



european post-carbon  
cities of tomorrow

# QUALITATIVE SCENARIO BUILDING FOR POST- CARBON CITIES

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## LIST OF ABBREVIATIONS

<b>BAU</b>	Business as Usual
<b>CCS</b>	Carbon Capture and Storage
<b>GDP</b>	Gross Domestic Product
<b>IPCC</b>	Intergovernmental Panel for Climate Change
<b>KPI</b>	Key Performance Indicator
<b>RCPs</b>	Representative Concentration Pathways
<b>RE</b>	Renewable Energy
<b>SSPs</b>	Socio-economic Pathways
<b>WP</b>	Work Package

## I EXECUTIVE SUMMARY

In defining a common roadmap for European cities 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 case study 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 the European case study cities of the POCACITO project, which employed a three-step methodology consisting of an initial assessment, vision building and backcasting exercises. The case study cities include a selection of eight cities across Europe, and all exercises have a strong focus on the inclusion of stakeholders. Comparison of the visions and scenarios resulting from these workshops provides insights into drivers that determine different directions in policy action for cities working to transition toward post-carbon futures. Results from the case study cities show similar elements in the local strategies that have been proposed by local stakeholders, focusing primarily on urban projects for energy efficiency and transition to non-fossil energy resources. On the contrary, 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.

## II INTRODUCTION

A significant proportion of global greenhouse gas emissions are attributed to urban areas, with figures ranging from 31 to 80 % of global emissions (Duren and Miller 2012; Satterthwaite 2008). It is therefore of pivotal importance that cities, while being the centre of economic and social activities, become crucial players of carbon reduction strategies worldwide. Sustainable urban solutions have great potential to contribute to climate change mitigation.

The existing literature has so far 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, Nadkarni, and Rhie 2012; Castán Broto and Bulkeley 2013), or by collecting published urban climate change mitigation plans or strategic policy and planning documents (Reckien et al., others 2014).

Beyond these plans, which frequently are related to relatively short term policy priorities, plans for a transition towards a post-carbon future need to consider time horizons, extending 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 till 2050. The objective of the foresight exercises, conducted in the eight case study cities of the Post-Carbon Cities of Tomorrow (POCACITO) project, is the exploration of post-carbon futures.

Within the POCACITO framework, the concept of “Post-Carbon Cities” is conceived as a development based on a rupture in the trajectories of carbon-dependent urban development. Present day, carbon dependent urban development has led to high levels of anthropogenic greenhouse gases, whereas new trajectories need to lead to new types of cities that are at the same time low-carbon and environmentally, socially and economically sustainable. The term post-carbon, as defined in the POCACITO Project, emphasises the process of 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 such long timeframes and the uncertainties they entail, due to social processes as well as to physical and technical change: forecasting techniques, including complex simulations and modelling, developing images for the future based on the knowledge of existing trends; they are thus incapable of considering important changes and transformation. 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 are at the same time ambitious for representing radical policy changes like those that might be needed for a post-carbon transition. Foresight exercises and especially scenario building can support planning transition processes by informing decisions that entail long term transformation, such as investments in infrastructures and policy decisions that will change the urban shape, urban carbon performance and ultimately 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 a context 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 are structured and systematic forms of constructing “possible futures”. 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 (van Notten 2006; Börjeson et al. 2005). These efforts have not yet resulted in a commonly agreed typology or definition. For example Börjeson et al. (2005, 4) classify “predictive scenarios” as one major subgroup, while van der Heijden et al. (2009) state that it is a consensus 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 aim, rather than at exploring how things might evolve, at how a certain future can be reached. Considering the aim of the POCACITO workshops of building strategies and roadmaps towards urban post-carbon futures, the normative approach to scenario building best fits the project objectives. 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, 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 are used to explore which futures are likely to occur under certain conditions, this approach helps define, “how desirable futures can be attained” (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 and what policy measures would be 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, which is used by the European Foresight Platform, is adopted in the present paper. 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 contest.



According to an European Environment Agency 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 in interaction with representatives in eight cities of different sizes, located across Europe. Meetings with stakeholders from these cities have been organised in the context of the POCACITO project, which aims at the development of an evidence-based roadmap for post-carbon European cities in 2050. During the workshops organised in each city, vision building and backcasting exercises have been conducted to identify a transitioning process towards post-carbon cities. The final aim of the analysis is to provide elements for the definition of a roadmap towards post-carbon urban futures. This roadmap needs to be suitable for different European urban realities, and thus takes into consideration different needs and policy priorities from which to start a transition process.

First, the methodology section describes the process that has been followed to create visions and actions towards post-carbon cities in the case study cities. The data and results section describes the elements of the city visions, central issues and strategies, and characterises the case study cities using information derived from the socio-economic and environmental indicators in the single case study cities. The discussion section tries to connect 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, the concluding section reiterates the main findings of the analysis.

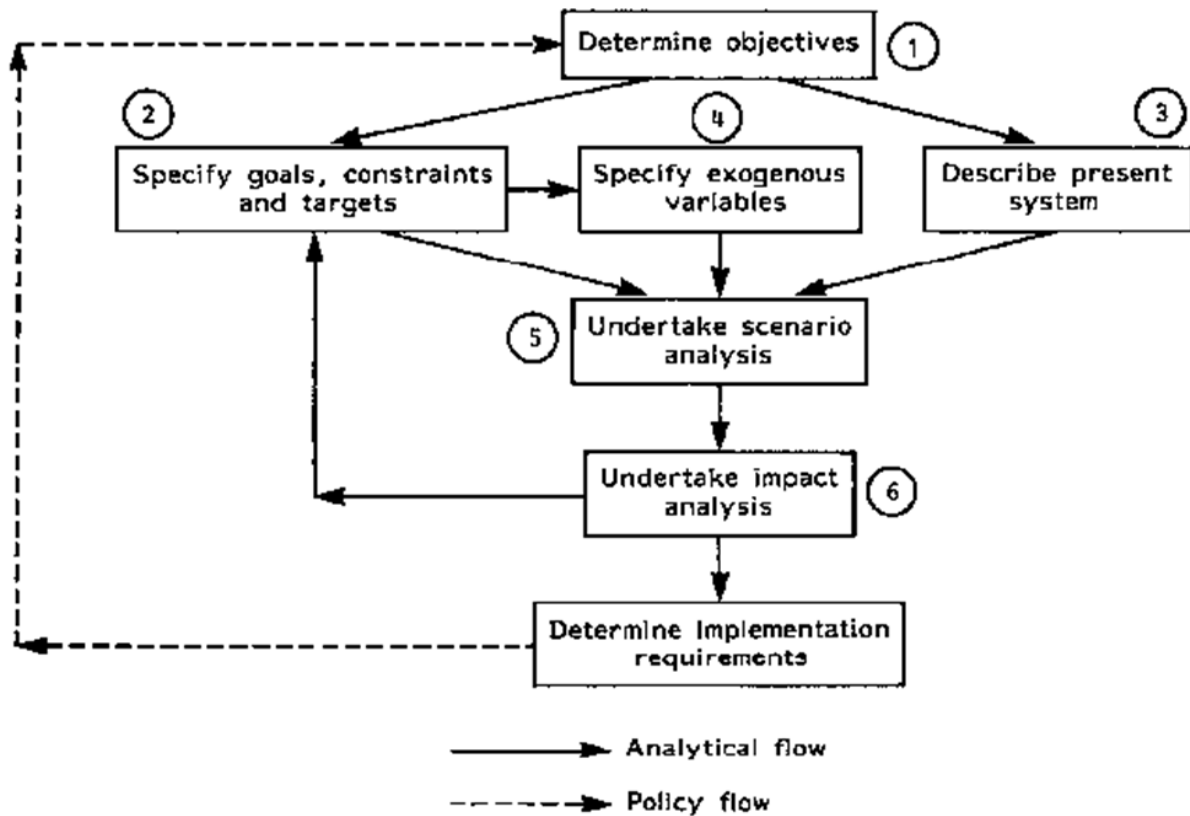
## II.1 METHODOLOGY

Case study cities include Barcelona, Malmö, Istanbul, Lisbon, Litoměřice, Milan, Turin, and Zagreb. The selection of cities was made in the preparatory phase of the POCACITO project and aimed at obtaining a wide range of geographically different cities. The characteristics of the case studies differ furthermore according to city typology, size, density, wealth, and climate as well as governance and economic structures.

The workshops organised in the POCACITO case study cities involved different types of actors, which were considered potentially relevant for the definition of policies towards a post-carbon transition. Nevertheless, in the context of a research project like this one, the availability of stakeholders for participating in the exercise has some limits, and thus the range of stakeholders cannot be considered representative, as would be required in the context of a decision making process. The fact that the POCACITO team has no deliberative mandate, and the scenario building process was not connected to any planning process in the cities, effectively limited the quantity and type of stakeholders who responded to the invitation. This said, the type and number of stakeholders involved in the participatory workshops varied from city to city, and comprised representatives from urban administrations and agencies, non-governmental organisations (NGOs), research, and to some extent representatives of private business and the “civil society”.

In each city, visioning and backcasting workshops were organised by inviting local stakeholders. The workshops followed a common three-step procedure.

**Figure 1: Procedure for a backcasting exercise**



Source: Robinson (1990)

The approach was adapted from the procedure proposed by 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 if compared to “real life” deliberation processes. The approach consists of a first step where a common vision on the baseline and objectives was established among participants. The description of the actual situation of the single city was made using the common set of indicators developed in the POCACITO project (Silva et al. 2014), which aims at assessing and monitoring the post-carbon city transition process. The discussion of the results from the data collection for this indicator set with the participating stakeholders represented the starting point for the second step, aimed at the building of a local vision, during which elements for a post-carbon vision were designed and discussed among stakeholders. In a third step, the backcasting scenario was built, during which the vision was made tangible by identifying actions and timelines, as well as obstacles to reaching goals. The framework for these scenario building exercises was represented by a set of background scenarios set out for the case study cities, which described possible future for economic, demographic, and climatic developments determined by external drivers, acting as variables for the future development that

are exogenous to the vision. 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<sup>1</sup>. It was decided to present these background scenarios only at the end of the procedure as a form of feasibility or sensitivity check.

