POCACITO

european post-carbon cities of tomorrow

Collated Strategy Papers for the Case Study Cities

CEPS

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I THE CITY STRATEGY PAPERS – OVERVIEW

This report presents the strategy papers developed with the assistance of the city case study stakeholders. The cities involved in the exercise were Malmö, Copenhagen, Barcelona, Zagreb, Istanbul, Milan, Turin, Litoměřice and Lisbon. The strategies are collated in full, except for those that were written in the local language, in which case the strategy is summarised in English.

This report on strategy transition intends to summarise the key findings from the stakeholder workshops and the recommendations on further steps to bring the cities onto a decarbonisation pathway. The document presents the lessons from the vision and backcasting exercises, offering city authorities clues on how to perform consultations, define visions in line with the views of citizens, fix milestones and plan actions in a long-term perspective.

This report reflects the results of stakeholder workshops. In these workshops stakeholders were asked to develop a vision and then a strategy through a backcasting process. It brings together the preparatory work of the POCACITO team on the challenges facing the city to achieve a sustainable decarbonised future, backed by a global trends analysis.

Each case-study city paper will be structured as follows:

1. A brief description of the objectives of the workshops and the process of visioning, back-casting and setting milestones and actions;
2. A summary of the current and possible future situation in the city, making reference to the key challenges identified in the initial assessment of WP3;
3. Insights from the GAP analysis for the city;
4. The main results of the visioning process and the objectives, milestones and actions proposed by stakeholders;
5. A brief presentation of the results of trends of the city based on the proposals of workshop participants.
6. Recommendations for the city authorities and policy recommendations for national and EU authorities.

This document is not a fully-fledged strategic recommendation document for the cities because the experimental nature of the exercise offers results that are too limited. It shows however how the approach can be used for a larger visioning and back-casting process which refines the analysis and approach presented in this document. The exercise helped participants to appreciate the challenges that reaching a long-term objective would pose. It encourages action and clarifies the role of different stakeholders.

THE STRATEGY PROCESS AND THE RESULTS

POCACITO organised workshops in various cities to develop visions and strategies for the cities using backcasting. The basic methodology was developed in a POCACITO guidance document "T4.2 Case study workshop guidelines". The case study leaders needed to adapt the process to fit the profile of the stakeholders and adopt the most successful approach, given local circumstances and attitudes of the stakeholders. Each strategy has therefore been developed under a slightly different process, always aiming, however, at presenting milestones and actions. The outcomes were affected by the composition of the groups and the backgrounds of the stakeholders.

VISIONING

The visions generated by the stakeholders in each city varied considerably. Each city has clearly different characteristics and citizens have a different view of what a sustainable, green and social city should be. The challenges also varied considerably, and an important factor was the very different backgrounds of the stakeholders. Nevertheless, visions share common themes and overlapping ideas.

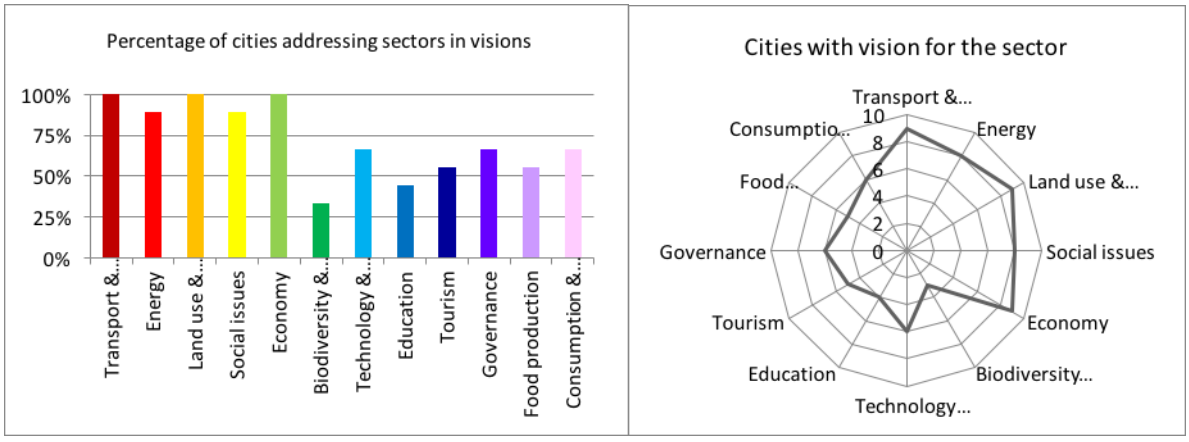
Table I-1 presents the 12 main sectors relevant to local decision-making for the transition to a post-carbon city. Not all cities placed the same importance on each sector: transport and mobility, energy, land use and infrastructure, social issues, economy, biodiversity and conservation, technology and innovation, education, tourism, governance, food production, and consumption and waste. Transport, energy, economy and social problems topped the concerns of stakeholders, but surprisingly, areas like the environment and education were not considered to be central by all. Only three cities included biodiversity and conservation in their visions.

