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A multi-level perspective analysis of urban mobility system dynamics: What are the future transition pathways?

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ABSTRACT

Transport sector is one of the main contributors to air pollution, greenhouse gases and CO_2 emissions, specifically in urban areas, and is the only sector that has not yet achieved sustainability objectives. Increasing concerns about emissions from the transport sector highlight the need for urgent actions for change to more sustainable systems that consider the needs of all social groups, be more affordable and less polluted. Transition studies focus on actions and plans used to change the current system to more sustainable ones, a radical shift in incremental steps. Multi-level perspective considers the transition as a nonlinear process of change resulted from the interactions of social and technological factors at different levels. While most studies focused on historical transition reviews or future pathways and scenarios, this paper is a study of current system as the change process is performed. The paper aimed at identifying the main mobility regimes and dynamics of low carbon mobility transitions to see what are the current pathways and most probable pathways in the scope of 2030 targets. A comprehensive review of related literature combined with stakeholder interviews in a qualitative data analysis process to see what the driving and restraining forces of transition process are and which innovations has the greater potential to get aligned in future mobility regimes. The paper contributed to transition studies through combining multi stakeholder and MLP approach for detailed investigation of passenger urban mobility transition dynamics. The results can also help urban mobility planners to know the factors that can help or challenge them in planning for more sustainable transport systems.

1. Introduction

Transport systems were introduced as the backbone of economic and social progress in the twentieth century (Gudmundsson et al., 2016), but beside all their positive functions, transport activities have several negative impacts including traffic congestion, pollution, greenhouse gas emissions, fatalities and injuries, energy consumption and other environmental impacts. Transport activities are the main cause of unsustainability patterns especially in urban areas. European Commission reported “Despite significant efforts to reduce emissions, transport has not yet achieved its decarbonizing targets. If these trends continue, transport is expected to contribute 50% of all CO_2 emissions in the EU by 2050, if not within the next two decades” (European Union, 2012). The European Union aims at cutting its greenhouse gas (GHG) emissions by 40% from 1990 levels by 2030, and continue this course to an 80–95% reduction by 2050. To achieve those targets, the necessary transition to a low-carbon systems is under way.[1] Looking at the transport sector objectives for transition towards low carbon transport systems, EU programs reserved a specific attention to urban transport regarding the urban population in the EU (Schoemaker et al., 2012).

The world is increasingly urban and ever more mobile, urban mobility is acquiring more and more central role (Jiménez Herrero, 2011). More than 50% of the world's population (World bank, 2017) and around 75% of Europe's population (EC (European commission), 2012;[2] EEA, 2006[3]) live in urban areas. Cities highly affect the world's sustainability (Wittmayer et al., 2014) and are considered the key context to apply sustainable development and climate change policies and strategies. In Europe, 25% of greenhouse gas emissions, and more than 30% of the total energy consumed in 2010, was due to the

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[1] Strategic note #17: Towards low emission EU mobility.
[2] EC: European commission.
[3] EEA: European Environment Agency.

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transportation sector (Staricco, 2013). Urban transport has been estimated to account for around 25% of the CO_2 transport emissions responsible for climate change, almost all attributed to road transport from which 58% is due to passenger transport (EEA, 2013).[4] In this regards, sustainability is a key concern for modern transportation systems (Jiménez Herrero, 2011), and so for urban planning (Pinna et al., 2017) and the organizations involved in the process. Effective and integrated solutions for sustainability can only be found – and efficiently implemented –in cities and urban areas (Dodman, 2009; McCormick et al., 2013; Roseland, 1997; UN-Habitat, 2010; Wheeler and Beatley, 2010). Literature provides an analysis of the effects and the implications of transition in the transport sector. However, the focus of the studies is mainly on historical trends (e.g. from horse carriage to car, or from sail to steam ships, see Geels, 2002), or on forecasting future transition pathways and scenarios (Crozet and Lopez-Ruiz, 2013; Dhar and Shukla, 2015; Marletto, 2014; Silvester et al., 2013; Spickermann et al., 2014). This paper aims at filling a gap in transition literature focusing on the study of the current mobility regimes in practice, and on the definition of the dynamics affecting the transition process to low carbon urban mobility. Thus, the present paper is not a study of past trends, nor the study of future scenarios, but is a study of current system change factors as it is going on in practice. The paper contributes to previous studies of transition towards low carbon mobility systems by combining multi stakeholder and MLP approach in the detailed investigation of passenger urban mobility transition dynamics.

As a country of about 60% urban population (World bank, 2017), Italy has been chosen as the study context. The country has the second highest number of private vehicles registered in Europe, with 604 vehicles per 1000 inhabitants; this high motorization rate is caused by the lack of valid alternative transportation that fostered private ownership of high number road motor vehicles (Pinna et al., 2017). Furthermore, being Italy an EU member state, the European regulation and recommendation on sustainable urban mobility contributes to depict its institutional context.

The study aimed at identifying the current path of low carbon mobility transition in Italy through an analysis of passenger urban mobility system dynamics. In order to achieve this aim, the main regimes of urban mobility and the dynamics of the transition process that affect those regimes in all levels are identified. Thus, the main research question is expressed as follow: what are the most probable pathways for transition towards low carbon mobility?

Consequently, two secondary research questions have been developed:

- Which mobility regimes play an important role in low carbon mobility transitions?
- What are the regime dynamics at macro, *meso* and micro level?

To answer to the previous questions, a qualitative data analysis was conducted through the investigation of the scientific literature, administrative and national reports, enriched with interviewing urban mobility stakeholders.

2. Methodology

A qualitative research methodology was applied to identify the dynamics of transition towards low carbon urban mobility in Italy. The research aims at finding the most probable transition pathways by examining and analyzing transition forces through collecting literature evidence and empirical data.

Given the aims of this research and the available knowledge, there is a need to identify the factors that affect each dimension of current mobility regimes. Those factors are identified through the collection of qualitative data, recommended to be used when the investigated phenomenon is new and when the investigator seeks to answer “why” and “how” questions (Yin, 2014). Thus, a combination of different qualitative data gathering methods was adopted: literature reviews and semi-structured interviews, as described further in this section.

