2015). In this study, heterogeneous sampling design is used which is known also as maximum variation sampling that is a design under the first group category explained by Palinkas et al., (2015); a technique that is used to capture a wide range of perspectives relating to the problem under investigation. The basic principle behind maximum variation sampling is to gain greater insights into a problem by looking at it from all angles, this approach best aligns with the aims of the first phase of study.

B) Phase Two: Questionnaire Respondents

The mobility managers or the transport responsible authorities in municipalities are asked to answer the questionnaire. Considering that the public authorities in Italy consist of ministries, administrative regions, agencies (in some provinces) and municipalities[62].

[61]http://dissertation.laerd.com/purposive-sampling.php

[62]The Italian transport regulation authority was established on 17 September 2013 and became operational on 15 January 2014, but in this research it is not considered as the public governance body because as it is

Among these agents, municipalities are chosen as the main study population considering that they are local regulatory agents that prepare transport plans, and set the policy goals at urban level. Moreover they are engaged in implementation process, and are more aware of practical impediments and challenges.

For data collection in phase two, a sample population of 308 municipalities that has a dimension of more than 30,000 inhabitants was selected out of a national population of 8.047 municipalities. In Italy, most of municipalities (70.5%) have less than 5.000 inhabitants, characterized by a weak organizational structure and low ability to participate to the strategic planning process that is mainly demanded to the provinces authority[63]. The reason for choosing municipalities with more than 30,000 inhabitants lies behind the sustainable mobility planning activity required to the institution. According to the Italian law (Law Decree/D.Lgs. 285/92), only municipalities with more than 30,000 inhabitants ought to define and adopt a PUT (Piano Urbano del Traffico-Urban Traffic Plan), which is a classic urban transportation plan and is mainly devoted to managing city transport demand and supply issues, such as public transit, parking policies, and road safety measures(Velazquez Valoria, 2013; Percoco, 2007; Morrison et al., 2007). The chosen population includes the entire population of municipalities (having more than 100,000 inhabitants) for which it is compulsory also to define a second plan, named Urban Mobility Plan (PUM).

5.4.2 Data Collection Methods, Reasons and Motivations

Data collection techniques are tools and approaches used to collect data relevant to answer the research question or testing the defined hypothesis. The main issues that are suggested to be considered in relation to data collection process are: the sources of data available, the form in which the data are available, the amount of data needed, the accuracy and reliability of the data, and whether the data fit the parameters of the design (Bickman and Rod, 2008). More than one technique can be used for data collection process, the most common techniques are questionnaires and interviews; both of them are used in different phases of this study, while other techniques also used along those main techniques.

---

noted by Cambini and Perrotti (2015): "the Authority is fully independent from government, regulated businesses and infrastructure operators"

[63] Based on a recent national reform dated 2013, the province authority has been cancelled. Thus, in this transition phase, provinces are only managing the ordinary activities and the projects that were already approved. However, they cannot be considered anymore the local government coordinating municipalities.

In this context, considering that the study is conducted in two phases which have different aims, methodological approaches and designs, different methods for data collection and analysis were employed in each phase.

In phase1 the main objective was to identify the main factors that affect the transition process towards low Carbon urban mobility that are identified by semi-structured open ended interviews with the key stakeholders of the transport sector. But before that there was a need to obtain a better knowledge of current situation, policies, strategies and plans related to emission reduction objectives defined in Italy as well as in the European context. This process performed through analysis of secondary data sources (policy declarations, annual reports and strategic plans mainly prepared by Italian local and national authorities to the higher levels of policy makers; as well as official website analysis and reviewing academic papers and articles discussing the current state, drivers and barriers of emission reduction plans in Italy).

Phase 2 is focused on questionnaire as a method for data collection. The questionnaire was designed based on the previous step findings and literature review. **Table 5-3** shows the different data collection methods used in both phases of this research regarding the aims of related phase, types of data (primary and secondary).

Research process	**Aim**	**Data collection method**	
		Primary data	**Secondary data**
Phase 1	Identifying the factors and variables that affect emission reduction targets	• Semi-structured interviews	• Literature review • Website analysis (international and national level) • Document and data analysis (Reports, policy guides, etc.)
Phase 2	Evaluating the efforts of municipalities for emission reduction objectives	• Questionnaire	• Literature review • Website analysis (Local level-municipalities) • Document analysis (transport plans, reports) • Attending seminars and workshops

Table 5-3: Data collection methods in based on aims and objectives of research process

Source: own work

A) Interviews

Semi structured face to face interviews conducted to gather data about the strategies, plans, challenges and drivers of Carbon reduction targets in Italy based on the viewpoints of transport sector stakeholders.

In this study both individual face to face and group interviews were used in combination with literature reviews and document and website analysis. The main advantage of face to face interviews is that the researcher can adapt the questions as necessary, clarify doubts and ensure that the responses are properly understood by repeating or rephrasing the questions (Sekaran, 1992; P197). Group interviews take in the form of focus groups, with multiple participants sharing their knowledge or experience about the research problem (Merton et al, 1956; Barbour and Kitzinge, 1999; Morgan, 1997 and Owen, 2001). The interviews designed on semi structured format that are generally organized around a set of predetermined open-ended questions, with other questions emerging from the dialogue between interviewer and interviewees (DiCicco-Bloom and Crabtree, 2006). The reasons for choosing semi-structured interviews instead of structured interviews in this study are:

- **First:** it allowed the interviewer to investigate and expand the interviewee's responses and develop questions based on new ideas which may be formed during the interview process (Hitchcock and Hughes, 1989; Ayres, 2008; Warren and Karner 2005; Berg 2009; Denzin and Lincoln 2011; Cohen, and Crabtree, 2006; Wilson, 2014; Harrell and Bradley,2009;Barriball and While, 1994and Stuckey, 2013)
- **Second:** because of the varied professional, educational and personal experiences of sample group hampered the use of structured interview method (Barriball, and While, 1994) and
- **Third:** because semi-structured interviews "lend themselves well in combination with other methods" as also noted by Robson (2002, p. 270) and in this research the semi-structured interviews were used in combination with literature reviews and document and website analysis. The interviews then coded, categorized and labeled to identify the main variables (mainly, innovations and emission reduction strategies and policies used in Italy's urban mobility management system, tools.

The interviews have been then coded, categorized and labeled in order to identify the main variables; the concepts have been compared with literature findings and those concepts who have enough supports in the literature considered for building the theoretical framework.

B) Literature Review, Document and Data Analysis

The literature review and document analysis were conducted in both phases of the study; at the first phase the aim was a parallel investigation with interview results in order to identify the variables that affect emission reduction targets, and to compare them with the

viewpoints of stakeholders. The analyzed literature consists of scientific papers and articles on urban transport management and mobility planning related to both Italian and the international context, about emission reduction strategies, policies, challenges, viewpoints and driving forces were reviewed, summarized and the main variables extracted from those researches for further analysis.

The document analysis process consist of review and summarizing the policy documents presented by local, national and international authorities, such as Italy's national reports (Greenhouse gas inventory report 1990-2014), international reports (IPCC; IEA, OECD annual reports and databases) and EU legal documents (e.g. White paper on transport, Green paper on urban transport, etc.) which provide background information of urban mobility policy development and emission trends in Italy.

At the second phase the literature and document reviewed mainly consists of those papers, reports, legal and policy documents (like transport plans of municipalities, regions and reports to higher level authorities) published by local authorities and agencies which mainly aimed at introducing and presenting the main efforts and short term plans.

C) Website Analysis

This process is also conducted in both phases. At the first phase, the website of European commission, ministry of transport, ministry of environment, land and sea in Italy, vehicle producing companies; and international organizations like United Nations, International Energy Agency (IEA), and World Business Council on Sustainable Development (WBCSD) were investigated to get the general knowledge about emission trends, reduction plans and strategies and policy priorities for emission reduction.

At the second phase website analysis process was focused mainly on national and local context (like literature, data and document analysis) and is performed by investigating the website of municipalities to get more information about news action plans, efforts and events, and the participation in national and international projects related to sustainable mobility or promotions of clean mobility services.

D) Postal Questionnaires

According to Sharp and Howard (1996, p 145), "over the past century, questionnaires became a common method of gathering information". It can be defined as "a pre-formulated written set of questions to which participants record their answers, usually within largely closely defined alternatives" (Sekaran, 1992, p. 200). Questionnaire is a narrowed category of surveys in which methods other than asking questions are used to gather information and data from sample population (such as direct observation, physical

measurements, judgments by a researcher, analyses of other existing data). In terms of reliability, posting questionnaires avoid accusations of incorporating researcher bias as compared to administered questionnaires (Hameed, 2000).

In this dissertation data gathering through questionnaire only performed in phase 2 in which, the questionnaires are built based on variables founded through interviews and designed based on questions derived from literature review and interviews. The questionnaires then mailed to the sample participants, with a pre-paid self-addressed envelope and providing also an email address for sending back the surveys to encourage the response. There were also no obligation to specify the name of the respondent municipality; although the questionnaire was administered anonymously, the researcher planned to track the respondents through a coding process. In any case, the data analysis was conducted grouping the responses, thus the anonymous approach was kept.

The questionnaire was designed based on close ended questions (scaled questions based on 7 point Likert scale, nominal and Yes/No questions) in which responses are graded on a continuum, although there were a few number of open ended questions that respondent were asked to write down a few words or numbers (such as the year they start to apply mobility plans).

E) Attending seminars and workshops

participation in seminars, workshops and conferences is introduced as one of the data gathering methods, where research findings were disseminated and new knowledge shared by the participants, and help them to exchange ideas and experiences (Manyasi et al., 2012; Kratochvil, 2011 and Sreenivasulu, 2015). In this study, the attending seminars and workshops used as a data collection method in both phases of research process provided a learning experience that helped in stimulating the research project by:

- Learn from the international team of experienced coaches and experts.
- Benefit from a strong focus on practical implementation within industry and international networking
- Gain a systemic view of current mobility challenges
- Interact with peers and mobility transitions experts from across Europe
- Build a solid network, become part of an active community of professionals and stimulate (international) crossovers between projects
- Evaluate the research findings and discuss them with experts and compare them with the strategies applied in other regions and countries

5.4.3 Data Analysis Methods

Once the data gathering process has been completed, the researcher organizes the data to be analyzed. Organizing the data correctly can save a lot of time and prevent mistakes. Data analysis is a process for obtaining raw data and converting it into information useful for decision-making by users. Data is collected and analyzed to answer questions, test hypotheses or disprove theories (Judd and McCleland, 1989). Most researchers choose to use a database or statistical analysis program (Microsoft Excel, SPSS) that they can format to fit their needs.

According to Trochim and Donnelly (2001), the data analysis involves three major steps, done in roughly this order:

- **Data Preparation:** involves checking or logging the data in; checking the data for accuracy; entering the data into the computer; transforming the data;
- **Describing the data:** providing simple summaries about the sample and the measures. Together with simple graphics analysis, in order to simply describe what the data shows.
- **Testing Hypotheses and Models:** investigate questions, models and hypotheses. inferential statistics used to make inferences from data to more general conditions;

It should be also considered that the distinctive features of data collection methods are also reflected in the methods used to analyze those data (Schutt, 2012). So the analysis procedures for qualitative data are different from those for quantitative data. With this introduction the data analysis methods and tools which is used in this dissertation are explained in this section based on the methodological approach (qualitative or quantitative). The more detailed explanation on analysis methods will be presented in the next chapter.

A) Qualitative data analysis

Qualitative data are in the form of text; the "text" that qualitative researchers analyze is most often transcript of interviews or notes from participant observation sessions, but text can also refer to pictures or other types of data (Schutt, 2012). In this research, the main feature of qualitative data is the transcripts of interviews gathered at the first step, also other types of qualitative data like document and website analysis, catalogues and report content exploration results were gathered. The qualitative data analysis process has been done manually in some steps including:

- Preparing row data,

- ❖ Coding,
- ❖ Categorizing and
- ❖ Building the analytical framework.

The arrangement of these steps is illustrated in Chart 5-2, and the application of these steps in research process will be explained with more details in Chapter 6, while presenting the results of phase one data analysis.

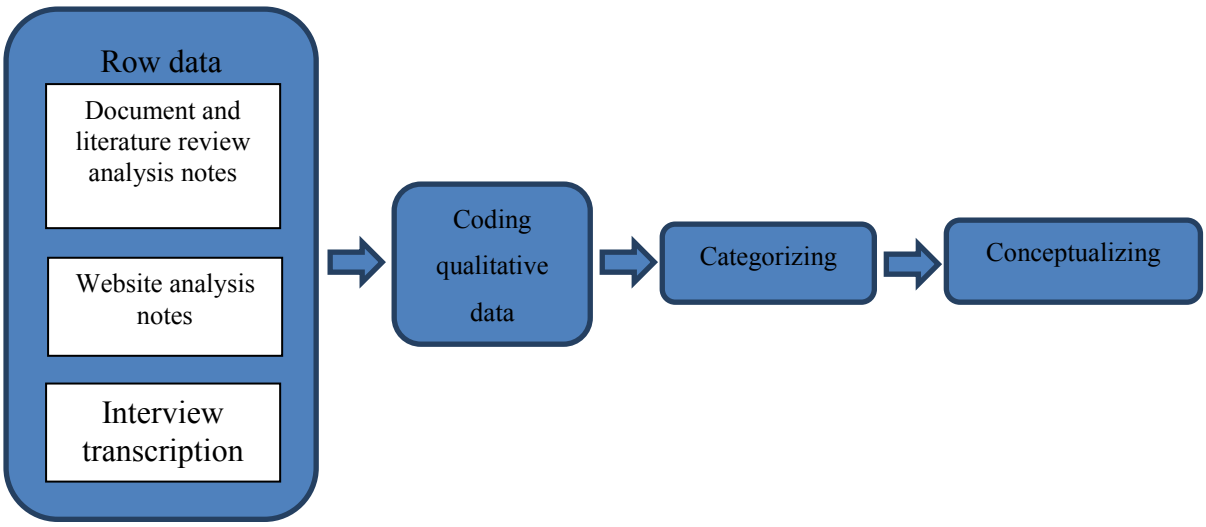

Chart 5-2: Qualitative data analysis process

Source: Own work based on the model presented by Lichtman (2013)

A.1. Preparing Row Data

The process of analyzing qualitative data begins when the researcher start to prepare row data through general reading, followed by careful reading (and thick description; Geerts, 1973) of each piece of information including the interviews, website analysis, notes from documents and reports, etc. In this process, researchers can (and in some cases must) take notes, in the form of memos (Strauss& Corbin, 1998), to record their impressions and insights, which can help them in later stages of the analysis.

Semi structured interviews with open ended questions are the main feature of qualitative data which are analyzed in this study. Each interview last between 30 and 90 minutes. The interviews were tape recorded with prior permission of the participants (there were only two participants who didn't give the recording permission). Also, notes were taken during the interview in order to emphasize the main topics. Then, the researcher made the transcripts, in order to extract row data from interviews, website contents, documents, etc. Since the collected data were both in Italian and English, in some cases there were need

to translate the transcripts, which was done with the help of dissertation supervisor and other colleagues.

A.2. Coding qualitative data

The transcripts reviewed; relevant words, phrases, sentences, or sections labeled in order to assign the codes. The initial code can be a word, a phrase, or the respondent's own words which are obtained by a careful reading of the text (Lichtman, 2012). The codes were chosen based on:

- The factors and phrases that were mentioned by most of the interviewees;
- The variables that any interviewee explicitly states that it is important;
- The points that had some similarities with the findings of literature review (e.g. scientific articles; reports, etc.)

When creating codes for qualitative analyses, (content analysis for example), researchers decided to be both inductive (allowing themes, patterns, and categories to emerge from the data) and deductive (relying on previous analytical categories, obtained from a theory of reference or even an interview guide), at the same time (specifically suggested in mixed research designs; (Creswell, 2008)).

A.3. Categorizing

At this point, the purpose of analysis is to reduce the material even further, at the same time raising its level of abstraction. Classifying or clustering themes or codes into categories allows researchers to organize them and develop conceptualizations about them—that is, explain them (Bendassolli, 2013). This step is used to decide which codes are the most important, and create categories by bringing several codes together, the process is done by searching through all the codes created in the previous step, reading them, creating new codes by combining two or more codes. There were no obligation to use all the codes that have been created before, and many of those initial codes dropped. The important codes grouped based on similarities and the main themes in order to shape sub-categories. The categories were made by grouping sub-categories based on their similarities and relevance. For this aim, the researcher compared them to theories and other findings discussed in the relevant literature. Categories help to conceptualize the data and do not need to be of the same type, necessarily. They can be about objectives, strategies, challenges, affecting factors, or whatever. In fact these categories shape the elements of theoretical framework which is described as "Concepts" by Lichtman (2012) but in this study we simply named them "concepts" or "influencing factors" respecting

the aim of the first phase (which is to identify the factors influencing Carbon reduction targets).

A.4. Building the analytical Framework and hypothesis

The final step in qualitative data analysis is the process to synthesize the key concepts that reflect the meaning of the collected data (Lichtman, 2012) for building theoretical or conceptual framework.

Current usage of the terms conceptual framework and theoretical framework are vague and imprecise. In this study, the conceptual framework is defined not only as a collection of concepts rather, a construction that provides a comprehensive understanding of a research problem; in which each concept plays an integral role (Jabareen, 2009). According to Miles and Huberman (1994), a conceptual framework "lays out the key factors, constructs, or variables, and presumes relationships among them" (p. 440). Thus, theoretical or conceptual framework is a design of concepts and the relations between them; in which the concepts are the factors that affect emission reduction targets, and the connection between concepts are described by the secondary research questions which are developed with the help of scientific hypothesis and literature.

In this study, it is preferred that a limited number of concepts use for shaping the theoretical framework, respecting Lichtman's idea emphasizing that fewer well-developed and supported concepts make for a much richer analysis than many loosely framed ideas (Lichtman, 2012).

This process of building theoretical framework is iterative and includes repetitive synthesis and re-synthesize until the researcher recognizes a general theoretical framework that makes sense (Jabareen, 2009). As Miles and Huberman (1994) have suggested, researchers who use qualitative methods "need to know how they are constructing 'theory' as analysis proceeds, because that construction will inevitably influence and constrain data collection, data reduction, and the drawing and verification of conclusions" (p. 434). In this research after building the concepts another phase of literature review began, because the primary literature showed that these factors affect the final target, but the relation between the factors was not yet identified because the factors have not been clearly identified. They were the results of interview analysis and before finishing those analyses nothing could be mentioned certainly.

The theoretical framework is the ending point of phase one and an introduction for starting the second phase. The theoretical framework and detailed description will be explained in chapter 5 where the analysis results are presented.

Once a theory has been formulated, it is likely that researchers will want to test it. Does the theory sound reasonable when faced with empirical evidence? However, it is rarely possible to test a theory as such. Instead, we are more likely to find that a hypothesis, which relates to a limited facet of the theory, will be deduced from the theory and submitted to a searching enquiry (Bryman and Cramer, 2001). Hypotheses often explain the relationships between two or more factors (concepts).

B) Quantitative Data Analysis

Quantitative data analysis is a systematic approach to analyze numerical data. Sometimes other kind of data (qualitative data for example) transferred into numerical data with the help of special tools and measures (like what has been done in this study). Quantitative methods of data analysis can be of great value to the researcher who is attempting to draw meaningful results from a large body of qualitative data. The main beneficial aspect is that it provides the means to separate out the large number of confounding factors that often obscure the main qualitative findings (Abeyasekera, 2005). In this study, the qualitative data analysis helped to identify the main factors that affect emission reduction targets, but measuring the inter-relationships between factors and their effect on final targets requires some degree of quantification of the data and a subsequent analysis by quantitative methods.

The use of quantitative procedures in analyzing qualitative information can also lend greater credibility to the research findings by providing the means to quantify the degree of confidence in the research results (Abeyasekera, 2005).

The main steps in the process of quantitative research is described by Bryman and Cramer (2001) is shown in **Chart 5-3**, the steps that are followed in this study is more or less the same, considering that this study is based on survey/correctional design and the experimental approach is not followed in this phase. In addition, some steps in this process are explained before in current chapter (like theory and hypothesis building, selection of respondents or participants); these steps are highlighted to be separated from the others. The remaining steps are going to be explained in this section.

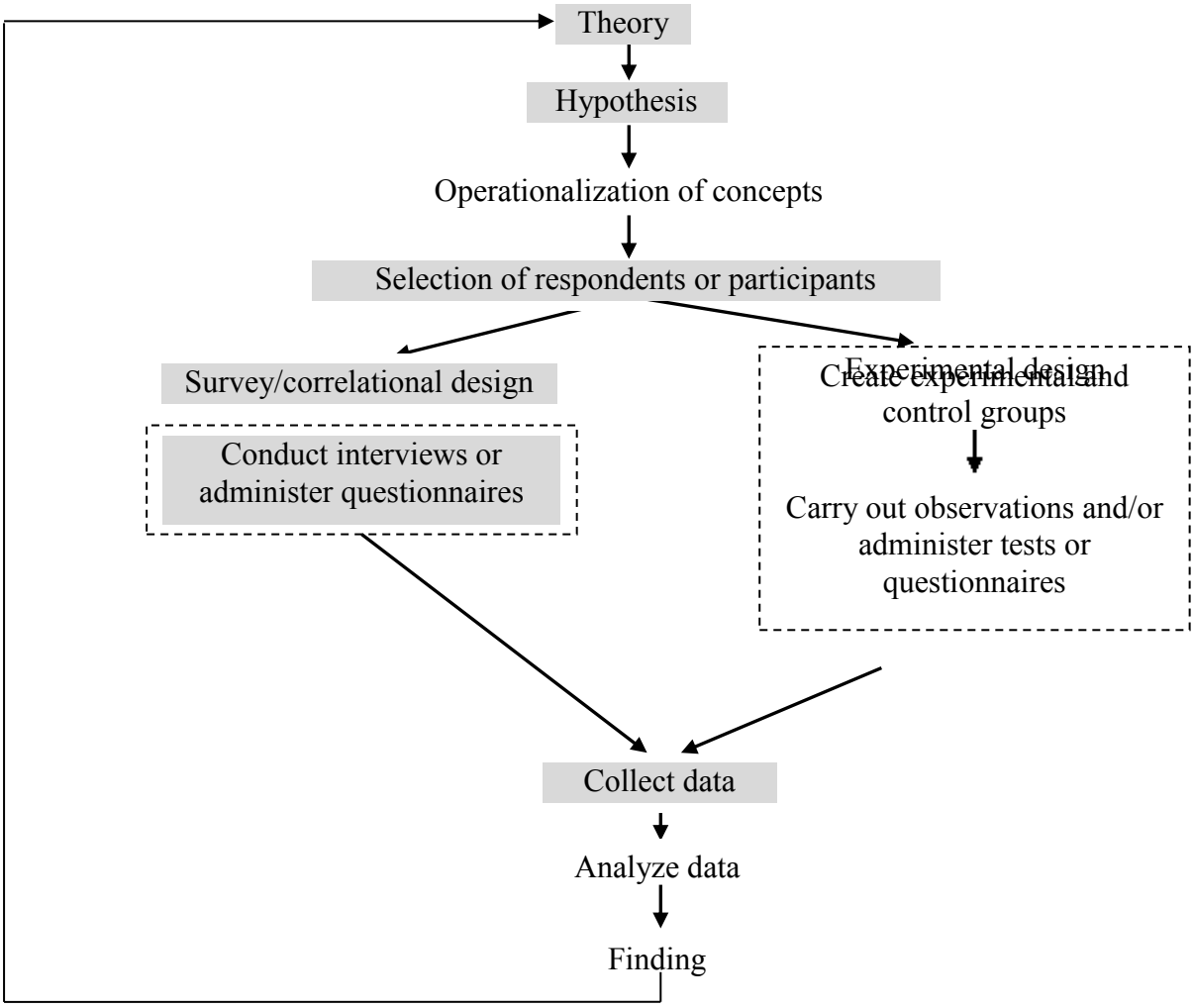

Chart 5-3: The main steps in quantitative research process

Source: Bryman and Cramer (2001)

B.1. Developing measurements (operationalization of concepts)

In order to assess the validity of a hypothesis it is necessary to develop measures of the constituent concepts. This process is often referred to as operationalization, following expositions of the measurement process in physics (Bridgman, 1927). In effect, what is happening here is the translation of the concepts into variables, that is, attributes on which relevant objects (Bryman and Cramer, 2001).

Likert scales are a common ratings format for surveys, which is used also in this study. Here, Likert items are used to measure respondents' attitudes and responses of the questions or statements: although other types of questions (Nominal and Yes/No questions). A Likert item is simply a statement that the respondent is asked to evaluate according to any kind of subjective or objective criteria; in general, the level of agreement

or disagreement is measured. It is considered symmetric since there are equal amounts of positive and negative positions.

