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**Qualitative Scenario Building
for Post-carbon Cities**

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Summary

In defining the transition towards a post-carbon future, understanding the needs and determinants for policy priorities in different types of cities will help tailor a common roadmap that can be adopted under various socio-economic contexts. This paper provides an analysis of results collected in a participatory scenario building exercise undertaken within a research project on post-carbon urban futures (Post-Carbon Cities of Tomorrow, POCACITO). It is based on local workshops organised in nine European case study cities, which employed a three-step methodology consisting of an initial assessment, vision building and backcasting exercises. All exercises had a strong focus on the inclusion of stakeholders. Comparison of outcomes from the visions and scenarios resulting from these workshops provides insights on the drivers that determine different priorities in policy action for cities working to transition toward post-carbon futures. Results from the case study cities show similar elements in the strategies proposed by stakeholders, focusing primarily on urban projects for energy efficiency and the transition to non-fossil energy resources. However, the specific mix of strategies envisaged for each city has been influenced by local issues, such as the geographical location or the size, as well as different points of departure with regards to emission reductions and sustainability strategies already achieved.

Keywords: Post-carbon, Visions, Scenarios, Transition, Sustainability

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Abstract

In defining the transition towards a post-carbon future, understanding the needs and determinants for policy priorities in different types of cities will help tailor a common roadmap that can be adopted under various socio-economic contexts. This paper provides an analysis of results collected in a participatory scenario building exercise undertaken within a research project on post-carbon urban futures (Post-Carbon Cities of Tomorrow, POCACITO). It is based on local workshops organised in nine European case study cities, which employed a three-step methodology consisting of an initial assessment, vision building and backcasting exercises. All exercises had a strong focus on the inclusion of stakeholders. Comparison of outcomes from the visions and scenarios resulting from these workshops provides insights on the drivers that determine different priorities in policy action for cities working to transition toward post-carbon futures. Results from the case study cities show similar elements in the strategies proposed by stakeholders, focusing primarily on urban projects for energy efficiency and the transition to non-fossil energy resources. However, the specific mix of strategies envisaged for each city has been influenced by local issues, such as the geographical location or the size, as well as different points of departure with regards to emission reductions and sustainability strategies already achieved.

Keywords (4-5)

Post-carbon, visions, scenarios, transition, sustainability

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Introduction

A significant proportion of greenhouse gas emissions are attributed to urban areas, with figures between 70 and 80 percent of global emissions (Duren and Miller, 2012; Satterthwaite, 2008). It is therefore of pivotal importance that cities, while being centres of economic and social activities, commit to and advocate carbon reduction strategies. Sustainable urban solutions have great potential to contribute to climate change mitigation.

The existing literature has focused on existing plans for mitigation at the urban level. These plans have been identified by means of self-reported measures, such as survey questionnaires or interviews of city representatives and experts (Carmin et al., 2012; Castán Broto and Bulkeley, 2013), or by collecting published urban climate change mitigation plans or strategic policy and planning documents (Reckien et al., 2014). Beyond these plans, which frequently are related to relatively short term policy priorities, plans to transition towards a post-carbon future need to consider time horizons, which stretch well beyond time frames considered in normal planning processes. This paper is based on visioning and scenario development as a forward-looking activity aimed at a long time horizon, spanning from now until 2050. The foresight exercises conducted in the case study cities aim at exploring urban post-carbon futures.

The concept of “Post-Carbon Cities” embodies a rupture in the trajectories of carbon-dependent urban development. Present-day development has led to high levels of anthropogenic greenhouse gases, whereas future paths must lead to new types of cities that are low-carbon, and environmentally, socially and economically sustainable. The term post-carbon emphasises the transformation connected to a shift in paradigm, which is necessary to respond to the multiple challenges of climate change, ecosystem degradation, social equity and economic pressures (Ridgway et al., 2014).

Considering the high inertia of urban ecosystems (Vidalenc and Theys, 2013), disruptive trajectories need to be conceived and planned on long time frames. Foresight exercises, framed as systematic, vision building processes, offer the necessary framework for reflecting on how to enable action leading to such fundamental changes. There are different approaches for dealing with uncertainties long time frames entail. Generally either forecasting techniques, including complex simulations and modelling approaches, are used to develop images of the future based on the knowledge of existing trends, or foresight techniques, which are based on different types of scenario approaches. Compared to foresight approaches, forecasting is less capable of capturing important changes and transformations. As Popper puts it "... no scientific predictor-whether a human scientist or a calculating machine-can possibly predict, by scientific methods, its own future results" (K. R. Popper, *The Poverty of Historicism*, [Routledge & Kegan Paul, London 1961 (1957)], cited by Dreborg, 1996: 823).