Table I-1: Sectors addressed in the 2050 post-carbon visions [POCACITO D.4.3 Synthesis of Stakeholder Workshop Reports]

CITY	TRANSPORT & MOBILITY	ENERGY	LAND USE & INFRASTRUCTURE	SOCIAL ISSUES	ECONOMY	BIODIVERSITY & CONSERVATION	TECHNOLOGY & INNOVATION	EDUCATION	TOURISM	GOVERNANCE	FOOD PRODUCTION	CONSUMPTION & WASTE
Barcelona	●	●	●	●	●		●	●	●	●		
Istanbul	●	●	●	●	●	●	●			●		●
Lisbon	●	●	●	●	●		●		●	●	●	
Litoměřice	●	●	●	●	●		●	●	●	●	●	●
Malmö	●	●	●	●	●		●				●	●

CITY	TRANSPORT & MOBILITY	ENERGY	LAND USE & INFRASTRUCTURE	SOCIAL ISSUES	ECONOMY	BIODIVERSITY & CONSERVATION	TECHNOLOGY & INNOVATION	EDUCATION	TOURISM	GOVERNANCE	FOOD PRODUCTION	CONSUMPTION & WASTE
Milan	●	●	●	●	●	●	●	●		●		●
Rostock	●	●	●	●	●				●		●	●
Turin	●		●	●	●				●			
Zagreb	●	●	●		●	●		●		●	●	●

Figure I-1: Sectors addressed in cities' visions [POCACITO D.4.3 Synthesis of Stakeholder Workshop Reports]



Going beyond the commonly addressed sectors and urban issues, the case study cities identified challenges that are specific to their context. The following overview highlights some of these specific challenges, which differ greatly.