When responding to a Likert questionnaire item, respondents specify their level of agreement with specific statements, frequency of using funds and cooperation with other stakeholders, importance of listed challenges and obstacles, and priorities of applying the strategy headlines. Thus, the range captures the intensity of their feelings for a given item (Burns & Burns, 2008). Four types of 7 point scales are used, in the questionnaire designed for this study, the scales and related descriptions are shown in **Table 5-4**:

Likert Scale	Agreement	Frequency	Importance	Priority
1	Strongly disagree	Never	Not at all important	Not applicable
2	Disagree	Very rarely	Low importance	Not a priority at this time
3	Somewhat disagree	Rarely	Slightly important	deliberating the issue
4	Neither agree or disagree	Occasionally	Neutral	Have adopted policies/ guidelines
5	Somewhat agree	Frequently	Moderately important	Implementing pilot project(s)
6	Agree	Very frequently	Very important	Implementing in specific case(s) or area(s)
7	Strongly agree	always	Extremely important	Implementing throughout municipality area

Table 5-4: Likert scales used in the questionnaire

B.2. Questionnaire design

As it was described before the questionnaire designed based on close ended questions (scaled questions based on 7 point Likert scale, Nominal and Yes/No questions), also a few number of open ended questions were used in the questionnaire, requiring the respondents to write down a few words or numbers (such as the year they start to apply mobility plans). The personal information just consists of two questions about the role of the respondent and the sector they belong to (because the questionnaires are answered by either mobility or environment managers). The questionnaire's structure consists of different sections, described as follows:

General information: asked some questions about existence of transport or mobility responsible (that could be a person or a division), the existence of transport plans or sustainable mobility strategies (specifically strategies for GHG and CO_2 reduction).

After general information each part in the questionnaire assigned to one of the factors identified at the phase 1, asking questions about perceptions, preferences, and experiences regarding:

- Attitudes toward sustainability
- External funds and resources to support mobility plans
- Collaboration and cooperation activities
- Strategies and plans (for clean mobility and reduction of personal vehicles)
- Challenges and obstacles
- Efficiency of emission reduction strategies[64].

Although the response rate was below expected but the returned surveys were enough to conduct statistical analysis. The statistical analysis will be explained in the next part.

B.3. Software and Tools

After quantifying the qualitative data, the questionnaire coded and returned questionnaires are entered in SPSS software for further analysis. SPSS Statistics (Statistical Package for the Social Sciences) is a software package widely used for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners[65].

In this study SPSS software package 18.0 used for quantitative data analysis and the following analysis used for evaluating the obtained data[66]:

- Calculating the variable from the set of questions
- Correlation analysis (Pearson correlation, Spearman's and Kendall's rank correlation analysis),
- Path analysis

These analyses and their application in current research is going to be described here:

B.3.1. Correlation Analysis

In this study, the researcher was specifically interested in identifying the relation between variables, mainly the relation between dependent and independent variables, but sometimes also the relation between both independent variables.

---

[64] The questionnaire is available in the Appendix part at the end of this dissertation

[65] KDnuggets Annual Software Poll: Analytics/Data mining software used?". *KDnuggets*. May 2013.

[66] Other tests used for estimating and measuring the reliability and validity of questionnaire that will be described later in thus chapter

Bivariate correlation is a measure of the relationship between the two variables; it measures the strength of their relationship, which can range from absolute value 1 to 0. The stronger the relationship, the closer the value is to 1. The relationship can be positive or negative; in positive relationship, as one value increases, another value increases with it. In the negative relationship, as one value increases, the other one decreases.

There are several correlation coefficients, measuring the degree of correlation. The most common is the Pearson correlation coefficient, which is sensitive only to a linear relationship between two variables (which may exist even if one is a nonlinear function of the other). Other correlation coefficients have been developed to be more robust than the Pearson correlation – that is, more sensitive to nonlinear relationships (Croxton et al, 1968; Dietrich, 1991 and Aitken, 1957).If the variables are independent, Pearson's correlation coefficient is 0, but the converse is not true because the correlation coefficient detects only linear dependencies between two variables. The information given by a correlation coefficient is not enough to define the dependence structure between random variables (Mahdavi Damghani, 2013), so it is often suggested that correlation analysis used with visual examination of the data.

For observing nonparametric correlations in this study, rank correlation coefficients, such as Spearman's rank correlation coefficient and Kendall's rank correlation coefficient measure the extent to which, as one variable increases, the other variable tends to increase, without requiring that increase to be represented by a linear relationship. If, as the one variable increases, the other decreases, the rank correlation coefficients will be negative. It is common to regard these rank correlation coefficients as alternatives to Pearson's coefficient, used either to reduce the amount of calculation or to make the coefficient less sensitive to non-normality in distributions (Yule and Kendall, 1950; Kendall, 1955).

B.3.2. Path Analysis

Multiple regressions fits a linear equation to observed data, but the relation between variables may not be linear. Generally, regression models only show the direct effect of independent variables on the dependent variable and not the indirect effects. In this situation it is not possible to test the theoretical model which aims to identify the relations between independent variables as well as the effect of independent variables on dependent variable. In order to solve such problems, path analysis could be considered as a solution.

Path analysis introduced by Swell Wright (1918, more extensively described in 1920, 1921 and 1934), is a special case of structural equation modeling (SEM), developed form of multiple regression analysis. It has been applied to a vast array of complex modeling areas, including biology, psychology, sociology and econometrics (Dodge, 2003).

The main advantage of path analysis to regression analysis is regression analysis just reveal the direct effects of each independent variable on dependent variable but path analysis enable the researcher to identify the indirect effects in addition to direct effects (Habib Pour and Safari, 2009). It goes beyond regression in that it allows for the analysis of more complicated models. In particular, it can examine situations in which there are several final dependent variables and those in which there are "chains" of influence, in that variable A influences variable B, which in turn affects variable C (Steiner, 2005), so in path analysis the researcher face a number of standardized linear regression equations, while in regression analysis only one linear regression equation appears (Mansourfar, 2006).

Chart 5-4 shows a simplified path model adopted from Garson's most cited article "path analysis" (Garson, 2008); but before explaining the model, which will be the base assumption for developing theoretical framework in this study, a brief explanation of usual customs in path models is presented as follows:

- Independent variables usually called exogenous variables and dependent variables are called endogenous variables.
- A path coefficient indicates the direct effect of a variable assumed to be a cause on another variable assumed to be an effect.
- Path coefficients are standardized because they are estimated from correlations (a path regression coefficient is un-standardized).
- Path coefficients are written with two subscripts. The path from 1 to 2 is written P_{21}, the path to 2 from 1 (the effect is listed first).
- A path analysis in which the causal flow is unidirectional (no loops or reciprocal causes) is called recursive[67].
- All relations are linear and additive. The causal assumptions (what causes what) are shown in the path diagram.
- The variables are measured on interval scales or better.

[67] http://faculty.cas.usf.edu/mbrannick/regression/Pathan.html

- An endogenous variable can be a cause of another endogenous variable, but not of an exogenous variable (Aryee, 1993).

These customs will be followed in current research, while representing the primary theoretical model and the final modified model.

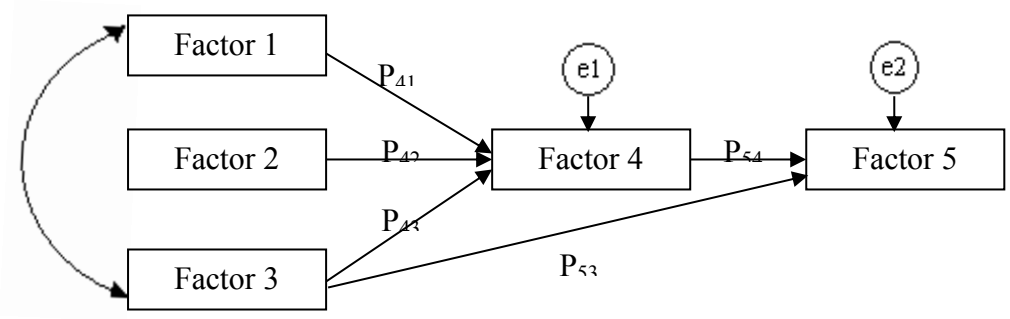

Chart 5-4: path analysis model, adopted from Garson (2008)

In this chart, Factor 1, 2 and 3 are exogenous (independent) variables, Factor 4 and 5 are endogenous (dependent) variables. Each endogenous variable is explained by 1 or more variables in the model, plus an error term (e1 and e2). The straight arrows represent regression paths for presumed causal relationships (for example factor 1,2 and 3 are the causes of factor 4 and factor 4 is the cause of factor 5); the curved double-headed arrows represent assumed covariance among the exogenous variables. It may not be clear one variable is the cause of the other variable or if both variables share common causes (1 causing 2 and/or 2 causing 1; and/or may be 1 and 2 sharing common causes) (Garson, 2008).

These customs will be used and more explained in chapter 5 while presenting the results of the study.

5.5 Validity and reliability

Evaluating the quality of research is essential if findings are to be utilized in practice and incorporated into care delivery (Noble and Smith, 2015). The terms reliability and validity traditionally have been associated with quantitative research, increasingly they are being seen as important concepts in qualitative research as well. Examining the data for reliability and validity assesses both the objectivity and credibility of the research (Anderson, 2010). In order to achieve validity and reliability, this research applied controls on each step of the research process including: identification of the study population, data collection and interpretation and discussions and conclusions. Considering the differences between evaluating validity and reliability in quantitative and

qualitative methods; these terms are presented separately regarding the different methodological approaches followed in phase 1 and 2.

5.5.1 Qualitative Approach: Trustworthiness

The criteria of Measuring reliability and validity of quantitative research instruments are not appropriate in qualitative approaches. Although reliability and validity are treated separately in quantitative studies, these terms are not viewed separately in qualitative research. Instead, terminology that encompasses both, such as credibility, transferability, and trustworthiness is used (Golafshani, 2003). Unlike quantitative researchers, who apply statistical methods for establishing validity and reliability of research findings, qualitative researchers aim to design and incorporate methodological strategies to ensure the 'trustworthiness' of the findings (Noble and Smith, 2015). In qualitative approach trustworthiness introduced as a method that shows how much the research is accurate in representing the experience of participants (Streuber and Carpenter, 1999:333).

Lincoln and Guba (1985) offer alternative criteria for demonstrating rigor within qualitative research namely truth value, consistency and neutrality and applicability; Noble and Smith (2015) matched these criteria to the corresponding quantitative method strategies (**Table 5-5**) (for detailed description of strategies see Noble and Smith, 2015).

Quantitative research terminology and application to qualitative research	Alternative terminology associated with credibility of qualitative research
Validity	Truth value
Reliability	Consistency and Neutrality (or conformability)
Generalizability	Applicability

Table 5-5: Terminology and criteria used to evaluate the credibility of research findings

Source: Noble and Smith (2015)

Related to each strategy, there are set of actions could be taken to insure trustworthiness of qualitative method. The main actions used in this research to ensure trustworthiness are as follows:

Triangulation: One of the main actions introduced for increasing the validity of research methodology is 'triangulation' (Denzin, 1978). Triangulation is defined as "a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study" (Creswell & Miller, 2000, p. 126).It refers to the use of two or more data sources, methods, investigators, theoretical perspectives and approaches to analysis in the study of a single phenomenon and then

validating the congruence among them. The major goal of triangulation is to circumvent the personal biases of investigators and overcome the deficiencies intrinsic to single-investigator, single-theory, or single-method study thus increasing the validity of the study (Denzil, 1989).

Validation from others: include discussing the research process and results with transport and methodology experts in order to reduce the researcher's bias which is also known as peer examination, conducted both for findings and research methods. At the end of each interview Conclusions are given to the informants and feedback is requested about the accuracy of the content. This ensures that the researcher and the informant are viewing the data consistently (Brink, 1993)

Searching for disconfirming evidences: involved purposive sampling (choosing interviewees from different groups of transport sector stakeholders), in order to extract different ideas from different viewpoints. According to Brink (1993), purposeful sampling allows the researcher to include informants who may differ from key informants in critical ways. This purposeful sampling of individuals and the inclusion of conflicting as well as complementary accounts strengthens the description.

Literature control: (after analyzing qualitative data): includes checking for the representations of the data, coding categories and the identified variables with the results presented in the literature and confirming the variables that have enough supports in the literature as the affecting variables.

Thick description: validity and reliability can only be judged if a very detailed account of the context or setting within which the study took place and a thorough description of the procedures from the beginning to the end are given. Lincoln and Guba (1985) use the term auditability which means that any reader or another researcher can follow the progression of events in the study and understand their logic. For this aim the motivations, study aims, theoretical backgrounds, data collection and analysis methods, research procedure, reliability and validity and limitation and challenges should be explained clearly (Brink, 1993).

The strategies used in this study and related actions taken by the researcher are summarized in **Table 5-6.**

Strategies	Actions
Truth value	Triangulation of data sources, peer examination, literature control
Consistency	Triangulation of data sources, peer examination
Neutrality	Thick description, validation from others, Searching for disconfirming evidences

Applicability	Rich detail of context, literature control and thick description

Table 5-6: Strategies and related actions for achieving trustworthiness

Source: own work

5.5.2 Quantitative Approach: Validity and Reliability

Validity and reliability are key aspects of all research. Paying attention to these two aspects can help to assure that fellow scientists accept findings as credible and trustworthy. Examining the data for reliability and validity assesses both the objectivity and credibility of the research. Validity relates to the honesty and genuineness of the research data, while reliability relates to the reproducibility and stability of the data (Anderson, 2010).According to Bryman and Bell (2007) validity is connected with the accuracy and truthfulness of the findings, while reliability is concerned with the consistency of the tool for measuring. Golafshani (2003) argued that the definitions of reliability and validity in quantitative research reveal two strands: Firstly, with regards to reliability, whether the result is replicable. Secondly, with regards to validity, whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure.

B) Validity

Validity shows that weather data analysis tools be able to measure and analyze the variables or not? Joppe (2000) provides the following explanation of what validity is in quantitative research: “Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull’s eye" of your research object? Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others”. (p. 1). So validity or credibility shows how much the practical definition is in accordance with conceptual definition. There are different ways to assure validity of research methods and tools. Three main categories of validation strategies introduced by Murphy and Davidshofer (1988): content, construct and criterion validity; among them content and construct validity use for validation of measurement and criterion validity is used for decisions (Murphy and Davidshofer, 1988). In this research the validation strategies for measurement applied as follows:

Content Validity

Content validity is the degree to which elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose, while the term “assessment instrument” is meant to reflect the applicability of content validity for all assessment method (Haynes et al, 1995). In fact, content validity concerns the adequacy with which the test items adequately and representatively sample the content area to be measured, this kind of validity mainly analyze the credibility of measurement tools based on common sense, experience and is depended to researcher’s judgment. Haynes et al, (1995) name several methods to address content validity stressing the desirability of careful definition and quantitative evaluation of the targeted construct, multi-element approach to content validation, the use of population and expert sampling in initial item development, quantitative evaluations from experts and potential respondents, evaluation of the proportionate representativeness of items, detailed reporting of the results of content validation, and the relevance for content validity of subsequent psychometric analyses.

Criterion Validity

Criterion validity is a measure of how well one variable or set of variables predicts an outcome based on information from other variables, it is often divided into two main categories: concurrent and predictive validity (Habib Pour, and Safari, 2009). Concurrent validity “reflects only the status quo at a particular time" but Predictive validity, compares the measure in question with an outcome assessed at a later time. Although concurrent and predictive validity are similar, it is cautioned to keep the terms and findings separated. "Concurrent validity should not be used as a substitute for predictive validity without an appropriate supporting rationale.

Construct Validity

Cronbach, L. J., & Meehl, (1995) state that construct validity is involved whenever a test is to be interpreted as a measure of some attribute or quality which is not “operationally defined” The problem faced by the investigator is, “What constructs account for variance in test performance?” In fact this kind of validity reveals that to what extent the results of a measurement tool is appropriate with the theories that the test is constructed based on them. One of the main methods to evaluate construct validity is “Factor analysis” which is a statistical method used to describe variability among observed, correlated variables in

terms of a potentially lower number of unobserved variables called factors[68]. For example, it is possible that variations in say six observed variables mainly reflect the variations in two unobserved (underlying) variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms. Factor analysis includes two categories of "Exploratory Factor Analysis-EFA" and "Confirmatory Factor Analysis" (Habib Pour, and Safari, 2009). In this dissertation factor analysis the second method (confirmatory factor analysis is used to evaluate validity because it is aimed at evaluating the adaptability of predefined analytical framework with the obtained data and refine the inconsistent questions in predicting the variables that are obtained as the results of qualitative analysis.

5.6 Ethical considerations

Welman, Kruger and Mitchell (2005:182) explain that ethical considerations and ethical behavior are as important in research as they are in any other field of human activity. Saunders et al. (2009) discuss that it is very important to consider also the following potential ethical issues that could occur during the data collection process. Some issues they mentioned and the appropriate considerations in this dissertation are:

- **Privacy:** considering the rights of the people to refuse participation in research, just one call to follow the questionnaire completion.
- **Confidentiality:** sharing of the information without the participant permission is avoided.
- **Misuse of the findings:** This dissertation is based on the ethical standards and the information obtained will not be misused from the interested party in a way that could affect them.

In addition researcher tried to avoid any form of dishonesty; the open-ended questions which were analyzed by the researcher were also checked by the supervisor for confirmation of credibility.

This chapter described the methodological consideration and approaches that are followed in this dissertation; the next chapter presents the results obtained based on these tests and analysis process.

[68] http://www.hawaii.edu./powerkills/UFA.HTM

Chapter6:

Research Findings

As it was mentioned in previous chapters the current study developed a theoretical framework based on socio-technical approach and multi-level perspective presented in chapter 4 for identifying the variables through which municipalities affect GHG and Carbon emission reduction targets. The transition pathway "Eco-city" presented by Marletto (2014) is used as the main approach in this study regarding the important role of local actors in transition towards low emission mobility systems.

Chapter 6 presents the results of analysis. The input of the analysis carried out in this chapter is represented by the data collected through interviews and administrated questionnaire, as well as by the data collected through secondary resources for discussing the results of questionnaire analysis. The expected output shows the justified framework that shows the variables that affect transition pathways and their importance from local government's viewpoint. It indicates the common approaches of Italy's municipalities used in emission reduction plans, and the extent to which those variables affect each other is revealed.

6.1 Demography of respondents

The research consists of two phase study plans each of them performed different methodological approaches, different data and populations for analysis. Regarding these differences the results and demography of respondents will be explained separately in this chapter. In the first phase of the study, the qualitative data gathered through semi structured interview with transport sector stakeholders in order to identify the barriers of transition process and the role of local authorities in transition towards low Carbon mobility systems. The study population for the first phase was comprehensively introduced in chapter 4 (methodology), so in this section, the characteristics of the population of respondent municipalities will be presented before explaining the results of data analysis.

Public authorities in Italy consist of ministries, administrative regions, agencies (in some provinces) and municipalities[69]. Among these agents, municipalities are chosen as the main representations of local regulatory agents that define transport plans, and set the policy goals at urban level. Moreover they are engaged in implementation process, and in this sense they are more aware of practical impediments and challenges linked to the actions undertaken to reduce GHG emissions.

As mentioned in chapter 4, in phase two of the study, a sample population of 308 municipalities with more than 30,000 inhabitants was selected out of a national population of than 8.047 municipalities. In Italy, most of municipalities (70.5%) have less than 5.000 inhabitants, characterized by a weak organizational structure and low ability to participate to the strategic planning process that is mainly demanded to the provinces authority[70].

[69]The Italian transport regulation authority was established on 17 September 2013 and became operational on 15 January 2014, but in this research it is not considered as the public governance body because as it is noted by Cambini and Perrotti (2015): "the Authority is fully independent from government, regulated businesses and infrastructure operators"

[70] Based on a recent national reform dated 2013, the province authority has been cancelled. Thus, in this transition phase, provinces are only managing the ordinary activities and the projects that were already approved. However, they cannot be considered anymore the local government coordinating municipalities.

Considering the selected municipalities to administer the survey, 63 questionnaires returned representing 20.45% response rate. Among the analyzed sample, a sub-sample of 20 municipalities with more than 100,000 inhabitants, out of a total number of 47, returned the questionnaire allowing at determining a response rate of 42.5 %. The geographical distribution of responding municipalities revealed that at least more than half of the respondents are located in northern Italy, and about 75 % of respondents were from central and northern areas of the country (**Figure 6-1**). The outlined geographical distribution of the respondents requires considering that the contribution of southern municipalities in this study is considerably lower than northern and central Italy located municipalities.

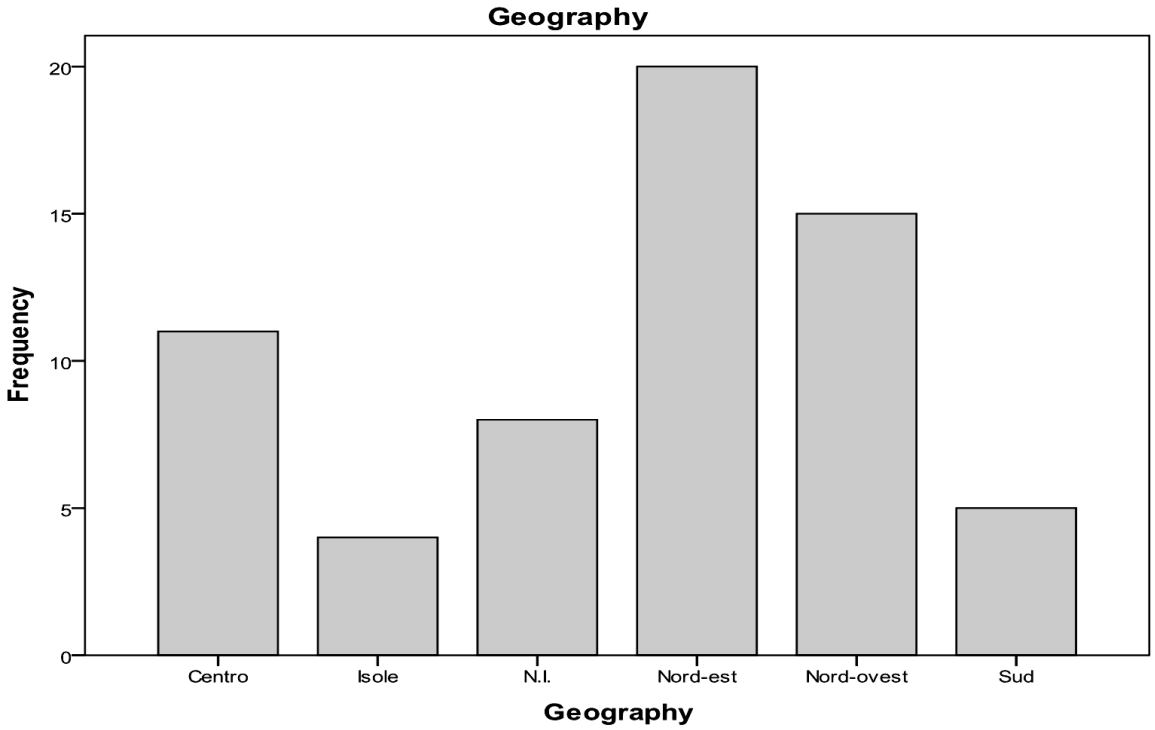

Figure 6-1: Geographical distribution of respondent municipalities

Source: Data analysis

6.2 Analysis Results

It was noted in previous chapters that this dissertation focused on studying the role and contribution of local government in managing the transition process towards low Carbon urban mobility. In this regard, the main research question is defined as:

- **How local governments (municipalities) affect the transition process towards low Carbon urban mobility?**

Before analyzing the role of local government, it is essential to identify the dynamics of transition process and the factors that affect them, and then in order to know how government can influence these dynamics, the government tools in managing the transition process should be identified. To do this, the following research questions formulated as the secondary research questions that need to be answered before the main question:

R1: What are the dynamics of transition process and the main government tools for influencing transition pathways

R2: What is the role of each factor as a driving force or restraining force of transition process,

R3: How local government (in this case, municipalities) contribute in managing, controlling and influencing those dynamics and forces.

The study sample consist of two groups of municipalities based on their planning approaches, the first group are medium and small municipalities that have a population between 30,000 and 100,000 inhabitants; according to the Italian legislation, this municipalities have to develop an operational plan for traffic management. The second group is a subsidiary of first group that consist of bigger municipalities that have more than 100,000 inhabitants and according to the legislation suggest them to develop a long term strategic plan of mobility (PUM). The last question aimed at investigating the difference between these two groups of municipalities based on the conceptual framework of analysis:

R4: What is the difference between two groups of municipalities (those who have PUT only, and the bigger municipalities that developed PUM in addition to PUT)

This chapter present the answers of following research questions based on the different research methods followed in two phases of exploratory experimental study described in chapter 5 (methodology). It was also noted in methodology description, that the data analysis process in this study conducted in two separate phases of qualitative and quantitative analysis process, in which phase one is an exploration mainly aimed at answering the first two questions (R1 and R2). The results of first phase of the analysis present the conceptual framework; used for designing the questionnaire and evaluating the efforts of local government based on a quantitative analysis of qualitative data obtained in phase one. The final results helped in answering the other two questions (R3 and R4) and developing the modified framework that shows the experiment of Italian municipalities in affecting the transition process and pathways.

6.2.1 Identifying the Factors Influence the Transition Process

Transition is the process of change from existing regimes toward desired sustainable regimes. It was mentioned in Chapter 3 that in order to achieve the sustainability objectives in transport sector a set of plans and strategies are suggested by different organizations. These strategies are expected to affect the success of emission reduction targets. Local government more engaged in defining the strategies for achieving the broad objectives of emission reduction (which is usually defined by national government).

Also it was explained in previous chapters (Chapter 4), that except the dynamics of transition process a set of other factors affect the transition process, these factors are the governance instruments that mentioned in Table 4-12, through them government affect the final goals or the strategies and actions.