2.1. Data collection methods

Both primary and secondary qualitative data are collected in this research process. Firstly, a review of the literature on transition studies was conducted to identify the variables that affect emission reduction targets. To analyze the transition dynamics and identify the factors that affect the transition process and objectives we reviewed the literature on: urban transport management and mobility planning; emission reduction strategies, policies and challenges; and country reports on barriers and drivers of low carbon mobility transitions, both in Italy and in the international context.

The literature also used for identifying the main stakeholder groups. After that, specific stakeholders were selected from those groups, to share their viewpoints about the research questions. Thus, 11 individual face-to-face and 2 group interviews were conducted to discuss the mobility regimes and their dynamics. The groups of stakeholders, their related categories and representation bodies in Italy who participated in the interviews are presented in Table 1.

Interview participants were selected based on purposive sampling, which seeks to maximize the depth and richness of the data to address the research question (Kuzel, 1992). Here, respecting the multi stakeholder view, we tried to have at least one interviewee from each stakeholder group. In addition to knowledge and experience, the availability, willingness to participate, and ability to communicate experiences and opinions have been considered in the selection of interviewees (Bernard, 2002; Spradley, 1979).

The semi-structured interviews were conducted based on a ‘loose’ guide (Kvale, 1996). Thus, general questions were designed to open up the conversation about the topic, and a few follow up questions developed regarding interviewees' role to clarify doubts and learn from the interviewees the real practice (suggested by Sekaran, 1992, p. 197 for face to face interviews). Semi-structure interviews were used because they allowed the researchers to develop new questions based on the ideas that may be formed during the interviews.

Interviews were conducted by both researchers at the interviewees' work place; interviewees were acknowledged of the aim of the interview, at least a week in advance. All the interviews were conducted between September 2014 and September 2015. The interviews were recorded, and they last on average 75 min each. Memos were written during and after each interview to be used for developing questions in current or future interviews, as some interviewees pointed out the factors that needed to be handled or provided by other stakeholders (usually at higher levels of authorities).

Individual interviewees were the decision makers at international and national level (2) managers of local transport providers (3), head and managers of R & D sector in vehicle manufacturing companies (3), researchers including university and research center members engaged on sustainable low carbon mobility (2), civil society members (1) (nonprofit organizations, such as biking associations, ...).

Two focus groups were conducted with regional and local authorities of urban mobility system in which the problems and difficulties of public transport system and clean transport niches where investigated.

2.2. Analysis process

Data analysis started while the research process was still ongoing. The process of analyzing qualitative data began when the raw data were prepared through general reading, followed by careful reading and

[4] These are updated estimates for 2010 based on the PRIMES-TREMOVE model and are not from official statistics, a short description of the model is provided in the impact assessment accompanying the 2011 Transport White Paper.

Table 1
Stakeholder groups, viewpoints and representations in Italy.

Stakeholder groups	Perspectives/ aspects	Representation in Italy	Role of interviewees
National government	Political/Strategic	Ministries	Direction for sustainable development, climate and energy
Regional administration	Strategic/Planning	Regions/Agencies	Regional transport
Local authorities	Strategic/Planning implementation	Municipalities	Mobility managers, transport agencies
Public transport providers	Infrastructure	Local bus and freight companies	Fleet manager Head of the information systems
Automotive industry	Technological	Vehicle producers	R & D directors in car manufacturing companies
Academia	Scientific	Universities and research centers	Researchers worked on sustainable urban mobility
Civil society	User	Customer association	Cycling associations

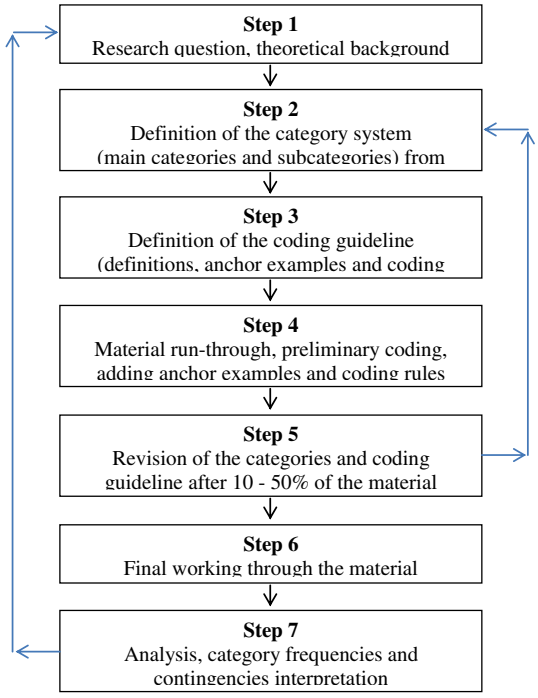

Chart 1. Steps of deductive category development method (Mayring, 2014).

thick description (Spiggle, 1994). The interviews were audio-recorded and labeled with the name of the interviewee and the date of interview. The qualitative data analysis process was done manually following a qualitative content analysis approach. The transcripts of the interviews as well as other text materials were analyzed, coded, categorized through the step model of deductive category method (Chart 1) introduced by (Mayring, 2014). The coding process started with searching the text material fulfilling the category definitions extracted from the theoretical background. The examples of categories, preliminary codes and anchor examples[5] are presented in the Table 2, showing how they are extracted from the theoretical background and research questions.

In this paper, the research questions are linked to the theoretical background that is based on transition theory and its main approaches such as MLP analysis. The main categories and coding guidelines are defined based on different levels of MLP (landscape, regime and niche); different regimes within urban mobility system (private cars, public transport and non-motorized transport) and the niches on low carbon mobility objectives. The theoretical framework will be described later in Sections 3 and 4.

3. Theoretical background: Transition towards low carbon mobility

To move towards more sustainable systems and societies, different initiatives and interventions upgrade infrastructure networks to reduce Carbon emissions, stimulating economic development (McLean et al., 2015); nevertheless, structural radical changes are necessary in societal systems to achieve sustainable development goals (Kern, 2012). Roggema et al. (2012) states that these changes can occur in different ways: incremental, through a transition or in the form of a transformation.

While incremental change is seen as a slow process, slightly modifying the landscape, transition is considered as a fluent change towards a new future, which is an improved version of the existing; and transformation is seen as a change towards a fundamentally different future.[6] Geels and Schot (2010) noted that transition is different from an incremental change process in the following aspects:

- Transitions require multiple changes in societal systems (co-evolution).
- Transitions are multi-actor processes, which entail interactions between societal groups such as businesses, users, scientific communities, policymakers, social movements, etc.
- Transitions are radical shifts, referring to the scope of change (not the speed).
- Transitions are long-term processes (40–50 years), but breaktroughs may be relatively fast (e.g. 10 years).
- Transitions are 'macroscopic', i.e. affect a whole 'organizational field' (aggregation of suppliers, consumers, regulatory agencies, etc.).