Foresight approaches on the other side, especially if based on scenario building, are more flexible for taking into account novel impacts and changes in trends, and are at the same time formalised for producing outputs which are sufficiently robust. They are thus credible for providing policy support, and can at the same time be sufficiently ambitious for representing radical policy changes needed for a post-carbon transition and to inform decisions -that will change the urban shape, urban carbon performance and ultimately urban lifestyles. Scenarios and visions are based on assumptions and views on future developments, which are able to take into account uncertainty, complexity and discontinuity, are adequate in contexts where both uncertainty and complexity are high. Rather than providing reliable predictions of the future, scenarios support the learning process about factors and trends conditioning future developments (Schoemaker, 2004). Although the field of future studies that these approaches belong to has been famously described as a "very fuzzy multifield" (Marien, 2002: 269), in the literature it is widely agreed that scenarios as well as other forms of foresight represent structured and systematic forms of constructing "possible futures" and are useful inputs in

policy processes. In order to facilitate the matching of scenarios to the context in which they are used, several efforts have been undertaken to develop scenario development typologies (Börjeson et al., 2005; van Notten, 2006). These efforts have not yet resulted in a commonly agreed typologies or definitions. For example Börjeson et. al. (2005) classify “predictive scenarios” as one major subgroup, while Van der Heijden et. al. (2009) state that a scenario “is not a prediction”. Despite these ambiguities, several scenario typologies have been arranged along different shapes of “probable, possible and preferable”, or “predictive, explorative and normative” (Börjeson et al., 2005: 14). Among these, the normative scenarios are of particular interest for the present work, as they, rather than at exploring how things might evolve, describe how a certain future can be reached.

Normative approaches to scenario building have been used in specific policy contexts using the problem solving approach (how can the specific normative endpoint be reached?), especially in the context of energy and transport policies, and more generally in the context of sustainability concepts where paradigm changes seem to be particularly relevant. One specific technique for building normative scenarios consists of the “backcasting” technique presented by Robinson (1990: 822). Whereas scenarios generally provide a view towards different possible futures, under this approach the way “... desirable futures can be attained” is explored (Robinson, 1990). It involves working backwards from a particular desired future end-point to the present in order to determine the physical feasibility of that future identifies policy action required to reach that point.

Within foresight studies, the participatory element plays a prominent role. The term ‘foresight’ has been defined as a “systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at enabling present-day decisions and mobilising joint actions,” (Gavigan et al., 2001; Van Cutsem, 2010: 5). This definition is adopted herein. According to Gavigan et al (2001), it is the participative dimension that distinguishes ‘foresight’ from other planning activities, and Robinson points to the added value of involving eventual end users of the scenario

analysis like authorities that are relevant for the implementation or the general public (Robinson, 1990). Their involvement is seen as crucial not only for the sake of discussing results, but also for the relevance of the analysis delivered and for the capacity to provide tailored inputs to the local contexts.

According to a recent study, “even well-crafted scenarios can fail to have their intended policy impact if they present irrelevant information, lack support from relevant actors, are poorly embedded into relevant organisations or ignore key institutional context conditions,” (EEA, 2009). The challenge in scenario development lies in the capacity of providing relevant and precise scenarios which integrate both scientific and local knowledge (Reed et al., 2013), generating a balance between credibly anchoring scenarios in the local situation, and providing results that are not trivial but offer novel inputs into the local context.

This paper presents and analyses the outcomes of a set of foresight exercises undertaken together with representatives in nine European cities, namely Barcelona, Istanbul, Lisbon, Litomerice (CZ), Malmo, Milan, Rostock (G), Turin, and Zagreb. During the stakeholder workshops, vision building and backcasting exercises were conducted to identify a post-carbon transitioning process. First, the methodology section describes the process of creating visions and defining actions for a post-carbon transition. The data and results section presents the elements of the city visions, central issues and strategies, and frames these results using socio-economic and environmental indicators for the case study cities. Next, the visions and scenarios are considered in relation to present day policies in the cities. The analysis connects the salient characteristics of the local visions and specific mix of strategies envisaged for each city to the socio-economic and environmental characteristics of the city. Finally, we conclude that the visions produced in the different local case study workshops across Europe convey, at a first glance, a relatively high convergence with regards to visions and strategies to be undertaken for reaching post carbon urban futures. At a closer look, nevertheless, in some

cities sustainability concerns relating to economic development and social justice have a considerable weight among priorities in the visions and strategies.

Methodology

All stakeholder workshops followed a common three-step approach consisting of an initial assessment, and vision building and backcasting exercises. The approach was adapted from Robinson (1990) to fit the possibilities of an explorative exercise undertaken within a research project, without a direct mandate within any formal policy process, and with relatively short time for activities compared to “real life” deliberation processes. This common methodology was applied with some variations in all workshops, which proved necessary either because the local political situation did not allow for extensive stakeholder participation (in Lisbon a combination of interviews and a small workshop was chosen) or because the approach to creative brainstorming was not deemed suitable for the attending stakeholders (as in Barcelona and Istanbul).

The starting point used in the approach consists in the creation of a common view on the baseline and objectives to be established among participants. The description of the actual situation of the single city was made using the common set of indicators (Silva et al., 2014), intended to assess and monitor the post-carbon city transition process. The discussion of the indicator data set with stakeholders represented the starting point for the second step, building of a local vision, during which elements for a post-carbon vision were designed and discussed by stakeholders. Creative brainstorming was employed to induce stakeholders to first envision the future of their city, then in the third step, develop qualitative scenarios describing how the **transition** to reach their post-carbon vision might be translated into single actions. Multiple background scenarios were proposed in order to allow for a first form of sensitivity analysis, verifying whether the external development factors described in these scenarios would have compromised the achievement of the goals defined in the city vision.