In this regard the primary framework for local government's contribution in transition process mainly investigates the effect of strategies on the success of emission reduction targets noting that there are some other factors (based on MLP) describing the dynamics of transition process (**Figure 6-2**).

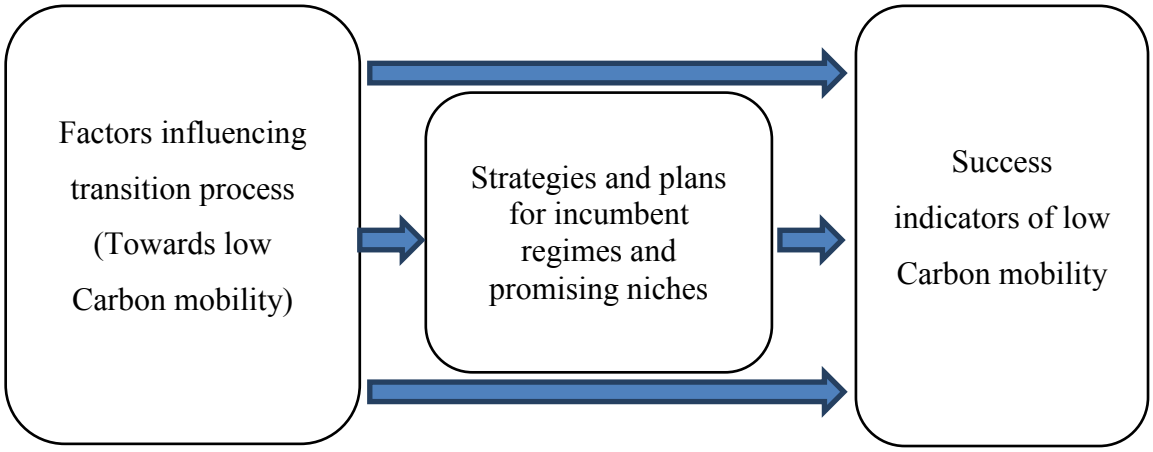

Figure 6-2: Primary research framework

The process was described in Chapter 5, and here only the results of those analyses are represented. In this section we just review the current research findings after a brief summary of reviewed literature. The literature reviewed in previous chapters mainly focused on case studies for identifying the specific dynamics of transition process related to the studied cases and context; but some general dynamics introduced by international guidelines and scholars, for instance according to OECD's Green Growth document, promoting successful transition towards green growth implies following steps: developing strategies for reform, facilitating adjustment in the labor market, accounting for concerns

about distributional impacts and promoting international cooperation (OECD G, 2011). UNEP's Green Economy strategy (2011) foresees three steps for reversing the process of unsustainable development:

- Improvements in environmental valuation and policy analysis;
- Implementation of effective and appropriate information, incentives, institutions, investments and infrastructure;
- Increasing collaboration between environmental scientists, ecologists and economists (UNEP, 2011)

Foxon et al. (2010) introduce the general categories of dynamics based on different levels of multi-level perspective (**Table 6-1**). This research performs the same approach of considering the broad categories of dynamics; in which each category consist of several dynamics same as those mentioned in chapter 4; so the dynamics presented as the main variables of conceptual framework are more similar to dynamics presented in **Table 6-1**.

Level	Dynamics and influencing factors
Landscape factors	❖ Public awareness of climate change and willingness to accept and undertake changes in response, ❖ Government commitments to meet national and international targets for emissions reductions, ❖ Ideological commitments to liberalized markets, ❖ Concerns over security of energy supplies, affordability and fuel poverty ❖ External factors leading to high oil and gas prices ❖ Factors threatening physical disruption of external supplies (war, terrorism, foreign governments limiting supply, etc.)
Regime tensions and dynamics	❖ Policies, regulations and markets ❖ Values, strategies and behavior of decision makers ❖ Service, infrastructure and delivery network
Niche level Dynamics	❖ Entrepreneurial activities; ❖ knowledge development and diffusion through networks; ❖ Guidance of search activities; ❖ Market formation; ❖ Mobilization of resources; ❖ Creation of legitimacy/ overcoming resistance to change.

Table 6-1: Dynamics of transition process based on the levels of MLP

Source: Foxon et al. (2010)

Although literature discuss a set of dynamics at different levels of MLP, introduced in **Table 4-1 to 4-5**, in this dissertation another type of qualitative data used for choosing the dynamics that are more related to the study context (urban mobility in Italy). These dynamics have been chosen based on the semi structured interviews with transport sector stakeholders represented in **Table 6-2**, then, through content analysis the factors mentioned by interviewees are classified in five main categories representing five

variables introduced as the main factors influencing success of emission reduction targets (Table 6-3Errore. L'origine riferimento non è stata trovata.).

Stakeholder groups	Factors affecting transition process (stakeholder viewpoints)
Policy makers (national and international)	Important role for mobility manager Project participation Co-financing projects Open and general goals-absence of specific reduction targets at municipal level Growing awareness of citizens, institutions, local government financial resources for research activities
Policy makers (Regional)	Financial supports Emerging niches which need to be nurtured Lack of infrastructure for clean mobility Political changes and changes at local level Political change and viewpoints of new authorities Strategies and action plans
Local authorities	Social responsibilities of public transport The importance of cooperation Financial resources Government support Infrastructure availability Non feasible regulations
Public transport providers	Demand management Fleet age and outdated technologies Financial supports Cooperation between stakeholders Government's viewpoints and policies
Industry	Tax and financial incentives Clean fuels and vehicle infrastructure Standard and regulations Organizational change
Universities and research centers	R&D cooperations Cracks in alternative technologies Strategies for clean transport Government's attitudes
Civil society	Government's viewpoints Rules and regulations Increasing citizen awareness

Table 6-2: Stakeholder's viewpoints about the factors that influence success of emission reduction objectives, Source: content analysis (interview transcripts)

Variables	Includes	Role
Green attitudes	(visions of policy makers) Rules and regulations	Landscape dynamic
Strategies	❖ Destabilizing automobility regime ❖ Stabilizing public and non-motorized transport	Regime dynamic
	❖ Supporting emerging niches of clean mobility	niche support
Cooperation	Cooperation based on R&D activities and other types of activities with different groups of transport sector	Governance instrument

	stakeholders	
Financial Supports	International and national funds used for CO_2 and GHG reduction projects	Governance instrument
Existing Challenge and obstacles	Including the whole restraining forces: ❖ Challenging areas of planning ❖ Obstacles for achieving emission reduction goals	External forces
Success perception	Including the factors representing the success perception of local government for low Carbon transition	Dependent variable

Table 6-3: Variables influencing the transition process

Source: Content analysis

In the next section the driving and restraining role of the abovementioned variables in transition process will be presented as well as the factors shaping each category.

6.2.2 Drivers and barriers of transition process

The previous section only named the main variables identified during the interviews and qualitative data analysis, in this section a more detailed introduction of each variable is presented to see how it affect the transition process. Whether they facilitate the achievement of emission reduction targets (Driving role), prevent or challenge the final objectives of emission reduction. These roles are studied through reviewing the literature.

1) Green Attitudes

Sustainability transition is defined as the change process from existing incumbent regimes towards sustainable systems and an important prerequisite for such changes is a raised awareness of behavioral consequences and improving managers' attitudes and environmental concerns (Fransson et al.., 1999; Hensher et al.., 1999; Piecyk, 2010). As a consequence, attitudes towards environmental protection are substantially associated to environmental activities (Cordano et al.., 2000) as an important part of environmental issues and are even recognized as being central to environmental policy formation (Miller 1984/85, Walther 1987, Clark 1992; Swaffield 1998, p. 495).

Sweet et al.. (2003) argue that information processing and decision-making styles are central aspects of the environmental performance of sustainable systems. Referring to Ajzen's 'Theory of Planned Behavior', attitudes, subjective norms and perceived behavioral control clearly influence the intention and, thus, the behavior (Ajzen, 1991, 2005; Fishbein et al.., 1975). Further research, broadly accept the fundamental impact of decision-makers' attitudes on their eventual behavior (Fransson et al.., 1999; Kirk, 1998; Kotchen et al.., 2000). This indicates that, the decision makers' attitude towards sustainability and environmental management is fundamental for their actions, and it can

be argued that the attitudes of decision makers can affect policies, defined objectives, strategies and action plans as a consequence. So an important prerequisite besides policy, strategy and resources for transition towards sustainable mobility seems to be the planners' personal attitudes towards the low Carbon mobility and GHG reductions. Local governments are a group of decision makers contribute to the overall goal of sustainable development as well as other network stakeholders (Robinson, 2000; Schmidheiny, 1992; Shrivastava, 1994, 1995); they participate in transition process by applying respective regulations from higher level authorities, so it is important to understand how they think about and plan for sustainability is important for the development of policies and steering strategies. An important issue should be considered while studying the effect of decision maker's attitudes on defined objectives, strategies and actions, is the gap between attitudes and performed actions highlighted by a number of interviewees in this dissertation which is also supported by previous researches (e.g. Burgess et al.., 1998). The theory of planned behavior (TPB) from Ajzen (1991) specifically explores the gap between attitudes and acts. In decision making process, although many managers have a positive attitude towards environmental management and are aware of the fact that activities may improve their economic results, only few entities convert this into proactive environmental behavior (Gadenne et al.., 2009). Sometimes managers and policymakers don't appreciate the change which is needed in transition process. This is mainly argued by CIVITAS Energycities and TRASFORM report. CIVITAS stresses that reluctance to change is the most influential negative aspect in making innovative changes for the future of mobility. CIVITAS notes that this reluctance affect project financing projects where shrinking municipal resources causes city planners to resist against change because they are afraid of losing their job. In addition, TRANSFORM report states that sometimes more senior civil servants can be reluctant to change old policies into more progressive ones. The unwillingness to change old habits, notices by a number of interviewees in this dissertation as well, so an important factor beside attitudes is the commitment of decision makers to perform the required actions and their behavior in this context.

Foxon (2010) argued that the actors' behaviors may be characterized by the values they hold, the resources they command, and the strategies they choose to follow, so in order to evaluate "Green Attitudes" and municipality's commitment to achieve low Carbon mobility objectives, the interview responses pointed out to the issues related to these three area classified under the category of "green attitudes and municipality's commitment"

which evaluates the positive attitudes and commitment of decision makers towards low Carbon mobility objectives. a set of statements or declarations pointed out by interviewees about the values, strategies and resources that influence GHG and CO_2 emission reduction, are used to evaluate the attitudes of municipalities about emission reduction plans, these items are summarized in **Table 6-4**:

Items in the questionnaire (derived from interview results)	Attitude dimension
Viewpoints (prioritizing) emission reduction especially GHG and CO_2 reductions	Values
Measurements of CO_2 emission levels in cities	
Definition of specific objectives for CO_2 reduction	
The existence of written strategies for CO_2 reduction; evaluation, modification and publication of strategies	Strategies
The existence of strategies for supporting innovations related to CO_2 reduction	
Allocating specific funds and resources for CO_2 reduction projects	Resources
The existence of persons or departments responsible for transport in municipality	

Table 6-4: Items related to attitude and commitment evaluation in questionnaire

Source: Interview and qualitative data results

Respondent municipalities declared their opinions, attitudes as well as practical actions (in order to consider the gap between attitudes and behaviors) for above questions, using a seven-point Likert scale. The final evaluation show the how they think and behave toward low Carbon mobility programs. The positive attitudes of local government can help in pursuing the emission reduction targets and in this sense could be a driving force in transition towards low Carbon urban mobility and can facilitate the success of achieving the defined objectives.

Exploratory factor analysis using the principal component method (with Varimax rotation) was performed in order to establish the reliability and validity of the measures. KMO scale obtained for this variable was 0.695 that showed the sampling adequacy suggesting some modifications. In accordance with Kaiser's criterion, factors with Eigenvalues greater than 1 were retained. In addition, the course of the Scree plot graph confirmed the three-factor solution for "Green Attitude" variable. Items loading more than 0.4 on the same component were clustered in order to define the specific factors. In this regard, "Green Attitudes" variable was categorized as 'values" showing the preferences of municipalities in the planning phase, "Strategies" represent the viewpoints for the plans and strategic actions and another category identified instead of "resource allocation" that was more related to "monitoring process". These three factors explain explaining 71.5 % of total variance.

Cronbach's alpha was used to verify that the aggregated scores of the items for each type were a reliable measure for each construct. Cronbach's alpha 0.841 at 95% confidence level, indicated outstanding to acceptable levels of reliability for all constructs (Brosius, 2006).

2) Strategies for Low Carbon Urban Mobility

Strategy is seen as the way of integrating the activities of diverse functional departments (Porter 1991). The strategic framework for sustainable urban transport aims to guide city authorities and other decision makers in policy, investment decisions related to urban transport systems. It is not possible to develop a unique universal framework of actions and strategies because as Silva (2009) argued each city is confronted with particular mobility problems and different sensitivities on behalf of the citizens and decision makers and the strategies and actions should be defined regarding the specific patterns of mobility and characteristic of each city. However, it is possible to identify a set of general recommendations and effective actions to manage the mobility options. For this aim, first the general areas need to be managed in urban mobility context, and the strategies applied to manage them is reviewed and then through the interviews with transport stakeholders the main strategies currently used in Italy are introduced and categorized in the **Table 6-5**.

Strategies and actions

Many authors argue that a combination of strategies and actions are required to achieve long-term reduction in GHG and CO_2 emissions (Bristow et al., 2008; Santos et al., 2010; Schwanen et al., 2011; Vieira et al., 2007). The main categories of strategies and related actions investigated as a result of reviewing literature, mobility plans, country reports and interviews are represented in **Table 6-5**.

Related Level of MLP	Strategy	Actions
Incumbent regimes (private cars)	Motivation and restriction	Tax reduction for cleaner vehicles Limited traffic zones Fuel price regulations
Incumbent regimes (Non-motorized and alternative modes)	Alternative modes	Shifting passenger transport to other modes Shifting freight transport to other modes Promote walking and cycling
Incumbent regimes (public transport efficiency)	Effectiveness of public transport	Car sharing-car pooling Integrated ticketing systems Expanding subway lines Decentralization Parking regulations Technologies for traffic congestion reduction

		Renovating bus fleet Renovating commercial vehicle fleet
Incumbent regimes (private cars)	Citizen awareness	Public campaigns, Special events, Interactive information
Niche	Clean vehicles	Expanding infrastructures for EVs, natural gas (GPL and CNG), methane, diesel
	Clean fuels	Using clean vehicles in passenger and freight transport

Table 6-5: Strategies and actions for incumbent regimes and clean niches

Source: Interview and qualitative data results

It could be clearly seen from this table that the results of this study confirms EPOMM (2013) and KpVV (2012) report that introduce the main strategies of local municipalities in Italy as follows:

- Delivery of services and infrastructure for public transport
- Upgrading vehicles with low emissions and enhanced mobile information
- Streamlining delivery of goods
- Park and ride and intermodality
- Fuels with a low environmental impact
- Promotion of the Mobility Manager
- Additional services to local public transport (car sharing, taxi, etc.)
- Promoting cycling
- Implementation of specific actions to increase the safety of users

Other scholars introduce more or less the same strategies; for instance Banister (2008) noted that the required actions for achieving sustainable mobility are based on reducing the need to travel (less trips), encouraging modal shift, reducing trip lengths and encouraging greater efficiency in the transport system (Banister, 2008). The strategies identified in current dissertation showed two differences with those are suggested by Banister (2008):

1. Replacing the category of "reducing the need to travel" by the category that defines a set of "restrictions for private car use and motivations for cleaner vehicles".
2. Adding another category for strategies related to nurturing clean niches (includes clean Vehicles and fuels)

This strategy is introduced as one of three main categories of strategies for achieving sustainable mobility named as "Efficiency" strategies; which emphasize on developing

more efficient technologies to replace old, inefficient, and polluting materials and methods. The other two are:

- "Substitution" strategies that argues for a change to less polluting means of transport; corresponds to "Alternative modes" strategies and
- "Volume reduction" pointed out to changing behavior and consumption patterns; in this study introduced in two categories ("Citizen Awareness" and "Motivation and restriction" strategies) (Walnum et al., 2014).

So a broad category of strategies introduced by literature and interviewees, each city applies some of them according to the specific situation and traffic and transport patterns of city.

Between different strategies of low Carbon transition, factor analysis could be applied only on the strategies that were focused on improving public transport efficiency. KMO scale 0.765 shows that factor analysis could be done without any modifications. Two factors identified (**Table 6-6**), represent mainly actions related to current systems and future plans representing long term approach to be implemented. These two factors predict 60.6% of variances of public transport efficiency.

Factor 1	Factor 2
Transport infrastructures and integrated tickets Parking regulations Technologies for reducing traffic congestion Renovating bus fleet Renovating trucks and other commercial vehicle fleet	Expanding and improving subway lines Car sharing- car pooling Decentralizing public offices
Current systems	**Future plans**

Table 6-6: Factor analysis results for public transport efficiency strategies

Source: data analysis results

3) Cooperations

Participation of different stakeholder groups is suggested in order to achieve sustainable mobility objectives. It is important to understand how each stakeholder group can be affected by climate change and how they can collaborate to improve the resilience to these effects (Costa Jordao et al., 2011). WBCSD's Vision 2050, that proposed a mix of new alliances in which a range of stakeholders, including government, academia, business and society, are to work closely together on a number of issues (including climate change and shifting values and behaviors toward sustainability) in the first part of the envisioned transformation (2010-2020). Cooperation with other stakeholders is usually introduced as stakeholder involvement as an elements for "network governance", used to achieve common objectives in a structured manner. Early involvement of citizens and

stakeholders in the planning and implementation process, as well as good communication skills, introduced as issues of critical importance for successful policy implementation (Banister, 2008; Isaksson and Richardson, 2009; Little, 2011).

In this research, interviewees mentioned the different groups of stakeholders engaged in mobility related activities, and respondent municipalities are asked to prioritize their interest in cooperation with those stakeholders, in two themes, first the cooperations for R&D activities and then the cooperation for other activities mainly represent the executive and implementing activities

- Vehicle producer
- Public transport companies
- Local transport agencies
- Energy and fuel providers
- Universities and research centers
- Ministry and other policy makers
- European commission and EU level organizations
- Other local companies
- Civil society

Factor analysis helped in grouping the stakeholders based on the same cooperation patterns with respondent municipalities. KMO scale 0.786 showed that factor analysis could be done with no need for modifications. After doing factor analysis, 4 groups of stakeholders identified predicting 77.1% of cooperation variable. These factors are shown in **Table 6-7**, for "R&D cooperation's for vehicles and low emission fuels" and "other[71] types of cooperations":

	Factor1	**Factor2**	**Factor3**	**Factor 4**
R&D cooperations with	Vehicle manufacturers	Universities and research centers	Local public transport companies	
	energy and fuel suppliers	Ministries and other policy makers	Local transport agencies	
		EU commission and European agencies	Other local companies	
		Civil society		
Other types of	Vehicle manufacturers	Universities and research centers		Local public transport companies
	energy and fuel suppliers	Ministries and other policy makers		Local transport agencies

[71]The term "other" here refers to any types of cooperation which is not related to R&D, for example cooperations on implementations,

		EU commission and European agencies		Other local companies
		Civil society		
	Infrastructure	**Knowledge**	**Planning**	**Implementation**

Table 6-7: Stakeholder groups based on cooperation context

Source: Data analysis results

Table 6-7 categorizes the stakeholders with same cooperation patterns in the same categories, this shows that municipalities have cooperations with other stakeholders about infrastructure, knowledge cooperations, planning and implementation activities. The main conclusion is that:

- Same cooperation patterns could be seen for R&D and other types of cooperations in two groups of stakeholders:
  - Vehicle producers, energy and fuel suppliers
  - Universities, research centers, EU commission and other stakeholders
- At local context the cooperations for R&D differs from other types of cooperations. Cooperation for R&D with local transport companies and agencies show the planning objectives of cooperations while other cooperations with these partners could be related to the implementation activities.

Cooperation with other stakeholder is a driving force for transition process and higher levels of cooperation with other stakeholders can help in defining better policies and objectives that are suitable to local conditions (OECD G, 2011), effective implementation of strategies (Banister, 2008), access to funds and other resources (Mowery et al., 1998).

4) Finance

"Finance" here means the amount of financial support a municipality received from national and international organizations for applying its strategies and plans. Fiscal instruments provide protection to some niches and help them to develop and replace the existing regimes or improve the efficiency of incumbent regimes. These fiscal instruments are affected by government's attitudes and values. Government's decision to provide funds for a demonstration program, enable shielding, nurturing and empowering specific niches (Smith and Raven, 2012) and the related strategies and action plans accordingly. While municipalities relied on funds from higher levels of authorities interviewees from Regional authorities noted that some municipalities aren't aware of available funding and don't even apply or ask for financial supports.

Roy et al. (2013) argue that success of fiscal instruments during the transition process is also evaluated in terms of its leveraging ability depend on cooperative activities, the capacity to generate finance by involving a multiplicity of actors and institutions: private investors, multi-lateral/bi-lateral financing agencies for investments in R&D together with demand side policy reforms, national and global Carbon trading facility, etc. This is also highlighted by interviewees from public transport companies that were interested to cooperate with private sector firms.

5) Challenges and impediments

The interviews conducted with Transport sector stakeholders and decision making authorities revealed that there are a range of challenges that make difficulties in the implementation of low Carbon mobility initiatives. Other challenges are mentioned in the literature, policy guidelines and country reports. Challenges identified by the international organizations are derived from the experience of low Carbon mobility measures and usually are general and national level challenges. In the first phase of this research the local level challenges and impediments are identified, but before analyzing the effect of this variable on other variable it is important to distinguish between challenges and obstacles. In this dissertation and according to the English Dictionary, the term "obstacle" refers to something which prevents the progress of actions and objectives. "Challenge" is something difficult but something which could be overcome. Thus a challenge is regarded as more positive than the obstacle. In this dissertation only obstacles are considered as the restraining forces that affect other variables.

First: some aspects of urban mobility are naturally challenging areas; this means that it is not easy to change the current trends of those areas. This category is more related to the executive operations and just mentions the importance of different areas which needs to be considered and evaluated by transport planners; it doesn't affect the goals and strategies, because it is about implementation of predefined strategies. Challenging areas noted by interviewees are:

- Aligning the objectives of transport plans with the issue of environmental sustainability
- Providing efficient and adequate public transport services
- Providing public parkings especially in city centers
- Providing adequate infrastructure for clean fuels and fuels with lower Carbon contents
- Regulations and administrative process

- ❖ Promoting non-motorized transport
- ❖ Reducing traffic congestion
- ❖ Changing citizen's behavior toward the use of private vehicles

These items mentioned in the questionnaire to see from the viewpoints of municipalities which one is more important. KMO score obtained in factor analysis 0.747, revealed that these challenges could be classified in two main groups: challenges influence operation and utilization of current system, and the challenges that influence the future plans (**Table 6-8**)

Factor1	**Factor2**
Integrating transport plans with objectives of environmental sustainability Providing efficient and adequate public transport service Administrative process Promotion of non-motorized transport Traffic congestion reduction Changing citizen's behavior toward the use of private vehicles	Public Parking Adequate clean transport infrastructure
Current systems	**Future plans**

Table 6-8: Factor analysis results for challenging areas of urban mobility

Source: Data analysis results

Second: the impediments exist for achieving low Carbon objectives. These impediments can be related to technology and infrastructure, demand management and planning, implementation, expansion and maintenance of public transport service, culture and citizen's behavior, etc. this category affect the strategies, objectives and cooperation patterns.

- ❖ Lack of financial resources
- ❖ Lack of government supports
- ❖ Social responsibilities of public transport
- ❖ Inefficiency of other transport modes
- ❖ Cultural barriers
- ❖ Changes at higher level authorities (political leaders, managers or executives)
- ❖ High costs of technological innovations
- ❖ Strict environmental regulations (ambitions objectives)
- ❖ Lack of cooperation between transport sector actors

Respondent municipalities asked to rank the levels of importance for the obstacles as well as challenges. The results of factor analysis suggest the existence of three

categories for this variable; represent the obstacles for demand management, rules and regulations, and sociotechnical sub-system changes and evolutions. The importance means for all abovementioned obstacles were higher than average (more than 4 on a scale of 7), this indicates that municipalities believe all obstacles are important, among them lack of funds and cultural barriers ranked as the most important obstacles (**Figure 6-3**).