Rotmans (2003) pointed out the difference between transition and transformation, arguing that transition can be understood as a gradual transformation that occurs because of simultaneous development in different societal domains and combined actions of macro, *meso* and micro level. Grin et al. (2010) argued that radical change (immediate transformation) will lead to maximal resistance from the incumbent actors, that cannot adjust to a too-fast radical change, so the change process should be followed by small steps. Transition theory is introduced for solving the paradox of radical changes in incremental steps.

Transition theory has been used to analyze the experienced transition process that has occurred in the present or past (like the studies of Geels, 2005a, 2005b), or to forecast future transition pathways by designing and developing scenarios or future efforts (see e.g., Crozet and Lopez-Ruiz, 2013; Dhar and Shukla, 2015; Marletto, 2014; Silvester et al., 2013; Spickermann et al., 2014). Lachman (2013) stated that the most used transition approaches are: multi-level perspective (MLP), strategic niche management, transition management, innovation systems, techno-economic paradigm and socio-metabolic transitions. In

[5] Anchor examples: concrete passages belonging in particular categories are cited as typical examples to illustrate the character of those categories.

[6] These changes are fully discussed in the cited reference.

Table 2
Qualitative data analysis: coding example.

Research questions	Theoretical background	Category	Subcategory	Preliminary codes	Anchor examples (from literature and interviews)
RQ1: what are urban mobility regimes	Transition theory	Public transport	Rail, tram Bus	Metro, bus, mini bus, van, taxi	"subaltern regimes that co-exist with the automobility regime: the slow mode[a] regime and the public transport regime" (Turnheim et al., 2015a)
	Sustainable urban mobility context	Private transport	Automobility	Car, Automobile, Passenger cars	"the dominant mobility regime is that of car use" (Meek and Parkhurst (2014).
		Non-motorized transport	Walking Cycling	Pedestrian, Sidewalk, Bicycle, Bike	"In transport there is a regime of automobility and a separate regime of public transport" (Kemp et al., 2011)
RQ2: What are the regime dynamics	Multi-level Perspective (MLP)	Landscape dynamics	Political factors	Climate change debates and policies	"Car-based mobility systems, for instance, are stabilized by landscape trends such as:
			Economic factors	Peak oil price Economic crisis	(a) globalization and increasing world-trade,
			Social factors	Demographic change, Ownership, privacy, wealth, convenience, Public awareness,	(b)Individualization and people becoming more footloose,
					(c) rapidly growing international tourism,
			Technological factors	Clean technologies, Technological strengths, manufacturing base	(d) growing wealth and the rise of second and third cars in households, and (e) a shift towards a network society" (Geels et al., 2011).
					"At the landscape level, macroeconomic policies, a tradition of government-led growth strategies, pre-existing strengths in information technology, and worldviews on GHG reduction are key factors" (Ngar-yin Mah et al., 2012)
					The existing manufacturing base in car manufacturing companies does not support revolutionary changes for clean vehicles (Interviewees from automobility sector)
		Regime dynamics	Public transport	infrastructure, ticket, accessibility, operation	"Buses share infrastructure elements with cars, which strengthens their existence and gives them flexibility in planning and operation" (Turnheim et al., 2015a)
					Integrated ticketing system can motivate people to use public transport (interviewee-local bus operator)
			Private transport	Lock –in, cracks and tension, Tax, convenience, comfort, fuel, congestion, LTZ[b], factory, automobile industry, Parking, traffic planning	"we are locked in car-based modes of transport" (Kemp et al., 2011)
					Car embedded in lifestyles and mobility patterns (Hodson et al., 2015)
					Taxes are large source of income for government (Van der Eerden, 2013)
					The car is stabilized by associations with cultural values such as freedom, choice, progress, wealth and status (Sachs, 1994)
			Non-motorized transport	Bicycle, cycling track, health benefit, sidewalk	"Cycling remains a marginal activity" (Hodson et al., 2015)
					Pedestrian environments (sidewalks, paths and hallways) are a major portion of the public realm.
					"Improving walking and cycling conditions provides enjoyment and health benefits" (Litman, 2013)
		Niche dynamics	Mobility management	Integrated intermodal, Smart growth, sharing	The niches of intermodal transport, demand management, sustainable urban planning, car and bike-sharing offer possibilities for more radical and systemic change with potentially greater sustainability benefits (Banister, 2008)
			ICT[c]	ITS, Teleworking, internet	ITS-niche has gathered momentum since the 1990s (Geels, 2007)
					ITS can help reduce congestion problems (Geels, 2012)
			Clean vehicles and fuels	Green propulsion Hybrid, Electric Battery, Biofuel, CNG, methane, diesel	Niches of green propulsion technology such as battery electric vehicles (BEV) and fuel-cell vehicles (FCV) have acquired substantial momentum in the last five or ten years (Orsato et al., 2012)
					Electric vehicles have limited performance (interviewee-public administration)

[a] "slow mode regime" is interpreted and walking and cycling modes in the study of Turnheim et al. (2015c), in our paper named "non-motorized transport".
[b] LTZ: limited traffic zone.
[c] Information and communication technology.

this paper, the analysis of transition dynamics is performed by the use of MLP approach because it can describe, map and analyze the entire long-term process of change; it unites various transition approaches, in which transitions are viewed as the outcome of developments at the micro, *meso* and macro level.

3.1. Multi-level perspective

Geels (2011) introduced MLP as a middle-range theory that conceptualizes overall dynamic patterns in socio-technical transitions. The basic concept of MLP is that there is no single driver of transitions. Instead, MLP views transitions as non-linear processes that result from the alignments of developments at three analytical levels:

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

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 (Freeman and Perez, 1988); niche-innovations that are supported by more actors and receive more resources get 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 starts (Raven and Verbong, 2009).

Kemp (2010) describes socio-technical regimes as the heart of transition scheme, where the transition process occurs. Regime refers to the dominant practices and consists of three interlinked elements: network of actors and social groups, the set of formal and informal rules, and the material and technical elements (Geels, 2004).