## II.II WORKSHOPS

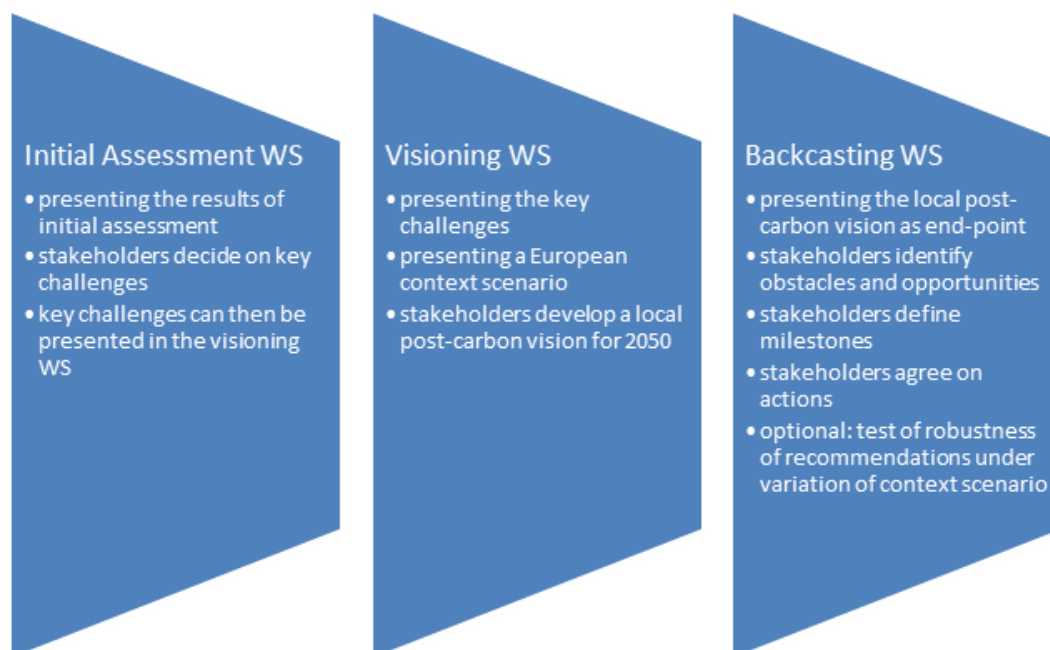
All stakeholder workshops were held between September 2014 and May 2015. Workshops held in the case study cities followed a common three-step approach adopted by the common workshop guidelines produced in the POCACITO project, consisting of an initial assessment, a vision building and backcasting exercises (Figure 2). After reaching an agreement on the present state of the city, i.e. establishing a baseline, creative brainstorming was employed to induce stakeholders to first envision the future of their city, then develop qualitative scenarios describing how the *transition* to reach their post-carbon vision might be translated in single steps or actions. Obstacles and opportunities that might be encountered along the way were identified, and in particular, actions needed to meet future goals were highlighted. The feasibility and robustness of scenarios were tested to consider how the scenario might work in a different socio-economic environment than business as usual. This common methodology was applied with some variations in all workshops. Some adaptation were needed, 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, asking the participants to draw pictures of their vision were deemed not suitable for some types of stakeholders (Barcelona, Istanbul).

General problems occurred with the approach to the robustness check, which could not be applied in the suggested form in any of the workshops. Apparently, the quantitative descriptions provided in the SSP for each case study city (demographics, GDP etc.) would have required a consistent translation into a qualitative narrative in order to match the narratives of the backcasting scenarios. Furthermore, the time available for the definition of actions, milestones and timelines was relatively limited, so that time was insufficient for reflections on the robustness of strategies. This step will need to be included in the subsequent steps of the definition of the local roadmaps.

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<sup>1</sup> A description of these background scenarios can be found in the POCACITO deliverable 4.1

**Figure 2: Three-step approach adopted in the Workshops**



## II.II.I INITIAL ASSESSMENT AND VISION BUILDING WORKSHOP

In most case study cities, the first two steps were joined in one single workshop, dealing in a single meeting with the presentation and discussion of the results from the initial assessment, and proceeding with the vision building exercise. Presenting the results of the initial assessment undertaken for each city to stakeholders provided indeed the occasion for discussing the key challenges the city is facing using social, economic, and environmental indicators, the key performance indicators defined in a common approach for all case study cities. This discussion of the current strengths and weakness helped clarify what municipal competencies are and where progress can be made and is needed most, and which potential problems need to be addressed. Stakeholders provided local knowledge that might not have been captured by the data sources used for the initial assessment, and discussion of the initial assessment provided an opportunity for them to relay that information. The discussions about the initial assessment helped define the starting points from which the vision is projected and, in the cases where the two activities were dealt with conjointly, provided an introduction to the work on the vision.

The vision to be built for the city represents the normative end point, different than the one that would be reached proceeding with business as usual. Stakeholders were encouraged to imagine how their city should look like in 2050 as a post-carbon city. To do this, stakeholders were divided into smaller groups and prompted to collectively draw their vision. This creative activity encouraged stakeholders to relax and be more expressive, facilitating a disconnection 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.

### II.II.II 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 might be necessary 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. As in the previous workshop, the methodology adopted during the backcasting was based again on visualisation techniques, so participants used coloured cards for writing down titles for actions, milestones and opportunities, which were then be placed on a sheet visually representing the timeline from the present day until 2050.

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

- Define a normative “desired” end point (the vision from the previous visioning workshop)
- Consider context-scenario specific obstacles and opportunities in reaching the end point
- Identify milestones or interim projects that would signify progress in reaching the end point
- Define actions that must be taken to get to the end point
- 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 that they anticipate encountering in working towards the endpoint under a business as usual scenario, and wrote them down on index cards. The index cards were then arranged on a timeline between now and 2050. The same process was carried out for milestones and interim projects, highlighting intermediate objectives that mark the way towards the desired endpoint. Next, stakeholders brainstormed concrete actions needed to reach interim and final goals (i.e. to reach milestone X by 2030, what actions must be taken?), 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. Finally, actions identified to achieve the vision were checked for robustness, considering the local impacts from possible global socio-economic and environmental trends, from present day to 2050, represented under the form of different “background scenarios”. Actions proposed should have been considered under different future scenarios, for instance, the SSP narratives “Middle of the Road”, “Sustainability” and “Fragmentation”, to see how differing socio-economic conditions might affect the plan to transition to become post-carbon.

## II.III DATA AND RESULTS

### II.III.I CHARACTERISATION OF CASE STUDY CITIES

The range of case study cities provides coverage of different geographic areas and socio-economic conditions in the EU Member states. Cities include Barcelona, Spain; Lisbon, Portugal; Istanbul, Turkey; Litoměřice, Czech Republic; Malmö, Sweden; Milan, Italy; Rostock, Germany; Turin, Italy; and Zagreb, Croatia. All cities have already begun some activities in terms of mitigating climate change, so some initial experiences were already available when the POCACITO workshops started.

With regards to the socio-economic and environmental characterisation of the cities, a common set of indicators (Key Performance Indicators) developed in the POCACITO project was used to describe the current state representing the baseline for the scenario development (see Table 1 for a selection).

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 densest city, while the lowest population density is registered in Malmö. The selected cities display a large dispersion as far as GDP per capita is concerned. Litoměřice is the city with the lowest number, with 11,800 Euros per capita. Carbon intensity has been used as an indicator for the energy efficiency of the productive sector. Among the sample cities, 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. Another environmental indicator that has been collected during the project is modal share. The city which records the largest share of trips by public transport, bicycle or foot is Litoměřice, where more than 70 percent of trips are made using actual or potential low-carbon means of transportation. Conversely, in two very different cities, Turin and Istanbul, the share of non-individual car transport drops to only 55 percent, in Lisbon to 51 percent. Another important environmental indicator used refers to the share of urban waste recycled. Among the sample of cities, Rostock recycles the largest portion of waste, 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.

**Table 1: selected socio-economic and environmental indicators for the case-study cities**

	POPULATION	AREA (km <sup>2</sup> )	Density (pop/ km <sup>2</sup> )	GDP pc	CARBON INTENSITY	ECO modal share (%)	URBAN WASTE RECOVERY (%)
Barcelona	1'620'000	102	15'898	28'300	216	70	36
Istanbul	13'854'720	5'343	25'931	20'100	268	54	3
Lisbon	547,733	100	548	na	134	51	20
Litoměřice	24'136	18	1'341	11'800	na	75	
Malmö	313'000	157	1'995	45'400	127	60	36
Milan	1'324'169	182	7'276	45'600	170	63	39
Rostock	203'673	181	1'125	29'000	133	65	54
Turin	902'137	130	6'940	28'900	190	55	42
Zagreb	792'875	641	1'237	27'400	na	na	

Notes: Area is expressed as squared km; density is expressed as total population over squared Km; GDP is Euro per capita expressed in Purchasing Power Parity; Carbon Intensity is expressed in tonnes of CO<sub>2</sub> over Million Euros; Eco modal share identifies the share of internal city move done by public transport, bicycle and foot; urban waste recovery represents the share of waste that is recycled. The data for GDP is taken from the Eurostat database (<http://ec.europa.eu/eurostat/data/database>). The other information is taken from the Assessment Reports produced for each case study within the POCACITO project.