Table I-2: Key Specific Challenges

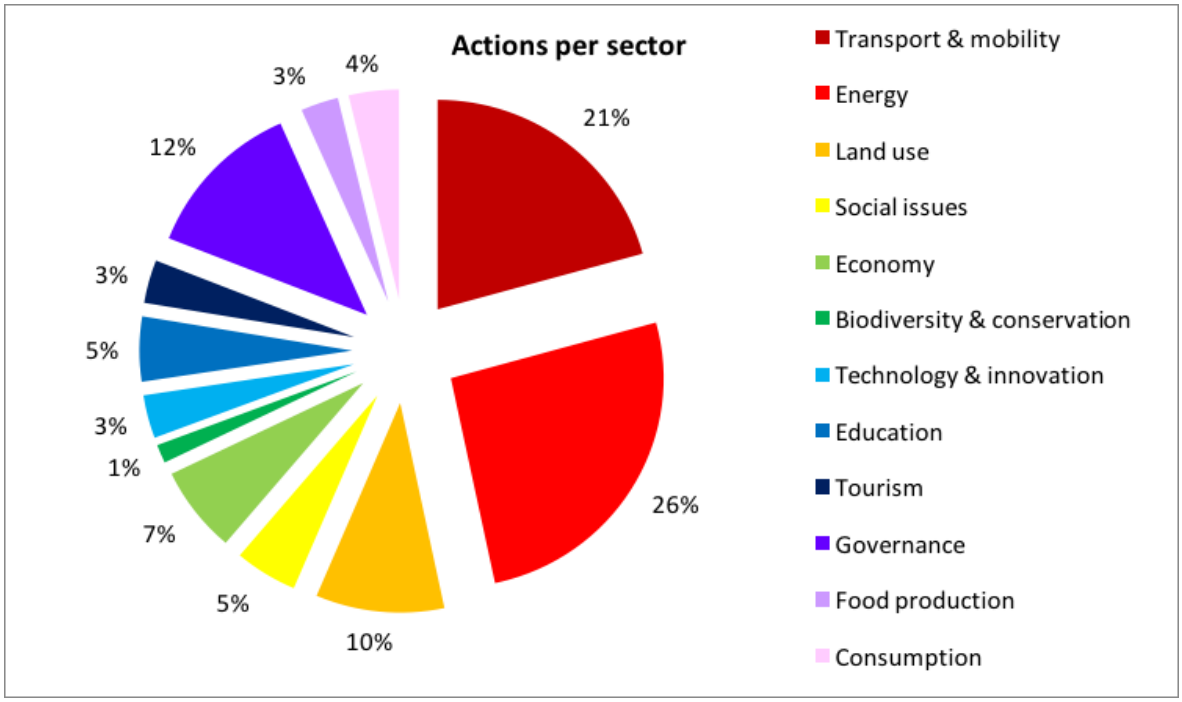
CITY	KEY SPECIFIC CHALLENGES
Litoměřice	- Air pollution from nearby chemical factory placed in another town - Financing of geothermal plant
Barcelona	- Developing real mobility, not only modes of transport - Preserving the local authenticity of the city (too much emphasis on tourism) - Social integration - Effective reduction of emissions, including those outside the city area but affected by it: Airport (outside the city], Port (city)
Milan/Turin	- Economic development (specialisation) - Soil consultation - Accessible and compact city
Rostock	- Networking with regions - Quality of life
Istanbul	- Ineffective and untimely usage of public resources - Conflicts in the region/terrorism/security problems - Migration/population growth - Lack of institutional coordination & cooperation
Lisbon	- Natural disaster (floods, earthquakes) - Mobility (private car is the main transport mode used by population) - Social inclusion (poverty, unemployment, ageing etc.)
Malmo	- Integration (housing segregation) - Social sustainability
Zagreb	- Management issues (urban strategies, programs and plans; lack of long-term urban planning and strategy) - Non-active citizens (lack of awareness, non-proactive, lack of education on sustainable development)
Copenhagen	- Rising social inequality - Affordable housing - Private transportation locked into fossil fuels (limited introduction of alternative fuels)

BACKCASTING SCENARIOS

Through backcasting scenarios the cities explored how to realise their visions and stakeholders set out listed milestones for how to achieve them. These are target dates to achieve individual objectives that ultimately lead to a decarbonisation of the cities. Each of the eight cities created different scenarios based on their own socio-economic and environmental situation and experiences in the workshops. Most milestones focused on energy (25%), transport and mobility (17%), land use (13%), and governance (11%); all other sectors had a share of less than 10% of the milestones. Some 48% of the milestones are envisioned in the short term (up to 2025), 34% in the medium term (2025-2035), and 17% in the long term (after 2035).

The challenge, however, was for stakeholders to identify the actions necessary to achieve those milestones – the who, how and when; how to develop the rules, who should propose them, decide on them, and who would implement them. The actions have been organised by sectors, identifying the sector they look at. Some sectors have received a larger number of actions than others. Figure I-2 lists the number of actions by sector, which gives an indication of the importance granted by stakeholders. The divergences on the value given for each area are significant between the cities; this is mainly due to the composition of the stakeholders. It is also evident that results would change if the stakeholder composition changed. The results are based on an experimental process to validate the approach. To ensure results compatible with the average position of interested stakeholders, more workshops with a larger number of stakeholders covering a representative division of sectors would be necessary.

Figure I-2: Distribution of actions by sector



Source: POCACITO quantification of case study cities D 5.2.

GENERAL OVERVIEW

The POCACITO local workshops in case study cities placed great emphasis on transport and energy generation in urban areas, where many of the envisaged actions aim to increase quality of life, decarbonise private transport, and increase the share of non-motorised mobility (walking, cycling). Some visions point to changes in urban form, implicitly relating to the goal of more compact cities, increasing the economic efficiency of collective transport, and the carbon impact of land use changes. (POCACITO D.4.3)