Socio-technical landscape is the environment in which a regime is embedded and it includes the physical environment and material infrastructures, societal values and concerns, macroeconomic trends, and long-term geopolitical dynamics (Geels et al., 2011).

According to Geels (2011), the usefulness of MLP has been illustrated by 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 (Geels, 2006a; Nastar, 2014), aviation (Geels, 2006a, b; Nakamura et al., 2013), highway systems (Geels, 2007), and industrial production. However, MLP has also fruitfully been applied in studies of contemporary and future transitions to sustainability, for example in electricity systems (Hofman and Elzen, 2010; Verbong and Geels, 2007, 2010), biogas and co-combustion (Raven, 2004), and 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 (Bertolini, 2011; Kohler et al., 2009; Sheller, 2011; Zijlstra and Avelino, 2011). Although some works have been done for identifying transition dynamics, scenarios of mobility and "green" innovations, they are mainly focused on the analysis of the changes of automobility regime (Geels et al., 2008; Marletto, 2014; Nykvist and Whitmarsh, 2008; Van Bree et al., 2010). This paper considered the broader context of urban mobility and focused not only on technological transitions, but also on other aspects of socio-technical transitions. In addition, the paper studied the dynamics of ongoing change process - not those happened in the past or that may happen in the future - in a practical approach. The paper focused on multi-level perspective because:

- MLP is based on co-evolutionary of technology and society involving multiple dimensions (technology, industry, markets, consumer behavior, policy, infrastructure, and cultural values);
- MLP is an actor-based approach considers the interactions among different groups of stakeholders;
- MLP is focused on complex dynamics not only linear cause and-effect relationships or simple drivers;
- MLP covers stability (lock-in and resistance to change) on the one hand, and radical change on the other hand (Geels, 2012).

3.2. Transition dynamics and pathways

Transition pathways describe how technological innovations matured and are developed by different social actors, and how they contribute to shift the current regimes to the desired regimes, or healing the regime cracks and incumbencies. Different types of interactions between different levels of MLP lead to different transition pathways (Geels, 2005a; Geels, 2002; Geels and Schot, 2007; Rip and Kemp, 1998). Geels (2012) described the general *dynamic* of transitions through the interaction among processes at different levels:

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

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, and it evolves by the forces of niche innovations from lower level and landscape dynamics at upper level. Radical innovations (niches) are nurtured and experimented in protected spaces, and developed and tested by pioneers, entrepreneurs, social movements. Niches 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. Niches shape their trajectory (pathways) to replace, align, reconfigure or transform into new regimes that are expected to be more sustainable than the existing ones (Geels, 2012). The whole process occurs in the context of broader evolutionary landscape that exerts pressure on the existing regimes and creates windows of opportunity by destabilizing the regime configuration and re-framings norms and rules (Schot and Geels, 2008).

Transition *pathways* are defined by the interactions between activities and structures of internal regime dynamics, wider landscape dynamics and promising niches. These dynamics destabilize the incumbent regime and contribute to change it; the result of these changes is the emergence of a new regime.

Different pathways are introduced for regime substitution through the case studies of transport sector. Differences in the pathways are depended on the timing and nature of interactions, the main actors who lead the change and the supported niches. The summary of these differences is presented in Table 3.

This paper follows the typology of pathways presented by (Marletto, 2014), since it perfectly match the main aim of the study about the socio-technical analysis of current and future dynamics of urban mobility system and the objectives of low-carbon urban mobility. It is also compatible with the typology of Geels and Schot (2007).

4. Results

This section presents the results from qualitative data analysis. These results come from the secondary data sources and the viewpoints of stakeholders. The results will be presented in two separate sub-sections to allow the comparison of the dynamics of transition process in Italy with those presented by literature in other countries. In the first

Table 3
Transition pathways and their differences.

Authors	Pathways	Main actors	Interactions
(Berkhout et al., 2004)	Endogenous renewal	Existing regime actors	Coordinated response-internal adaption Existing capacities
	Re-orientation of trajectories	Outsiders, landscape or niche actors	Uncoordinated response to technological shocks- internal adaption- existing capacities
	Emergent transformation	Outsiders, landscape or niche actors	Uncoordinated pressures for change and responses formed beyond the incumbent technological regime- External adaption with external resources
	Positive transition	Social actors- regime actors	Reflect the expectations of a broad and effective set of interests, located outside the regimes. Coordinated response- external adaption- external resources
(Geels and Schot, 2007)	Technological substitution	Niche actors-new core actors emerge	Niche innovation replace the existing regime-bottom-up push
	Reconfiguration	Integration of new core actors	Niche innovations adopted into existing regime and change system architecture
	Transformation	Incumbent actors	Incumbent actors change regime elements-accommodate external pressure
	De-alignment and *Re*-alignment	Landscape actors	Landscape change led to regime breakdown + niches gradually align around winner
(Foxon et al., 2010)	Market rules	Government	Market led government pattern
	Action-reaction	Government	Bifurcation of market rules by government
	Central control	Government	Government directly manage sociotechnical regimes
	Thousand flowers	Local authorities and citizens	Bottom-up diverse solutions for regime replacement
(Marletto, 2014)	Auto-city (Reconfiguration)	Car industry-related niche actors	Transport policy influenced by automotive industry-dominant regime (automobility) is not destabilized
	Eco-city (De-alignment and *Re*-alignment)	Coalition of actors (NGOs, local government, industries)	Multi-level urban policy ease the diffusion of integrated urban transport system-new visions develop
	Electricity (Substitution)	Electric car and smart grid supporters (new core actors)	Transport energy policy are influenced by electricity industry

sub-section a comprehensive literature review was followed to browse the dynamics of transition towards low carbon systems. The second sub-section reflects the viewpoints of interviewed stakeholders about the dynamics that affect transition process and low carbon mobility objectives in Italy.

4.1. Urban mobility regimes

Everyday mobility practices and associated mobility regimes are shaped by cities through public policies; forms of urban governance and policies directing transport and communication infrastructures, and access to them; and by urban technological innovations and regional agglomerations that re-make mobility systems (Sheller, 2015). In the context of urban mobility, different regimes are interacting and affected by landscape pressure and niche developments, and by each other. Different studies gave different classifications of passenger transport regimes; sometime different words are used to describe the same regime (like car-based mobility or automobility). Some authors introduced the general regimes of private car and public transport (Elzen et al., 2003; Hoogma, 2002; Van der Eerden, 2013), while some others proposed a more detailed classifications such as the regimes of automobility, rail, bus and cycling (Hodson et al., 2015), or different hierarchies in which the slow mode and public transport regimes have been introduced as subaltern of automobility regime (Turnheim et al., 2015a).