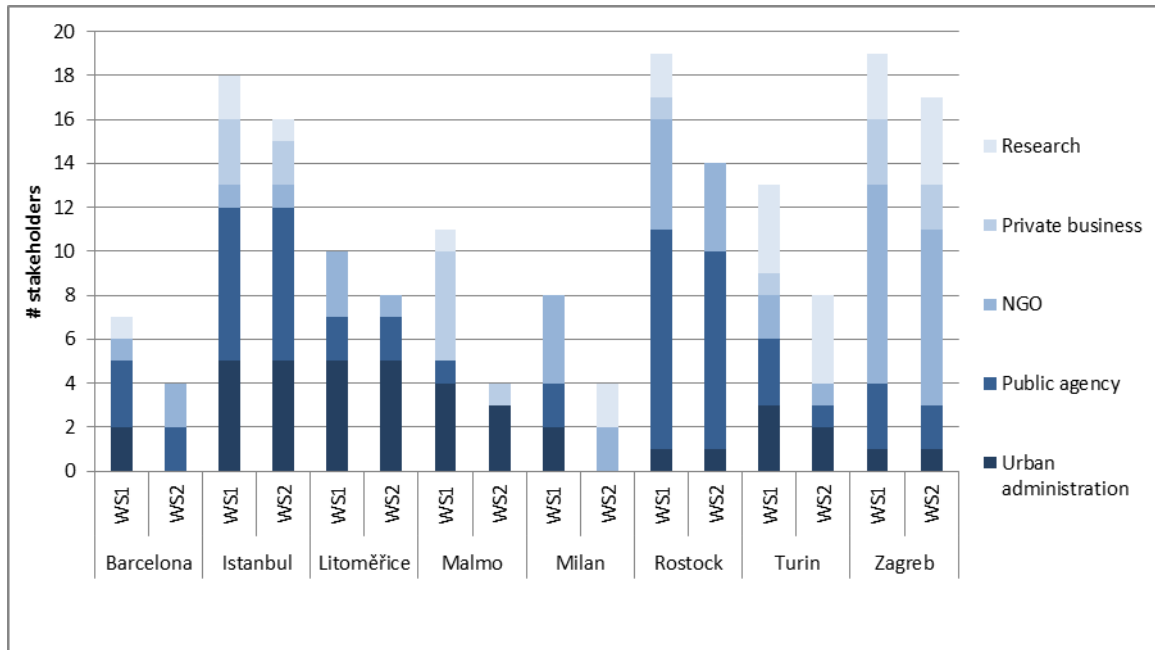
## II.III.II CHARACTERISATION OF THE STAKEHOLDERS

The scenario workshops organised in the case study cities involved different types of local stakeholders. The type and number of stakeholders involved in the participatory workshops varied from city to city, and included representatives from urban administrations and agencies, NGOs, research and, to some extent, also representatives of private business and the “civil society”.

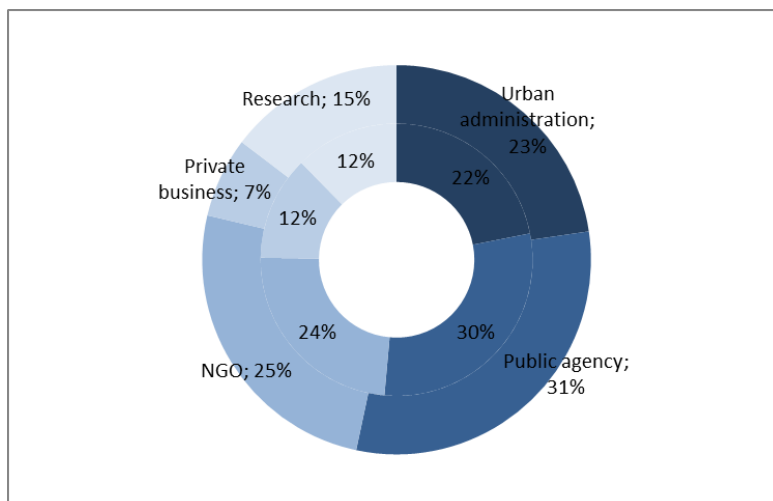
On average, 13 stakeholders per city attended the first round of workshops and 9 stakeholders attended the second set of workshops, with a limited continuity between the two workshops, as not all participants in the first event succeeded in participating also in the second event. Participants mainly came from public administration and agencies and from NGOs (Figures 3 and 4).

One challenge of post-carbon policies and their implementation consists in the generation of public consent and availability of citizens for changes in their lifestyle 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 would require, 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 (although stakeholders were asked to participate as citizens first, and only secondly as representatives of their respective organisations), but some representatives of private business did participate. The participation of representatives of the research sector was limited in Litoměřice due to the absence of universities and major research centres in that area.

**Figure 3: Types of stakeholders at each workshop, number**



**Figure 4: Types of stakeholders at First Workshop (inside) and Second Workshop (outside), %**

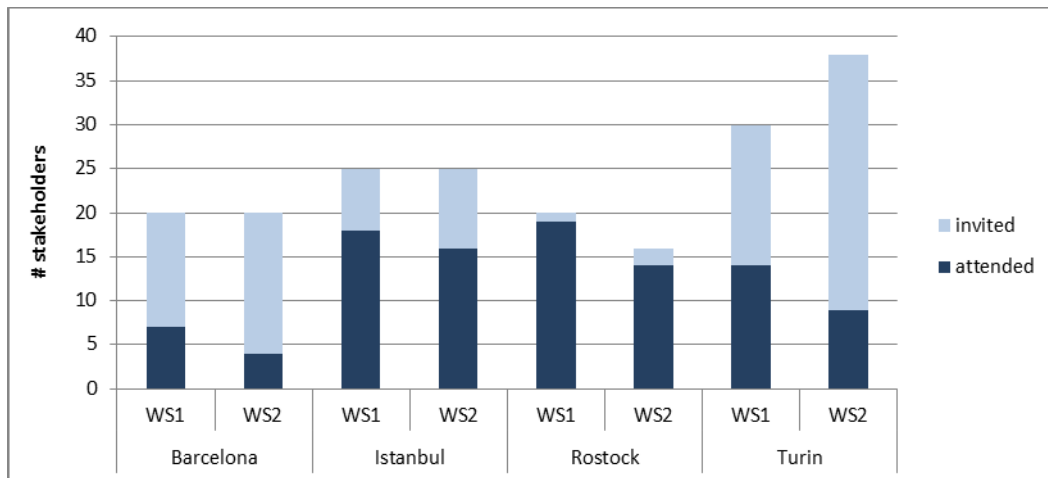


Major efforts were made to involve stakeholders, but response rates were not high for some research teams (see Figure 5 for an overview). On an average, 55% of the invitees attended. In Barcelona, one of the biggest case study cities, a visioning process initiated at the city level had recently been concluded. In this case, the interest in participating in the POCACITO workshops was relatively low. Conversely, in the small city of Rostock, the POCACITO team succeeded in benefitting from the existence of an active discussion forum on Energy issues in the city, and from the recent design of the local Master Plan *100% Klimaschutz* – a climate protection programme to reduce CO<sub>2</sub> by 95% until 2050 compared to 1990 levels. In fact, many invitees attended the workshop.

Overall, the attendance of stakeholders corresponds largely to those Dreborg (1996) identifies as the main addressees of backcasting studies, that is governmental and municipal authorities, organisations, private enterprises and an informed general public (Dreborg 1996, 826).



**Figure 5: Invited versus attended stakeholders in the two Workshops**



### II.III.III POST-CARBON VISIONS

The urban post-carbon visions developed in the case study cities 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 to some extent 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 development, and energy performance of single buildings and transport alongside with aspects of waste management and consumption. Furthermore, economic development was considered as a central issue in the visions of several cities, specifically promoting technology change and research activities in the private sector to support innovators, supporting innovative business models, and increasing tourism. Whereas technology change was seen as a field of action not so much for creating new technological options for urban infrastructures, but 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 in the case study cities 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.

**Figure 6: Number of sectors addressed in the Vision Workshop by cities**



The variety of sectors addressed varied from city to city (Figure 6). For example in Turin the vision concentrated very much on issues connected to transport, including land use changes and the local economy, addressing also tourism. On the contrary, in Litoměřice, nearly all sectors were addressed.

**Table 2: Sectors covered during the Vision Workshop by cities**

	Transport and mobility	Energy	Land use and infrastructure	Social issues	Economy	Biodiversity and conservation	Technology and innovation	Education	Tourism	Governance	Food production	Consumption and waste
Barcelona	•	•	•	•	•	•	•	•	•	•	•	•
Istanbul	•	•	•	•	•	•	•	•	•	•	•	•
Litoměřice	•	•	•	•	•	•	•	•	•	•	•	•
Lisbon	•	•	•	•	•	•	•	•	•	•	•	•
Malmö	•	•	•	•	•	•	•	•	•	•	•	•
Milan	•	•	•	•	•	•	•	•	•	•	•	•
Rostock	•	•	•	•	•	•	•	•	•	•	•	•
Turin	•	•	•	•	•	•	•	•	•	•	•	•
Zagreb	•	•	•	•	•	•	•	•	•	•	•	•

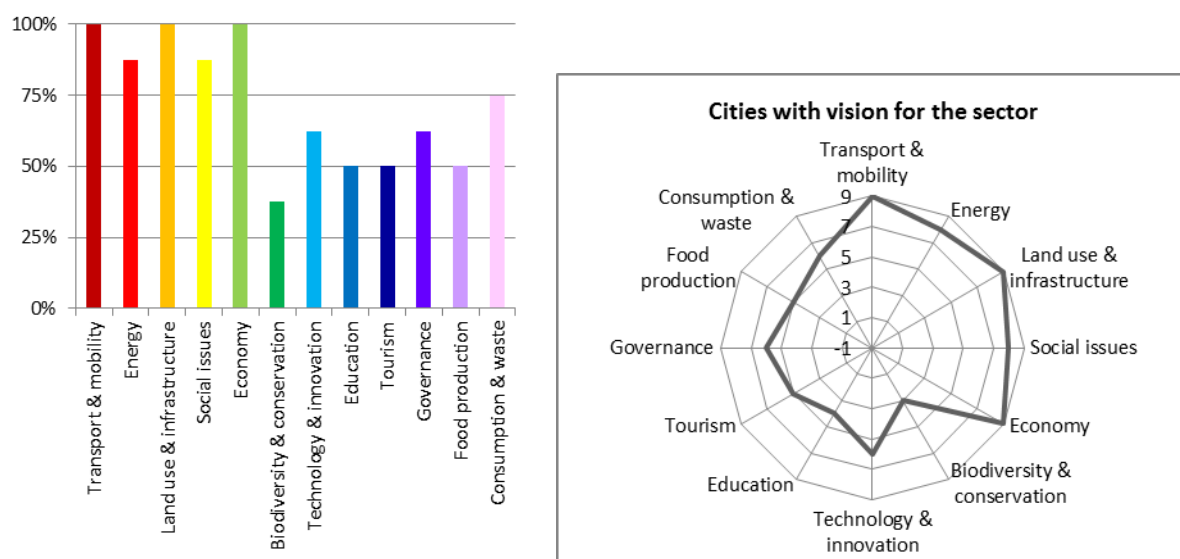
The coverage of sectors by the visions sheds light on the importance attributed by the cities to some policy areas, in turn giving a first indication on potential areas to be addressed in a European roadmap. Urban transport and mobility, and, in relation, adequate land use planning are prominent issues together with economic changes, which were addressed by all local visions. Energy related issues were also addressed by all cities.