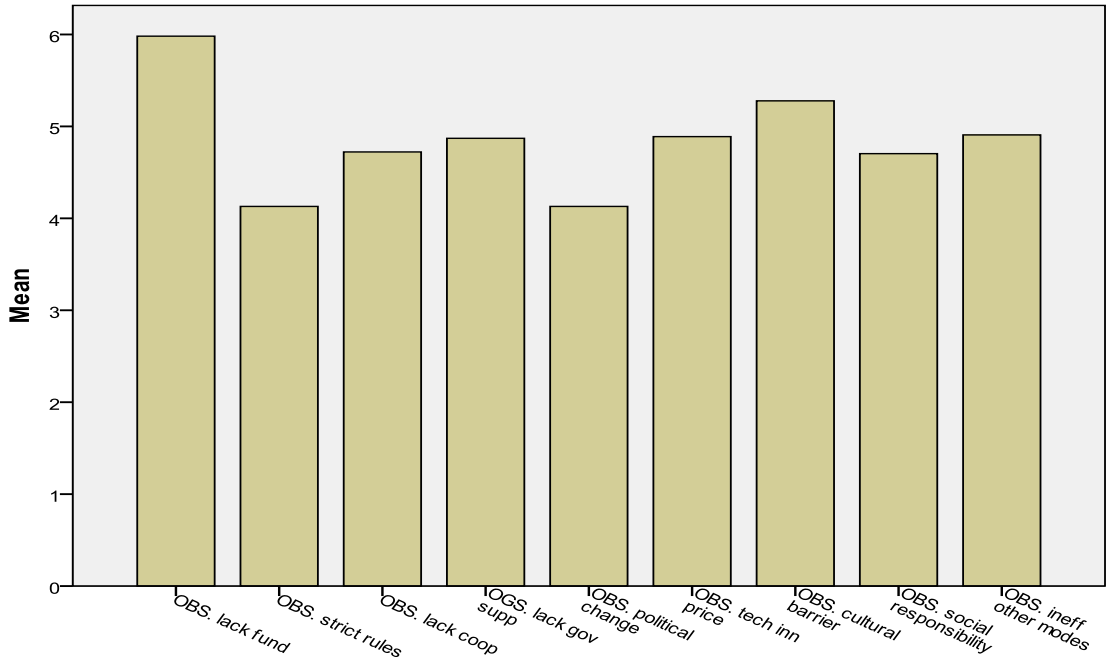

Figure 6-3: Importance of existing obstacles according to respondent municipalities

Source: Data analyses

The results of factor analysis for the existing impediments or obstacles of transition towards low Carbon urban mobility showed the KMO score scale: 0.617, three factors presented accounting about 60% of impediments for low Carbon urban mobility systems; the results show that the main barriers are related to: "demand management", "Rules and regulations" and "Sociotechnical sub-systems".

6) Success

Different aims and issues considered for low Carbon mobility transitions that are mainly related to demand-side management, technology procurement and a combination of policy measures have been identified as key in previous research on low-Carbon transport policy (e.g. Banister, 2008; Bristow et al., 2008; Santos et al., 2010; Schwanen et al., 2011; Vieira et al., 2007). In addition, the literature has paid attention to the 'routes'

through which GHG emission reductions can be achieved. Nykvist and Whitmarsh (2008) have recognized three routes to a more sustainable mobility system:

- Technological change: Technological change incorporates changed vehicle technologies, fuels or motive power (Monni and Raes, 2008)
- Modal shift: change from private to collective transport
- ICT and information society: may support reduced travel demand through new practices, such as Tele-shopping and Tele-working (see, e.g., Geels, 2012).

Erl & Feber (2000) consider that sustainable mobility can be achieved if the following chain of goals/actions is taken into account:

- Improvement of accessibility and the use of space;
- Increase the contribution of environment-friendly modes (public transport, cycling, walking); Traffic congestion reduction;
- Safety improvement;
- Air pollution, noise, and visual nuisance reduction;

In another study, Campos et al. (2009) introduce main objectives of sustainable mobility:

- Increasing use of public transport and walking and cycling trips;
- Integrating transport policies and land use planning;
- Improving environmental quality;
- Reducing use of private vehicle trips; and,
- Promoting urban economy.

In this research the main objectives of low Carbon transport identified as the results of literature review and interview results are introduced in **Table 6-9** based on the different levels of MLP.

Objectives	Focused on	MLP
Meeting the demands of public transport	Demand management	Landscape
Citizen awareness from emission risks	Public participation	
Increasing share of public transport	Stabilizing alternative regimes	Incumbent Regimes
Increasing satisfaction of public transport		
Increasing share of non-motorized transport		
Decreasing share of private cars	Destabilizing dominant regime	
Providing enough infrastructure for clean fuels	Niche Support	Niche

Table 6-9: Objectives of low Carbon mobility in Italy

Source: literature review, content analysis

KMO score obtained in factor analysis for this variable was 0.625, helped in sorting the qualitative indicators of success perception under three main categories (factors) contributing around 80% percent of total success perception of local authorities. These

factors are about “effectiveness of plans”, “incumbent regime change” and the “contribution of citizen” indicating different dimensions of success perception at local level; among them the factor related to “effectiveness of plans” seems to be more important and exclusively contribute around 44% of success perception.

These variables explained above affect the transition towards low Carbon urban mobility, among them “Success” variable is the dependent variable estimated by the effect of other variables. The other variables are the determinants, each of them apply a driving or restraining force on system dynamics. These variables and their role in transition process are shown in **Table 6-10** that summarize the above consideration from literature and interview analysis. These variables will be used to build the conceptual framework in the next section. They also used for designing the questionnaire that was the backbone of quantitative analysis that is going to be presented in the next section.

Determinants	Sub- category	Role
Green Attitudes	Values	(+): Driving (-): Restraining
	Strategic views	
	Resources	
Strategies and action plans.	Public transport	Driving
	Non-motorized transport	
	Clean niches	
Cooperation with other stakeholders	Infrastructure	Driving
	Knowledge	
	Planning	
	Implementation	
Financial supports for mobility plans	National funds	
	International funds	
Impediments	Demand management	Restraining
	Rules and Regulations	
	Sociotechnical subsystem	

Table 6-10: Driving and restraining forces of transition process

Source: qualitative data analysis

6.2.3 Contribution of municipalities

Figure 6-4 shows the conceptual framework analyzed in this dissertation; this framework represent the main variables affecting transition process towards low Carbon urban mobility as building blocks (affecting variables) and the evidence in the literature used to figure out the relation between variables (links and ties). The ties are expressed by the hypothesis developed to figure out the relation between variables:

H1: Success of low Carbon objectives is depended on: Green attitudes of local government (visions), strategies of incumbent regimes, financial supports, existing obstacles (restraining forces), and cooperative activities

H2: Strategies of incumbent regimes are affected by green attitudes, financial supports, obstacles and cooperations with other stakeholders.

H3: Cooperative activities are depended on attitudes of local government and existing obstacles.

H4: Financial supports can help in tackling the obstacles of low Carbon transition process and are affected by cooperation levels and attitudes of local government.

The hypotheses have been tested through statistical test of "Bivariate Correlation" and "Path Analysis" that is based on multiple regression analysis. First Correlation analysis used to estimate the relations between variables and then Path analysis used for more precious evaluation of those relations. The final results are used to justify the conceptual framework, eliminate the excessive links and variables and presenting the final framework.

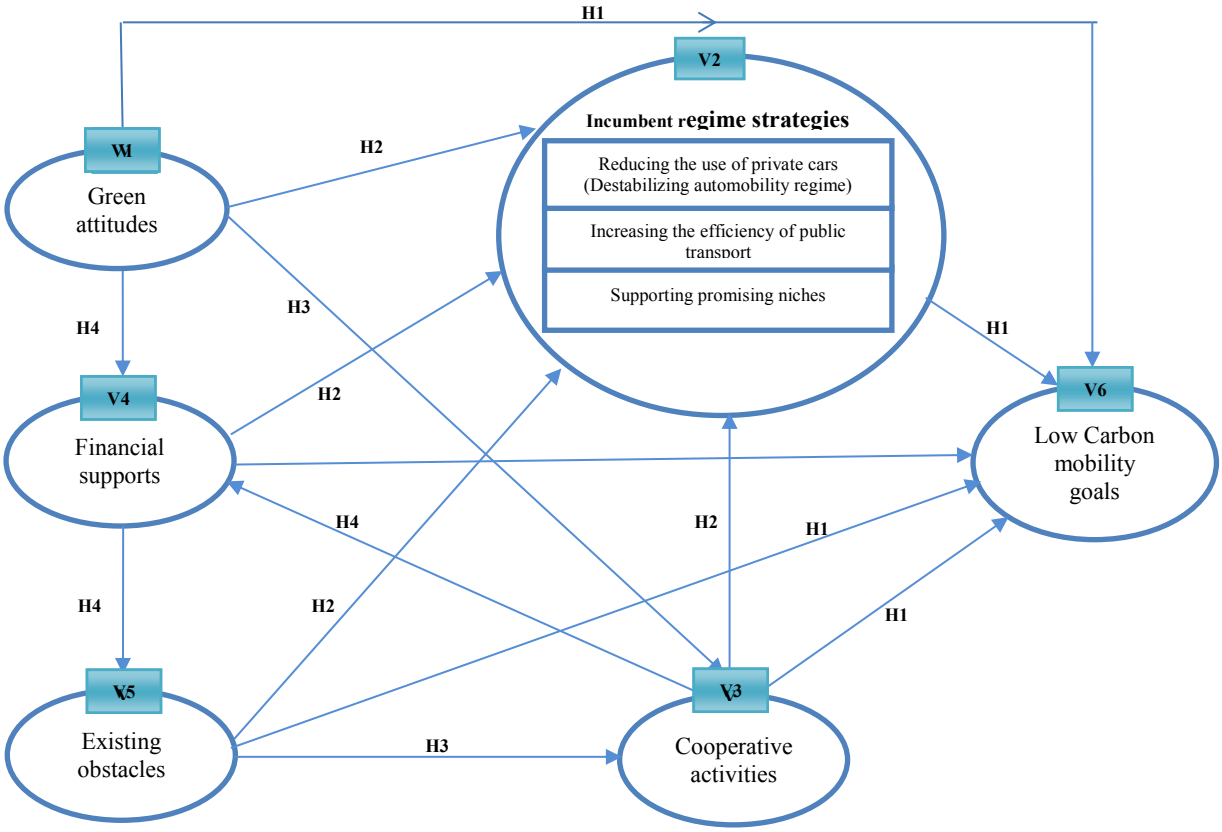

Figure 6-4: Conceptual framework: transition process dynamics and affecting variables

Source: qualitative data analysis

A) Correlation analysis results

The aim of performing correlation analysis was to calculate the paired links between variables. The correlation coefficient is a measure of linear association between two

variables. Values of the correlation coefficient are always between -1 and +1. In this dissertation correlation analysis was the first step in testing the analytical framework and the relations between variables, for this aim this framework was splitted into several parts showing the relations of each variable. This pairs are represented in **Figure 6-5**:

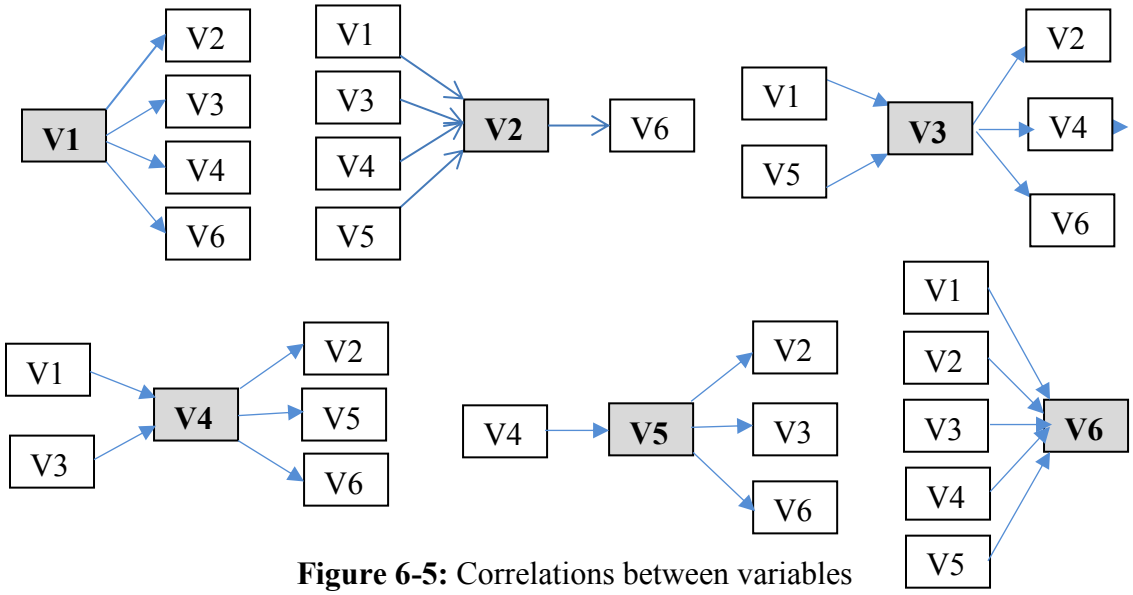

Figure 6-5: Correlations between variables

Source: Conceptual framework

Bivariate correlation matrix displaying the relations between pairs of variables are presented in **Table 6-11** noting that the significance level was greater than 0.05 indicates that there is no meaningful correlation between two variables: in this cases the cells connecting two variables are highlighted, the black cells show that no correlation was expected in the analytical model.

	Attitudes V1	**Strategies V2**	**Cooperation V3**	**Finance V4**	**Obstacles V5**	**Success V6**
Attitudes V1	----		0.216			
Strategies V2		----	0.620**	.540**		0.315**
Cooperation V3	0.216	0.620**	----	0.368**		0.238*
Finance V4		.540**	0.368**	----		
Obstacles V5					----	
Success V6		0.315**	0.238*			----

Table 6-11: Meaningful correlation coefficient between variables

Source: Data analysis

The ** sign indicates that the correlations are significant at 0.01 error level, which means 99% confidence; respectively * sign shows the significant correlation with 0.05 error level and 95% confidence. This indicates that the respondents only choose the variables that they could feel very confident about. In addition correlation coefficient shows that success of low Carbon mobility objectives mainly depended on the strategies applied for incumbent regimes, and the cooperation between stakeholders, while the strategies are affected to a great extent by the level of cooperation and financial supports.

Path analysis results

Path analysis is an extension of the ordinary multiple regression method introduced by Swell Wright in 1934 and is used to describe the directed dependencies among a set of Variables (predictors), and also the interaction between these variables. The direct contribution was indicated the statistic effect, not the causal effect. The indirect effect in the path model indicated a predictor has no main effect but is only involved in an interaction (Ducan, 1996). This analysis permits the partitioning of correlation coefficient into component parts in which the researcher could see the indirect effects of independent variables on dependent variables; it would be also possible to clarify the direction of these effects[72] (Habib Pour and Safari, 2009). In this dissertation, path analysis is used to clarify the contribution of variables to the success of low Carbon mobility objectives which reveals that to what extent the analytical model is in compliance with the experience of local authorities in Italy. The general rule in path analysis is to eliminate the variables which their path coefficient (β) is not meaningful at error levels lower than 0.05 (95% confidence level), in this regard the paths of those variables also will be eliminated from model. Considering the analytical model presented in figure 6-1, path analysis performed in three different steps:

- The direct effect of all variables on dependent variable (Success)
- The indirect effect of all variables on dependent variable (Success)
- The effects of variables on each other

The first step of path analysis is to analyze the effect of variables V1 to V5 on variable V6, the results of this analysis is shown in **Table 6-12**.

Coefficients[a]

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.

[72] Before starting the analysis the researcher considers a specific direction and performs the analysis, if the path coefficient obtained at the end of analysis is minus (-), the considered direction should be reversed.

		B	Std. Error	Beta		
1	(Constant)	2.164	1.160		1.867	.069
	Attitudes	.031	.163	.029	.188	.852
	Strategies	.468	.217	.451	2.152	.037
	Obstacles	.168	.164	.150	1.026	.310
	Finance	-.125	.187	-.125	-.667	.508
	Cooperations	-.220	.198	-.219	-1.112	.272
2	(Constant)	3.866	.167		23.100	.000

a. Dependent Variable: Success

Table 6-12: Path analysis results for direct effect of all variables on success perception

Source: data analysis

The results of path analysis suggest that only applied strategies have a direct effect on success of low Carbon mobility objectives. The next step is to analyze the indirect effect of variables on dependent variable. To investigate the indirect effects, we have to analyze the effect of excluded variables on the remained variables (here "Strategy" is the only variable which is remained). The results of this analysis are shown in **Table 6-13**, which revealed that the two variables "Finance" (international and national financial supports) and "Cooperation" with transport sector stakeholders considerably affect the applied strategies, while the effect of "Attitudes" (Visions toward sustainability" and "obstacles" are not meaningful at 95% confidence level. Although the correlation analysis showed that there is a relation between cooperations and success of emission reduction objectives, but path analysis revealed that this relation is not a direct effect, but the level of cooperations affect success variable through affecting the applied strategies for low Carbon mobility, which seems logical.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.401	.776		1.806	.078
	Attitudes	-.023	.113	-.023	-.201	.841
	Obstacles	.008	.114	.008	.073	.942
	Finance	.440	.112	.459	3.947	.000
	Cooperations	.394	.124	.405	3.176	.003
2	(Constant)	3.291	.161		20.394	.000

a. Dependent Variable: Strategies

Table 6-13: Path analysis results for indirect effect of other variables on strategies of incumbent regimes, Source: data analysis

The final step is to examine the interrelations between variables based on the analytical model. Based on this model variable V1 (Attitudes) is an exogenous variable which is not affected by any other variables, in this regards next depended variable which is going to be analyzed here is "cooperations" which is supposed to be affected by "Attitudes", and "Finance", the results of path analysis represented in **Table 6-14** revealed that "Cooperation" is only depended on "Attitudes" of local authorities.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.054	.982		-.055	.957
	Attitudes	.312	.137	.310	2.280	.027
	Obstacles	.145	.150	.131	.968	.338

a. Dependent Variable: Cooperations

Table 6-14: Path analysis results for the effect of "Attitudes" and existing "Obstacles" on the levels of "Cooperation"; Source: data analysis

The effect of other variables on strategies were examined before so the next variable for interaction analysis is "Finance", which is supposed to be affected by "Attitudes" and "Cooperation"; the results of path analysis are represented in Table 6-14,**Errore. L'origine riferimento non è stata trovata.** which revealed that "Finance" variable is only affected by "cooperation" level.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.736	.737		2.356	.023
	Cooperations	.270	.126	.300	2.137	.038
	Attitudes	-.004	.146	-.004	-.026	.980

a. Dependent Variable: Finance

Table 6-15: Path analysis results for the effect of "Attitudes" and existing "Obstacles" on the levels of "Cooperation"; Source: data analysis

Also analyzing the effect of "Finance" and "cooperation" on the "Obstacles" showed that respondent doesn't believe that these factors can help in facing the obstacles of transition process towards low Carbon mobility.

Final framework

Based on the above analysis the final framework could be developed by eliminating the excluded relations, and variables. As it was supposed in the primary framework (**Figure 6-2**), the analysis revealed that strategies are the main tools of achieving low Carbon mobility objectives; but the primary framework supposed that other dynamics (introduced as variables in this dissertation) could have a direct effect on the success factors, but the analysis showed that the transition dynamics indirectly affect the objectives only through affecting the strategies of incumbent regimes. The final framework which is modified based on the analysis results is represented in **Figure 6-6** that shows the link between remained variables; noting that the variable "Obstacles of existing systems" is eliminated, because the analysis doesn't showed ant relation between this variable and other variables in the model.

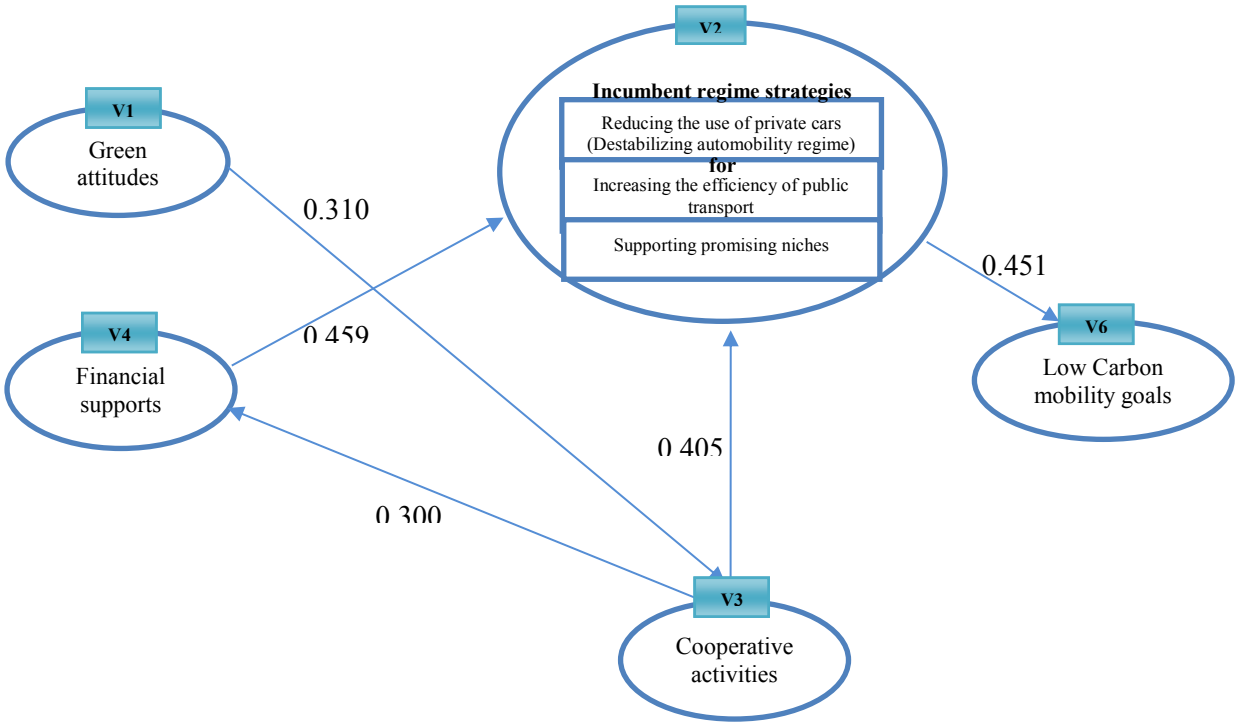

Figure 6-6: Final framework explaining the experience of low Carbon mobility transitions in Italy, Source: data analysis

This framework shows that low Carbon urban mobility at local level in Italy is directed by the triangle of Strategy, Finance and cooperations; at least local authorities don't believe in any other factors that can have a significant effect on achieving low Carbon mobility objectives. It means that they mainly rely on building networks and attracting financial resources for perusing the strategies that are focused on three main categories:

- Destabilizing car based regimes
- Effective public transport systems
- Nurturing clean mobility niches

More discussions about the obtained framework would be presented in the next chapter. The last section in this chapter is about comparing two groups of municipalities (municipalities with more than 100,000 inhabitants compared with those which have between 30,000 and 100,000 inhabitants, respectively, municipalities that have another type of transport plan (PUM) in addition to PUT) based on the interactions described by the modified framework.

6.2.4 Comparison of two groups of municipalities

The last analysis conducted in this study aimed at comparing two groups of municipalities to see if there is a difference in affecting the transition process dynamics between bigger metropolitan municipalities (municipalities which strategic long term plan (PUM)) with smaller municipalities (that only develop operational plan (PUT)). To do this, the following hypothesis developed in addition to the previous hypotheses.

H5: There is a difference between municipalities (who developed PUM in addition to PUT) with other municipalities in the studied sample

This Hypothesis (H5) compares two groups of municipalities in the sample, to see if the metropolitan municipalities have stronger effect on transition process or not. This hypothesis was tested through "Maan Withney U" analysis which is a nonparametric test for comparing two separated sample groups to see if one distribution is stochastically greater than the other (Fay and Proschan, 2010). All variables have been tested to see if there is a difference in the "Green Attitudes", "Strategies", "Cooperation levels", "Financial resources received" and "Success perception" in two groups of municipalities. The results of analysis are represented in **Table 6-16**, revealed that the mean of the variables shaping the main triangle of justified framework (strategy, finance cooperation) have different patterns in two groups of municipalities (Sig. <0.05), and in bigger municipalities higher levels of applied strategies, financial resources and cooperations

observed; while for the category of applied strategies this difference was significant and more clear. This shows that municipalities that develop long term strategic plan launched more successful strategies than the other group.

Variables	Clusters	Mean Rank	Asymp. Sig. (2-tailed)
Success	municipalities only have PUM	28.76	0.421
	Municipalities have PUT+PUM	32.61	
Attitudes	municipalities only have PUM	25.30	0.129
	Municipalities have PUT+PUM	32.29	
Finance	municipalities only have PUM	24.51	0.001
	Municipalities have PUT+PUM	39.74	
Cooperations	municipalities only have PUM	27.00	0.043
	Municipalities have PUT+PUM	36.83	
Strategies	municipalities only have PUM	25.49	0.001
	Municipalities have PUT+PUM	41.32	
Obstacles	municipalities only have PUM	29.70	0.424
	Municipalities have PUT+PUM	25.97	

Table 6-16: Comparison of research variables between two groups of municipalities

Source: data analysis

This chapter only presented the obtained results, more discussions about the results, their significance and implications, why they prove or disprove hypothesis will be presented in the next chapter.

Chapter7:

Discussions and Conclusions

This chapter aimed at summarizing the main results of the study and their interpretation, significance, implication and limitations of the study. For this aim An explanation of whether results prove or disprove the research hypothesis will be provided, while discussing the results in the light of previous studies and the existing literature in transition research context. Then the wider implication of this study and limitations will be explained and at the end the suggestion for future research as well as concluding remarks will be presented.