In this paper three main regimes are considered respecting the core actors, formal and informal rules and regulation of transport modes and the infrastructure needed to expand those regimes; the regimes are: private car based regime (automobility); public transport regime including bus and urban rail (subway, trams), and non-motorized transport (walking and cycling).

4.2. Transition dynamics

This section describes the dynamics derived from literature and secondary data sources such as country and project reports. This section acknowledged the results of “pathways project”, and among them, the dynamics of urban mobility system in Netherlands and UK were analyzed.

4.2.1. Landscape dynamics

Changes that occur in the landscape are slower than changes at the regime and niche level, and they determine the stabilization and destabilization of regimes. Landscape changes may gradually put pressure on the regime, creating “cracks”, and causing the realignment of some of its elements (Geels, 2004). Landscape 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, 440). Table 4 shows the dynamics at landscape level.

4.2.2. Regime dynamics (lock-ins and cracks)

The regime is stabilized by the interactions between its constituent technologies, institutions, business strategies and users' practices (Foxon et al., 2010). Regimes are path dependent or in a situation of lock-in (Kemp et al., 1998). Lock-ins occur in institutions, social practices and technological infrastructures (Raven et al., 2010) and stabilize the existing regime, leading incumbent actors to prefer incremental changes that stay within the bounds of the existing regime (Geels, 2012).

Generally, land-based passenger transport (which includes urban mobility regime) consists of three separate regimes: private car-based regime (automobility); public transport regime including rail (tram and subways in urban mobility), buses and mass transport sub-regimes; and non-motorized transport (walking and cycling). Lock-ins, cracks and tensions introduced in these regimes are summarized in Tables 5 to 7.

Tables 5 to 7 clearly show that stabilizing factors for one regime could destabilize the other regimes. The dominant regime of private cars should be substituted by, or transformed towards, more sustainable regimes that are related to cleaner features of urban mobility, such as public transport regimes and non-motorized transport regimes (cycling, walking, etc.). In some cases, the current regimes re-align with the prospective changes, such as the technological developments in automobility regimes that are aimed at reducing the cars' emissions by improving the engine and fuel technologies.

4.2.3. Promising niches

Various “green” niches have emerged in the context of transition

Table 4
Landscape dynamics affecting mobility regimes.

Source	Resisting low carbon mobility	Supporting low carbon mobility
Literature	• Economic growth and crisis (Freund and Martin, 2000; Geels, 2012; Hodson et al., 2015; Sperling and Gordon, 2009) • Industrial development strategies (Rogge et al., 2015)	• Climate change debates (Geels, 2012; Geels et al., 2011; Hillman and Sanden, 2008; Hodson et al., 2015; Rip and Kemp, 1998) • Macro-political developments (Ngar-yin Mah et al., 2012; Rock et al., 2009) • Energy and fuel prices and market change (Foxon et al., 2010; Geels, 2012; Geels et al., 2011; Hillman and Sanden, 2008; Hodson et al., 2015; Rip and Kemp, 1998) Physical disruption of external supplies (war, terrorism, etc.) • Changes in international economic financial situation (Foxon et al., 2010)
Literature + interview	• Customer preferences (speed, convenience, time saving, etc.) (Geels, 2012; Geels et al., 2011) • Demographic factors (Elzen et al., 2002) • Mobility demand (Floricel et al., 2009) • Government strategies (Ngar-yin Mah et al., 2012) • Cultural values (ownership, privacy, choice, progress, wealth) (Geels, 2012; Geels et al., 2011)	• Government–industry links (Geels et al., 2011) • Commitment to international low carbon targets (Foxon et al., 2010) • Carbon trading policies and debates (Hillman and Sanden, 2008) • Economic crisis (Hodson et al., 2015) • Fuel prices (Hillman and Sanden, 2008; Hodson et al., 2015; Rip and Kemp, 1998) • Greening production processes (Chiarini, 2014a)
interviews	• Land use and urban structure • Resistance of decision makers • Open and general goals and regulations for clean mobility • Increasing demand for mobility • Resources and infrastructure • Funds for infrastructure development • Technological strengths	• Smart city strategies • Public awareness and willingness to changes • Changes in values and ideologies of younger generations • EU policies and upstream documents • Government viewpoints, supports and policies for low carbon mobility • High competition in the industry and the need for introducing new innovations

towards low carbon mobility systems. Niche-innovations that are supported by more actors and receive more resources get higher degrees of momentum (Geels, 2012); this means that they have more likely to be nurtured and to emerge as the new regimes of mobility. Table 8 shows niche-innovations, related examples, applications, difficulties and driving forces that can help them to grow and develop.

The analysis of literature and interview data about niche dynamics revealed that the main driving forces are the following:

- Support by national government, political and upstream regulations
- Supports by incumbent regime actors and powerful emerging core actors
- Market share and user acceptance
- Niche maturity and
- Compatibility with existing infrastructures.

Although in the literature a number of difficulties for nurturing niches are mentioned such as uncertainties about the niche performance in future, economic interests regarding the forecasted revenues to investment costs and the low level of niche support by incumbent and potential actors, the interviewed stakeholders mainly worried about economic interests and niche performance. Also based on the results of interview analysis, the niches getting higher momentum in Italy are: plug-in hybrid and battery electric vehicles, sharing schemes,

Table 5
Dynamics of private car-based regime (automobility).