Initial Assessment and Vision Building Workshop

In most cities, the first two steps were joined in a single meeting, including the presentation and discussion of the initial assessment results and the vision building exercise. Presenting the initial assessment results provided an opportunity to discuss the main challenges the city is facing in terms of social, economic, and environmental indicators. Stakeholders offered local knowledge not always captured by the data sources used for the initial assessment, and discussion of current strengths and weakness helped clarify what municipal competencies are and where progress can be made and is needed most. Discussions on the initial assessment furthermore served as the starting points from which each vision was projected.

The vision represents the normative end point, different than the one that would be reached without specific dedicated action. Stakeholders were encouraged to imagine how their city should look in 2050 as a post-carbon city. To do this, participants were divided into smaller groups and prompted to collectively draw images representing their vision. This creative activity encouraged stakeholders to be more expressive, facilitating a disconnect from daily policy discourse and encouraging interaction in a less formal way. They were furthermore invited to reflect on the vision as members of the community first, and only subsequently as representatives of their respective organisations. Stakeholders then summarised the drawings, and organised their ideas using a mind map. The main themes were identified and the key messages were synthesised to develop the post-carbon vision.

Backcasting Workshops

While the purpose of the first workshop was to imagine what a post-carbon future could look like, the purpose of the second was to consider what steps should be taken to get there. The backcasting workshop was based on the visioning process and developed the pathway from the current situation towards the post-carbon vision. Specifically, the aim was to engage stakeholders to conceive of the

intermediate steps of future actions, measures and strategies for urban management, in achieving the vision. The qualitative scenario was intended to reflect local challenges identified through the initial assessment of the case study city.

The backcasting workshop methodology followed a five key steps as proposed by Kok et. al. (2011):

1. Define a normative “desired” end point (the vision from the previous visioning workshop)
2. Consider potential obstacles and opportunities in reaching the end point
3. Identify milestones or interim projects that would signify progress in reaching the end point
4. Define actions that must be taken to get to the end point
5. Validate the robustness of actions in the case of other background scenarios playing out

Using the 2050 post-carbon vision, stakeholders created a clear definition of several endpoints that represent the main sectors and ideas proposed in the first workshop. For each normative end point, stakeholders discussed the various obstacles and opportunities anticipated in working towards the endpoint under a business as usual scenario, and wrote them down on index cards which were then arranged on a timeline from present day to 2050. The same process was carried out for milestones and interim projects, visually highlighting intermediate objectives that mark the way towards the desired endpoint. Next, participants brainstormed concrete actions needed to reach interim and final goals, and again placed them on the timeline. Attention was given to what has to be done, who needs to do it, and when it has to happen. Groupings of actions and interrelations between actions were considered.

Data and Results

Characterisation of case study cities

The range of case study cities provides coverage of different geographic areas and socio-economic conditions in Europe. The characteristics of the case studies differ according to city typology, size, density, wealth, and climate, as well as governance and economic structures. All cities have already engaged in some climate change mitigation activities, so initial experiences were already available when the workshops began.

The case study cities are of varying size, ranging from a minimum of 24 thousand inhabitants in Litoměřice, to a maximum of nearly 14 million in Istanbul. The ranking of the cities in terms of population reflects the ranking in terms of extension, with Litoměřice and Istanbul being the smallest and the largest cities in the sample, respectively. Istanbul is also the most dense city, while the lowest population density is registered in Malmö. The selected cities display a large dispersion as far as economic performance is concerned, with Litoměřice at the low end and Milan at the high end of the spectrum, with a GDP of 11,800 and 45,600 euros per capita, respectively. Carbon intensity has been used as an indicator for the energy efficiency of the productive sector. Malmö performs best, having the lowest intensity in terms of carbon emission in relation to the GDP, while the highest intensity is registered in Istanbul. In terms of the environmental indicator modal share, Litoměřice records the largest share of trips by public transport, bicycle or foot is, as more than 70 percent of trips are made using actual or potential low-carbon transportation. Conversely, in two very different cities, Turin and Istanbul, the share of non-individual car transport drops to only 55 percent, and to 51 percent in Lisbon. Among the case study cities, urban waste recycled is highest in Rostock, with a share of 54 percent, while Istanbul is the city with the lowest percentage, recycling slightly less than three percent of the collected waste.

Characterisation of the stakeholders

The type and number of stakeholders involved in the participatory workshops varied between cities, and included representatives from urban administrations and agencies, NGOs, research, and private business. However, the availability of stakeholders to participate in the exercises had some limits, and thus the range of stakeholders cannot be considered representative, as would be required in the context of a decision making process. Because the scenario building process was not connected to any municipal planning process, it effectively limited the quantity and type of stakeholders who responded to the invitation. On average, 13 stakeholders per city attended the first round of workshops and 9 attended the second, with limited continuity between the two workshops. Participants mainly came from public agencies (30%), urban administration (22%), NGOs (24%), research (13%), and private business (10%). Overall, the attendance of stakeholders corresponds largely to those (Dreborg, 1996: 826) identifies as the main addressees of backcasting studies, that is governmental and municipal authorities, organisations, private enterprises and an informed general public.