7.1 The research process and contribution

Foxon et al. (2010) describe three main lines in transition studies:

1. MLP as a framework of analysis of historical dynamics of transition (literature in this context mainly developed by well-known scholars like Geels, Schot, Rip, kemp and others)
2. Transition management studies: which is a process of governance aimed to steer and modulate dynamics of transition through interactive –interative engagement of different stakeholders. The first step in this process is the creation of a 'transition arena' followed by mobilizing change through transition experiments, learning and evaluation of the relative successful experiments (Kemp and Rotmans, 2005; and Loorbach, 2007).
3. Using MLP for developing "Sociotechnical Scenarios" describe the potential transition pathways not only in terms of technological developments but also exploring the link between various affecting factors and analyze how development effect and are affected by strategies and stakeholders behavior (Elzen et al., 2002, p. 6).

This research tried to develop a framework for sustainable low Carbon urban mobility connecting these three research lines. For this aim the first step was to identify the dynamics of transition process and the factors that may influence them. Then, choosing a defined pathway, and mapping the relations between the identified variables based on the existing scenarios and literature in the study context; the result of this phase would be a conceptual framework which will be tested from the governance point of view. To do this, the researcher chooses the municipalities as the main representator of local government because they engaged more or less in three levels of governance activities (strategic, tactical and operational) introduced by Loorbach (2004). The study population was the sample of municipalities which are obliged to develop at least one kind of transport plan (PUT) at municipal level according to Italian legislation[73]. This population includes a group of bigger (metropolitan) municipalities that are suggested but not obliged to develop another transport plan (PUM). The results of municipality's responses to an administrated questionnaire have been analyzed using statistical correlations and regression analysis to find out how local governments (municipalities in this case) consider the identified variables and to what extent affect them.

[73] Art. 36 del decreto legislativo 30 aprile 1992, n. 285

7.2 Discussing the Key Findings

Some general dynamics of transition process introduced by international guidelines and scholars described in previous chapter (OECD G, 2011; UNEP, 2011, Foxon et al., 2010). The existing literature about dynamics of transition process fully discussed in previous chapters (Chapter4: Theoretical framework), the detailed dynamics are presented in Tables 4-1 to 4-5 based on the corresponding levels of MLP. In this dissertation another type of qualitative data (semi structured interviews with transport sector stakeholders) used for choosing the dynamics more related to the study context (urban mobility in Italy).

Here the variables shaping the building blocks of conceptual framework are presented, described based on previous research findings and their expected contribution in the model is compared with the results of municipalities responses, in case of any disconfirmation from the previous findings the possible causes and reasons regarding the study context will be discussed.

Six variables shape the theoretical framework, among them five variables are supposed to determine the final success perception for emission reduction objectives. Each of these variables discussed in previous literature, yet the contribution of this dissertation is to link them together. These variables are: “Green Attitudes”, “Strategies” applied for incumbent regime optimization and niche protection and nurturing, levels of “Cooperation” with other stakeholders, “Finance” for emission reduction projects and existing “Obstacles” for achieving emission reduction objectives. In these research only variables that could get enough support from literature, reports and guidelines of sustainability transition considered for developing the conceptual analytical framework. These variables and their implications in transition towards low Carbon mobility are explained as follows:

7.2.1 Green Attitudes

The results of administrative questionnaires analyzed using statistical techniques described in previous chapters. As it was displayed in **Figure 6-5**, “green attitudes” considered as an exogenous variable that affect “Success perception”, “Strategies”, “Finance” and “Cooperative activities”. The quantitative analysis revealed that respondent municipalities believe that it only affect “Cooperative activities” and the meaningful relation not identified between “Green Attitudes” and other contributing variables (at the confidence level of 95%). These means that local government in Italy underestimated green attitudes toward low Carbon mobility; while transport sector

stakeholders believe that the "Green Attitudes and commitment" of decision makers affect the strategies and objectives of transition process which is also supported by the previous studies (Miller 1984/85, Walther 1987, Clark 1992; Swaffield 1998, p. 495; Robinson, 2000; Schmidheiny, 1992; Shrivastava, 1994, 1995). So municipalities, doesn't consider their attitudes and commitment affect strategies and success in emission reduction targets. One interpretation for this results may be due to the fact that in Italy regional and provinces are more engaged in planning efforts and local Authorities have the competence of running of local transport and maintenance of transport infrastructure, promoting mobility management measures and local mobility management policies. It means that municipalities mainly perform the goals and strategies defined by higher level of authorities. As it is argued by Marchetti (2010) Regions in Italy have been provided with major powers in view of ensuring the development of the respective territories; for many years, Regions limited themselves basically to seeking the involvement of local authorities by asking for their opinions, which were not binding; but in recent years a new scenario is presented in which they will have to act as coordinators for the various levels of government without prevailing over sub-regional bodies.

7.2.2 Strategies for achieving sustainable mobility

In the questionnaire respondent municipalities asked to rank the extent to which they applied each strategy or action using a seven-point Likert scale. The results of analysis revealed that strategies and related actions are the only variable that directly affects emission reduction success. The previous research findings also support the effect of strategies on achieving the objectives of transition process among them OECD's Green Growth report introduce strategy development as the first step for promoting successful transition towards green growth (OECD G, 2011). Also Kemp and Loorbach (2006) state that "Interactive strategy development is one of the most pressing elements that facilitate transitioning towards sustainable development".

Strategies are affected by financial supports, it means more financial supports result in the implementation of more strategies and actions. These strategies could be related to the incumbent regimes (automobility and public transport regimes) or could be the strategies for supporting the niches that have the potential to grow up and replace the existing regimes. While interviewees believe that the amount of financial supports for strategies is affected by government's attitudes and preferences, for example controls in Limited Traffic Zones (LTZ) that usually cover the historic city centers, is more favored than fuel

taxation; or governmental decision in providing protected space for specific niches (Smith and Raven, 2012) like clean fuels (methane and natural gas) rather than EVs. The interviewed stakeholders believe that this depend on government preference, also some of these strategies and action plans are mentioned in EPOMM (2013) and KpVV (2012) report as the main strategies of local municipalities; but the analyzing municipalities response show that they don't see any relations between their attitudes and applied strategies, this could be justified by choosing the main strategies through higher level authorities (Provinces and Regions).

7.2.3 Cooperations

The results of analysis revealed that cooperation with other stakeholders in transport sector is affected by attitudes of policy makers and have an effect on strategies and the amount of external funds and resources received. Some interpretations of these results are:

First, a positive link exist between attitudes and efforts of policy makers with the cooperative activities, it means that higher levels of stakeholder involvement depend on the positive attitudes of policy makers toward sustainability. This confirms the finding of a study made by Pisano et al., (2014) that studied sustainable development governance proves in six EU member states (Austria, Belgium, Finland, France, Germany, and Netherlands) which showed that although sustainable transition initiatives and activities are led by government and public authorities, but they were interested in stakeholder involvement. The stakeholders involved come, apart from the national and sub-national public administration, primarily from research, businesses, consultancies, and civil society organizations.

Second is the effect of cooperations on strategies and actions, the results showed those higher levels of cooperations, results in defining better policy mixes (OECD G, 2011) and launching more strategies. About the definition of policy mixes and strategies it was argued before that each city should define a set of strategies based on the specific conditions, existing transport networks and available resources. OECD report highlight the role of cooperations with other stakeholders by emphasizing on the necessity "to build on a high degree of co-ordination among ministries and levels of government as well as stakeholders outside government, to identify a policy mix suitable to local conditions" (OECD G, 2011)

The other aspect is the implementation of strategies noted by banister's (2008) argument: "effective implementation of sustainable mobility strategies requires the engagement of key stakeholders"; and the results of other studies emphasize the role of different stakeholder groups and the cooperation between them to perform system change strategies (Spickermann et al., 2013; street, 1997; World trade report, 2003, EU Rural Review, 2015)

Third the positive effect of cooperation with other stakeholders to have better access to financial resources. The resource-based view states that one of the crucial motivations for the creation of alliances is the will of partners to acquire capabilities from an external source (Mowery et al., 1998). The results of this study confirm the role of cooperations in gathering more financial resources from both national and international organizations. For example in urban mobility context Spickermann et al., (2013) states that funding should be fairly distributed in creating transport systems, so local, state, and federal governments should cooperate with other stakeholders in allocating investments to multimodal mobility;

Forth the last point comes out of the study results is the engagement of different groups of stakeholders representing different levels of international, national, regional or local authorities. In this research we choose stakeholders from all levels mentioned above (international to local) and from different sectors related to science, industry, political bodies, and supply chain. The results showed that although there are different patterns of cooperations between different groups of stakeholders, sometimes weaker or stronger, but at least there were some levels of cooperations with each stakeholder. This confirms multi stakeholder partnership according to thematic areas suggested by UN Secretary Panel on the post-2015 Development Agenda[74] that helps in guiding the way targets meet.

In addition more cooperation links created with local authorities, rather than the other groups of industry stakeholders, and knowledge sharing partners; and the cooperation patterns with local partners show difference between R&D and other types of cooperation, the interesting point was that cooperation with local partners, was mainly in planning activities while it is expected that local authorities engage more in implementation and executive responsibilities.

High importance of cooperation for municipalities could be explained by the presence of municipal associations in Italy that focus specifically on sustainable development issue

[74] General's High-Level Panel of Eminent Persons on the post-2015 Development Agenda

(Sauer et al., 2016). Since 1987, the Italian Development Cooperation recognizes a growing role in development and cooperation to local authorities and autonomous administrations, such as Regions, Autonomous Provinces and Local Entities (Rossignoli et al., 2015).

7.2.4 Finance

The results of analysis revealed that finance variable is affected by cooperations and have a direct effect on the number and level of strategies and actions applied successfully. Fiscal instruments provide protection to some niches, Smith and Raven, (2012) argue that these fiscal instruments are affected by government's decision to provide funds for a program, enable shielding, nurturing and empowering niches related to that program. This fact is supported by the analysis results that showed when municipalities have better access to financial resources; they have better performance in supporting strategies and performing related actions.

Analyzing the effect of cooperation on financial supports received in different stakeholder groups revealed that cooperation with two groups of stakeholders has a meaningful effect on the amount of funds received for plans and projects; R&D cooperations with local entities (public private partnership), and cooperations with ministry and higher level authorities (public-public partnership). These results showed that there is municipalities don't believe in cooperation with local partners for financing projects. Perretti (2014) pointed out to financial burdens and conflicting functions of public transport for the local authorities and suggest to provide more supports of private finance and greater share of private owned companies in providing local public transport arguing that local authorities in Italy often have simultaneous roles of policy-maker, market regulator, employer and/or controller of the service and sole or majority shareholder of the local public transport companies.

7.2.5 Challenges and impediments

The path towards low-Carbon mobility is challenging for all cities. Some scholars believe that urban planners underestimate the key challenges and obstacles[75] in transport planning process (Banister, 2005; Balaker and Staley, 2006; Wickham, 2006). Challenges

[75] "Obstacle" and "challenges" are common terms in everyday language. In this dissertation and according to the English Dictionary, the term "obstacle" refers to something which prevents progress or movement. But "Challenge" is something difficult but also something which could be overcome. Thus a challenge is regarded as more positive than an obstacle. This dissertation introduced the challenges and barriers of low Carbon mobility, but only considered barriers as the restraining forces that affect other variables.

identified by international organizations usually show general and national level challenges. In the first phase of this research the local level challenges and impediments are identified and in the second phase, the analysis aimed at introducing the most challenging areas from the perspective of local government's viewpoints and to find out how those challenges and impediments affect the strategies, goals, and cooperation patterns.

In this study correlation and path analysis doesn't show any relation between this variable and the other variables, while a wide variety of literature and report emphasize the effect of obstacles as the restraining forces for achieving objectives and implementing the strategies as well as networking (cooperative activities). This indicates that although municipalities believe that those obstacles are important but they underestimated the effects obstacles on goals and strategies of low Carbon mobility, while there is a great emphasize in the literature for considering the effects of challenges and obstacles in setting goals and strategies for sustainability (TRANSFORM, 2014; Banister 2005; Balaker and Staley, 2006; Wickham, 2006; Transforum, 2014; Mobility 2030).

So this is the area that needs more attention from municipalities, systematic efforts should be planned to identify the challenges and barriers (in terms of general national level difficulties and also specific context related difficulties) and consider them in setting goals and strategies.

7.2.6 Success

Analysis of results indicate municipalities believe that the emission reduction objectives are only affected by strategies and action plans, while the other stakeholder as well as transition literature introduce other factors described as the main driving and restraining forces in Chapter 6. Although municipalities considered some of these forces as having indirect effect on final objectives, but some of them like the existing challenges and obstacles didn't get enough attentions or doesn't considered as important factors by the respondent municipalities; while the majority of policy guidelines start with identifying the challenges and impediments before starting to develop policies and strategies.

Between the objectives mentioned in **Table 6-9**, municipalities were more satisfied of achieving the objectives of Incumbent regime improvement (increasing the share of non-motorized and public transport, decreasing the use of private cars), while feel less successful in supporting niches (providing enough infrastructures for clean fuels). This is justified through the strategies performed by municipalities and indicates that

municipalities in Italy focused on best use of current infrastructure rather than supporting and developing niches which seems to be more costly.

Finally the results showed that overall success perceptions in respondent municipalities were above average and there were no difference between two groups of municipalities regarding the success perception.

7.3 How Municipalities affect low Carbon mobility transition

The abovementioned variables identified as the key variables influencing transition process and pathways, the depended variable was success in achieving the objectives of low Carbon mobility, a set of objectives from country reports and interviews considered to measure this variable, although there may be other goals and objectives but the goals considered in this dissertation were those that are affected by local governments (municipalities).

The municipalities believe that only strategies and action plans (like their mobility plans) directly affect the objectives and other variables only have indirect influence on the final aims through affecting those strategies and plans, for instance financial supports from national government and international organization positively affect the performance of strategies and the number of successful projects within mobility plans; or in a same manner stakeholder involvement affect the strategies and related actions forecasted by planners. Although literature suggest to involve stakeholders in decision making process (OECD G, 2011, TRANSFORM, 2014; Edelenbos, 2006); but the results of this study showed that Italian municipalities doesn't consider any link between stakeholder involvement and success of targets. This may be because mainly higher levels of authorities (regions and state government) are responsible for policy making (Vesperini, 2009), and "administrative functions are attributed to the municipalities, pursuant to the principles or subsidiary, differentiation and proportionality, to ensure their uniform implementation" (ART 118 of the Constitution and Law 131/2003).

Based on the analysis performed in this dissertation, for Italian municipalities strategies and action plans in current mobility system, which is mainly based on their transport plans (PUM or PUT) is the main contributor of success. So they develop a plan and seek for financial resources and cooperating partners (in specific and limited level), to perform the strategies.

The last point is that the level of cooperations depends on the attitudes and commitment of municipalities to sustainable development objectives, more positive viewpoints and behavior resulted in higher levels of stakeholder involvement.

7.3.1 Suggestion and Implication for Decision Makers

This research explored the current governance patterns at local level for transition towards low Carbon mobility, the result highlighted the role of strategy, finance and cooperations in achieving emission reduction objectives, but during the research process, and after analyzing the results some facts cleared that highlighted the implications for decision makers and local authorities examining ways to improve performance of sustainable urban mobility planning.

First, although there are some levels of cooperations between municipalities and other stakeholders of transport sector, but still there is a need for more political-administrative systems to choose the best strategies in relation to the goals, involving the stakeholders from private sector and civil society is highlighted in literature and needs more attention from local government. Participation in international and EU level projects enable municipalities to improve the amounts of funds, resource and administrative supports for the specific research or practical projects. Also cooperation with nearby municipalities can help the small and medium sized municipalities to develop long term strategic plans (PUM) for their area and receive better funding supports for their mobility plans from government, considering that the article 22 of the Law n. 340/2000 assigns a state funding up to 60% of the whole investment of Urban Mobility Plan (PUM) for group of Municipalities (as well as individual municipalities). The office of area mobility manager is defined for supporting such cooperations.

Second is the need for developing more strategic and visionary goals in order to identify and tackle the barriers of achieving targets, specially cultural and financial barriers. The role of visions and commitment of deciding authorities is an important issue that can directly affect the policy goals and strategies which needs to be considered more seriously in local transport planning.

Third is the importance of identification of impediments and defining strategies and actions for tackling them. This needs the engagement of other stakeholders in goal setting, planning and implementation phases.

7.4 Conclusions

This dissertation was set out to explore the patterns of low Carbon transition management at local level and identified how Italian municipalities contribute in managing the transition process towards low Carbon urban mobility.

Transition is a process of broad changes, not only in technological systems but also in different sociotechnical systems, and it is impossible to fully control, predict or direct transitions; instead it is possible to influence ongoing transition dynamics in terms of speed and direction. Analyses in terms of transitions help to identify dynamics that could be influenced (Loorbach, 2010b). The role and contribution of local government in influencing those dynamics is particularly important, because they address non-technological barriers to support the transition process and they have unique position (closest to the citizens) to understand, inform, guide and lead local inhabitants, businesses and industries (Van Staden et al, 2014).

The general theoretical literature on this subject is related to transition theory and management approaches and based on transition theory, MLP, and transition management approaches, this dissertation seek to answer the following questions:

- What are the main factors that influence transition process and pathways, dynamics of transition process and the government tools as external forces influencing the overall objectives of emission reduction?
- What is the role of each factor as a driving force or restraining force of transition process, and finally
- How local government (in this case, municipalities) contribute in managing, controlling and influencing those dynamics and forces.
- What is the difference between two groups of municipalities (those who have PUT only, and the bigger municipalities that developed PUM in addition to PUT)

The dynamics of transition process identified based on MLP, are introduced as: “Green attitudes” and commitment of policy makers to emission reduction targets (Landscape dynamic), “Strategies” for changing the dominant regimes of private cars to more sustainable less polluted ones (public and non-motorized transport), and strategies for developing the niches of clean mobility (Niche and Regime level dynamics). In addition government has some tools for affecting and controlling those dynamics, introduced as “Cooperations” (Networking) and “Finance”. These four factors (Green attitudes, Strategies, Cooperations and Finance) shape the driving forces of transition process.

Restraining forces consist of obstacles of achieving emission reduction objectives, there are also challenges for achieving the targets, but they are not considered as restraining forces because they only represent the tasks that are difficult to manage but nor a real barrier. Regarding the emphasized role of local government, a predefined pathway (ECO-city scenario introduced by Marletto (2014)), used to map the relations between the identified variables based on the literature in the study context and the viewpoints of stakeholders; resulted in presenting the final framework. The framework developed in this dissertation offers a number of enhancements that improve the application of current socio-technical regime strategies and management theories to transitions. These include; clearer articulations of the forces affect transition process and the role of local government in affecting them.

The second phase of analysis tested the efforts of Italian municipalities in the context of conceptual framework. The results revealed that only strategies and action plans have a direct effect on success of emission reduction objectives and these strategies are depended to the management tools (Cooperations and Finance), while the landscape factor (attitudes of policymakers) only affect the cooperation patterns.

The framework developed for sustainable low Carbon urban mobility in this dissertation connects three main lines of transition research studies introduced by Foxon et al (2010): MLP, transition management, and scenarios for transition pathways. The analysis results showed the current level of local policies and strategies for low Carbon urban mobility in Italy, the extent to which each force is considered and the neglected variables that need to be considered in future (the existing obstacles). Also the results showed that although there is some levels of cooperations between municipalities and stakeholders but the overall cooperation is weak and still more could be done within the political-administrative system to decide on joint strategies in relation to the goals, involving the stakeholders from private sector and civil society, this confirms the results obtained in "TRANSFORUM" project.

Another point is the difference between two groups of municipalities, the research showed that municipalities that developed PUM in addition to PUM launched more projects in their strategic actions, and have more cooperation links and better access to international and national funds. It is suggested that small and medium sized municipalities made groups for developing joint PUM and receive better funding for their mobility projects.

There is need to develop more strategic and visionary goals to tackle the barriers specially cultural and financial barriers, that sometimes prevent or delay the achievement of emission reduction objectives. Participation in international and national projects in the context of sustainable urban mobility allow municipalities access to better resources and financial supports for the implementation of plans, interview with higher level authorities showed that some municipalities even are not aware of the existing funds available for sustainable mobility, so local authorities have to take more active role in decision making process and establish stronger links with higher level authorities. Also involving other stakeholders in mobility projects may help in getting a better vision about the existing practical barriers in urban mobility context.

This dissertation offered an evaluative perspective on local urban mobility management context, and was conducted at local decision making level through sampling municipalities as the local government bodies. As a direct consequence, the study encountered a number of limitations, which need to be considered. The existing available statistics of urban mobility mainly classified at regional and national level while there is a need for the availability of measures at local level, in that case it could be possible to conduct better quantitative analysis and gain better view of local mobility patterns, trends and developments.

In spite of the existence of plans and projects aimed at improving urban mobility situation at local, regional and national context in Italy, and the effectiveness of mobility plans I improving the overall urban mobility situations; it seems that the defined objectives, strategies and action plans at local level need more coordination between all stakeholders involved in transport sector, and better understanding, mapping and planning for the existing barriers of emission reduction projects. The need for measures of strategy and plan effectiveness at local level is also highlighted in this research.

7.5 Future Research

The influencing factors identified in this dissertation represent an interesting contribution to existing literature, specifically in transport sector, as the previous studies mainly focused on studying the historical transition process. Still, future research could explore the implications of using the variables in a systematic way, or the consequences of partial or varying levels of strength between the different factors. Future studies could, for example, consider the question of whether weaker or stronger application of the links

between variables influences the content of outputs such as strategies or the success of targets.

This dissertation focused on regime transformation, and the study of niche development was beyond the scopes of this study, but other researches could be defined to study the process of niche development and strategic niche management for the promising niches (for instance EVs, HEVs, Hydrogen fuel cells, ITS systems, etc.) introduced in this dissertation as well as the relevant literature.

Other research could explore the validity this findings by conducting the case studies, at local or regional level by defining the quantitative indicators to measure the progress toward low Carbon mobility, effectiveness of strategies in certain areas or measuring the progress in specific timeframes.

The validity and relevance of findings such as those presented in this dissertation may be reinforced by increased diversity in the literature, and more systematic measurements of common factors influencing municipal efforts for urban sustainability. This dissertation has attempted to make a contribution to this debate and hopes to inspire future research in this field.

References:

1. Abeyasekera, S. (2005). Quantitative analysis approaches to qualitative data: why, when and how?.Statistical Services Centre, University of Reading, White knights Rd., UK.

2. African Technology Policy Studies Network, ATPS. (2013). Vehicular Carbon Emissions Concentration Level in Minna, Nigeria the Environmental Cum Climate Change Implication [OkelolaOlumayokun Francis, Okhimamhe Apollonia], ATPS WORKING PAPER No. 71

3. Agrawal, A., Kononen, M., Perrin, N. (2009). The Role of Local Institutions in Adaptation to Climate Change, Social Dimensions of Climate Change. Social Development Department, The World Bank, Washington DC.

4. Aitken, Alexander Craig (1957). Statistical Mathematics 8th Edition. Oliver, Boyd. ISBN 9780050013007 (Page 95)

5. Alley, R. B. (2000). Ice-core evidence of abrupt climate changes. Proceedings of the National Academy of Sciences, 97(4), 1331-1334.

6. Allman, L., Fleming, P. & Wallace, A. (2004) The progress of English and Welsh local authorities in addressing climate change, Local Environment, 9, pp. 271–283.

7. American Psychological Association, Inc. (1974). "Standards for educational and psychological tests" Washington D. C.

8. Anderson, C. (2010). Presenting and evaluating qualitative research. American journal of pharmaceutical education, 74(8).

9. Annan, J., Bowles, J., Bloch, D. A. (2010). Climate Hedging Explained. Available at SSRN 1676146.

10. Arthur, W.B., 1989, 'Competing technologies, increasing returns, and lock-in by historical events', Economic Journal, 99(394), 116-131

11. Aryee, S. (1993). A path-analytic investigation of the determinants of career withdrawal intentions of engineers: some HRM issues arising in a professional labor market in Singapore. International Journal of Human Resource Management, 4(1), 213-230.

12. Asstra, H. and Isfort A., (2014), 11° Rapporto sulla mobilità in Italia, Roma, available at: http://www.isfortprogetti.it/Convegni/Audimob/05_28052014_R.pdf

13. Austin, et al, (2012), moving people: towards sustainable mobility in European metropolitan regions, INTERREG IVC Catch-MR project. Joint spatial planning department Berlin-Brandenburg, Berlin, November 2012

14. Avelino, F., Wittmayer, J. M. (2015). Shifting Power Relations in Sustainability Transitions: A Multi-actor Perspective. Journal of Environmental Policy & Planning, 1-22.

15. Azorín, J. M., Cameron, R. (2010). The application of mixed methods in organizational research: A literature review. Electronic Journal of Business Research Methods, 8(2), 95-105.

16. Baeumler, A., Ijjasz-Vasquez, E., and Mehndiratta, S. (Eds.). (2012).Sustainable low-carbon city development in China. World Bank Publications.

17. Banister, D. (2005). Overcoming barriers to the implementation of sustainable transport. In: Rietveld, P., Stough, R. R. (Eds.). Barriers to Sustainable Transport: Institutions, Regulation and Sustainability. Spon Press, UK.