Source	Lock-in (stabilizing forces)	Cracks and tensions (destabilizing forces)
Literature	• Taxes incomes for government (Van der Eerden, 2013) • Increasing returns to adoption (Arthur, 1989) • Household income growth (Elzen et al., 2003; Floricel et al., 2009; Freund and Martin, 2000; Geels, 2012) • Increasing demand for personal mobility (Castells, 2011, Castells, 2010; Geels, 2012); • Land development policies (Elzen et al., 2002) • Government strategies to support industry (Ngar-yin Mah et al., 2012)	• Energy security and affordability (Foxon et al., 2010; Geels, 2012; Geels et al., 2011) • Liberalized energy markets (Foxon et al., 2010) • Fuel price (Hillman and Sanden, 2008; Hodson et al., 2015; Rip and Kemp, 1998) • Economic crisis- declining sales (Hodson et al., 2015) • Market saturation (Geels, 2012) • Environmental policies (Turnheim et al., 2015a) • Pressure from EU and national policy makers (Geels, 2012; Hodson et al., 2015; Turnheim et al., 2015a) • Carbon trading policies (Hillman and Sanden, 2008) and CO_2 labeling strategies (Turnheim et al., 2015a) • Weakening commitment of policymakers to car regime (Geels, 2012) Concerns about road and car safety
Literature + interview	• Diversity of models and prices • Large market segment (Turnheim et al., 2015a) • Existing resources for infrastructure, manpower, machinery (Arthur, 1989; Geels, 2012; Geels et al., 2011; Hodson et al., 2015; Rock et al., 2009) • Vehicle efficiency (user interface, convenient, entertainment, safety and comfort) and better environmental performance (Turnheim et al., 2015a) • Symbolic representation of cars (Hodson et al., 2015; Van der Eerden, 2013) • Manufacturing base, technological innovation and reconfigurations (Geels, 2012; Hodson et al., 2015; Ngar-yin Mah et al., 2012; Rogge et al., 2015; Turnheim et al., 2015a, b)	• Anti-car discourse (Hodson et al., 2015) • Traffic plan limitations for cars (Elzen et al., 2004; Geels, 2012; Hodson et al., 2015; Turnheim et al., 2015a) • Public transport regime improvements (Geels, 2012; Hodson et al., 2015; Kim, 2015; Turnheim et al., 2015a) • Congestion problems (Hodson et al., 2015; Turnheim et al., 2015a) • Citizen awareness of pollution threats (Hodson et al., 2015) • Parking availability and rates (Elzen et al., 2004) • Competition for environmental standard certification • Environmental management system in the industry (Chiarini, 2014b)
Interviews	• Powerful manufacturing companies • Alternative fuels	• Limited traffic zones in cities • Interest of local government to clean mobility • Urban form and structure

Table 6
Dynamics of public transport regime (mainly bus system).

Source	Lock-in (stabilizing forces)	Cracks and tensions (destabilizing forces)
Literature	• Number and variety of users • Shared infrastructure elements with cars (for buses) Integrated transport usage • Spatial planning strategies (compact city; network of cities) (Turnheim et al., 2015a) • Government incentives (Turnheim et al., 2015a; Van der Eerden, 2013) • BRT service • Intelligent Transportation Systems (Van der Eerden, 2013) • Simplified ticketing (Turnheim et al., 2015a)	• Negative cultural representation: 'people transport', slow, infrequent, etc. (Hodson et al., 2015; Turnheim et al., 2015a; Van der Eerden, 2013) • Negative or challenging public debates and opinions (Turnheim et al., 2015a)
Literature + interview	• Real-time information • Alternative engines and fuels • Improving service quality (accessibility, speed, continuity and frequency) (Turnheim et al., 2015a) • Road and parking facility cost saving Suitable for people who can't drive (teenagers, disabled etc.) (Litman, 2017)	• Fleet age (Turnheim et al., 2015a) • Travel time (slower than car) • Waiting time (Xin et al., 2005)
Interviews	• Competition between service operators • Low costs • No need to search for parking	• Upstream rules and regulations • Not beneficiary in low population density zones • Costs for government • Limited operating hours • Low financial support from government

demand management, ICT and public transport innovations. Other niches are not supported by the key actors, or at least at the scope of current plans.

5. Discussion

This paper aimed to identifying and discussing the driving and restraining forces of the transition process towards low carbon urban mobility in Italy, and the pathways in which the transition process is moved on. The dynamics of urban mobility system based on corresponding level of MLP were presented in the previous section. The current section brings a discussion of those dynamics, which forces they pointed out to and the differences and similarities of stakeholder viewpoints in Italy with the studied literature that are usually conducted at international context.

5.1. Landscape level

Landscape dynamics describe the broad changes including macro level variables such as cultural changes, demographic trends and broad political changes. These changes usually take place slowly and put pressure on regime variables (Geels, 2002) that lead to re-framing norms and rules. The re-framings can open up windows of opportunity for a niche by destabilizing the capability of a regime configuration to perform well according to those norms and rules (Schot and Geels, 2008). The same viewpoints were observed between the interviewed stakeholders and studied literature in which a set of economic, political, industrial, and social trends have been considered:

- Economic variables: trends in demand and supply, economic growth and crisis, international fuel and energy markets;
- Political variables: international debates and policies for climate change, greenhouses gases and CO2 reduction strategies and agreements; policy supports, rules and regulations;
- Industrial variables: physical infrastructure and manufacturing base, technological revolutions and R & D trends;
- Social variables: demographic factors, values and ideologies, climate change awareness and behavior change.

In addition, while the viewpoints about social and industrial factors were quite similar, the Italian stakeholders mainly paid attention to the operational and strategic aspects of political and economic variables such as infrastructure development funds, government supports, existing rules and regulations, political changes and their related consequences at local level.

5.2. Regime dynamics

These are forces that drive mobility systems to be more sustainable and less carbon intensive; the existing drivers and barriers to the

Table 7
Dynamics of non-motorized transport regime.

Source	Lock-in (stabilizing forces)	Cracks and tensions (destabilizing forces)
Literature	• Trend of cycle usage • Policy-push around cycling and associated infrastructure • Growth of a wider cycling industry of associated products (clothing, accessories) (Hodson et al., 2015; Krizec, 2007) • Cycling remains a marginal activity (Hodson et al., 2015) • Integration with public transport (Boschetti et al., 2014)	• Non-existent, incomplete, and poor quality sidewalks and crosswalks • Not supported by transportation agencies (Litman, 1994) • Poorly designed infrastructure • Lack of participation in policy design (Kim, 2015)
Literature + interview	• Innovative technologies (like *E*-bikes) • Health benefits (Hamnett, 2015; Litman, 2004) • Smart urban planning regulations (Cherp et al., 2012)	• Bike theft (Replogle and Mundial, 1992) • Slow modes • Inadequate lane space for cyclists • Walking and cycling considered travel modes of last resort (Litman, 1994) • Accident risk (for cyclists) (Hatfield et al., 2015) • Physical environment (such as the weather or topography)
Interviews	• No additional costs	

Table 8
Dynamics related to the existing niches of low carbon mobility.