Social issues are included in the visions of 7 cities, and consumption and waste are included in 6 visions. Technology and innovation and governance are discussed in 5 visions. Half of the cities covered education, tourism, and food production. The importance of biodiversity urban was seen, at least in this context, as less crucial: only 3 cities included biodiversity and conservation in their visions (Table 2 and Figure 7).

The concrete issues addressed within each of these policy fields gives further indication as to where cities see margins for action.

As far as energy is concerned, 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, and calculations of emissions from buildings. Visions on energy covered 4 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.

**Figure 7: Percentage (left) and number (right) of cities addressing the specific sectors in visions**



Regarding transport, visions 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. Interestingly, urban governance was explicitly addressed as an element of the vision in different cities. Future forms of urban governance focused on 5 main areas: information systems, participation, procedure and coordination, instruments for governance, and resilience. With regards to land use, visions 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. With regards to urban economics, visions are focused on improving competitiveness or on the transition of the urban economy to a sustainable low-carbon economy. 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. Related to social issues, visions 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 visions can be categorised into 3 main areas: waste reduction, efficient use of resource, and closed cycle. 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. Related to biodiversity, 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. Finally, 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.

## II.III.IV BACKCASTING EXERCISE

After the 2050 post-carbon visions were produced, the stakeholders were invited to suggest specific actions that should be taken to meet these visions through a back-casting approach. Given the long timeframe between now and 2050, and given the possible different nature of the actions, the stakeholders specified short, middle as well as long-term actions.

Table A1 in the Appendix displays the correspondence between visions and actions. Examples of visions in the different sectors are mapped with corresponding example of actions in the same sector. The actions have been organised by sectors, identifying the sector they are addressing. For example, technological improvements in the energy sector are considered as among actions regarding the energy sector. Some examples are given for the way in which the actions were detailed for the different sectors in the local scenarios:

- The scenario developed in Rostock identifies, with regards to the energy sector, the assessment of options for new wind energy parks (on/offshore) close to Rostock as a possible action to achieve the vision of further developing and increasing the storage capacities of offshore wind, photovoltaics, bio gas, and geothermal energy.
- Stakeholders from Milan identify the development of informatics infrastructure, including smart stops and smart times for public transportation on buses, trains, and trams, as a

possible action in the sector of urban planning measures to achieve the post-carbon vision of Milan as a city that is more accessible and usable without a car.

- Stakeholders from Barcelona identify necessary improvements in the governance including rules for impact analysis to be executed by local authorities as a possible action to achieve the vision of using reliable and consistent tools to support public policy.
- Stakeholders from Istanbul identify waterfront planning and easy accessibility to parks and green areas as possible actions to achieve the vision of integrated water and green lands.
- Stakeholders in Zagreb identify the establishment of incentives for craftsmen jobs as a possible action to achieve the vision of a largely localised economy. Furthermore, their scenario envisages education as a basis for the involvement of citizens, creating comprehensive schools with practical-skills learning, promoting of incentive measures for formal and informal education, and using education as a basis for involving citizens to take action to achieve the vision of a city in which long-life, free, critical, creative and holistic education is available for everybody, and produces active citizens.
- Stakeholders from Turin identify enhancing social housing, innovating tools and resources for welfare, and improving welfare through information and communications technology as possible actions to achieve the vision of a city with high birth rates, strong resilience, high quality of life and strong identity.
- Stakeholders from Milan identify increased waste sorting, with the separation of waste and recyclables more user-friendly and more efficient, and increased efficiency of energy recovery of residual waste as possible actions to achieve the vision of reuse and recycling of materials.
- Stakeholders from Litoměřice identify nominating the city to UNESCO and building tourist accommodations, including hotels and restaurants, as possible actions to achieve the vision of a city that is attractive for tourism, where tourism will contribute significantly to the local economy.
- Stakeholders from Malmö identify large-scale cultivation of shrimp, algae, and vegetables using residual heat, and introduction of government subsidy of fossil-free and sustainable agriculture as possible actions to achieve the vision of city gardening and farming, and optimising the use of arable land by producing food in a resource efficient and large scale manner outside the city and in small scale inside the city.
- Stakeholders from Istanbul identify determining endemic species and developing new systems to protect and monitor those species, and giving the status of 'protected forest' to all forest areas in Istanbul as possible actions to achieve the vision of the protection of natural resources.
- Stakeholders from Istanbul identify the introduction of new approaches to R&D and the use of renewable technology for natural resource usage, transportation, buildings and industry as

possible actions to achieve the vision of a city which uses innovative R&D approaches for development and innovative activities.

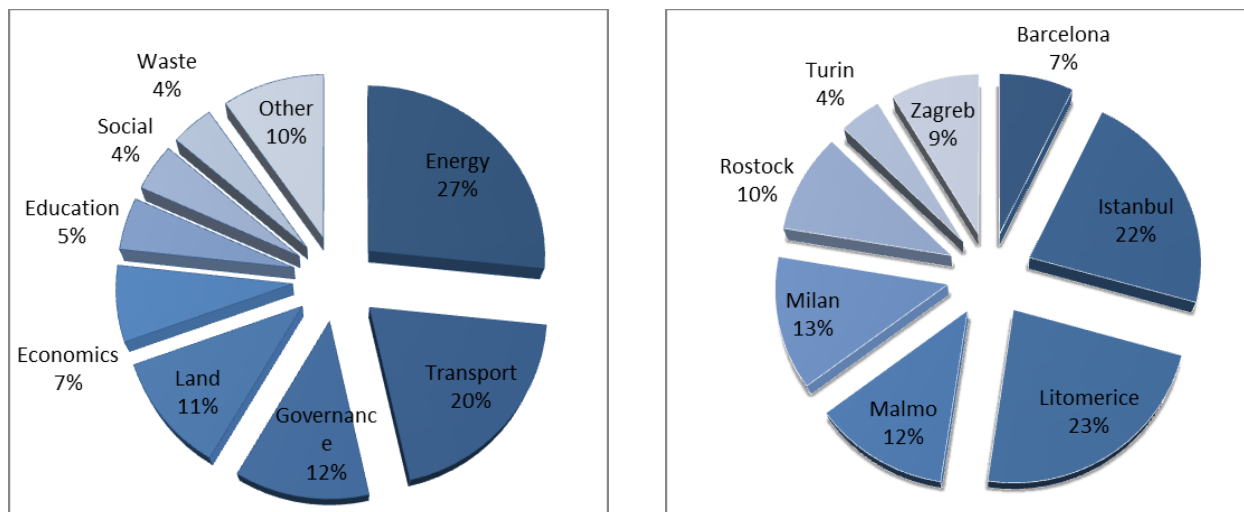
An analysis of these different priorities, as they have been described in the case study city stakeholder workshop reports, is based on the number of actions proposed for each thematic area or sector for achieving the vision. This approach implies a series of risks, as the material used has been filtered in different stages.

The application of a semi-quantitative approach to this rather qualitative material represents a second best choice, which was made in order to deal with very heterogeneous material both in formal sense and with regards to contents related issues like framing. Furthermore, a confrontation of the number of actions does not take into account important qualitative differences such as differences in weight and timeframes of these 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.

The number of actions proposed by the stakeholders varies considerably depending on the sector they refer to and on the detail dedicated to some sectors. Some sectors are addressed by a larger number of actions compared to others. Obviously the energy sector, as indicated in Figure 8, was addressed by the greatest share of single actions, corresponding to 27 percent of total actions suggested by the stakeholders. 20 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.

The number of actions proposed also varied by the city considered. Stakeholders from Litoměřice and Istanbul were the most productive, contributing to 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.

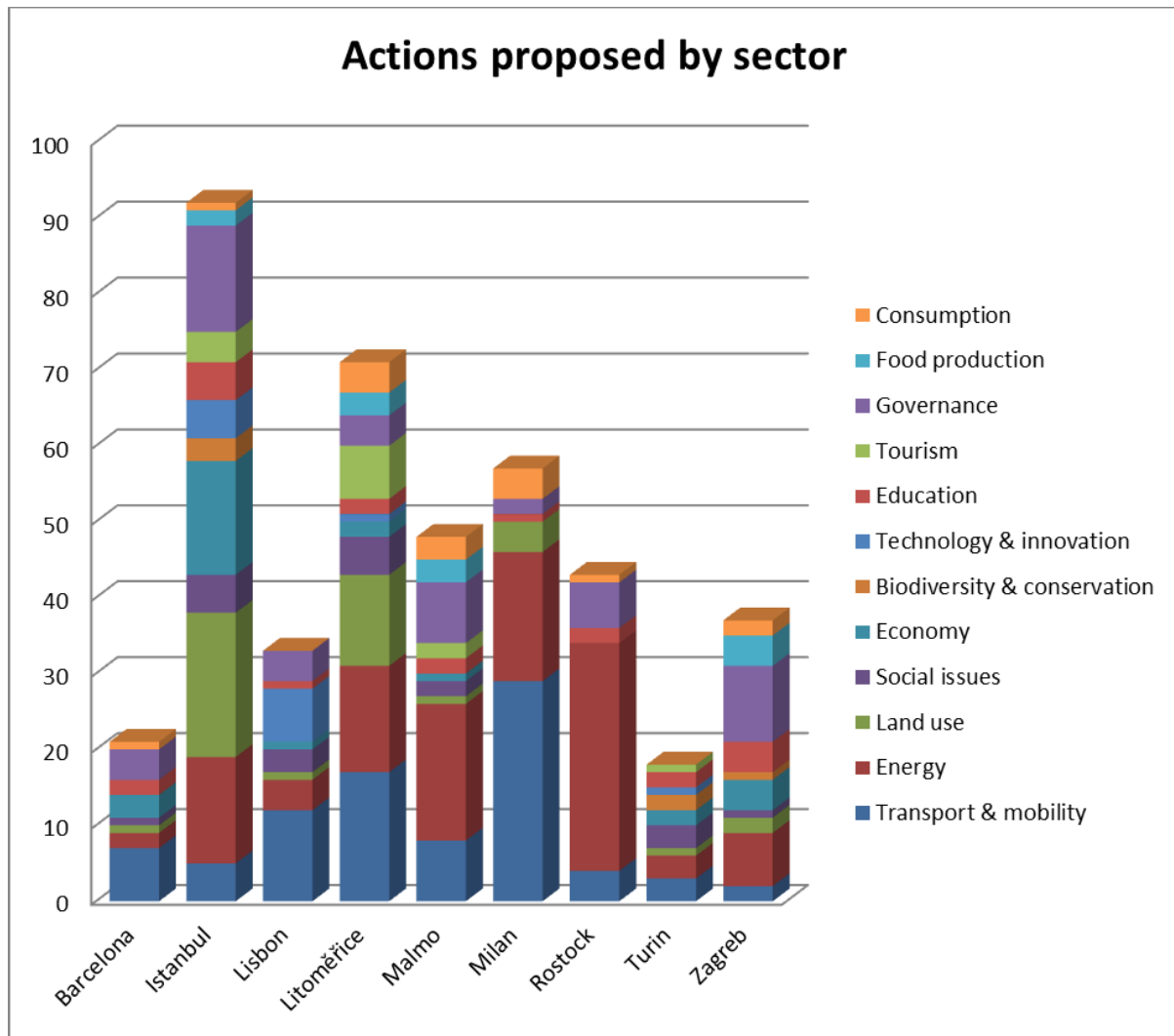
**Figure 8: Distribution of actions by sectors (left) and cities (right)**