One challenge of post-carbon policies and their implementation consists in the generation of public consent and willingness of citizens to change their lifestyles and consumption decisions.

Furthermore, civil society plays a very significant role by “creating spaces for champions of policy reform and providing platforms where these champions can advance these ideas” (Sathaye et al., 2007). This requires, in a deliberative process, the involvement of civil society at large in order to tailor policy decisions in a participative manner and to gain commitment for the necessary actions. Nevertheless, in these exercises, the civil society was not directly represented, but some representatives of private business did participate.

Major efforts were made to involve stakeholders, but response rates were not high in all cases. On an average, 55% of the invitees attended. In Barcelona, one of the biggest case study cities, a

visioning process initiated at the city level had recently been concluded, so interest in participating in the workshops was relatively low. Conversely, in the small city of Rostock, the POCACITO benefitted an ongoing discussion forum on Energy issues in the city, and from the recent design of an ambitious local Climate Plan. In fact, in this case, most invitees actually attended the workshop.

Post-carbon visions

The post-carbon visions developed in the case study cities each envisage changes in many different policy sectors, mainly those where urban administrations are responsible or have some autonomy for decision making. The sectors considered in the visions encompass, in addition to energy policies (where the possibility of policy changes at local level are somehow limited), many aspects of the urban policies that contribute to shaping future patterns of energy consumption. Regarding urban form, this includes both design of urban form and growth, and energy performance of single buildings and transport alongside with aspects of waste management and consumption.

Furthermore, economic development was considered a central issue in the visions of several cities, specifically promoting technology change and research activities in the private sector to support innovators, innovative business models, and to increase tourism. On the other side technology change was seen as a field of action not so much for creating new technological options for urban infrastructures, but rather as a means of economic development, issues like tourism and protecting or enhancing biodiversity were seen as direct or indirect means of improving urban quality within existing development paths. Economic innovation was addressed referring to a “circular economy”, mentioning changes in consumption patterns and in waste management. The content of the visions formulated was not restricted to decarbonisation alone, but encompassed also fundamental elements of a sustainability vision, like social justice or improved governance.

The 2050 visions were described in different ways, yet all of the visions shared common themes and overlapping ideas for the future. For comparison, the main points of each vision have been organised

according to twelve sectors: transport and mobility, energy, land use and infrastructure, social issues, economy, biodiversity and conservation, technology and innovation, education, tourism, governance, food production, and consumption and waste. The sectors addressed varied from city to city.

The coverage of sectors in the visions sheds light on the importance attributed by the cities to some policy areas. Urban transport and mobility, and in relation land use planning, are prominent issues together with economic changes, which were addressed by all local visions. Economic development issues were also addressed by all cities. The concrete issues addressed within each of these policy fields give further insights as to where cities see margins for action.

Three sectors were considered in the visions of all cities: transport and mobility, land use and infrastructure, and the economy. Visions on transport contain a range of qualitative ideas such as efficient, clean, and accessible public transport to management and form of transport means, like sharing and smart logistics. Issues covered in the transport and mobility sector can be divided into five main categories: quality of transport; carbon-free transport; public over private transport; integration, connection, and multimodality; and reduced impact from traffic. Visions for land use focused mainly on the quality of the urban environment and efficient management of natural resources, as well as buildings and the re-use of urban areas. Visions for the economic sector are either focused on improving competitiveness or on the transition of the urban economy to a sustainable low-carbon economy.

In terms of energy, eight local visions touch on energy efficient development, self-production and consumption of energy, alternative energy sources, increased use of and investment in clean energy, regulation of energy policies at city level, energy and the carbon market, or calculations of emissions from buildings. Visions on energy covered four categories for urban action, namely reform of energy generation and distribution; concepts, plans, and performance; reducing energy consumption; and energy efficient or energy generating buildings.

Social issues are included in the visions of seven cities, and aim at social inclusion, increase safety, and enhance cultural identity. The planning of city development, transportation, and infrastructure are also included as they positively affect quality of life in the city. Generally, social visions can be divided into 3 main groups: healthy community, safe community, and quality of life. Related to waste and consumption, visions see cities under a metabolism approach, where inputs and outputs of matter become relevant and allow for addressing the phenomena of carbon leakage.

Consumption and waste, included in six visions, can be categorised into three main areas: waste reduction, efficient use of resource, and closed material cycles.

Technology and innovation and governance are discussed in five visions. Future forms of urban governance focused on five main areas: information systems, participation, procedure and coordination, instruments for governance, and resilience. For the technological sector, visions see technology and technological innovation as tools for the post-carbon transition, which will help drive economic development. Visions on technology and innovation include ideas such as smart technology and integrated systems and networks.

Half of the cities covered education, tourism, and food production. For education, two distinct approaches became evident: one part of the vision focused on access to education as related to social justice and as a basis for economic development (all citizens receiving a scholastic education), whereas the scope of generic public education was seen by many cities as a way to promote a higher level of social and environmental awareness, and essentially as a prerequisite for achieving a post-carbon urban future. For tourism, visions seek a balance between tourism and quality of life for the local population, where the city is attractive for tourism and tourism contributes significantly to the local economy. As far as food production is concerned, visions focus on self-sufficiency through local production of food, and in turn reduced transport of food, as well as healthy eating and enjoying a high quality of food.