18. Banister, D. (2005). Unsustainable transport: city transport in the new century. Taylor Francis.

19. Banister, D. (2008). The sustainable mobility paradigm. Transport policy,15(2), 73-80.

20. Banister, D. (2011). Cities, mobility and climate change. Journal of Transport Geography, 19(6), 1538-1546. Available at : http://www2.fiu.edu/~revellk/pad3800/Banister.pdf

21. Barbour R, Kitzinger J(1999). Developing Focus Group Research, Politics, Theory and Practice. Thousand Oaks, California: Sage 1999. 26

22. Barrutia, J. M., Echebarria, C., Hartmann, P., and Apaolaza-Ibáñez, V. (2013). Municipal managers' engagement in multi-level governance arrangements: An empirical analysis grounded in relational economic geography. Geo-forum, 50, 76-87.

23. Bartlett, M. S. (1950). Tests of significance in factor analysis. British Journal of statistical psychology, 3(2), 77-85.

24. Beirão, G., Cabral, J. S. (2007). Understanding attitudes towards public transport and private car: A qualitative study. Transport policy, 14(6), 478-489.

25. Bell, D. V. (2002). The role of government in advancing corporate sustainability. Background Paper. Final draft. Sustainable Enterprise Academy, York University (Canada).

26. Bendassolli, P. F. (2013). Theory building in qualitative research: reconsidering the problem of induction. In Forum Qualitative Sozialforschung/Forum: Qualitative Social Research (Vol. 14, No. 1).

27. Berkhout, F., Smith, A., Stirling, A., (2004). Socio-technological regimes and transition contexts. In: Elzen, B., Geels, F.W., Green, K. (Eds.), System Innovation and the Transition to Sustainability: Theory, Evidence and Policy. Edward Elgar, Cheltenham, pp. 48–75.

28. Bernard, H. R. (2002). Research methods in anthropology: Qualitative and quantitative approaches (3rd ed.). Walnut Creek, CA: Alta Mira Press.

29. Bertolini, L. (2011). Achieving sustainable urban mobility: What can we learn from transition theory? ,Paper presented at the 3rd World Planning Schools Congress, Perth, Australia, 4-8 July 2011

30. Bertuccio, L., Cafarelli, E. (2011). Mobility Management Monitor: Italy 2011. Euromobility. EPOMM Plus

31. Bertuccio,L. Galli,C. Iacovini, C. and Parmagnani, F. (2001). "Mobility Management.Stato dell'arte e prospettive",ENEA - euromobility,2001

32. Betsill M., Bulkeley H. (2007). Looking back and thinking ahead: a decade of cities and climate change research. Local Environment: The International Journal of Justice and Sustainability. 2007; 12:447–456.

33. Bickman, L., Rog, D. J. (2008). The Sage handbook of applied social research methods. Sage publications.

34. Bongardt, A., Torres, F. (2010). The competitiveness rationale, sustainable growth and the need for enhanced economic coordination. Europe, 136-141.

35. Brink, H. I. L. (1993). Validity and reliability in qualitative research. Curationis,16(2), 35-38.

36. Bristow A, Tight M, Pridmore A, May A. (2008). Developing pathways to low carbon land-based passenger transport in Great Britain by 2050. Energy Policy 36: 3427–3435. DOI: 10.1016/j.enpol.2008.04.029

37. Brown, H. S., Vergragt, P., Green, K., Berchicci, L. (2003). Learning for sustainability transition through bounded socio-technical experiments in personal mobility. Technology Analysis and Strategic Management, 15(3), 291-315.

38. Brown, R. R., M. A. Farrelly, D. A. Loorbach. (2013). Actors working the institutions in sustainability transitions: The case of Melbourne's stormwater management. Global Environmental Change 23:701-718. http://dx.doi.org/10.1016/j.gloenvcha.2013.02.013

39. Brown, S. L., Nesse, R. M., Vinokur, A. D., and Smith, D. M. (2003). Providing social support may be more beneficial than receiving it results from a prospective study of mortality. Psychological Science, 14(4), 320-327.

40. Bryman, A (1988). Quantity and Quality in Social Research, London, Routledge

41. Bulkeley H., CastánBroto V., Marvin S., Hodson M. (2011). Cities and Low Carbon Transitions. Routledge; London.

42. Burbank, C. J., Brinckerhoff, P. (2009). Strategies for Reducing the Impacts of Surface Transportation on Global Climate Change.NCHRP 20-24. Transportation Research Board, www.ruraltransportation.org/uploads/nchrp20-24 (59).pdf

43. Burla, M., Laniado, E., Romani, F., Tagliavini, P. (2001). The Role of Decision Support systems (DSS) in Transportation Planning: the Experience of the Lombardy Region. In Proceedings of Seventh International Conference on Competition and Ownership in Land Passenger Transport, Molde, Norvay(pp. 25-28).

44. Burns, A; Burns, R. (2008). Basic Marketing Research (Second ed.). New Jersey: Pearson Education. p. 245. ISBN 978-0-13-205958-9.

45. Butera, F. M. (1998). Moving towards municipal energy planning - the case of Palermo: The importance of non-technical issues. Renewable Energy 15(1-4): 349–355.

46. Caldwell, L. K. (1984). Political Aspsects of Ecologically SustainableDevelopment. Environmental Conservation, 11(04), 299-308.

47. Camagni, R., Gibelli, M. C., Rigamonti, P. (2002). Urban mobility and urban form: the social and environmental costs of different patterns of urban expansion. Ecological economics, 40(2), 199-216.

48. Cameron, R. A., Trudy, D., Scott, R., Ezaz, A., Aswini, S. (2013). Lessons from the field: Applying the Good Reporting of A Mixed Methods Study (GRAMMS) framework'. Electronic Journal of Business Research Methods,11(2), 53-64.

49. Campbell, D. T., Fiske, D. W., (1959). "Convergent and discriminant validation by the multitrait multimethod matrix." Psychological Bulletin, 56: 81-105.

50. Campos, V. B. G., Ramos, R. A. R., de Miranda e Silva Correia, D. (2009). Multi-criteria analysis procedure for sustainable mobility evaluation in urban areas. Journal of advanced transportation, 43(4), 371-390.

51. Carmien, S., Dawe, M., Fischer, G., Gorman, A., Kintsch, A., Sullivan Jr, J. F. (2005). Socio-technical environments supporting people with cognitive disabilities using public transportation. ACM Transactions on Computer-Human Interaction (TOCHI), 12(2), 233-262.

52. Carter, N. and Ockwell, D. (2007). New Labour, New Environment? An Analysis of the Labor Government's Policy on Climate Change and Biodiversity Loss, Report for Friends of the Earth, Center for Ecology, Law and Policy, York: University of York

53. Castells, M. (1996). The rise of the network society. The information age: Economy, society and culture. Massachusetts and Oxford: Blackwell.

54. Castells, M. (1998). End of Millennium, The Information Age: Economy, Society and Culture Vol. III. Cambridge & Oxford: Blackwell.

55. Cherp, A., Adenikinju, A., Goldthau, A., Hughes, L., Jewell, J., Olshanskaya, M., Vakulenko, S. (2012). Energy and security. Global Energy Assessment: Toward a Sustainable Future, 325-383.

56. Chin, A. (2000). "Sustainable Urban Transportation: Abatement and control of traffic congestion and vehicular emissions from land transportation in Singapore", Environmental Economics and Policy Studies 3, 355-380

57. Cirilli, A., Veneri, P. (2010). Spatial Structure and CO2 Emissions Due to Commuting: An Analysis on Italian Urban Areas (No. 353).

58. CITYNET. (1993). Tripartite terminal review of ESCAP/UNDP/CITYNET project (RAS/86/116) for the period of 1988–1992. Fourth session of the Executive Committee Meeting of the Regional Network of Local Authorities for the Management of Human Settlements (CITYNET), 1993, Colombo, Sri Lanka

59. CIVITAS. (2013). Policy recommendation for EU sustainable mobility concepts based on CIVITAS experience.

60. Clark, K.B. , (1985). The interaction of design hierarchies and market moncepts in technological evolution, Research Policy, 14 (1985), pp. 23–33

61. Clark, V. L. P., Huddleston-Casas, C. A., Churchill, S. L., Green, D. O. N., Garrett, A. L. (2008). Mixed methods approaches in family science research. Journal of Family Issues, 29(11), 1543-1566.

62. Clean cities five year strategy (2011). US Department of Energy Clean Cities Five-Year Strategic Plan.

63. Cleancities five year strategy (2011). US Department of Energy Clean Cities Five-Year Strategic Plan.Conference, Seeon.

64. Collier, U. (1997). Local authorities and climate protection in the European Union: Putting subsidiarity into practice?. Local environment, 2(1), 39-57.

65. Commission of the European Communities, CEC. (2006). Thematic Strategy on the Urban Environment. Communication from the Commission to the Council and the European Parliament, COM (2005) 718 final. Brussels

66. Commission of the European Communities, CEC. (2007). Towards a new culture for urban mobility. Green Paper, COM (2007) 551 final. Brussel

67. Committee on Climate Change, (2012). How Local Authorities Can Reduce Emissions and Manage Climate Risk, Department of Energy and Climate Change.

68. Common M., (1995). Sustainability and Policy: Limits to Economics Cambridge University Press, Cambridge

69. Cooper, R., Foster, M. (1971). Sociotechnical systems. American Psychologist, 26(5), 467.

70. Correlje, A. Verbong, G. (2004) The transition from coal to gas: radical change of the Dutch gas system, in: B. Elzen, F. Geels & K. Green (Eds), sustem innovation and the transition to sustainability:theory, evidence and practice. pp. 114-134. Cheltenham: Edward Elgar.

71. Costa Jordao T., Jordao Filho W., and Quartey, E. (2011). A framework of governance for sustainable development facing climate change in the Caribbean Small Island Developing States: the case of Guanaja island in Honduras. Environmental Economics Policy and International Relations. 13th International Conference of Postgraduate Students, Young Scientists and Researchers. Prague: University of Economics in Prague, pp. 66-80. ISBN: 978-80-86709-17-8

72. Costello, A. B., Osborne, J. W. (2011). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. Pract Assess Res Eval 2005; 10. URL http://pareonline. net/getvn. asp, 10, 7.

73. Creswell, J .w., Plano Clark, V. L. (2011). Designing and conducting mixed method research (2nd ed.). Thousand Oaks, CA: Sage

74. Creswell J. w., Garrett, A.L., (2008). The "movement" of mixed methods research and the role of educators, South African Journal of Education, Vol 28:321-333

75. Creswell, J. W. (2013). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

76. Creswell, J. W., Clark, V. L. P. (2007). Designing and conducting mixed methods research.

77. Creswell, John W. (2008). Research design: Qualitative, quantitative, and mixed methods approaches. Thousand Oaks: Sage.

78. Croxton, Frederick Emory; Cowden, Dudley Johnstone; Klein, Sidney (1968). Applied General Statistics, Pitman. ISBN 9780273403159 (page 625)

79. Crozet, P. Y., Lopez-Ruiz, H. G. (2013). Macro motives and micro behaviors: Climate change constraints and passenger mobility scenarios for France. Transport Policy, 29, 294-302.

80. D. Loorbach (2007). Transition Management: New mode of governance for sustainable development, International Books, Utrecht, the Netherlands.

81. Da Silva, A. N. R., Da Silva Costa, M., & Macedo, M. H. (2008). Multiple views of sustainable urban mobility: The case of Brazil. Transport Policy,15(6), 350-360.

82. Dalkmann, H., & Brannigan, C. (2007). Transport and Climate Change. Module 5e. Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities. Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ).

83. Dansero E., Bagliani M., (2011), Politiche per l'ambiente. Dalla natura al territorio, Torino, UTET, (seconda edizione) [N.B. limitatamente ai capitoli 1, 3, 5]

84. Davis, K (1945). "The world demographic transition cited by: Rotmans et al (2001) "More Evolution than Revolution: Transition Management in Public Policy". Annals of the American Academy of Political and Social Science 237 (4): 1–11

85. De Haan, J. H., Rotmans, J. (2011). Patterns in transitions: understanding complex chains of change. Technological Forecasting and Social Change, 78(1), 90-102.

86. De Santis, F., Allegrini, I. (1992). Heterogeneous reactions of SO2 and NO2 on carbonaceous surfaces. Atmospheric Environment. Part A. General Topics, 26(16), 3061-3064.

87. De Vaus, D. (2013). Surveys in social research. (6th ed.). Routledge.

88. Demerse, C., Drummond, D., and Bramley, M. J. (2008). Choosing greenhouse gas emission reduction policies in Canada. Pembina Institute.

89. Dhar, S., Shukla, P. R. (2015). Low carbon scenarios for transport in India: co-benefits analysis. Energy Policy, 81, 186-198.

90. DiCicco-Bloom, B., Crabtree, B. F. (2006). The qualitative research interview. Medical education, 40(4), 314-321.

91. Dietrich, Cornelius Frank (1991). Uncertainty, Calibration and Probability: The Statistics of Scientific and Industrial Measurement 2nd Edition, A. Higler. ISBN 9780750300605 (Page 331)

92. Dimitrov, P. (2004). Overview of the environmental and health effects of urban transport in the Russian Federation and the other countries in Eastern Europe, the Caucasus and central Asia. In Report presented on behalf of the WHO, UNECE, and PEP, at the Conference on Implementing Sustainable Urban Travel Policies in Russia and Other CIS Countries (Vol. 30)

93. Dodge, Y. (2003). The Oxford Dictionary of Statistical Terms. OUP. ISBN 0-19-920613-9

94. Dodman, D. (2009). Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories. Environment and Urbanization, 21(1), 185-201.

95. Droege, P. (2008). Urban energy transition: from fossil fuels to renewable power. Elsevier.

96. Ducan, O.D., (1996). Path analysis: sociological examples. American Journal of Sociology, 72 (1), 1–16.

97. Durrant, R. A. (2014). Civil society roles in transition: towards sustainable food? Doctoral dissertation, University of Sussex.

98. EEA (European Environmental Agency), (2014). Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014. Retrieved from http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014

99. EEA., (2009). Greenhouse gas emission trends and projections in Europe 2009: Tracking progress towards Kyoto targets". Report No 9/2009. European Environment Agency

100. Elkington, J. (2004). Enter the triple bottom line. The triple bottom line: Does it all add up, 11(12), 1-16.

101. Elzen, B. (2003). The eve of transition. In Themes and challenges to understand and induce transitions, Paper for the Open Meeting of the Human Dimensions of Global Environmental Change Research Community, Montreal, Canada.

102. Elzen, B., Geels, F. W., Green, K. (Eds.). (2004). System innovation and the transition to sustainability: theory, evidence and policy. Edward Elgar Publishing.

103. Elzen, B., Geels, F. W., Hofman, P. S. (2002). Sociotechnical Scenarios (STSc): Development and evaluation of a new methodology to explore transitions towards a sustainable energy supply. University of Twente: Centre for Studies of Science, Technology and Society. Enschede

104. Elzen, B., Geels, F.W., Leeuwis, C.S., Van Mierlo, B., (2011). Normative contestation in transitions 'in the making': animal welfare concerns and system innovation in pig husbandry (1970–2008). Research Policy 40, 263–275.

105. Emilia, R. Italy, (2011). BiciBus–an Innovative Alternative to the Car. Reggio Emilia. downloadable at www.epomm.eu

106. EPOMM. (2010). Definition of mobility management [Online]. European Platform on Mobility Management. Available: http://www.epomm.eu/index.phtml?Main_ID=820

107. EU INNOVA, (2011). The newsletter of the Europe INNOVA initiative. Year 6 - Issue 24 - December 2011. Available at: www.europe-innova.eu

108. Euro-cases (1998).Mobility, Transport and Traffic, in the perspective of Growth, Competitiveness and Employment, The European Council of the Applied Sciences and Engineering. Available at http://www.euro-case.org/ , accessed in 05.01.07

109. European Climate Foundation. (2009). Low Carbon Growth Plans: Advancing Good Practice. Climate Works Foundation.

110. European Commission (2007). Freight Transport Logistics Action Plan, COM(2007) 607 final, Brussels.

111. European Commission, (2010). How to develop a Sustainable Energy Action Plan (SEAP) – Guidebook, Luxembourg: Publications Office of the European Union.

112. European Commission, (2011). White Paper, Roadmap to a Single European Transport Area, Towards a competitive and resource efficient transport system, COM(2011) 144 final, Brussels.

113. European commission, (2012). towards low carbon transport in Europe, ISBN: 978-92-79-23255-8, doi:10.2832/7573

114. European Conference of Ministers of Transport-ECMT. (2002a) implementing Sustainable Urban Travel Policies. Final Report. OECD, Paris

115. European Conference of Ministers of Transport-ECMT. (2002b) Implementing Sustainable Urban Travel Policies: Applying the (2001) Key Messages. OECD, Paris

116. European Environmental Agency-EEA. (2014). Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014. Retrieved from http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014

117. European Federation for Transport and Environment (T&E). (2007). Reducing CO2 emissions from new cars, a study of major car manufacturers' progress in (2006). Brussels: T&E (European Federation for Transport and Environment)

118. European Platform on Mobility Management (2013). Mobility management: The smart way to sustainable mobility in European countries, regions and cities. Brussels

119. Falvo, M. C., Lamedica, R., Bartoni, R., Maranzano, G. (2011). Energy management in metro-transit systems: An innovative proposal toward an integrated and sustainable urban mobility system including plug-in electric vehicles. Electric Power Systems Research, 81(12), 2127-2138.

120. Farla, J., J. Markard, R. Raven, L. Coenen. (2012). Sustainability transitions in the making: a closer look at actors, strategies and resources. Technological Forecasting and Social Change 79:991-998. http://dx.doi.org/10.1016/j.techfore.2012.02.001

121. Fay, M. P., Proschan MA. (2010). "Wilcoxon–Mann–Whitney or t-test? On assumptions for hypothesis tests and multiple interpretations of decision rules". Statistics Surveys 4: 1–39. doi:10.1214/09-SS051.

122. Floricel, S., Michela, J., George, M. (2009). Resource feedbacks for continuous innovation: the articulation of firm, university and government roles. In Copenhagen, Dinamarca, Summer Conference, Copenhagen Business School (CBS).

123. Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K. A., Flynn, E. J. (1990). Empirical research methods in operations management. Journal of operations management, 9(2), 250-284.

124. Foxon, T. J., Hammond, G. P., Pearson, P. J. (2010). Developing transition pathways for a low carbon electricity system in the UK. Technological Forecasting and Social Change, 77(8), 1203-1213.

125. Frantzeskaki, N., Loorbach, D., Meadowcraft, J., (2012), Governing transitions to sustainability: Transition management as a governance approach towards pursuing sustainability, International Journal of Sustainable Development, 2012 Vol 15 Nos ½

126. Freeman, C., Louca, F., (2001). As Time Goes By: From the Industrial Revolutions to the Information Revolution. Oxford University ˇPress, Oxford.

127. Freund, P., Martin, G. (2000). Driving south: the globalization of auto consumption and its social organization of space. Capitalism Nature Socialism, 11(4), 51-71.

128. Gargiulo, C. (2011). Urban Quality vs single travel: the Personal Rapid Transit. Tema. Journal of Land Use, Mobility and Environment, 3.

129. Garson, G. D. (2008). Path analysis. from Statnotes: Topics in multivariate analysis. Retrieved, 9(05), 2009. Available at: http://hbanaszak.mjr.uw.edu.pl/TempTxt/Garson_2008_PathAnalysis.pdf

130. Geels, F. W. (2012). A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. Journal of Transport Geography, 24, 471-482.

131. Geels, F. W. (2014). Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective. Theory, Culture & Society, 0263276414531627.

132. Geels, F. W., Schot, J. (2007). Typology of sociotechnical transition pathways. Research policy, 36(3), 399-417.

133. Geels, F. W., Schot, J. (2010) The dynamics of transitions: a socio-technical perspective. In: Grin, John,Rotmans, Jan and Schot, Johan (eds.) Transitions to sustainable development: new directions in the study of long term transformative change. Routledge, pp. 11-104. ISBN 9780415876759

134. Geels, F., (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms, Environmental Innovation and Societal Transitions 1 (2011) 24–40

135. Geels, F., Hekkert, M., Jacobsson, S. (2008). The dynamics of sustainable innovation journeys. Technology Analysis and Strategic Management, 20(5), 521-536.

136. Geels, F.W., (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy 31 (8– 9), 1257–1274.

137. Geels, F.W., (2004). From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory. Research Policy 33, 897–920

138. Geels, F.W., (2005). Processes and patterns in transitions and system innovations: refining the co-evolutionary multi-level perspective. Technological Forecasting & Social Change 72, 681–696.

139. Geels, F.W., (2005). Technological Transitions and System Innovations: A Co-Evolutionary and Socio-Technical Analysis. Edward Elgar, Cheltenham

140. Geels, F.W., (2005). The dynamics of transitions in socio-technical systems: a multilevel analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). Technology Analysis & Strategic Management 17 (4), 445–476.

141. Geels, F.W., (2007). Transformations of large technical systems: a multi-level analysis of the Dutch highway system (1950–2000). Science Technology & Human Values 32 (2), 123–149.

142. Geels, F.W., (2015). Deliverable D2.2: Analysis of stability and tensions in incumbent socio-technical regimes. PATHWAYS project. http://www.pathways-project.eu/output The study is partly funded by the Academy of Finland, grant number 286230

143. Geels, F.W., Kemp, R., Dudley, G., Lyons F. G. (2011). Auto mobility in Transition? A Socio-Technical Analysis of SustainableTransport. Routledge, New York

144. Geels, F.W., Schot, J.W., (2007). Typology of sociotechnical transition pathways. Research Policy 36 (3), 399–417.

145. Geerlings H., Shiftan Y., Stead D., (2012) 'Transition towards Sustainable Mobility: theRole of Instruments, Individuals and Institutions',Ashgate, Farnham

146. Geertz, Clifford (1973). The interpretation of cultures. New York: Basic Books.

147. Genus, A., Coles, A. M. (2007). A critique of Geels' multi-level perspective of technological transition. ponenciapresentadaen la International Summer Academy on Technology Studies, Graz.

148. GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) (2011): Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I), Division 44 Water, Energy, Transport. Eschborn: Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH. http://www.sutp.org/index.php/furtherdownloads/category/125-english-factsheets?download=565:factsheet-sustainable-urban-transport-avoidshift-improve-a-s-i

149. Goldman, T., Gorham, R. (2006). Sustainable urban transport: Four innovative directions. Technology in society, 28(1), 261-273.

150. Gori S., Nigro M., Petrelli M. (2012). The Impact of Land Use characteristics for Sustainable Mobility: the case study of Rome, European Transport Research Review (2012), pp. 1–14

151. Gorsuch, R. L. (1997). Exploratory factor analysis: Its role in item analysis. Journal of personality assessment, 68(3), 532-560.

152. Graugaard, J. D. (2014). "Transforming Sustainabilities: Grassroots Narratives in an Age of Transition. An Ethnography of the Dark Mountain Project." PhD diss., University of East Anglia.

153. Green, J. L., Camilli, G., & Elmore, P. B. (2012). Handbook of complementary methods in education research. Routledge.

154. Greene, R., Devillers, R., Luther, J.E. and Eddy, B.G. (2011). GIS-based multiple-criteria decision analysis. Geography Compass 5/6, 412-432.

155. Grin, J., Rotmans, J., Schot, J. (2010). Transitions to sustainable development: New directions in the study of long term transformative change. Routledge.

156. Grin, J., Rotmans, J., Schot, J. (2011). On patterns and agency in transition dynamics. Environmental Innovation and Societal Transitions, 1: 76-81

157. Gronau W., Kagermeier A. (2004). Mobility Management outside metropolitan areas: case study evidence from North Rhine-Westphalia, Journal of Transport Geography Vol. 12/4 pp. 315 - 322

158. Gross, R., Heptonstall, P., Anable, J., et al., (2009). What Policies Are Effective at Reducing Carbon Emissions from Surface Passenger Transport? A Review of Interventions to Encourage Behavioral and Technological Change. Report for UKERC, March. UKERC Technology and Policy Assessment.

159. Gudmundsson, H., & Höjer, M. (1996). Sustainable development principles and their implications for transport. Ecological Economics, 19(3), 269-282.

160. Gudmundsson, H., Hall, R. P., Marsden, G., Zietsman, J. (2016). Transportation and Sustainability. In Sustainable Transportation (pp. 81-109). Springer Berlin Heidelberg.

161. Gudmundsson, H., Schippl, J., Leiren, M. D., Sørensen, C. H., Brand, R., Anderton, K., Reichenbach, M. (2015). A roadmap for the EU White Paper goal on Urban Transport. In C. A. Brebbia, and J. L. Mirallesi Garcia (Eds.), Urban Transport XXI. (pp. 53-64). WIT Press

162. Habib Pour, K., & Safari, R. (2009). Comprehensive guidance of SPSS application in survey (analysis of quantitative data). Motafakeran publication. 5thed.

163. Habitat, U. N. (2011). Cities and climate change: Global report on human settlements 2011. London, Royaume-Uni, Etats-Unis: UN-Habitat.

164. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., Tatham, R. L. (2006). Multivariate data analysis (Vol. 6). Upper Saddle River, NJ: Pearson Prentice Hall.

165. Hall, A., Clark, N. (2010). What do complex adaptive systems look like and what are the implications for innovation policy? Journal of International Development, 22 , 308–324.

166. Hartwick, J. M. (1977). Intergenerational equity and the investing of rents from exhaustible resources. The american economic review, 67(5), 972-974

167. Hayashi, Y., Doi, K., Yagishita, M., Kuwata, M. (2004). Urban transport sustainability: Asian trends, problems and policy practices. European Journal of Transport and Infrastructure Research, 4(1), 27-45.