Goals and visions developed in relation to the energy sector mainly point to new energy efficiency measures at the building level, although some visions acknowledged that the potential of these changes may be limited because the potential for zero-energy concepts in existing buildings may be limited. Beyond these two areas, the visions and scenarios attributed great importance to economic development and technological innovation, seen mainly as a means of enhancing the (economic) competitiveness of urban areas. Issues like the circular economy were mentioned in some visions in relation to waste generation and recycling, whereas the de-carbonisation of industrial production or the services sector was not addressed at all, except for reducing emissions and heating and cooling. Aspects related to the quality of the urban environment were addressed either as part of sector-oriented strategies (increasing walkability and cycle paths in cities, conserve and enhance biodiversity) or as an instrument for economic growth, as far as the increase of the tourism sector as an economic sector valorising urban spatial qualities is concerned. (POCACITO D.4.3)

Economic growth was addressed in some cities, making evident that priorities for future urban development need to address issues which go beyond the generation of high-quality urban spaces and a reduction in carbon emissions. This is especially the case for cities affected by the consequences of the economic crisis (Lisbon, Turin) and striving to meet general development goals (Istanbul). The transition of urban economies to circular, more inclusive, socially and environmentally sustainable patterns was addressed in only one case (Malmö). Only in this context were consumption patterns also addressed, aiming at a less globalised economy, starting from the localisation of food production. Technological innovation as an instrument for new energy generation was not seen as an important perspective; visions mainly pointed to existing technologies (smart technologies, electric and hybrid cars, etc.). (POCACITO D.4.3)

An interesting fact to be underlined is the great importance attributed to urban governance in many visions and strategies. The role of public policies in achieving the goals described in the post-carbon visions is seen as crucial by practically all cases. In some, the calls to enforce the strategies and their translation into real policies appeared alongside demands for larger spaces for public participation in decision-making, in the design and management of urban (neighbourhood) spaces, and for social inclusion. (POCACITO D.4.3)

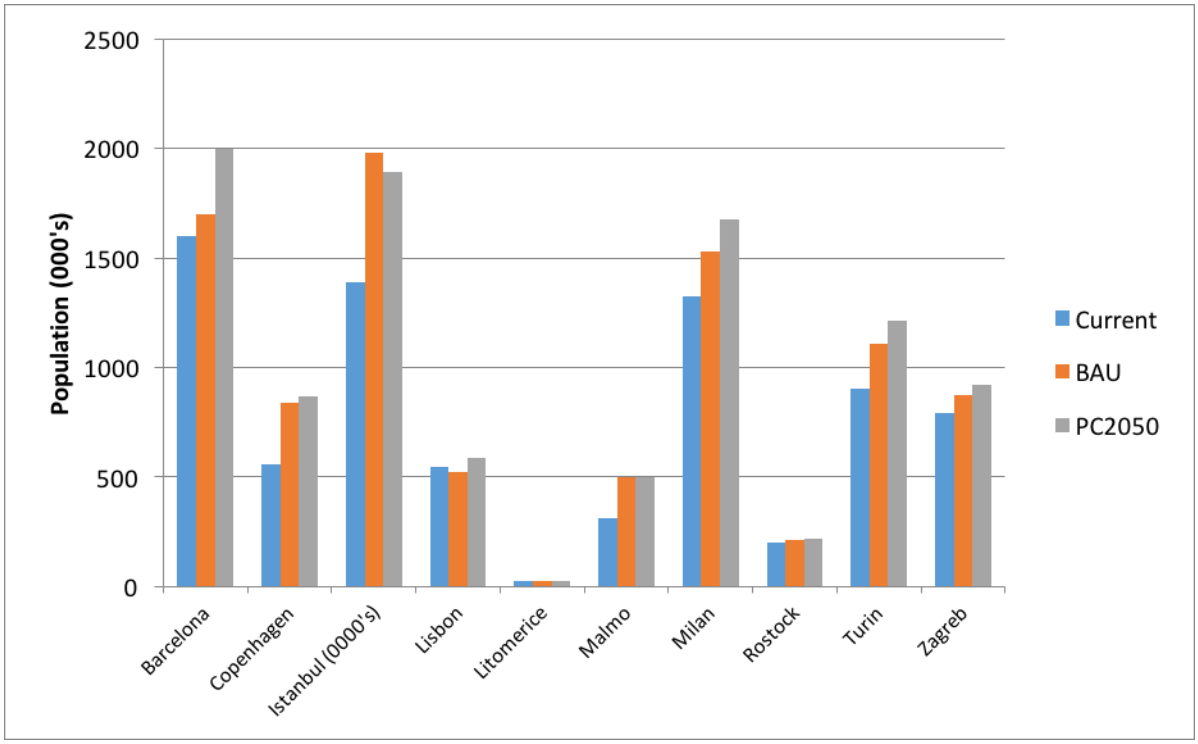
Quantification of the case study cities

Central to the development of the POCACITO project's Roadmap is the modelling, quantification and comparative analysis of two possible future scenarios in 2050: business as usual (BAU) and post-carbon 2050 (PC 2050). POCACITO will be using two complementary modelling and impact quantification methods. The first utilises the information and data already gained during the