Note: Other in the left hand graph includes Tourism, Food Production, Technology and Biodiversity

Even if overall energy is the sector where the largest number of actions is generated, some divergences emerge if each city is considered separately. For example, in Barcelona, stakeholders focused largely on transport, governance and economics, while the energy sector received only a limited number of contributions. In Istanbul, the land use sector contributed to 20 percent of total actions proposed, followed by the energy, governance and economics.

**Figure 9: Repartition of the actions in the different sectors by cities**



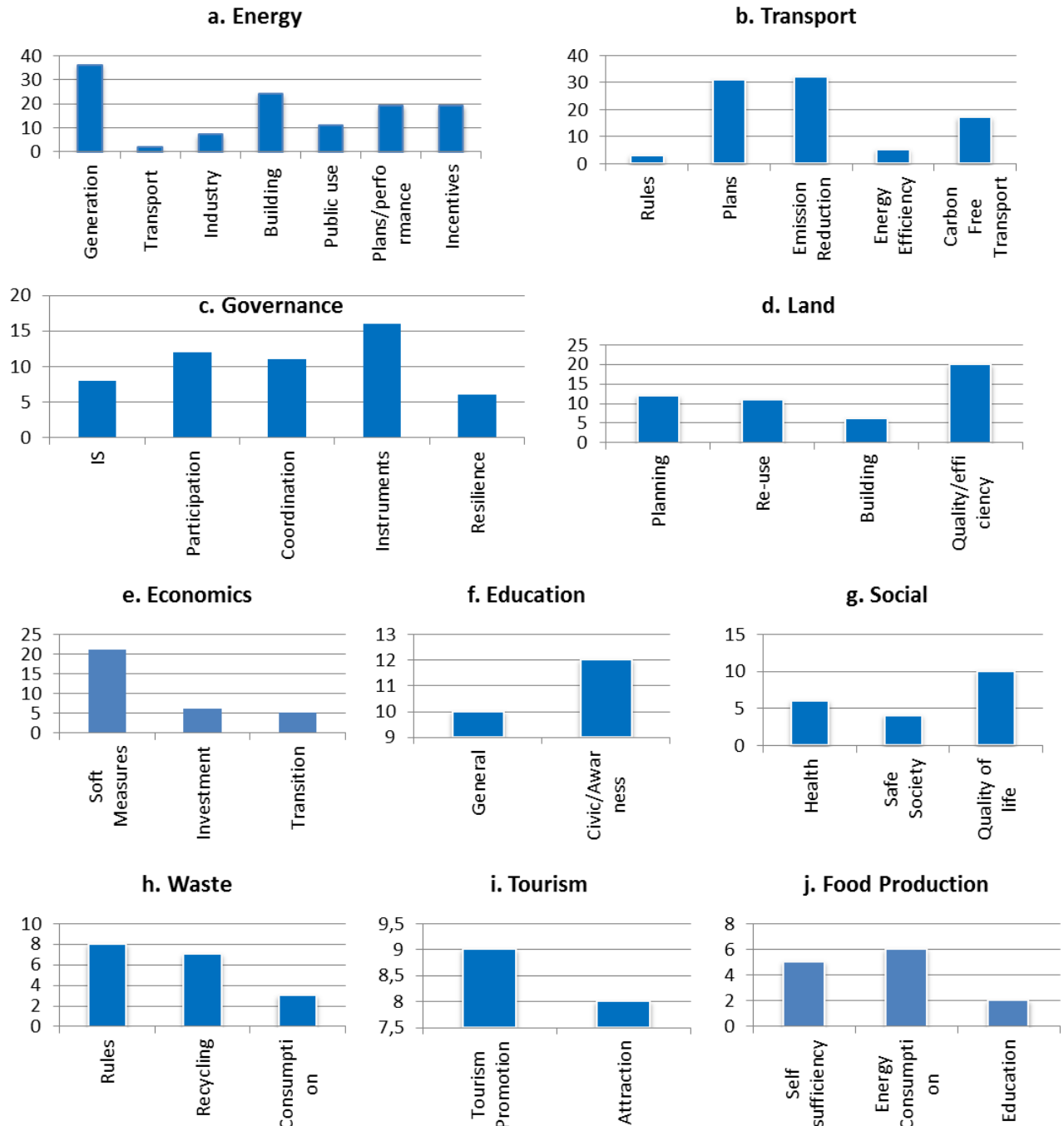
Note: Actions related to Food production, Technology and biodiversity have not been included in this graph.

In Zagreb, actions in the governance sector contributed to the largest share, being 10 percent of total actions. Impressive is the share of actions in the energy sector for Rostock, where about 30 percent of total actions are in this 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.



To give an idea of the type of actions that have been proposed, the list of actions has been sub-divided for those sectors with a greater number of actions, according to their specific typology. A list of sectors and examples for actions proposed can be found in the Appendix.

**Figure 10: Number of actions in the different sectors by type**

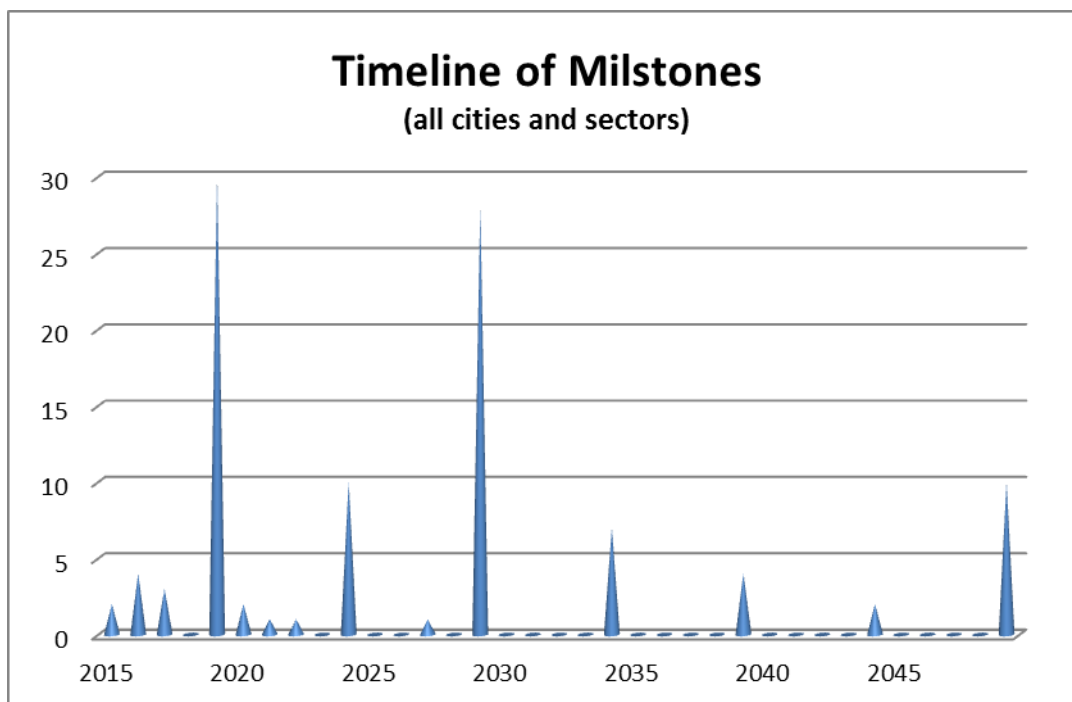


The total number of actions in the energy sector is 118, and the majority are related to the generation and distribution of energy. The actions in this area focus primarily on urban projects for the transition towards non-fossil energy resources. The second largest group is represented by

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 (Figure 10, panel A).

An analysis of the timeframes entailed in the scenarios is provided by the milestones indicated as indicators for the achievement of intermediate and final goals.

**Figure 11: Timeline of Milestones**



The difficulties encountered by stakeholders in detailing actions and goals for long time frames becomes obvious from graph (number), where only slightly more than 20% of the milestones refer to the period after 2030. Even considering the fact that milestones are not necessarily convergent with final goals, the great concentration in the period until 2020 (almost 40 % of the overall number of milestones are located in this period), indicates that stakeholders were more comfortable reflecting on short and medium time frames.

Although representing a variety of different urban contexts in Europe, the number of case study cities is rather small, and cannot be considered representative for all urban areas in Europe. The choice of stakeholders has already been mentioned as one critical element, especially in the context of a research project without a political mandate, which potentially leads to bias in the range of stakeholders involved. The reports from the workshops, translated from the original language by POCACITO researchers, potentially include forms of translation that do not remain on the linguistic level, but “translate” concepts from local discourses into those used within the POCACITO project.