168. Henson, R. K., Roberts, J. K. (2006). Use of exploratory factor analysis in published research common errors and some comment on improved practice. Educational and Psychological measurement, 66(3), 393-416.

169. Hickman, R., Ashiru, O., Banister, D. (2010). Transport and climate change: Simulating the options for carbon reduction in London. Transport Policy, 17(2), 110-125.

170. Hillman, K. M., Sanden, B. A. (2008). Time and scale in Life Cycle Assessment: the case of fuel choice in the transport sector. International journal of alternative propulsion, 2(1), 1-12.

171. Hillman, K., Nilsson, M., Rickne, A., Magnusson, T. (2011). Fostering sustainable technologies: a framework for analyzing the governance of innovation systems. Science and Public Policy, 38(5), 403-415.

172. Hiscock R., Macintyre S., Kearns A., Ellaway A. (2002) Means of transport and ontological security: do cars provide psycho-social benefits to their users? Transp. Res. D Transl. Environ. Vol 7. Page 119–135.

173. Hodson, M, Geels F.W., McMeekin A., (2015) Regime analysis of the UK land-based passenger mobility system "PATHWAYS project".

174. Hodson, M., Marvin, S. (2010). Can cities shape socio-technical transitions and how would we know if they were? Research policy. 39(4), 477-485.

175. Hofman, P., B. Elzen (2010), "Exploring system innovation in the electricity system through sociotechnical scenarios", Technology Analysis & Strategic Management 22:6, 653-670.

176. Howell, K. E. (2013). Introduction to the Philosophy of Methodology. London: Sage Publications

177. Huang, W. M., Lee, G. W. (2009). Feasibility analysis of GHG reduction target: Lessons from Taiwan's energy policy. Renewable and Sustainable Energy Reviews, 13(9), 2621-2628.

178. Huber, G. P., Power, D. J. (1985). Research notes and communications retrospective reports of strategic-level managers: Guidelines for increasing their accuracy. Strategic Management Journal (pre-1986), 6(2), 171.

179. Hughes, N. (2009). TRANSITION PATHWAYS TO A LOW CARBON ECONOMY. Working Paper of the UKERC and the EON.UK/EPSRC Transition Pathways Project

180. ICLEI. (2012). Local Sustainability: Taking stock and moving forward. Bonn: ICLEI.

181. IEA. (2010). Key World Energy Statistics. OECD/IEA, Paris 2010.

182. Indermuhle, A., E. Monnin, B. Stauffer, T.F. Stocker, M. Wahlen, (1999), Atmospheric CO2 concentration from 60 to 20 kyr BP from the Taylor Dome ice core, Antarctica. Geophysical Research Letters, 27, 735-738.

183. Ingram, G. K., Liu, Z. (1997). Motorization and road provision in countries and cities. World Bank Policy Research Paper, (1842).

184. Instituto superiore per la protezione e la ricerca ambientale-ISPRA, (2014), Italian greenhouse gas inventory 1990-2012, available at: www.isprambiente.gov.it/files/pubblicazioni/.../Rapporto_198_2014.pdf

185. Invernizzi G., Ruprecht A., Mazza R., De Marco C., Mocnik G., Sioutas C., Westerdahl D., (2011). Measurement of Black Carbon concentration as an indicator of air quality benefits of traffic restriction policies within the ecopass zone in Milan, Italy. Atmospheric Environment; Vol 45, pp:3522-27.

186. IPCC, (2013): Climate Change (2013): The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp

187. IPCC, (2014), Final draft report of Working Group III contribution to the IPCC 5th Assessment Report " Climate Change (2014) Mitigation of Climate Change".

188. Isaac, S., Michael, W. B. (1997). Handbook in research and evaluation.3rd ed. California: Educational and Industrial Testing Services.

189. Isaksson, K., Richardson, T. (2009). Building legitimacy for risky policies: the cost of avoiding conflict in Stockholm. Transportation Research Part A, 43A, 251-257.

190. Isfort, (2006). Osservatorio sulle Politiche per la Mobilità Urbana Sostenibile, Gli strumenti per la programmazione, Rapporti Periodici, N. 5, Roma

191. ISTAT. (2010) Istituto Italiano di Statistica, Available at: http://www.istat.it

192. Istituto Superiore per la Protezione e la Ricerca Ambientale-ISPRA. (2012). Program ReMo. National Monitoring Network on Soil Biodiversity and land Degradation. Quaderni Natura e Biodiversità 4/2012, ISBN: 978-88-448-0570-8. Available [in Italian], as of Jan. 28, 2014 at www.isprambiente.gov.it/en/publications/booklets/nature-and-biodiversity/programre-mo.-national-network-on-soil-biodiversity-and-land-degradation?set_language=en

193. Istituto Superiore per la Protezione e la Ricerca Ambientale-ISPRA. (2013). "Rapporto Rifiuti", 2013.

194. Jacobs, Michael. (1991). The Green Economy: Environment, Sustainable Development and the Politics of the Future. London: Pluto Press.

195. Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. Administrative science quarterly, Vol. 24, No. 4, Qualitative Methodology, pp. 602-611, DOI: 10.2307/2392366, Stable URL: http://www.jstor.org/stable/2392366

196. John Elkington (1997). Cannibals with Forks: The Triple Bottom Line of Twenty-First Century Business. Capstone, Oxford.

197. Jones, I. (2014). Research methods for sports studies. Routledge.

198. Kaiser, H. F. (1970). A second generation little jiffy. Psychometrika, 35(4), 401-415.

199. Keeling, C. D. (1960). The concentration and isotopic abundances of carbon dioxide in the atmosphere. Tellus, 12(2), 200-203.

200. Kemp, R. (1994). "Technology and the transition to environmental sustainability. Theproblem of technological regime shifts." Futures 26(10): 1023-1046.

201. Kemp, R. (2009). 'Eco-innovations and transitions, Economia delle fonti di energia e dell'ambiente (Special issue on 'Heterodoxenvironmentaleconomics'), 52 (1), pp. 103-124.

202. Kemp, R., D. Loorbach. (2006). Transition management: a reflexive governance approach. Pages 103–130 in J.-P. Voß, D. Bauknecht, and R. Kemp, editors. Reflexive governance for sustainable development. Edward Elgar, Cheltenham, UK.

203. Kemp, R., Geels W.F., Dudley G., (2011). Introduction: Sustainability Transitions in the Automobility Regime and the Need for a New Perspective. In: Geels, F. W., Kemp, R., Dudley, G. & Lyons, G. (eds.) Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport, Routledge, pp. 3-28.

204. Kemp, R., Loorbach, D., Rotmans, J. (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. The International Journal of Sustainable Development & World Ecology, 14(1), 78-91.

205. Kemp, R., Rip, A. Schot, J. (2001), Constructing Transition Paths through the Management of Niches, in Raghu Garud and Peter Karnoe (eds.), Path Creation and Dependence, Lawrence Erlbaum: Mahwah

206. Kemp, R., Schot, J., Hoogma, R., (1998). Regime shifts to sustainability through processes of niche formation: the approach ofstrategic niche management. Technology Analysis and Strategic Management 10, 175–196.

207. Kendall, M. G. (1955) "Rank Correlation Methods", Charles Griffin and Co.

208. Kent, J. L. and R. Dowling (2013). 'Puncturing automobility? Carsharing practices' Journal of Transport Geography 32, 86-92.

209. Kern, F. (2012). Using the multi-level perspective on socio-technical transitions to assess innovation policy. Technological Forecasting and Social Change, 79(2), 298-310.

210. Kim, A. (2015). Helmholtz International Research School for Teratronics-PhD Program.

211. Kirby, R, Tagell, M, Ogden, K (1986) Traffic management in Metro Manila, Part I: Formulating traffic policies, Traffic Engineering and Control, vol. 27, pp. 262-269.

212. Köhler, J., Whitmarsh, L., Nykvist, B., Schilperoord, M., Bergman, N., Haxeltine, A. 2009. A transitions model for sustainable mobility, Ecological Economics 68, pp. 2985-2995.

213. Kommission Europäische Gemeinschaften. (2001). White paper-European transport policy for 2010: time to decide. Office for Official Publications of the European Communities.

214. KpVV, (2012). Kennisplatform Verkeer en Vervoer – the Dutch Knowledge Platform on Transport and Traffic

215. Kuzel A. Sampling in qualitative inquiry. In: Crabtree B, Miller W, eds. (1999), Doing Qualitative Research. 2nd edn. Thousand Oaks, California: Sage 1999;33–45

216. La Rocca, R.A. (2011) "Mobilità sostenibile e stili di vita", TeMA Journal of Land Use Mobility and Environment, vol 4 n. 2 (2011) Green Mobility, DICEA – Università degli Studi di Napoli Federico II, http://www.tema.unina.it

217. Lachman, D. A. (2013). A survey and review of approaches to study transitions. Energy Policy, 58, 269-276.

218. Laes, E., Gorissen, L., Nevens, F. (2014). A comparison of energy transition governance in Germany, the Netherlands and the United Kingdom. Sustainability, 6(3), 1129-1152.

219. Langeland, A. (2009). The Quest after Environmentally Sustainable Transport Development: A study of Land Use and Transport Planning in 4 cities in 4 countries. Aalborg University.

220. lawrenceerlbaum associates, (2013), empirical research, Pennsylvania state university,

221. Lee, J., Hine, J. L. (2008). Preparing a National Transport Strategy: Suggestions for Government Agencies in Developing Countries.

222. Legambiente, (2010), Comuni Ricicloni, Editoriale la Nuova Ecologia Soc. Coop

223. Lempert, R., Scheffran, J., Sprinz, D. F. (2009). Methods for long-term environmental policy challenges. Global Environmental Politics, 9(3), 106-133.

224. Libertini, G. (2014). Project for powerful wind power plants with vertical axis of rotation: VertEolo Project. Copernican editions.

225. Lichtman, M. (2012). Qualitative Research in Education: A User's Guide: A User's Guide. (chapter 12) Sage.

226. Lincoln YS, Guba EG. (1985). Naturalistic inquiry. Beverly Hills, CA: Sage.

227. Litman T. (2005), Well measured – Developing Indicators for Comprehensive and Sustainable Transport Planning, Victoria Transport Policy Institute, Victoria, Canada

228. Litman T., (1998). Measuring Transportation: Traffic, Mobility and Accessibility. Victoria Transport Policy Institute

229. Litman, T. (2011). Well measured. Developing indicators for comprehensive and sustainable transport planning. Victoria Transport Policy Institute.

230. Litman, T. (2013). Understanding transport demands and elasticities. How prices and other factors affect travel behavior.(Victoria Transport Policy Institute: Litman) Available at http://www. vtpi. org/elasticities. pdf [Verified 22 November 2013].

231. Litman, T., (2015). Well Measured Developing Indicators for Sustainable and Livable Transport Planning. Victoria Transport Policy Institute.

232. Loorbach (2004). A multi-level framework for transition management. SEEON

233. Loorbach, D. (2010). Transition governance for a Low Carbon Society. Presentation on the occasion of the 2nd Annual Meeting of the Low Carbon Society Research Network (LCS RNet), 21st of September 2010.

234. Loorbach, D. (2010). Transition Management for Sustainable Development: A Prescriptive, Com plexityBased Governance Framework. In: Governance: An International Journal of Policy, Administration and Institutions, 23 (1): 161–183. doi:10.1111/j.1468-0491.2009.01471.x

235. Loorbach, Derk (2007). Transition Management: New mode of governance for sustainable development. Utrecht, Netherlands: International Books.

236. López Lambas, M. E., Corazza, M. V., Monzón de Cáceres, A., Musso, A. (2013). Rebalancing urban mobility: a tale of four cities. Urban Design and Planning-Proceedings of the ICE, 166(5), 274-287.

237. Lundqvist, L.J., Biel, A., (2007) From Kyoto to the Town Hall: Transforming National Strategies into Local and Individual Action, in Lund qvist, L.J., Biel, A. (Eds.), From Kyoto to the town hall: making international and national climate policy work at the local level, London: Earth scan.

238. Luthi, D., M. Le Floch, B. Bereiter, T. Blunier, J.-M. Barnola, U. Siegenthaler, D. Raynaud, J. Jouzel, H. Fischer, K. Kawamura, and T.F. Stocker. (2008).High-resolution carbon dioxide concentration record 650,000-800,000 years before present. Nature, Vol. 453, pp. 379-382, 15 May 2008. doi:10.1038/nature06949

239. Mackett, R. L., Robertson, S. A. (2000). Potential for mode transfer of short trips: review of existing data and literature sources.

240. Mah, D. N. Y., van der Vleuten, J. M., Ip, J. C. M., Hills, P. R. (2012). Governing the transition of socio-technical systems: A case study of the development of smart grids in Korea. Energy Policy, 45, 133-141.

241. Mahdavi Damghani B. (2013). "The Non-Misleading Value of Inferred Correlation: An Introduction to the Cointelation Model". Wilmott Magazine.doi:10.1002/wilm.10252

242. Mäkinen, K., Kivimaa, P., Helminen, V. (2015). Path creation for urban mobility transitions: Linking aspects of urban form to transport policy analysis. Management of Environmental Quality: An International Journal,26(4), 485-504.

243. Malik, A., Grohmann, E., & Akhtar, R. (2013). Environmental Deterioration and Human Health: Natural and Anthropogenic Determinants. Springer Science & Business Media.

244. Mameli, F., Marletto, G. (2009). A selection of indicators for monitoring sustainable urban mobility policies. Trasporti, ambiente e territorio. La ricerca di un nuovoequilibrio. Franco Angeli, Milano, 167-174.

245. Mansourfar K., (2006), Advanced Statistical Analysis Methods with Computer Software, Tehran, University of Tehran publication

246. Manyasi, J. N., Kibas, P. B., Chepkilot, R. (2012). Effects of organizational support for career development on employee performance: A case of Kenyan Public Universities.

247. Marchetti, G. (2010). Italian Regions and Local Authorities within the framework of a new Autonomist System. Perspectives on Federalism, 2(1), 89-121.

248. Marletto, G. (2013). Car and the city: Socio-technical pathways to 2030 (No. 201306). Centre for North South Economic Research, University of Cagliari and Sassari, Sardinia.

249. Marletto, G. (2014). Car and the city: Socio-technical transition pathways to 2030. Technological Forecasting and Social Change, 87, 164-178.

250. McCormick, K., Anderberg, S., Coenen, L., Neij, L. (2013). Advancing sustainable urban transformation. Journal of Cleaner Production, 50, 1-11.

251. McLean, A., Bulkeley, H., Crang, M. (2015). Negotiating the urban smart grid: Socio-technical experimentation in the city of Austin. Urban Studies, 0042098015612984.

252. Meadowcroft, J. (2009). "What about the politics? Sustainable development, transition management, and long term energy transitions". Policy Science (42): 323–340.

253. Merton R, Fiske M, Kendall P. (1956). The Focused Interview: a Manual of Problems and Procedures. Glencoe, Illinois: Free Press 1956.

254. Miles, M. B., Huberman, A. M. (1994). Qualitative data analysis: An expanded source book (2nd ed.). Newbury Park, CA: Sage.

255. Ministry for the Environment, Land and Sea, (2009) Fifth National Communication under the UN Framework Convention on Climate Change Italy, Nov, (2009), available at: http://unfccc.int/resource/docs/natc/ita_nc5.pdf

256. Mogridge, M. C. (1992). Jakarta transport network-planning and regulation project. 1: mass transit system proposals. Traffic engineering, control, 33(10).

257. Mogridge, M. J. (1997). The self-defeating nature of urban road capacity policy: A review of theories, disputes and available evidence. Transport Policy, 4(1), 5-23.

258. Mogridge, M. J. H. (1983): The Car Market. Pion, London.

259. Moloney, S. Horne, R E. Fien J. (2010). "Transitioning to Low Carbon Communities – From Behaviour Change to Systemic Change: Lessons from Australia", Energy Policy Dec. Vol. 38, Issue 12, p. 7614-7623

260. Monnin, E., A. Indermuhle, A. Dallenbach, J. Fluckiger, B. Stauffer, T.F. Stocker, D. Raynaud, and J.-M. Barnola. (2001). Atmospheric CO2 concentrations over the last glacial termination. Science, Vol. 291, pp. 112-114.

261. Monteiro, C. A., Teixeira, A. (2006). Local Sustainable Mobility Management: Are Portuguese Municipalities Aware? Faculdade de Economia, Universidade do Porto.

262. Morgan D. (1997). Focus Groups as Qualitative Research. 2nd edn. Newbury Park, California: Sage.

263. Morrison, G. M., Rauch, S., Rauch, S. (Eds.). (2007). Highway and Urban Environment: Proceedings of the 8th Highway and Urban Environment Symposium (Vol. 12). Springer Science & Business Media.

264. Murphy, J., and Smith, A. (2013) Understanding transition-periphery dynamics: renewable energy in the Highlands and Islands of Scotland. Environment and Planning A, Vol 45 (3). pp. 691-709. ISSN 0308-518X 278X

265. Murphy, K. R., Davidshofer, C. O. (1988). Psychological testing. Principles, and Applications, Englewood Cliffs.

266. Nakamura, Hiroko, Yuya Kajikawa, Shinji Suzuki, (2013). 'Multi-Level Perspectives with Technology Readiness Measures for Aviation Innovation', Sustainability Science Vol. 8, 87-101.

267. Nakamura, K., Hayashi, Y., (2012). Strategies and instruments for low-carbon urban transport: an international review on trends and effects.

268. Nash, C., Bray, D. (2014). "Workshop 5 Report: The Roles and Responsibilities of Government and Operators." Research in Transportation Economics, 48: 286-289.

269. Neftel, A., Moor, E., Oeschger, H., Stauffer, B. (1985). Evidence from polar ice cores for the increase in atmospheric C02 in the past two centuries.

270. Nelson, R.R., winter, S.G., (1982). An Evolutionary Theory of Economic Change. Belknap, NJ and London, 269-299.

271. Nicolas J.P., Pochet P., H. Poimboeuf (2003), "Towards Sustainable Mobility Indicators: Application To The Lyons Conurbation," Transport Policy, Vol. 10, pp. 197-208

272. Nijkamp, P., Ouwersloot, H., Rienstra, S. A. (1997). Sustainable urban transport systems: an expert-based strategic scenario approach. Urban Studies, 34(4), 693-712.

273. Nijkamp, P., Pepping, G. (1998). A meta-analytical evaluation of sustainable city initiatives. Urban Studies, 35(9), 1481-1500.

274. Noble, H., Smith, J. (2015). Issues of validity and reliability in qualitative research. Evidence Based Nursing, 18(2), 34-35.Other:http://classroom.synonym.com/advantages-disadvantages-mixed-methodology-research-4263.html

275. Nykvist B, Whitmarsh L. (2008). A multi-level analysis of sustainable mobility transitions: niche development in the UK and Sweden. Technological Forecasting and Social Change 75: 1373–1387. DOI: 10.1016/j.techfore.2008.05.006

276. OECD G. (2011). Towards Green Growth: Monitoring Progress. OECD Indicators. Paris: OECD http://www.oecd.org/greengrowth/towardsgreengrowth.htm

277. OECD (2015), Aligning Policies for a Low-carbon Economy, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264233294-en

278. OECD, (2013). OECD (Organization for Economic Co-operation and Development) Environmental Performance Reviews: Italy, Paris.

279. OECD, O. (1999). Science, Technology and Industry Scoreboard, (1999).Benchmarking Knowledge-Based Economies, OECD: Paris.

280. OECD/ IEA, (2009). Emissions from Fuel Combustion. (2009) edition. Paris: OECD/IEA.

281. OECD/ IEA, (2010). Low Emission Development Strategies. OECD Publishing.

282. OECD/IEA, (2013).CO2 Emissions from Fuel Combustion (2013) Edition. OECD/IEA, Paris (2013).

283. OECD/IEA, (2014).CO2 emissions from fuel combustion, Report, OECD/IEA, Paris 2014.

284. OECD/ITF (2009), The Cost and Efficiency of Reducing Transport GHG Emissions — Preliminary Findings

285. OECD/ITF. (2010). Organization for Economic Cooperation and Development. International Transport Forum. Effective Transport Policies for Corporate Mobility Management. OECD Publishing

286. Owen S. (2001). The practical, methodological and ethical dilemmas of conducting focus groups with vulnerable clients. J AdvNurs 2001;28(2):345–52

287. P. Street, Scenario workshops: a participatory approach to sustainable urban living? Futures 29 (1997) 139–158.

288. Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., &Hoagwood, K. (2013). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Administration and Policy in Mental Health and Mental Health Services Research, 1-12.

289. Pan, J. (2012). Research on Green Transportation and Transfer System in Urban Areas. Europe, 4550(53.0), 15500.

290. Papa, E., Battarra, R. (2010). Urban mobility plans in Italy. TEMA, 3, 29-36.

291. Parliament, E. U., Council, E. U. (2012). Proposal for a Regulation on the protection of individuals with regard to the processing of personal data and on the free movement of such data COM (2012) 11 final, 2012/0011(COD).

292. Percoco, M. (2007). Urban transport policies and the environment: evidence from Italy.

293. Perez, C., (2002). Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages. Edward Elgar, Cheltenham.

294. Perretti, M. E. (2014). Urban Mobility in Italy: time to get going again. Rivista Italiana di Antitrust/Italian Antitrust Review, 1(2).

295. Pesch, U. (2014). Sustainable development and institutional boundaries. Journal of Integrative Environmental Sciences, 11(1), 39-54.Press, Cambridge, MA.

296. Petit, J. R., Jouzel, J., Raynaud, D., Barkov, N. I., Barnola, J.-M., Basile, I., Bender, M., Chappellaz, J., Davisk, M., Delaygue, G., Delmotte, M., Kotlyakov, V. M., Legrand, M., Lipenkov, V. Y., Lorius, C., Pèpin, L., Ritz, C., Saltzmank, E., and Stievenard, M., (1999), Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica: Nature, v. 399, p. 429-436.

297. Pojasek R., (2005). Research Methods: Some Notes to Orient You. Harvard University

298. Pye, S. et al. (2015). Pathways to deep de-carbonization in the United Kingdom, SDSN - IDDRI.

299. R. Kemp, J. Rotmans (2005). "The Management of the Coevolution of Technical, Environmental and Social Systems", in M. Weber and J. Hemmelskamp (eds.), Towards Environmental Innovation Systems, Springer Verlag, Berlin.

300. Rashid, A. M., Khan, M. R. (2013). Community based adaptation: Theory and practice. In Climate Change Adaptation Actions in Bangladesh (pp. 341-362). Springer Japan.

301. Raven, R., Van den Bosch, S., Weterings, R. (2010). Transitions and strategic niche management: towards a competence kit for practitioners.International Journal of Technology Management, 51(1), 57-74.

302. Raven, R. (2004). Implementation of manure digestion and co-combustion in the Dutch electricity regime: a multi-level Analysis of market implementation in the Netherlands. Energy Policy 32, 29–39.

303. Rietveld, P. (2000). Non-motorised modes in transport systems: a multimodal chain perspective for The Netherlands. Transportation Research Part D: Transport and Environment, 5(1), 31-36.

304. RIP, A. (1992). Introduction of New Technology: Making Use of Recent Insights from Sociology and Economics of.

305. Rip, A., Kemp, R., (1998). Technological change. In: Rayner, S., Malone, E.L. (Eds.), Human Choice and Climate Change, vol. 2.Battelle Press, Columbus, OH, pp. 327–399.

306. Rip, A., R. Kemp (1996), 'Towards a Theory of Socio-Technical Change', mimeo University of Twente, Enschede.

307. Rocco, T. S. R. T. S., Bliss, L. A. B. L. A., Gallagher, S. G. S., Pérez, A. P. A., Prado, P. (2003). Taking the next step: Mixed methods taking the next step: Mixed methods research in organizational systems research in organizational systems. Information Technology, Learning, and Performance Journal, 21(1), 19.

308. Rock M, J. T. Murphy, R. Rasiah, P. van Seters, S. Managi (2009). A hard slog, not a leapfrog: Globalisation and sustainability transitions in developing Asia, Technological Forecasting and Social Change, Vol 76(2)

309. Roodman D.M. (1998). The Natural Wealth of Nations WW Norton, London

310. Roseland, M. (1997). Dimensions of the eco-city. Cities, 14(4), 197-202.

311. Rossignoli, S., Coticchia, F., Mezzasalma, A. (2015). A critical friend: Monitoring and evaluation systems, development cooperation and local government. The case of Tuscany. Evaluation and program planning, 50, 63-76.

312. Rotmans, J. (2003). Transitiemanagement. Uitgeverij Van Gorcum.

313. Rotmans, J. (2005). Societal innovation: between dream and reality lies complexity. Rotterdam, ERIM.

314. Rotmans, J., D. Loorbach, R. Kemp. (2007). Transition management: its origin, evolution and critique. Workshop on Politics and governance in sustainable socio-technical transitions, 19–21 September2007. Berlin, Germany.

315. Rotmans, J., Kemp, R., Van Asselt, M., (2001). More evolution than revolution: transition management in public policy. Foresight 3 (1), 15–31.Routledge, London

316. Rotmans, J., Loorbach, D. (2009). Complexity and transition management.Journal of Industrial Ecology, 13(2), 184-196.