Less importance was given to biodiversity, as only three cities included biodiversity and conservation in their visions. These visions focus on cities as socio-ecologic systems, which entail the consideration of natural components of the system as biodiversity in urban areas. Visions range from the protection of natural resources, to cities rich in biodiversity, and ideas of encouraging the symbiosis of rural and urban areas inside a preserved green zone, and conserving the environment and natural resources.

Backcasting scenarios

After the 2050 post-carbon visions were produced, the stakeholders proposed specific actions that should be taken to meet the visions through a backcasting approach. Given the long timeframe up to 2050, and the different nature of actions, the stakeholders specified short, mid, and long-term actions.

Applying a semi-quantitative approach to assess this rather qualitative material represents a second-best solution, which was made in order to deal with very heterogeneous material and with differences related issues like framing. Furthermore, consideration of the number of actions does not take into account important qualitative differences such as weight and timeframes of actions. For instance, in the case of Litoměřice, the realisation of the geothermal plant discloses a new source of energy and will enable the city to substantially improve its carbon footprint, using one single measure.

Actions.

The number of actions proposed also varied by the city considered. Stakeholders from Litoměřice and Istanbul were the most productive, contributing more than 20 percent each of total actions proposed. Actions suggested for the cities of Milan, Malmö and Rostock contributed to around 10 percent each of total actions. Actions for Zagreb, Barcelona and Turin are nine, seven and four percent of total, respectively.

The number of actions proposed by the stakeholders also varies considerably depending on the relative sector and on the detail dedicated to some sectors. Some sectors are addressed by a larger number of actions than others. Obviously the energy sector, as indicated in Figure 1, was addressed by the greatest share of single actions, corresponding to 27 percent of total actions suggested by the stakeholders. Twenty and 12 percent of actions were identified in the transport and governance sectors, respectively. The land use and building sector contributed to 11 percent of total actions, while economics seven percent. Education is responsible for five percent of actions, while social as well as waste for four percent. Tourism, food production, technology and biodiversity are also considered in the backcasting exercise, and these sectors jointly contribute to 10 percent of total actions.

Figure 1: Distribution of actions by sectors (left) and cities (right)

Considering all actions in local visions at an aggregate level, energy appears to be the sector with the largest number of actions, yet some divergences emerge from a comparison among the single local visions. For example, in Barcelona, stakeholders focused largely on transport, governance and economics, while only a small number of actions addressed the energy sector. In Istanbul, the land use sector contributed to 20 percent of total actions proposed, followed by energy, governance and economics.

Figure 2: Actions per sector by cities

In Zagreb, actions in the governance sector contributed to the largest share, 10 percent of total actions. About 30 percent of total actions in Rostock are in the energy sector. However, in Rostock, the land sector has not been covered by any action. In Milan, transport and energy are the sectors where the largest number of actions has been proposed. It should be noted, however, that stakeholders did not suggest specific actions in the economics, social, or tourism sectors. There are cities, like Barcelona, Turin and Zagreb, characterised by a balanced contribution of actions in all sectors. Other cities, like Milan, Rostock, Litoměřice, and Malmö, on the contrary, display a disproportional contribution of actions in specific sectors, in particular in the energy sector. Actions in the economic sector have received some prominence, making evident that if post-carbon cities are conceived as sustainable and resilient cities, priorities for future urban development need to address issues which go beyond the generation of decarbonisation and high-quality urban spaces.

The majority of actions proposed in the energy sector are related to the generation and distribution of energy. The actions in this area focus primarily on urban projects for the transition towards non-fossil energy resources. The second largest group is represented by actions related to the energy consumption in buildings, with a strong emphasis on new energy efficiency at the building level. It should be emphasised, however, that some stakeholders acknowledged that the potential of these changes may be limited due to the fact that the potential for realising energy generating or zero-energy concepts in existing buildings may be somehow limited. The third group in the energy sector is represented by actions related to the definition of concepts, plans incentives and improvements of the energy performance.

Timeframe.

The milestones used by participants for indicating the achievement of intermediate and final goals provides a view on the timeframes considered by participants. Most of the milestones are

concentrated in the period through 2020, and only about 30 percent refer to the period after 2030. Even considering that milestones are not necessarily convergent with final goals; this highlights difficulties encountered by stakeholders in detailing actions and goals for long time frames.

Relation to present day policies

The analysis of the measures proposed in the workshops requires detailed information on the present day policy projects and discourses on-going in the individual cities. Some of this information is provided in the initial assessments of the case study cities, describing the current situation on the basis of common key performance indicators, and existing and planned policies.

A comparison of the initial assessment results makes evident the heterogeneity of the cities in terms of ongoing or future strategies, and challenges identified in relation to a post-carbon transition.