## II.III.V RELATION TO PRESENT DAY POLICIES

The analysis of the measures and activities proposed in the backcasting workshops requires detailed information on the present day policy projects and discourses ongoing in the individual cities. Some information in this direction is provided in the initial assessments of the case study cities, which describe the present day situation on the basis of common key performance indicators, and existing and planned policies in each of the cities<sup>2</sup>.

A comparison of the results from initial assessments across the case study cities makes evident the heterogeneity of the cities in terms of strategies put in place or planned, and of challenges identified in relation to a post-carbon transition. Although all case study cities have started some activities towards a decarbonisation strategy for their urban area (this was in fact a selection criteria for the case study cities), differences between the strategies are quite important, ranging from cities already revising existing strategies, like Malmö and Barcelona, cities with a great number of ambitious strategies, including Rostock and Milan, and cities still working on single elements without having a comprehensive strategy, like Zagreb, Litoměřice and Istanbul. Istanbul, albeit having made some commitments as a member of C40 cities<sup>3</sup>, still needs to set up a basic accounting system for CO<sub>2</sub> emissions as they are not yet monitored, 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 in a particular manner to innovative and smart solutions for improving energy efficiency of public services, especially in the transport sector.

Considering relevant sectors for energy consumption, the transport sector 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 of these 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 of the cities which already has a decarbonisation strategy in place, Malmö. Only Barcelona did not experience growing energy demands. 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, in some cases, are concerned about social exclusion, as is the case in Malmö and Turin. The economic crisis has furthermore contributed to an increase in public debt, a factor that constrains potential ranges of local policies, as is articulated in the case of Turin.

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<sup>2</sup> For a complete vision of the initial assessments in the case study cities, refer to Pocacito deliverable 3.2 (Compiled Individual Assessment Reports) available at <http://pocacito.eu/internal/wp3-initial-assessment-case-study-cities/task-32-initial-assessment-1>

<sup>3</sup> Only the municipality of Karakoy, which is part of the Istanbul metropolitan area, has made a commitment to the Covenant of Mayors initiative and submitted a SEAP which is actually under examination by JRC ("Covenant of Mayors - Signatories" 2015)

Most cities highlight the need to promote economic growth as one of the priorities 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. Although Milan has also recently experienced increases in the rate of unemployment, the need for further economic growth is not directly addressed among the challenges described for this city; rather the vision focuses on smart technologies and innovation.

## II.III.VI ANALYSIS

The previous quantitative consideration of the workshop outcomes indicates that the greatest attention, measured in terms of number of actions, have been proposed in 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. This is true only at a broad level. A breakdown at the city level reveals that some divergences emerge; in some cities other sectors appear of primary importance.

An attempt to interpret this data tries to connect the outcomes of the workshops with the framework conditions, both in relation to the workshops (especially the characterisation of stakeholders) and the baseline conditions of the cities.

Stakeholders from cities that show greater progress in terms of CO<sub>2</sub> reductions, as measured in the initial assessment, might have suggested a corresponding larger share of actions in the economics sector compared to the energy and transport sector. The objective of the following analysis is to identify if there is a relationship between the characteristics of the stakeholders and the share of actions proposed in the different sectors, as well as between the city characteristics and the emergence of priority sectors. This exercise aims at understanding if the different needs and determinants for policy priorities differ by types of cities and stakeholders.

Table 3 places all cities in a comparative perspective based on the data emerging from this framework data. The second column describes the type of stakeholders that have been mostly represented in the two workshops. For example in Barcelona, Istanbul and Rostock representatives from the public agency were the most numerous group. In Litoměřice and Malmö, the largest group was comprised of participants from the urban administration. In Milan and Zagreb, NGOs were rather well represented, whereas in Turin an important part of participants came from the research sector, including universities. Columns 3 to 8 show a synthesis of the socio-economic, environmental characteristics of the cities (described in the data section of this paper), which are a selection of the indicators presented to the stakeholders during the Initial Assessment. For the purpose of the analysis, cities have been divided in three groups, small, medium and large, depending of the area size of the city, three groups depending on the population density, three groups depending on the GDP per capita, and two groups which describe how the cities score in terms of carbon emissions. The label high and low identifies cities that have high and low CO<sub>2</sub> emission intensity, respectively. 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.

Table 4 provides a synthesis of the importance attached to the actions in the different sectors. Column two displays the most importance sectors. They are the sectors where the largest number of actions has been proposed for each city. 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 is the 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.

The following columns provide a ranking of all sectors, not only the one which contributed to the largest number of actions. For each city, the sectors have been sorted from the one with the lowest to the one with the highest number of actions. Subsequently, the sectors have been labelled, with the label high identifying those sectors with higher number of actions and low those sectors with lower number of actions. The former represent high priority sectors and the latter low priority sectors.

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 – inter alia - for outcomes on energy efficiency and improved public and non-motorised transport, so land appears to be of high priority in Istanbul and Litoměřice, while the sector yielded an apparently low priority in Malmö, Rostock, and Zagreb. Actions in the governance sector seem to be 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. From Tables 5 to 12, the results of this priority analysis are matched with the stakeholder and city characteristics. Given the limited number of case study cities, this analysis should be interpreted with caution. Only a general pattern of relationship rather than a definite indication of connections should be drawn.

Table 5 identifies whether the most important sector that emerges in each city depends on the characteristics of the stakeholders. No clear pattern emerges as, depending on the city, the same class of stakeholder identified 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: those with the largest number of actions have been transport 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.

Does the location, the size or other city characteristics influence the sectors where the highest number of actions has been produced? The answer is provided by Table 6. Interestingly, the energy sector appears as the most important one to reach the zero carbon target by 2050 in Northern, medium-sized, low CO<sub>2</sub> intensity, and medium eco modal share cities. On the contrary, the

importance of the transport sector is emphasised in cities in the Southern Europe, of small size, of medium population density, of high CO<sub>2</sub> intensity and high eco modal share.

The level of GDP per capita does not seem to influence the identification of the most important sectors.

In the following tables, priority sectors (as defined below) rather than the most important sector are considered. Stakeholders of three out of three cities in the Northern Europe attributed high priority to the energy sector (Table 7). High priority in the energy sector appears also in three out of four low population density 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 five cities located in Southern Europe, in three out of three small size cities and in three out of four high CO<sub>2</sub> intensity cities (Table 8).

In the bigger cities, governance is of high priority, whereas in the two medium sized cities governance the priority attributed to this aspect is low (Table 9).

Economics tend to be of low priority in all medium size cities, in three out of four low population density cities and three out of three medium eco modal share cities (Table 10).

Low priority for land is the result in three out of four low population density cities. On the contrary, a high priority is attached in relatively bottom income cities.

Low priority for social actions tends to be associated with medium and large sized cities, and with medium eco modal share cities.

## II.IV SUMMARY AND CONCLUSIONS

Results from the eight case study cities show similar elements in the actions that have been proposed by local stakeholders. All cities have given great attention to the transport and energy sectors, where many of the envisaged actions are concentrated. The actions are largely pointing at non-fossil energy generation, new energy efficiency at building level, increasing the quality of public transport, decarbonising private transport, and increasing the share of non-motorised movements (walking, cycling).

An interesting fact to be underlined 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 and a more conscious behaviour of citizens as a first step toward active involvement in post-carbon strategies, and in some cases, also as an instrument of social justice, providing access to all forms of education for all. Further to these "classic" urban issues in the transition to become a post-carbon city defined by the objectives of the POCACITO project, some actions contain, for instance, a more or less pronounced goals related to local economic development and social inclusion. This holds especially for some cities with relatively low GDP, either if compared to the other cities of the study or in comparison with the country average. For example,

measures for directly promoting economic development had a prominent role among the actions indicated in the workshop at Istanbul. In this case, also indirect measures like improvement of the quality of urban spaces, creation of new attractions, etc. are envisaged as they will contribute to increasing the attractiveness of the city for new investments. Similar activities have been foreseen also 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 exists. A specific role is reserved for urban 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 for 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 competitiveness of urban areas. Interestingly, de-carbonisation of industrial production or in the services sector was not addressed at all, if not (in relation to the services sector) 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 seen as an important prospective, as actions mainly pointed to existing technologies (smart technologies, electric and hybrid cars, etc.).

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

A second conclusion of the analysis is that the specific mix of strategies envisaged for each city has been influenced by local issues, such as the geographical location of the cities, the size of the cities as well as different points of departure with regards to emission reductions (greater or smaller achievements in terms of CO<sub>2</sub> 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 great 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 seen 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 forum not composed mainly by “educated middle-class representatives”.

**Table 3: Classification of cities by socio-economic and environmental indicators and by type of stakeholder most represented during the Workshops**

City	Type of Stakeholder most represented	Size (Area)	Pop Density	GDP	CO <sub>2</sub> Intensity	Eco share	Modal	Waste Recovery
Barcelona	Public agency	Small	High	Medium	High	High		Medium
Istanbul	Public agency	Large	High	Bottom	High	Low		Low
Litoměřice	Urban administration	Small	Low	Bottom	na	High		na
Malmö	Urban administration	Medium	Low	Top	Low	Medium		Medium
Milan	NGO	Medium	Medium	Top	High	Medium		Medium
Rostock	Public agency	Medium	Low	Medium	Low	Medium		High
Turin	Research	Small	Medium	Medium	High	Low		Medium
Zagreb	NGO	Large	Low	Medium	na	na		na

**Table 4: Classification of cities by number of actions in the different sectors and by type of action most represented**

City	Type of action most represented	Energy	Transport	Governance	Land	Economics	Social
Barcelona	Transport	Medium	High	Medium	Medium	Medium	Medium
Istanbul	Land	High	Medium	High	High	High	Low
Litoměřice	Transport	High	High	Medium	High	Low	Medium
Malmö	Energy	High	Medium	Medium	Low	Low	Low
Milan	Transport	Medium	High	Low	Medium	Low	Low
Rostock	Energy	High	Medium	Medium	Low	Low	Low
Turin	Transport	High	High	Low	Medium	Medium	High
Zagreb	Governance	Medium	Low	High	Low	Medium	Low



**Table 5: Type of Stakeholders most represented and type of action most represented**

	Energy	Governance	Land	Transport	Total
NGO	0	1	0	1	2
Public Agency	1	0	1	1	3
Research	0	0	0	1	1
Urban administration	1	0	0	1	2