Niche innovations	Source	Driving forces	Problems, barriers
Integrated transport – Train-taxi – Bus rail – Bike-rail – Intermodal tickets	Literature	• Governance and policy support • Presence of policy entrepreneurs or particular coalitions of actors (Geels, 2012)	• Time losses in transfers • Low support from regime players • Absence of powerful advocacy coalition • Low economic interests (Geels, 2012)
Sustainable urban Planning – Compact cities – Smart growth – Clustering[a] – Transit Oriented Development – Livable streets		• Social movement networks and community organization support • Visions of new and 'retrofitted' cities (Geels, 2012) • Spatial planning innovation • Political support (national and local planning regulations) • 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)
Green propulsion technologies		• Support by CO2 regulations (in Europe) • Government subsidies for R & D programs and adoption • Joint ventures between car companies and component suppliers (Orsato et al., 2012)	• Experienced several ups and downs (hype disappointment cycles) Depend on: • taxes or subsidies, • Tougher CO2 regulations • Technical improvements • Public investments in infrastructure (Geels, 2012)
Hydrogen fuel cell vehicles		• Technologically at experimentation stage • Preliminary market experiments • High costs • Considered as option for the medium and long term (2030 and beyond) (Turnheim et al., 2015b)	• Repeated hype cycles (Geels, 2014; Turnheim et al., 2015b) • 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)
Plug-in hybrid Electric vehicles	Literature + interview	• Mass commercialization, important market share, stable design features (Turnheim et al., 2015b)	• Technical compromise (Turnheim et al., 2015b)
	Interview	• Industry support • Compatibility with existing regimes	• Purchase power
Battery electric vehicles	Literature + interview	• 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)
	Interview	• Quiet and smooth car • Home charging	• Purchase power • Low travel range per charge • Lack of charging points • Not supported by administrative bodies • Long refueling time
Sharing schemes – Car sharing – Bike sharing	Literature + interview	• Fast developing urban markets • Embedded in existing automobility networks • Positive cultural and symbolic meanings • Policy visions as integral part of future mobility systems • Different role in a variety of pathways (Turnheim et al., 2015b) • Alignment with visions of multi-modal transport (Turnheim et al., 2015b)	• Requires significant reconfiguration in conceptions of users, business model, tracking, monitoring and payment infrastructure and a mix of new and incumbent regime actors (Geels, 2014)
	Interview	• User friendly • Less parking problem • Low costs	• Trust • Less flexibility • Not suitable for everyday use
Demand management – Mobility management – Transport and travel planning	Literature + interview	• Voluntary nature • Zero costs • Attractive to policy makers (Geels, 2012)	• Still in the early stages • Limited momentum Dependent on good intentions (Geels, 2012)
	Interview	• Voluntary nature • Low costs • Project participation	• Changes of decision makers at local and municipal level • Depend on the interest of local government • Not obligatory for all cities • Lack of funds • Non feasible goals • Need for data and R & D • Absence of clear targets
Public transport innovations – Special bus lanes – Real-time information panels – Short-distance radio systems – alternative fuels	Literature + interview Interview	• Increasing political support (Harman et al., 2012) • Modal shift (Geels, 2012) • Supported by policy makers • The use of ICT for real time information • Possibility to use alternative fuels (like CNG, Methane, etc.)	• Expensive and unattractive in low density areas • Require greater focus on spatial planning strategies • Significant alterations to regulations and taxes (Geels, 2012) • Need continuous data updates

(*continued on next page*)

Table 8 (*continued*)

Niche innovations	Source	Driving forces	Problems, barriers
Information and communication technologies – Intelligent transport systems (ITS) – Tele-working, tele-shopping, etc.	Literature + interview	• Supported by policy makers, highway engineers, transport planners, and traffic managers • Commercial interests-economic potential • Integration into cars or public transport (Geels, 2012)	• Internet security, privacy, integrity and the protection of human rights • Data authorization and usage (Johm et al., 2015)

[a] Clustering important destinations around public transport hubs.

transition process were described as lock-ins and cracks in the transition literature. Lock-ins are forces that stabilize current dominant regimes, while cracks are the tension and weak points of existing system that can open the way for promising niches to emerge at regime level.

Incumbent actors tend to be locked in to existing regimes (Unruh, 2000), that is the automobility (private car) regime (Ananchev, 2016; Best, 1982, p. 61; Dudley and Chatterjee, 2011; Elzen et al., 2004, Elzen et al., 2003; Geels, 2005a, b; Hodson et al., 2015; Holtz et al., 2008, p. 629; Meek and Parkhurst, 2014). The aim of transport and mobility plans is to shift this regime to more sustainable ones.

As in other context, also in Italy the main mobility regime is the private car regime evidenced by the high rate of private car ownership (second country in Europe). Our study showed that the factors that lock the mobility system in the automobility regime are mainly linked to vehicle manufacturing industry, the huge investments in skills, factories and infrastructure, market share, and user preferences. While, it is possible to argue that tensions mainly emerged from landscape pressure on market variables, traffic problems (congestion and parking problems) and the strategies and plans to reconfigure the existing regime (like pollution limits for vehicles), or substitute it with more sustainable systems (public and non-motorized transport). Despite the strategic supports of public transport system, the system is fragile in user interface (geographical coverage, operation hours, travel and waiting time) and economic productivity (high costs for government and service providers). Interviewees from public transport companies and administrative authorities argued that the system is highly depended on government financial supports, the costs of system operation could not be covered by ticketing system incomes, and regarding the social responsibilities for providing affordable service for low income citizens, the administration could not increase the service rates. The same problems of user interface in non-motorized transport (regarding the travel time, believes and safety) did not allow at increasing the service rates, and could not be a powerful alternative for private cars, especially in bigger cities (Pinna et al., 2017).

Nevertheless, there are also some factors that help the existing automobility regime to be reconfigured to become cleaner and more sustainable like the competition between the vehicle manufacturers to apply the environmental standard certificates (Chiarini, 2014a, 2014b) and support the promising niches of clean propulsion technologies.