Although all cities have started some for decarbonisation policies (this was in fact a selection criteria for the case study cities), they range from revising existing strategies, like in Malmö and Barcelona, to having a great number of ambitious strategies, as in Rostock and Milan, to working on single elements without having a comprehensive strategy, evidenced by Zagreb, Litoměřice and Istanbul. Istanbul, albeit having made some commitments for decarbonisation being a member of C40 Cities still needs to set up a basic accounting system for CO₂ emissions, whereas Malmö is planning to adapt its accounting system to a more holistic version of measuring the carbon footprint, which even takes into account forms of carbon leakage connected to different consumption patterns. Barcelona is committed to innovative and smart solutions for improving energy efficiency of public services, especially in the transport sector.

Considering relevant sectors targeted, transport emerges as the most important in Lisbon and Barcelona, whereas households are first in Milan (alongside with services), Zagreb (alongside with commercial uses), Turin, and Malmö. In some cities, energy consumption has increased over the past

decade: this holds for services and transport in Milan, transport and industry in Lisbon, services in Turin, and also for one city that already has a decarbonisation strategy in place, Malmö. Among the case study cities, only Barcelona has not experienced growing energy demands during the period considered. The carbon intensity decreased in all cities considered, from different levels and at different rates.

All cities note challenges regarding economic and social policies, which have been accentuated by the economic crisis. In fact, all cities face increasing rates of unemployment, and are, in some cases, concerned about social exclusion, as in Malmö and Turin. The economic crisis has furthermore contributed to an increase in public debt, a factor that constrains the potential range of local policies, as seen in Turin.

Most cities highlight the need to promote economic growth as a priority among the challenges reported in the initial assessments. In cases such as Lisbon, perspectives on economic growth are explicitly connected to an increase in the possibility of the local authority to act. The only exception in this sense is made by Milan, where the need for further economic growth is not directly addressed as a challenge described for this city; rather the vision focuses on smart technologies and innovation.

Analysis

The previous quantitative consideration of the workshop outcomes indicates that the greatest attention, measured in terms of number of actions, has been given to the transport and in the energy sectors, respectively, with a strong emphasis on non-fossil energy generation, energy efficient buildings and emission reduction in local transport. Yet a breakdown at the city level reveals that some divergences as other sectors appear of primary importance in some cities.

One way to interpret this data is to connect the workshop outcomes with the framework conditions, both in relation to the workshops (especially the characterisation of stakeholders) and the baseline

conditions of the cities, assuming that for instance, stakeholders from cities that show greater progress in terms of CO₂ reductions, might have suggested a continuation of successful policies, proposing a correspondingly larger share of actions in the energy sector compared to the economic and transport sector. The objective of the following analysis is to identify whether there is a relationship between the characteristics of the stakeholders and the share of actions proposed in the different sectors, or between the city characteristics and the emergence of priority sectors. Furthermore, types of stakeholders attending the workshop varied, with public agencies well represented in most cities, and NGOs and representatives from the civil society represented mainly in single cities, like Milan and Zagreb.

For the purpose of this analysis, cities have been divided in three groups, small, medium and large, depending of the area of the city; three groups depending on the population density; three groups depending on the GDP per capita; and two groups describing how the cities score in terms of carbon emissions. The label high and low identifies cities that have high and low CO₂ emission intensity, referring to the relative differences within the case study cities. Three groups have been identified as far as eco-modal share is concerned. The high label identifies cities which have the higher share of trips by public transport, bicycle or foot. Finally, according to the indicator of waste recovery, three groups have been identified depending on the share of waste that is recycled.

Considering the sectors where the largest number of actions has been proposed, some conclusions can be drawn with respect to the importance attributed to each sector in the different cities. For example, in Barcelona, 31 percent of actions suggested belong to the transport sector. In Istanbul, 20 percent of actions are in the land sector. In Litoměřice, 25 percent of actions are in the transport sector. The most important sector for stakeholders of Malmö and Rostock was energy, with 42 and 70 percent of actions concentrated in this sector, respectively. In Milan and Turin, 51 and 17 percent

of actions are in the transport sector, respectively. In Zagreb, actions in the governance sector are responsible for 26 percent of total actions.

Local policies have limited influence on energy policies, which are largely determined at national level. Possibilities of action available for local policies principally concern aspects of energy consumption via sector-oriented policies, like transport or spatial planning. Consequently, the transport sector received middle to high number of actions in all cities except for Zagreb.

Interventions on land use and buildings are necessary for outcomes on energy efficiency and improved public and non-motorised transport, so land is of high priority in Istanbul and Litoměřice, while the sector is of low priority in Malmö, Rostock, and Zagreb. Actions in the governance sector are of low priority only in Milan and Turin. Actions in economics are of high priority only in Istanbul, while actions in the social sector are of high priority only in Turin. Finally, actions in education, waste, tourism, food production, technology and biodiversity have not been analysed as they were considered only in a small number of actions in all cities.

Matching these priorities with stakeholder and city characteristics can provide some information on general patterns of relationship between these dimensions. In fact no clear relation emerges between the characteristics of stakeholders among the workshop participants and the priority sectors. Depending on the city, similar groups of stakeholders identified indeed different priority sectors. For example, in cities where NGOs were the group of stakeholders most represented, as in Milan and Zagreb, no uniform image of priority sectors emerges: the transport sector yielded the largest number of actions in Milan, and governance in Zagreb. In cities where public agencies were the group most represented, the most important sectors are energy, land and transport.