317. Rydin, Y. (2010). Governing for Sustainable Urban Development, London: Earthscan.

318. Saija S. et al. (2000) Le emissioni in atmosfera da trasporto stradale. I fattori di emissione medi per il parco circolantein Italia , Roma, Agenzia Nazionale per la Protezionedell' Ambiente

319. Santos G, Behrendt H, Teytelboym A. (2010). Part II: Policy instruments for sustainable road transport. Research in Transportation Economics 28: 46–91. DOI: 10.1016/j.retrec.2010.03.002

320. Sauer, T., Elsen, S., Garzillo, C. (2016). Cities in Transition: Social Innovation for Europe's Urban Sustainability. Routledge.

321. Schafer, A., Victor, D. G. (2000). The future mobility of the world population. Transportation Research Part A: Policy and Practice, 34(3), 171-205.

322. Scheffer, M., Brovkin, V., Cox, P. M. (2006). Positive feedback between global warming and atmospheric CO2 concentration inferred from past climate change. Geophysical Research Letters, 33(10).

323. Schot, J.W., Geels, F.W., (2008). Strategic niche management and sustainable innovation journeys: theory, findings, research agenda and policy. Technology Analysis and Strategic Management 20, 537–554

324. Schutt RK. (2012). Investigating the Social World. Seventh ed. Thousand Oaks, CA: SAGEPublications; 2012. Chapter 10: Qualitative Data Analysis; pp. 320–357.

325. Schwanen T, Banister D, Anable J. (2011). Scientific research about climate change mitigation in transport: a critical review. Transportation Research Part A: Policy and Practice 45: 993–1006. DOI: 10.1016/j.tra.2011.09.005

326. Schwanen, T., Banister, D., Anable, J., (2011). Scientific research about climate change mitigation in transport: a critical review. Transportation Research Part A 45 (10), 993–1006

327. Sforzi, F. (1997). I sistemi locali in Italia. ISTAT, Rome.

328. Shani, A.B., Grant, R. M., Krishnan, R. Thompson, E. (1992). Advanced Manufacturing Systems and Organizational Choice: Sociotechnical System Approach. California Management Review, 34 (4), 91-111.

329. Shaw, I. and Holland, S. (2014). Doing Qualitative Research in Social Work. London: Sage Publications.

330. Shell Annual Report (2012). Available at: http://reports.shell.com/ sustainability-report/2012/ourperformance/social.html

331. Shove, E., Walker, G. (2007). CAUTION! Transitions ahead: politics, practice, and sustainable transition management. Environment and Planning A, 39(4), 763-770.

332. Siegenthaler, U., T.F. Stocker, E. Monnin, D. Luthi, J. Schwander, B. Stauffer, D. Raynaud, J.-M. Barnola, H. Fischer, V. Masson-Delmotte, J. Jouzel. (2005). Stable Carbon Cycle-Climate Relationship During the Late Pleistocene.Science, v. 310 , pp. 1313-1317, 25 November 2005.

333. Silva, A. B., Ribeiro, A. (2009). An integrated planning for cities to promote sustainable mobility. In Proceedings of European Transport Conference.

334. Silvester, S., Beella, S. K., van Timmeren, A., Bauer, P., Quist, J., van Dijk, S. (2013). Exploring design scenarios for large-scale implementation of electric vehicles; the Amsterdam Airport Schiphol case. Journal of Cleaner Production, 48, 211-219.

335. Skippon, S., Veeraraghavan, S., Ma, H., Gadd, P., Tait, N. (2012). Combining technology development and behaviour change to meet CO 2 cumulative emission budgets for road transport: case studies for the USA and Europe. Transportation Research Part A: Policy and Practice, 46(9), 1405-1423.

336. Smith A., Raven R., (2012). “What is protective space? Reconsidering niches in transitions to sustainability,” Research Policy, vol. 41, no. 6, pp. 1025–1036.

337. Smith, A., (2007). Translating sustainability between green niches and socio-technical regimes. Technology Analysis & Strategic Management 19 (4), 427–450

338. Smith, A., and Stirling, A. (2008). Social-ecological resilience and socio-technical transitions: critical issues for sustainability governance.

339. Smith, A., Stirling, A., and Berkhout, F. (2005). The governance of sustainable socio-technical transitions. Research policy, 34 (10), 1491-1510.

340. Smith, A., Vob, J.P., and Grin, J., (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. Research Policy. 39 pp. 435-448

341. Solow, R. M. (1974). Intergenerational equity and exhaustible resources. The review of economic studies, 41, 29-45.

342. Somerville, R. C. (2011). How much should the public know about climate science?. Climatic Change, 104(3), 509-514.

343. Sorrell, S., Speirs, J. (2009). UKERC Review of Evidence for Global Oil Depletion. Technical Report 5: Methods of estimating ultimately recoverable resources.

344. Sowers T., Bender M., (1995). Climate Records Covering the Last DE glaciation. Science, 269:210–214.

345. Sperling, D., Gordon, D., (2009). Two Billion Cars: Driving Towards Sustainability. Oxford University Press, New York.

346. Spickermann, A., Grienitz, V., Heiko, A. (2014). Heading towards a multimodal city of the future?: Multi-stakeholder scenarios for urban mobility. Technological Forecasting and Social Change, 89, 201-221.

347. Spradley, J. P. (1979). The ethnographic interview. New York: Holt, Rinehart & Winston.

348. Sprinz, D. F. (2009). Liability for Climate Change - A Decentralized Approach to Long-Term Climate Policy. Potsdam, PIK - Potsdam Institute for Climate Impact Research.

349. Sprinz, D. F. (2009). Liability for Climate Change - A Decentralized Approach to Long-Term Climate Policy. Potsdam, PIK - Potsdam Institute for Climate Impact Research.

350. Steg, L. (2005). Car use: lust and must. Instrumental, symbolic and affective motives for car use. Transportation Research Part A: Policy and Practice, 39(2), 147-162.

351. Stern, N. (2006). The economics of climate change: the Stern review. Cambridge: Cambridge University Press, 2006.Sussex, UK.

352. Strauss, Anselm, Corbin, Juliet M. (1998). Basics of qualitative research. Thousand Oaks, CA: Sage.

353. Street P., (1997). Scenario workshops: a participatory approach to sustainable urban living? Futures 29. 139–158.

354. Sukhdev, P. (2009) Green Economy for an Urban Age. Proceedings of the Urban Age Conference, 4-6 November 2009, Istanbul, Turkey.

355. Swaffield, S. (1998). Frames of reference: a metaphor for analyzing and interpreting attitudes of environmental policy makers and policy influencers.Environmental Management, 22(4), 495-504.

356. Sykes, A. O. (1993). An introduction to regression analysis. Coase-Sandor Institute for Law & Economics Working Paper No. 20

357. Symonds, J. E., Gorard, S. (2008). The death of mixed methods: Research labels and their casualties. In British Educational Research Association (Ed.), BERA Annual Conference, Heriot Watt University, Edinburgh.

358. Tabachnick, B. G., Fidell, L. S., Osterlind, S. J. (2001). Using multivariate statistics. Boston: Pearson Education

359. Tashakkori, A., Creswel, J. W. (2007), [Editorial]: The New Era of Mixed Methods, Journal of Mixed Methods Research; 1; (1), 3 -7, DOI: 10.1177/2345678906293042

360. Tashakkori, A., Teddlie, C. (2003). Handbook of mixed methods in social and behavioral research. Thousands Oak, CA: Sage.

361. Taylor, M., Rubin, E. S., Nemet, G. F. (2006). The Role of Technological Innovation in Meeting California's Greenhouse Gas Emission Targets.

362. Teddlie, C., Tashakkori, A. (2009). Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences. Sage Publications Inc.

363. Thomas, (2010). Environmental policy and local government in Australia, Local Environment: The International Journal of Justice and Sustainability, Volume 15, Issue 2, 2010

364. Thompson, B. (2004). Exploratory and confirmatory factor analysis: Understanding concepts and applications. Washington, DC: American Psychological Association.

365. Thompson, M., Warburton, M. (1985). Knowing where to hit it: a conceptual framework for the sustainable development of the Himalaya. Mountain Research and Development, 203-220.

366. Thorson, O., Robusté, F. (1998). Walking and Cycling in City.

367. Todd Litman (2003), "Measuring Transportation: Traffic, Mobility and Accessibility," ITE Journal (www.ite.org), Vol. 73, No. 10, October, pp. 28-32, available at www.vtpi.org/measure.pdf.

368. Todd Litman (2005), "Efficient Vehicles Versus Efficient Transportation: Comparing Transportation Energy Conservation Strategies," Transport Policy, Volume 12, Issue 2, March 2005, Pages 121-129; at www.vtpi.org/cafe.pdf.

369. TRANSFORM, (2014). Low-Carbon Mobility Report As part of the Transform Program

370. Transforum, (2014). Challenges and barriers for a sustainable transport system – state of the art report

371. Trochim, W. M., Donnelly, J. P. (2001). Research methods knowledge base

372. TRT, (2009). Mobility Management, European Parliament, Directorate General for Internal Policies, Policy Department B: Structural and Cohesion Policies, Brussels.

373. Turnheim, B., Berkhout, F., Håkansson, I. (2015).Analysis of green niche-innovations and their momentum in the two pathways. PATHWAYS project. PATHWAYS, 2, 2.

374. UN. (2014). Introduction and proposed goals and targets on sustainable development for the post2015 development agenda,

http://sustainabledevelopment.un.org/content/documents/4044140602workingdocument.pdf

375. UNCSD. (2012). The future we want. Available at: http://www.un.org/disabilities/documents/rio20_outcome_document_complete.pdf

376. UNCTAD. (2010). promoting poles of clean growth to foster the transition to a more sustainable economy, United Nations Conference on Trade and Development.

377. UNDP. (2011). Preparing Low-Emission Climate- Resilient Development Strategies. United Nations Development Program.

378. UNEP (2011). Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, www.unep.org/greeneconomy

379. UNEP. (2011). Towards a Green Economy-Transport: Investing in energy and resource efficiency, Nairobi.

380. UN-Habitat, (2010). State of the World's Cities 2010/2011: Bridging the Urban Divide Earthscan, London (2010)

381. UNHABITAT. (2011). State of the World's Cities (2010/2011): Bridging the Urban Divide. Nairobi.

382. United Nations-UN. (2010). Sustainable Development: From Brundtland to Rio 2012, Background Paper* prepared for consideration by the High Level Panel on Global Sustainability at its first meeting, 19 September 2010 (accessed 5 February 2014). http://www.un.org/wcm/webdav/site/climatechange/shared/gsp/docs/GSP1-6_Background%20on%20Sustainable%20Devt.pdf

383. United Nations-UN (1992). Agenda 21 Earth Summit: United Nations program of action from Rio. New York:Author.

384. United Nations. (2014). World Urbanization Prospects 2014: Highlights. United Nations Publications.

385. Unruh, G.C, (2000). Understanding carbon lock-in. Energy Policy 28, 817–830.

386. USDOT. (2010). Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, vol. 1. Report to Congress. U.S. Department of Transportation. www.dot.gov at: www.dot.gov/affairs/2010/dot7510.htm

387. Van Bree, B., Verbong, G. P., Kramer, G. J. (2010). A multi-level perspective on the introduction of hydrogen and battery-electric vehicles. Technological Forecasting and Social Change, 77(4), 529-540.

388. Van de Poel, I. (2003). The transformation of technological regimes. Research policy, 32(1), 49-68.

389. Van den Bergh, J. C., Truffer, B., Kallis, G. (2011). Environmental innovation and societal transitions: Introduction and overview. Environmental innovation and societal transitions, 1(1), 1-23.

390. Van der Eerden, M. (2013). The role of transnational processes in the worldwide diffusion of Bus Rapid Transit systems. TU/e Innovation Sciences.

391. Van Driel, H., Schot, J.W., (2005). Radical innovation as a multi-level process: introducing floating grain elevators in the port of Rotterdam. Technology and Culture 46, 51–76

392. Van Staden, M., Marques, A., Villaseñor, E. (2014). Urban Low Emissions Development Strategies and Action Plans. Energy Procedia, 57, 840-849.

393. Velazquez Valoria, I. et al. (2013). Final evaluation report D10.3 Evaluation & Analysis, civitas arcimedes.

394. Verbong G., Loorbach D., (2012). Governing the Energy Transition: Reality, Illusion or Necessity?

395. Vergragt, Ph. J. (1988). The social shaping of industrial innovations, Social Studies of Science, 18, 483-513.

396. Vesperini, G. (2009). Le regioni e gli enti locali (a cura di G. Vesperini), in Il sistema amministrativo italiano, a cura di L. Torchia.

397. Victor, P. A. (1991). Indicators of sustainable development: some lessons from capital theory. Ecological economics, 4(3), 191-213.

398. Vieira J, Moura F, Viegas J. (2007). Transport policy and environmental impacts: the importance of multi-instrumentality in policy integration. Transport Policy 14: 421–432. DOI: 10.1016/j.tranpol.2007.04.007

399. Wajdi Dusuki, A., Irwani Abdullah, N. (2007). Why do Malaysian customers patronise Islamic banks?. International Journal of Bank Marketing, 25(3), 142-160.

400. Walnum, H. J., Aall, C., Løkke, S. (2014). Can rebound effects explain why sustainable mobility has not been achieved?. Sustainability, 6(12), 9510-9537.

401. Walzer, M. (1998). The concept of civil society. In Walzer, M. (Ed.). Toward a global civil society (pp. 7–28). New York: Berghahn Books

402. WBCSD. (2004). Mobility 2030: meeting the challenges to sustainability. Geneva: The Council.World business council for sustainable development.

403. WBCSD. (2010). Vision 2050: The new agenda for business, http://www.wbcsd.org/pages/edocument/edocumentdetails.aspx?id=219&nosearchcontextkey=true

404. WCED (1987). Our Common Future World Commission on Environment and Development, Oxford University Press, Oxford

405. WCED, (1987). Our common future. World Commission on Environment and Development, Oxford University Press.

406. Wheeler, S. and Beatley T. (Eds.), (2010). Sustainable Urban Development Reader, Routledge, New York (2010)

407. Wild River, S (2006), 'The role of local government in environmental and heritage management', article prepared for the (2006) Australia State of the Environment Committee, Department of Environment and Heritage, Canberra.

408. Wilhelm, A., Posch, K. H. (2003). Mobility management strategies for the next decades: findings and recommendations from largest European Mobility management project. Transportation Research Record: Journal of the Transportation Research Board, (1839), 173-181.

409. Williams, B., Brown, T., Onsman, A. (2012). Exploratory factor analysis: A five-step guide for novices. Australasian Journal of Paramedicine, 8(3), 1.

410. Wittmayer, J., Roorda, C., van Steenbergen, F. (2014). Governing urban sustainability transitions – inspiring examples, DRIFT: Rotterdam, 2014

411. Wittmayer, J.M., N. Schäpke, F. van Steenbergen, I. Omann (2014). Making sense of sustainability transitions locally. How action research contributes to addressing societal challenges. Critical Policy Studies. Online first.DOI: 10.1080/19460171.2014.957336

412. World Bank-WB. (2010), Climate Change and the World Bank Group: The Challenge of Low- Carbon Development. Washington DC.

413. Wright, S. (1934). "The method of path coefficients". Annals of Mathematical Statistics 5 (3): 161–215. doi:10.1214/aoms/1177732676.

414. Young, S. T., Dhanda, K. K. (2012). Sustainability: Essentials for business. Sage.

415. Yule, G.U and Kendall, M.G. (1950), "An Introduction to the Theory of Statistics", 14th Edition (5th Impression 1968). Charles Griffin & Co. pp 258–270

416. Zijlstra, T., Avelino, F. (2012). A Socio-Spatial Perspective on the Car Regime, in Geels, F., Kemp, R., Dudley, G., Lyons, G. (Eds.) Auto mobility in Transition? A Socio-Technical Analysis of Sustainable Transport. Routledge, London (in press), chapter 8

417. Zou, P., Sunindijo, R. Y. (2015). Strategic Safety Management in Construction. John Wiley and Sons.

Appendix1: administrative questionnaire

A. Informazioni sul rispondente:

Ruolo .....

Settore/Servizio di appartenenza.....

B. Informazioni generali:

La preghiamo di rispondere alle domande seguenti considerando gli sviluppi più recenti del Suo Comune:

Domande	**Si**	**No**	**Note**
Il Comune ha un piano dei trasporti?			A partire dall'anno.....
E' stato individuato un servizio apposito o una persona responsabile dei trasporti?			Persona □ Servizio □
L'eventuale piano dei trasporti è già in via di implementazione?			A partire dall'anno.....
Il piano è riferito a tutta l'area territoriale di riferimento dell'ente?			
E' in atto un processo di monitoraggio e valutazione del piano della mobilità?			
Il Comune ha sviluppato possibili scenari/alternative circa la mobilità sostenibile?			
Sono stati usati fondi per finanziare progetti, studi o strategie inerenti la riduzione delle emissioni?			Quale è l'ente finanziatore? .....
Ci sono strategie per supportare innovazioni riguardanti la riduzione delle emissioni di CO_2?			
Sono state assegnate responsabilità e risorse a sostegno di un piano di mobilità sostenibile?			
Nell'ambito del bilancio dell'ente, è stato assegnato un budget specifico a sostegno della mobilità sostenibile?			

C. Attitudine verso la sostenibilità

Per cortesia, indichi la misura in cui concorda con ciascuna delle seguenti affermazioni, considerando che il valore 1 significa completo disaccordo, e il valore 7 significa perfettamente d'accordo:

Riduzione di gas serra e CO_2	1	2	3	4	5	6	7
La riduzione delle emissioni di gas serra è una priorità per il Comune							
Occorre definire specifici obiettivi per la riduzione di CO_2							
Occorre assegnare fondi specifici per i progetti di riduzione di CO_2							
Occorre assegnare specifiche risorse (tecnologiche, umane, etc.) per raggiungere gli obiettivi di riduzione di CO_2							
Ci sono strategie esplicite per la riduzione di CO_2							
E' importante attuare i nostri piani specifici, invece di continuare sulla realizzazione di piani pregressi definiti da altra							

amministrazione, o definiti da amministrazioni sovracomunali							
Vengono realizzate misurazioni periodiche per quanto riguarda il livello di emissione di CO_2 in città							
I risultati delle strategie adottate vengono periodicamente valutati							
I risultati delle valutazioni del grado di raggiungimento degli obiettivi vengono periodicamente resi pubblici							
Le strategie di mobilità sostenibile nel piano dei trasporti vengono modificate di tanto in tanto in considerazione dei risultati ottenuti							
Indagini periodiche vengono fatte per conoscere il livello di soddisfazione dei cittadini circa il trasporto pubblico							

D. Finanziamenti esterni e risorse a supporto dei piani di mobilità

Per cortesia, indichi la misura in cui sono stati utilizzati i finanziamenti indicati, dove 1 indica mai e 7 indica sempre:

Finanziamenti esterni e risorse per la riduzione delle emissioni	Mai	Molto raramente	Raramente	Occasionalmente	Spesso	Molto spesso	Sempre
	1	2	3	4	5	6	7
Sono stati utilizzati fondi ministeriali per sostenere programmi di riduzione di CO_2							
Sono stati utilizzati fondi ministeriali per sostenere programmi di riduzione di gas serra							
Sono stati utilizzati fondi internazionali per sostenere programmi di riduzione di CO_2							
Sono stati utilizzati fondi internazionali per sostenere programmi di riduzione di gas serra							

E. Attività di collaborazione e cooperazione

Per cortesia indichi la misura in cui l'Ente collabora con i seguenti stakeholder per perseguire gli obiettivi di riduzione delle emissioni, dove 1 indica mai e 7 indica sempre:

Cooperazione in tema di R&S per veicoli e carburanti a basse emissioni	Mai	Molto raramente	Raramente	Occasionalmente	Spesso	Molto spesso	Sempre
	1	2	3	4	5	6	7
Produttori di veicoli							
Imprese pubbliche di trasporto							
Agenzie di trasporto locali							
Fornitori di energia e carburanti							
Università e centri di ricerca							
Ministeri ed altri policy maker							
Commissione Europea o agenzie europee							

Altri Enti Locali							
Altri stakeholder (NGO, associazione cliente, etc.)							
Cooperazione in campi <u>diversi</u> dalla R&S per veicoli e carburanti a basse emissioni	1	2	3	4	5	6	7
Produttori di veicoli							
Imprese pubbliche di trasporto							
Agenzie di trasporto locali							
Fornitori di energia e carburanti							
Università e centri di ricerca							
Ministeri ed altri policy maker							
Commissione Europea o agenzie europee							
Altri Enti Locali							
Altri stakeholder (NGO, associazione cliente, etc.)							

F. Strategie per ridurre l'uso di veicoli privati

Per cortesia, indichi la misura in cui le seguenti azioni sono adottate nell'ambito del contesto in cui opera l'Ente:

Azioni per ridurre l'uso di veicoli privati	Non applicabile	Non è una priorità ad oggi	Azione decisa e deliberata	Sono state adottate linee guida e indicazioni di policy	Sono stati realizzati progetti pilota	Azioni implementate in casi o aree specifiche	Azioni implementate in tutto il bacino di riferimento dell'Ente
Politiche di motivazione e contenimento dei trasporti							
Riduzione delle tasse per veicoli meno inquinanti							
Chiusura dei centri storici per i veicoli inquinanti							
Zone a Traffico Limitato							
Politiche sul prezzo dei carburanti							
Altri incentivi o sanzioni							
Mezzi di trasporto alternativi							
Spostamento del trasporto passeggeri su altri mezzi (treno, ecc.)							
Spostamento del trasporto merci su altri mezzi (treno, ecc.)							
Promuovere gli spostamenti a piedi							
Promuovere l'uso della bicicletta							
Efficienza del trasporto pubblico							
Attuazione di sistemi di car sharing/ car pooling							
Infrastrutture di trasporto e sistemi tariffari integrati							
Espansione e sviluppo della rete metropolitana sotterranea							
Decentramento degli uffici pubblici							
Regolamentazione delle aree di sosta							
Tecniche per ridurre la congestione del traffico							
Rinnovamento del parco veicoli (autobus)							
Rinnovamento del parco veicoli commerciali ed altri							

veicoli pesanti							
Aumento della consapevolezza da parte dei cittadini							
Campagne pubblicitarie							
Educare la popolazione							
Organizzazione di eventi speciali							
Informazioni interattive su orari e ritardi							
Infrastrutture riguardanti carburanti puliti o a basse emissioni							
Espansione delle infrastrutture per i veicoli elettrici (punti di ricarica)							
Espansione delle infrastrutture per i veicoli a gas naturale (GPL, CNG)							
Espansione delle infrastrutture (punti di rifornimento) per altri tipi di carburanti (metano, diesel, ecc.)							
Veicoli meno inquinanti							
Utilizzo di veicoli ecologici per il trasporto merci in città							
Utilizzo di veicoli meno inquinanti per il trasporto pubblico							
Utilizzo di veicoli meno inquinanti per il trasporto merci							

G. Sfide e ostacoli

Per cortesia, indichi la misura in cui ritiene che le sfide e gli ostacoli riportati siano importanti nel contesto in cui opera l'Ente, dove 1 indica poco importante e 7 indica molto importante:

Sfide	1	2	3	4	5	6	7
Integrare i piani dei trasporti con gli obiettivi di sostenibilità ambientale							
Fornire servizi di trasporto pubblico efficienti ed adeguati							
Disponibilità di parcheggi pubblici, soprattutto nei centri							
Adeguatezza delle infrastrutture inerente i carburanti puliti o a basse emissioni							
Riduzione della burocrazia nei percorsi amministrativi							
Promuovere forme di spostamento non motorizzate (bici, a piedi)							
Ridurre la congestione del traffico							
Modificare i comportamenti dei cittadini sull'uso dei veicoli privati							
Ostacoli nel raggiungimento degli obiettivi di trasporto sostenibile	1	2	3	4	5	6	7
Mancanza di risorse finanziarie							
Norme in materia ambientale particolarmente stringenti							
Mancanza di cooperazione fra gli attori coinvolti nel settore dei trasporti							
Mancanza di supporto da parte del governo centrale/ministero							
Cambio dei vertici politici o di alti dirigenti							
Elevato costo dell'innovazione tecnologica							
Barriere culturali							
Responsabilità sociale del sistema di trasporto pubblico (es.							

prezzi dei biglietti)							
Inefficienza di altre modalità di trasporto							

H. Efficacia delle strategie di riduzione delle emissioni

Per cortesia, indichi la misura in cui concorda con ciascuna delle seguenti affermazioni, considerando che il valore 1 significa completo disaccordo, e il valore 7 significa perfettamente d'accordo:

Finalità ed obiettivi	1	2	3	4	5	6	7
Il trasporto pubblico soddisfa la domanda attuale							
Le infrastrutture per combustibili puliti sono abbastanza							
I cittadini sono soddisfatti del trasporto pubblico							
I cittadini sono consapevoli dei rischi delle emissioni inquinanti							
Il numero di cittadini che utilizza il trasporto pubblico è aumentato negli ultimi 5 anni							
Ci sono meno persone che utilizzano la propria automobile rispetto a 5 anni fa							
Ci sono più persone che si spostano a piedi o in bicicletta nel quotidiano rispetto al passato							
Indichi la misura in cui reputa che:	1	2	3	4	5	6	7
La collaborazione con gli attori sopra riportati potrà aiutare l'Ente a raggiungere gli obiettivi di riduzione delle emissioni							
La collaborazione con gli attori sopra riportati potrà aiutare l'Ente a vincere le sfide di mobilità sostenibile							