**Table 6: Type of actions most represented and characteristics of cities**

	Size			Population Density			GDP			CO <sub>2</sub> intensity		Eco Modal Share		
	Large	Medium	Small	High	Low	Medium	Bottom	Medium	Top	Low	High	High	Low	Medium
Energy	0	2	0	0	2	0	0	1	1	2	0	0	0	2
Governance	1	0	0	0	1	0	0	1	0	0	0	0	0	0
Land	1	0	0	1	0	0	1	0	0	0	1	0	1	0
Transport	0	1	3	1	1	2	1	2	1	0	3	2	1	1

**Table 7: Number of actions in the energy sector and characteristics of cities**

ENERGY	Size			Population Density			GDP			CO <sub>2</sub> intensity		Eco Modal Share		
	Large	Medium	Small	High	Low	Medium	Bottom	Medium	Top	Low	High	High	Low	Medium
High	1	2	2	1	3	1	2	2	1	2	2	1	2	2
Medium	1	1	1	1	1	1	0	2	1	0	2	1	0	1

**Table 8: Number of actions in the transport sector and characteristics of cities**

TRANSPORT	Size			Population Density			GDP			CO <sub>2</sub> intensity		Eco Modal Share		
	Large	Medium	Small	High	Low	Medium	Bottom	Medium	Top	Low	High	High	Low	Medium
High	0	1	3	1	1	2	1	2	1	0	3	2	1	1
Medium	1	2	0	1	2	0	1	1	1	2	1	0	1	2
Low	1	0	0	0	1	0	0	1	0	0	0	0	0	0

**Table 9: Number of actions in the governance sector and characteristics of cities**

GOVERNANCE	Size			Population Density			GDP			CO <sub>2</sub> intensity		Eco Modal Share		
	Large	Medium	Small	High	Low	Medium	Bottom	Medium	Top	Low	High	High	Low	Medium
High	2	0	0	1	1	0	1	1	0	0	1	0	1	0
Medium	0	2	2	1	3	0	1	2	1	2	1	2	0	2
Low	0	1	1	0	0	2	0	1	1	0	2	0	1	1

**Table 10: Number of actions in the economics sector and characteristics of cities**

ECONOMICS	Size			Population Density			GDP			CO <sub>2</sub> intensity		Eco Modal Share		
	Large	Medium	Small	High	Low	Medium	Bottom	Medium	Top	Low	High	High	Low	Medium
High	1	0	0	1	0	0	1	0	0	0	1	0	1	0
Medium	1	0	2	1	1	1	0	3	0	0	2	1	1	0
Low	0	3	1	0	3	1	1	1	2	2	1	1	0	3

**Table 11: Number of actions in the land sector and characteristics of cities**

Land	Size			Population Density			GDP			CO <sub>2</sub> intensity		Eco Modal Share		
	Large	Medium	Small	High	Low	Medium	Bottom	Medium	Top	Low	High	High	Low	Medium
High	1	0	1	1	1	0	2	0	0	0	1	1	1	0
Medium	0	1	2	1	0	2	0	2	1	0	3	1	1	1
Low	1	2	0	0	3	0	0	2	1	2	0	0	0	2

**Table 12: Number of actions in the social sector and characteristics of cities**

Social	Size			Population Density			GDP			CO <sub>2</sub> intensity		Eco Modal Share		
	Large	Medium	Small	High	Low	Medium	Bottom	Medium	Top	Low	High	High	Low	Medium
High	0	0	1	0	0	1	0	1	0	0	1	0	1	0
Medium	0	0	2	1	1	0	1	1	0	0	1	2	0	0
Low	2	3	0	1	3	1	1	2	2	2	2	0	1	3

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## II.VI APPENDIX

**Table A 1: Visions and types of actions in the different sectors:**

Visions in sector:	Examples of actions in sector:
Energy	
<p>An example of the narrative of the vision produced in Rostock for energy is:</p> <p>“Offshore Wind, PV (old), Bio gas, geothermal – will be further developed and storage capacities increased; cogeneration plant (district heating grid, electricity grid) – dismantle redundant grids/Power to Gas; hydrogen based cycles, energy cycles (utilize waste heat); solar panels on roofs; liquid gas operation of ships; energy cooperatives; small wind energy plants.”</p>	<p>Energy generation/distribution:</p> <ul style="list-style-type: none"> <li>• Assess options on new wind energy parks (on/ offshore) close to Rostock with physical network into Rostock</li> <li>• Introduce Roof-top solar systems</li> </ul> <p>Energy consumption in the different sectors:</p> <ul style="list-style-type: none"> <li>• Implement energy management systems in businesses</li> <li>• Use efficient technology (Green IT),</li> <li>• Stimulate space reduction and energy-oriented refurbishment</li> <li>• Increase the share of long-distance heating for home’s room heating</li> </ul> <p>Overall concepts /plans /performance:</p> <ul style="list-style-type: none"> <li>• Promote heating oil substitution in the compost plant</li> </ul> <p>Education/incentives:</p> <ul style="list-style-type: none"> <li>• Create foundation of energy co-operations / climate funds</li> </ul>
Transport	
<p>An example of the narrative of the vision produced in Milan for transport is:</p>	<p>Plans:</p> <ul style="list-style-type: none"> <li>• Promote already initiated actions, such as traffic limitations and better public transport, in order to create consensus and momentum for new further reaching policies, as public policies are highly visible</li> <li>• Overcome barriers and make the city more accessible for everyone</li> </ul>

Visions in sector:	Examples of actions in sector:
<p>“City of sharing, that makes services accessible even through alternative or complementary forms of private transport; Pedestrian friendly city with shared spaces; Accessible and usable without a car; Integrated transport systems; Carbon-free transport”</p>	<p>Emission Reduction:</p> <ul style="list-style-type: none"> <li>• Extend road pricing to encourage use of public transport and discourage private car use</li> <li>• Limit car use through extension of pedestrian areas, speed limit zones, parking payment</li> </ul> <p>Energy Efficiency:</p> <ul style="list-style-type: none"> <li>• Develop informatics infrastructure including smart stops and smart times for public transportation on busses, trains, and trams</li> </ul> <p>Carbon free transport:</p> <ul style="list-style-type: none"> <li>• Create incentives for buying electric rather than gasoline-fueled vehicles</li> </ul>
Governance	
<p>An example of the narrative of the vision produced in Barcelona for governance is:</p> <p>“Reliable and consistent tools to support public policy will be developed. Effective decision making process, based upon findings of research reports or cost-benefits analysis of questionable accuracy; new tools able to evaluate in a rigorous way both private and public interests are developed”</p>	<p>Participation:</p> <ul style="list-style-type: none"> <li>• Introduce new systems for citizen participation</li> </ul> <p>Procedure and coordination:</p> <ul style="list-style-type: none"> <li>• Create better impact analysis rules for local projects</li> <li>• Ensure better coordination between services</li> </ul> <p>Instruments for Governance (legal reforms, tax reforms)</p> <ul style="list-style-type: none"> <li>• Introduce legal reforms to allow RES integration and independent entities</li> <li>• Implement EU Fiscal decentralisation directive</li> </ul>
Land	
<p>An example of the narrative of the vision produced in Istanbul for land is:</p>	<p>Urban planning (compact city, decentralisation, accessibility):</p> <ul style="list-style-type: none"> <li>• Create easy accessibility to green areas, parks</li> <li>• Introduce a waterfront planning and ensure an effective usage of</li> </ul>



Visions in sector:	Examples of actions in sector:
<p>“The city will reach an efficient water management; High adaptive capacity to climate change; Integrated water and green lands”</p>	<p>waterfronts</p> <p>Re-use of urban areas:</p> <ul style="list-style-type: none"> <li>• Begin urban renewal of previously determined important areas</li> </ul> <p>Buildings (innovation and energy efficiency):</p> <ul style="list-style-type: none"> <li>• Create green buildings in city</li> </ul> <p>Quality of urban environment/efficient management of natural resources:</p> <ul style="list-style-type: none"> <li>• Develop plans for purifying water basins from urban development</li> <li>• Develop master plans for drinking water and sewage system</li> <li>• Integrate built and natural environment</li> </ul>
Economics/production	
<p>An example of the narrative of the vision produced in Zagreb for Economics is:</p> <p>“The economy will be largely localised, with a neutral ecological footprint or better. The use of certain resource will be maximised while minimising the number of mediator between producers and consumers”.</p>	<p>Soft measures that improve competitiveness:</p> <ul style="list-style-type: none"> <li>• Establish incentives for craftsmen jobs</li> </ul> <p>Transition of urban economy to sustainable low carbon economy:</p> <ul style="list-style-type: none"> <li>• Allow production to be owned by the users</li> <li>• Create the conditions for socio-green businesses</li> <li>• Promote social entrepreneurship</li> </ul>
Education	
<p>An example of the narrative of the vision produced in Zagreb for Education is:</p> <p>“The city in which long-life, free, critical, creative and holistic education</p>	<p>Schools/University/general education:</p> <ul style="list-style-type: none"> <li>• Encourage professional training of teachers</li> <li>• Create comprehensive schools and kindergartens with practical-skills learning</li> </ul>

Visions in sector:	Examples of actions in sector:
is available for everybody, will produce active citizens”.	<ul style="list-style-type: none"> <li>Promote incentive measures for formal and informal education</li> </ul> <p>Awareness/civic education/resilience:</p> <ul style="list-style-type: none"> <li>Use education as a basis for the involvement of citizens</li> </ul>
Social	
<p>An example of the narrative of the vision produced in Turin for social issues is:</p> <p>“The city will achieve high birth rate; strong resilience; Social differentiation and, at the same time, integration; High quality of life; Strong identity, built on the historic and specific vocation of the territorial context”</p>	<p>Quality of life:</p> <ul style="list-style-type: none"> <li>Enhance social housing</li> <li>Introduce innovating tools and resources for welfare</li> <li>Improve welfare through information and communications technology</li> </ul>
Waste/Consumption	
<p>An example of the narrative of the vision produced in Milan for Waste is:</p> <p>“Reuse and recycling of materials will be the standard; green space, which helps to create a micro-climate that reduces the heat island effect will be extended; green will be integrated into the urban fabric and connected to the territory; biodiversity will be enriched”</p>	<p>Rules/plans/logistics:</p> <ul style="list-style-type: none"> <li>Increase waste sorting, with the separation of waste and recyclables more user-friendly and more efficient</li> <li>Establish effective waste-management</li> </ul> <p>Consumption:</p> <ul style="list-style-type: none"> <li>Reuse waste or prepare it for reuse, recycle it, incinerate it with energy recovery</li> <li>Increase the efficient energy recovery of residual waste</li> </ul>