Relations between geographic location, size, or other city characteristics and priority sectors instead provide some insights into diversities among the cities. Stakeholders in all cities located in central

and northern Europe attributed high priority to the energy sector, including Malmö, Rostock and Litoměřice. These cities are also the four low population density cities among the case study cities.

The importance attributed to measures for the transport sector appears somehow related to the cities' performance in terms of modal share: the two cities with the highest share of non-motorised transport have also paid the most attention to this sector, whereas those with low or medium scores in terms of modal split attributed at least a medium high importance to this sector. The sector is of high priority in three out of the five cities located in southern Europe, specifically Turin, Milan and Barcelona, which are also among those cities with the highest carbon intensity considered. Visions and strategies that addressed issues related to governance as priority issues were formulated in the bigger cities, Barcelona and Zagreb. High priority for policies regarding land use and energy efficiency in the building sector is the result in cities with relatively low income, such as Istanbul and Litoměřice, whereas the same issue received less attention in the remaining smaller or less dense cities, like Malmö, Rostock, and Zagreb. Finally, low priority for social actions tends to be associated with medium and large sized cities, including Turin, Barcelona and Litoměřice.

Conclusions

Results from the nine European case study cities show similar elements in terms of the actions that have been proposed by local stakeholders. All cities considered have given great attention to the transport and energy sectors, where actions are largely focused on non-fossil energy generation, energy efficiency at building level, quality of public transport, decarbonising private transport, and increasing the share of non-motorised movements.

Remarkably, great importance was attributed to urban governance. The role of public policies in achieving post-carbon visions is seen as crucial by many stakeholders and in most cities, and in some

cases jointly with major possibilities for participation and social inclusion. Connected to this, the call for education was mainly understood as a tool for awareness raising and enhancing citizen consciousness as a first step toward active involvement in post-carbon lifestyles, and, in some cases, also as an instrument of social justice, providing access to all forms of education for all.

Further to these carbon-focused urban issues in the transition to become a post-carbon city, some actions contain more or less pronounced goals related to local economic development and social inclusion. An interesting finding is the great importance attributed to urban governance. The role of public policies for achieving goals described in the post-carbon visions is seen as crucial by many stakeholders and in most cities, in some cases jointly with major possibilities for participation and social inclusion. In connection to this, the call for education was mainly understood as a tool for awareness raising to promote a more conscious behaviour of citizens as a first step toward active involvement in post-carbon strategies. Interestingly for a study on European cities, some strategies address education furthermore as an issue related of social justice, proposing actions promoting access to all forms of education for all.

Less carbon oriented goals are also seen in some cities with relatively low GDPs, when compared to the other case study cities or with the country average, where great emphasis is made in the visions for promoting urban economies and for making cities more competitive. For example, measures directly promoting economic development had a prominent role among the actions indicated in the workshop in Istanbul. In this case, indirect measures like improvement of the quality of urban spaces and creation of new attractions are envisaged as they will increase the attractiveness of the city for new investments. Similar activities have been foreseen in other cities with a relatively low or decreasing level of GDP, such as Lisbon, Turin, and the two post-communist cities in the study, Zagreb and Litoměřice. The orientation towards a need for attracting new economic development is less pronounced in the other cities, but nevertheless has attracted some attention in all cities. A

specific role is reserved for tourism in this context, as high quality of urban spaces can attract tourism, translating thus urban qualities directly into preconditions for urban economic development. Further to this relationship between urban quality and economic development, there was a very low consciousness about potential synergies between decarbonisation strategies and economic development. On the contrary, the high priority attributed to economic activities, if compared to those directly connected to decarbonisation, could be interpreted as related to the fact that economic wealth is seen as a prerequisite for activating new strategies related to decarbonisation. The potential impact of increasing economic activities, and in turn increasing energy demand and carbon emissions, is reflected in some visions aiming at a transition of the urban economy to a sustainable low-carbon economy. In the visions of Barcelona and Milan, this aspect is not explicitly noted; only increasing competitiveness or increasing the use of smart technologies are envisaged as a goals.

A certain importance is also given to technological innovation, seen mainly as a means of enhancing the competitiveness of urban areas. Interestingly, de-carbonisation of industrial production or in the services sector was not addressed at all, if not implicitly included in the consideration of de-carbonisation of heating and cooling of buildings. Technological innovation as an instrument for new energy generation was not addressed as an important prospective, as actions rather pointed to existing technologies.

Aspects related to the quality of the urban environment were addressed either as part of sector oriented strategies, such as increasing walkability of and cycle path in cities, conserve and enhance biodiversity, or as instrumental for economic growth, as far as the increase in tourism as an economic sector valorising urban spatial qualities is concerned.

A second conclusion of the analysis is that the specific mix of strategies proposed for each city has been influenced by local characteristics, such as the geographical location, size, and point of

departure with regards to emission reductions (greater or smaller achievements in terms of CO₂ intensity). On the contrary, economic considerations, such as the level of GDP per capita of the city, seem to be less influential in driving the policy mix.