5.3. Niche dynamics

Niches dynamics represent “green” innovations that have emerged in the transition process to achieve low carbon mobility systems. Promising niches are radical alternatives developed and tried by pioneers, entrepreneurs, social movements and other relative outsiders (to the existing regime). It is usually difficult to apply these alternatives because they are more expensive than existing systems (since they have not yet benefited from economies of scale and learning curves), they require changes to user practices, face a mismatch with existing regulations or lack an appropriate infrastructure (Geels, 2012). Niches could be related to management innovations (such as integrated transport systems, sustainable urban planning, sharing schemes, demand management and public transport innovations) or may rise from technological innovations (such as ICT or green propulsion technologies, hybrid and battery electric vehicles, hydrogen fuel cells and biofuels). According to Geels (2012), niche-innovations that are supported by more actors and receive more resources have higher degrees of momentum, are more likely to be nurtured, and emerge as a new regime of mobility. Due to the price of innovation and long development lifetimes, technological niches have a lower chance of being nurtured as a regime in the near future, which is why many decision makers focused on managerial innovations that seem more probable as they need less financial resources.

In Italy, the main drivers of niches resulted to be the level of niche support from government and international policies as well as the supports by incumbent actors, and the power of niche actors. The main problems and cracks also shaped by the low level of supports by incumbent actors and government, uncertainties about the economic productivity and niche performance.

While compatibility with the existing car regime helped the niches of electric mobility and sharing schemes to open up their way in transferring to regime level, need for more supports from new core actors for infrastructure development was highlighted by both literature and interviewees.

Furthermore, niche maturity is another important factor that should be considered. In Italy, coalitions of industry actors shaped for hydrogen fuel cells and biofuels and the regional energy plans support them; however, the interviewed administrative stakeholders did not consider these niches as a reconfiguration for existing car regime in the scope of current transport plans. This is motivated by the idea that these niches are not fully matured and still are in the experimental and market development phase as pointed out by Turnheim et al. (2015b).

The same problem emerges in the demand management and urban planning niches. Although decision makers and public authorities support demand management and sustainable urban planning niches, the momentum of these niches is also limited and depend on good intensions (Geels, 2012). In the context of integrated transport systems, niches such as the multi-use transport cards, are developed in Italy; nevertheless, there is need to develop intermodal transport integration (EC, 2013), for example the urban and extra urban rail system has a very limited space for bikes and it is not linked to integrated ticketing system of bus and shared bikes.

In the previous section it was discussed that the dominant pathway (AUTO-City) needs to be shifted into more sustainable scenarios (ECO-City and ELECTRI-City pathways), and the Italian stakeholders preferred ECO-city pathway because they stated that it has more achievable objectives and that they can have more controls on it. Considering the nurtured niches in Italy and the aims of 2030 targets, the shift to ELECTRI-City pathway seems to be too ambitious to be applied in the near future as it depends on the interests of electricity grid operators as crucial in the integration of smart charging equipment into the electric vehicle system (Bakker et al., 2014). In Italy, the expansion of charging infrastructure does not get strong support from the interviewed deciding authorities both at a national and local level. The other scenario, ECO-City, which has more viable objectives, is more appreciated by the interviewed stakeholders. This is confirmed by looking at the aims of transport plans in Italy that is mainly focused on limitations for cars, enhancing public transport, and shared mobility services instead of providing electric mobility infrastructure (EC, 2013; Eltis, 2015).

6. Conclusions

This paper aimed at identifying the dynamics of the urban mobility system based on a MLP analysis, to analyze the driving and restraining role of those dynamics and finally to identify the pathway opened by those dynamics regarding the 2030 timeframe and visions. The study applied a qualitative research method based on the analysis of secondary resources and interviews with urban mobility system stakeholders. The results of this paper can help the transition researchers to get a review of the main dynamics of urban mobility system. It can also help the transport managers and decision makers (especially in Italy) to heal the cracks of sustainable transport regimes and improve their performances. In addition, the study introduced the landscape forces and promising niches that can help transport planners to move towards more sustainable transport modes.

The study revealed that at the macro level (landscape) the economics, market, industry and social variables shaped the macro trends of urban mobility systems, while in Italy the stakeholders mainly paid attention to the operational and strategic aspects of political and economic factors. At *meso* level, three mobility regimes were introduced; among them public and non-motorized transport regimes had contradictory dynamics with the automobility-private car regime in which drivers of the dominant regime (automobility) are the barriers to the other two regimes and vice versa. In Italy, the transport operators and deciding authorities expressed complains about the high costs of public transport system that cannot be covered by incomes, bringing the system to be highly dependent from government supports and could not be a powerful regime to replace automobility. The main cracks and tensions destabilizing dominant car based regime emerge from landscape pressure on market variables, traffic problems (congestion and parking problems) and the strategies and plans to reconfigure the existing regime (like pollution limits for vehicles). On the other side, industry and technology dynamics play an important role in stabilizing the automobility regime.

At micro level, some niches mentioned in literature does not get enough support in Italy, industrial coalitions and strategic plan supports are seen for some niches like biofuels and hydrogen fuel cells, but they are not fully matured to get enough supports from the regime actors. Some innovations are seen in terms of integrated transport planning and operations, but different modes in urban transport system are not joint together properly. Managerial innovations were more appreciated by administrative interviewees, but this niche has a limited momentum due to long-term effectiveness. Considering the maturity, momentum and power of public and non-motorized transport niches from one side, and the attractiveness of hybrid technologies introduced by car industry on the other side, AUTO-city pathway still is the dominant pathway in Italy, as highlighted in the country by the second highest number of vehicle ownership in Europe.

Therefore, looking at Marletto's (2014) classification, the current Auto-city pathway needs to be shifted to the other pathways (Eco-city or Electricity). Most of the interviewed stakeholders argued that the wide use of electric cars needed in ELECTRI-City pathway is an ambitious goal that requires long-term vision, planning strategies and infrastructure development of smart grid, which is less probable in the near future. The interviewed stakeholders showed their belief about the need to moderate that the current automobility regime through the development of public and non-motorized transport modes that lead to an ECO-City pathway. This viewpoint is aligned to the most recent study of Marletto et al. (2016) in which the authors state that the AUTO-City and the ELECTRI-City scenarios mostly result from global dynamics (landscape level dynamics), whereas the ECO-City scenario emerges from a two-dimensional diffusion process: horizontally, at the local level, and vertically, from the local to the national level, in order to gain greater political support (Marletto et al., 2016).

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