Visions in sector:	Examples of actions in sector:
	<ul style="list-style-type: none"> <li>• Make efficient use of the existing system, i.e. use incinerators to create energy and lower the amount of materials placed in landfills, and consider opportunity costs, i.e. in some cases there are high costs to recycle materials that also produce good energy</li> </ul>
Tourism	
<p>An example of the narrative of the vision produced in Litoměřice for tourism is:</p> <p>“The city will be attractive for tourism: Tourism will constitute significant contribution to the local economy”</p>	<p>Promote tourism:</p> <ul style="list-style-type: none"> <li>• Nominate the city to UNESCO</li> <li>• Encourage entrepreneurs to welcome the tourism</li> </ul> <p>Create attractions/structure:</p> <ul style="list-style-type: none"> <li>• Build appropriate accommodation capacities, including hotels and restaurants</li> <li>• Create city beach on the Elbe river side</li> </ul>
Food Production	
<p>An example of the narrative of the vision produced in Malmö for food production is:</p> <p>“City gardening and farming in all forms will be a common activity that encourages individuals, areas and the entire city! The use of arable land will be optimised by producing food in a resource efficient and large scale manner outside the city and in small scale inside the city”</p>	<p>Self-sufficiency:</p> <ul style="list-style-type: none"> <li>• Halve climate impact of food consumption in Malmö compared to 2015</li> </ul> <p>Consumption:</p> <ul style="list-style-type: none"> <li>• Identify large-scale cultivation of shrimp, algae, and vegetables using residual heat</li> <li>• Introduce government subsidy of fossil-free and sustainable agriculture</li> <li>• Enhance fossil-free farming</li> <li>• Make sure that 30% of the food consumed is produced within the city limits</li> </ul>

Visions in sector:	Examples of actions in sector:
Biodiversity	
<p>An example of the narrative of the vision produced in Istanbul for biodiversity is:</p> <p>“Natural resources will be protected”</p>	<ul style="list-style-type: none"> <li>• Determine endemic species and develop new systems to protect and monitor those species</li> <li>• Protect ecologically and biologically important areas</li> <li>• Give the status of 'protection forest' to all forest areas</li> </ul>
Technology	
<p>An example of the narrative of the vision produced in Istanbul for technology is:</p> <ul style="list-style-type: none"> <li>• <i>“innovative R&amp;D approaches for development, innovative activities as well as high investments in R&amp;D will be introduced”</i></li> </ul>	<ul style="list-style-type: none"> <li>• Determine energy production resources</li> <li>• Increase infrastructure technologies</li> <li>• Introduce new approaches centre R&amp;D</li> <li>• Use of renewable technology for natural resources usage, transportation, buildings and industry</li> </ul>

- a. Actions in the **Energy** sector are related to
  - The generation of energy and its distribution. An example is the action proposed by the stakeholders in Litoměřice: “Centralised system of energy distribution and operation “.
  - The energy consumption in the transport sector. An example is “Malmö’s first fossil-free, sustainable tanker and service station is opened” in Malmö.
  - The energy consumption in the industry sector. An example is “Clean energy usage and automatisisation in industry” in Istanbul.
  - The energy consumption in the building sector. An example is “Create a network for district heating and cooling” in Milan.
  - The energy consumption in the public use. An example is “Energy-oriented city refurbishment & quarter management” in Rostock.
  - Concepts, plans and performance. An example is “Government policy instruments for energy efficiency are introduced” in Malmö.
  - Incentives. An example is “Spread adoption of certifications of energy performance” in Turin.
  
- b. As far as the **Transport** sector is concerned, the actions have been organised in five different sub-groups (Figure 10, panel B). Actions are related to:
  - Rules. An example is “Law to ban fossil fuel transport and phasing in scheme” in Barcelona.
  - Plans. An example is “Central integrated traffic control and management system” in Litoměřice.
  - Actions aimed at emission reduction. An example is “Introduce congestion charge” in Turin.
  - Actions related to energy efficiency. An example is “Develop informatics infrastructure including smart stops and smart times for public transportation on busses, trains, and trams” in Milan.
  - Actions related to carbon free transport. An example is “Construction of hydrogen production station” in Litoměřice.
  - The total number of actions in the transport sector is 88, and around 30 of the total are related to Plans and other 30 to emission reduction. Actions for emission reductions focus largely on increasing the quality of public transport, decarbonising private transport, and increasing the share of non-motorised movements (walking, cycling).

- c. The third largest sector addressed is **Governance** with 53 actions being suggested in this sector. Five sub-groups have been created (Figure 10, panel C). Actions in governance are related to:
- The Information System. An example is “Creating real-time impact simulation systems” in Istanbul.
  - Participation. An example is “Engagement of citizens to cleaning, maintenance and local policies” in Litoměřice.
  - Procedures and coordination. An example is “Better coordination between services” in Barcelona.
  - Instruments for governance such as legal reforms or taxes. An example is “Green tax reforms” in Malmö.
  - Resilience. An example is “Climate protection planning, development and construction in cities” in Rostock.
  - The largest category of actions in governance are related to instruments, such as reforms and taxes, with 16 actions being produced in this group. Actions to increase participation and for a better coordination are the second and third largest groups. In this case the call for “education” was mainly understood as a tool for awareness raising and a more conscious behaviour of citizens and as an instrument of social justice, providing access to all forms of education for all.
- d. The **Land use and building** sector contributed with 49 actions, that have been divided into four groups (Figure 10, panel D). Actions are related to:
- Urban planning for a compact city, decentralisation and accessibility. An example is “Easy accessibility to green areas, parks” in Istanbul.
  - Re-use of urban areas. An example is “Conversion of existing unused urban spaces for start - up business” in Zagreb.
  - Innovation and energy efficiency in buildings. An example is “Greening the roofs” in Zagreb.
  - Quality of urban environment and efficient management of natural resources. An example is “Re-open some of the city’s waterways” in Milan.
  - The largest number of actions aims at improving the quality of the urban environment and at achieving an efficient management of natural resources, with 20 actions being produced in this group.

- e. Panel E of Figure 10 displays the sub-groups of actions related to the **Economics** sector. 32 actions have been produced in total and three distinct sub-groups have been identified. Actions are related to:
- Soft measures that improve competitiveness. An example is “Increase cooperation between universities and local companies” in Turin.
  - (Heavy) investments promoting competitiveness. An example is “Identifying appropriate location and financial resources to build and exhibition centre of international importance” in Litoměřice.
  - Transition of urban economy to sustainable low carbon economy. An example is “Breaking the monopoly and creating the conditions for socio-green businesses” in Zagreb.
  - The largest group of actions points to enhancing competitiveness of the urban areas, with more than 20 actions in this group.
- f. As far as the **Education** sector is concerned, the 22 actions have been organised in two different sub-groups (Figure 10 panel F). Actions are related to:
- General education. An example is “Define new models of education and training” in Turin.
  - Awareness, civic education and resilience. An example is “Ensure that citizens understand repercussions and costs of changes and demands” in Barcelona.
  - 12 actions aim at improving the awareness and increasing civic education, while 10 actions refer to general education.
- g. Another important sector where stakeholders were asked to focus on is the **Social** sector. Despite not being completely related to environmental issues, the social sector was considered essential as a vision of a carbon-free city cannot exempt a vision of a highly social city. The importance of the social sector is underlined by the large number of actions suggested. 20 actions have been proposed in two different categories (Figure 10, panel G). Actions are related to:
- Health. An example is “Increasing health service and making it accessible for everyone” in Istanbul.
  - Safe society. An example is “Central security system (cameras)” in Litoměřice.
  - Quality of life. An example is “24 hour school / culture / hobby houses for all ages” in Malmö.
  - Stakeholder primarily focused on actions to improve the quality of life, with 10 actions in this group.

- h. As far as **Waste** is concerned, 18 actions have been proposed in this sector. Many actions address the concept of circular economy, in relation to waste generation and recycling. The actions are related to:
- Rules, plans and Logistics. An example is “Large-scale logistics systems for recycling are established “ in Malmö.
  - Recycling. An example is “Make the separation of waste and recyclables more user-friendly and more efficient” in Milan
  - Consumption. An example is “Carbon tax on products is introduced” in Malmö
  - Panel H in Figure 10 shows that the actions are overall equally distributed in the three sub-groups.
- i. During the back-casting workshop, stakeholders suggested 17 actions that are related to the **Tourism** sector aiming at:
- Promoting tourism at the city level. An example is “Create innovative offers and holiday packages for tourists” in Turin
  - Creating attractions. An example is “City beach on the Elbe river side” in Litoměřice.
  - Nine actions have been suggested in the first group and eight in the second (Figure 10, Panel I).
- j. 13 actions refer to the **Food Production** sector, sub-divided into actions related to:
- Self-sufficiency and transport. An example is “Increasing areas for food production” in Zagreb
  - Energy consumption. An example is “Government subsidy of fossil-free and sustainable agriculture is introduced” in Malmö.
  - Education. An example is “Establishing school and farm focusing on biological agriculture” in Litoměřice.
  - The largest number of actions has been suggested in relation to energy consumption (Figure 10, Panel J).
- k. Actions in two remaining sectors have been proposed by stakeholders, namely **Technology** and **Biodiversity**. apparently stakeholders considered these sectors only of marginal importance for achieving post-carbon cities , as the number of actions suggested in these sectors is limited. Only stakeholders from Istanbul, Turin and Litoměřice focused on



technology. Surprisingly, technological innovation as an instrument for exploring, for example, new options for energy generation was not seen as an important prospective, actions pointed instead to the application of existing technologies (smart technologies, electric and hybrid cars, etc.) ore were seen as a form of promoting economic development (and were thus included into the category of economic promotion.. Actions in the **Biodiversity** sectors have been identified only in Istanbul, Zagreb and Turin for a total of six actions. Stakeholders in Zagreb suggested: “use of agro ecology in the management of public green areas”.