The relative homogeneity of the results and the high rate of correspondence to issues considered in the international debate on post-carbon transitions can be interpreted as a sort of bottom-up confirmation for these arguments. However, it can also be interpreted as a result of a relatively high-level of uniformity in the composition of stakeholder groups across the local case study workshops, raising the question of how visions and scenarios might be described in a more comprehensive forum.

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Figure 1: Distribution of actions by cities (right) and sectors (left)

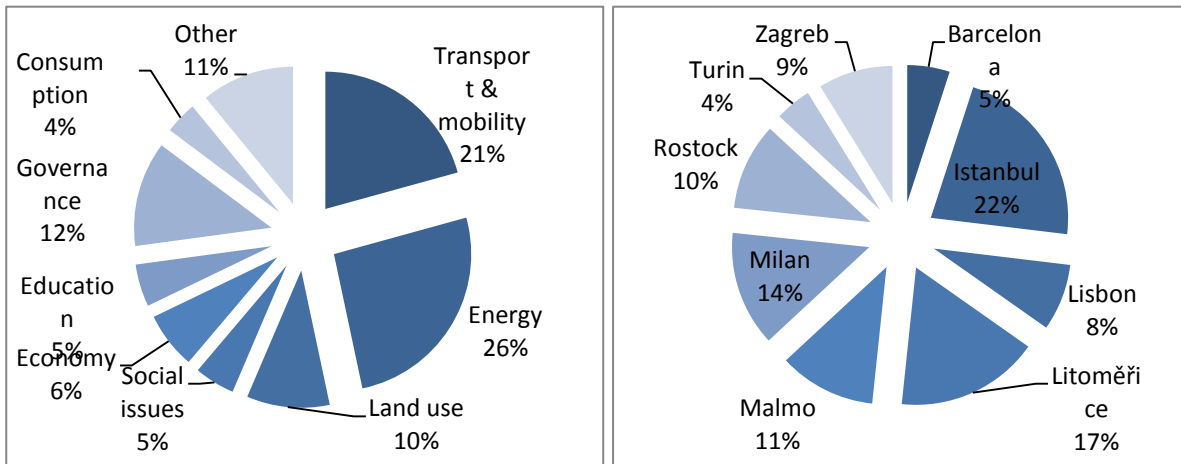
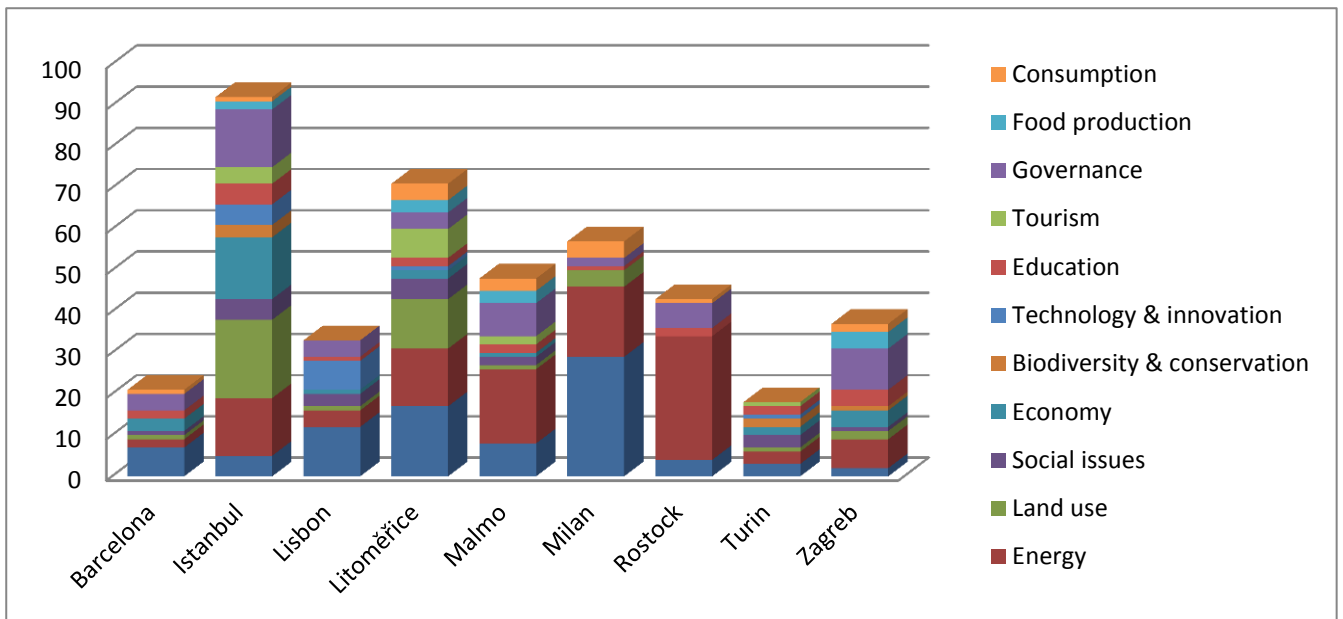


Figure 2: Actions per sector by city



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