preceding work packages to focus on the impacts within the city system boundaries (city level assessment). The second uses the economic multi-regional input-output (MRIO) approach to enable the consumption footprint of the cities to be assessed (supply chain and city). POCACITO already completed the modelling of the fundamental elements that help to describe the city: population, energy, transport, buildings and housing, GDP/economic development, industry sectors and employment. (POCACITO D.5.2)

For the majority of cities, population increases are expected in both scenarios, as shown in Figure I-3. Litoměřice is the only city expected to decline in both scenarios, although only a small decline is anticipated. Since we had utilised the IIASA SSP scenarios for national projections as background, the PC 2050 population is typically larger. This is accounted for through an increased densification of the cities. An exception is Istanbul, where PC 2050 is actually lower than BAU.

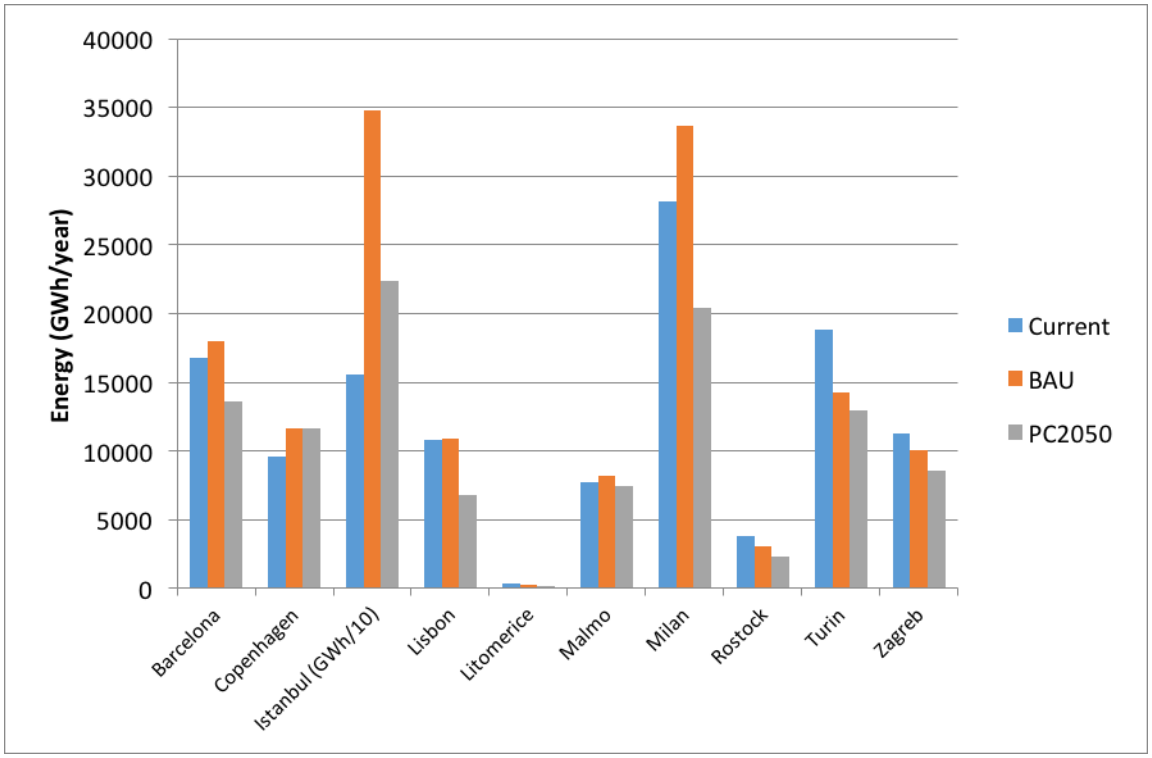
Figure I-3: Populations of the cities comparing the scenarios against the current levels (POCACITO D.5.2)



Source: POCACITO D. 5.2. Quantification of case study cities

For the majority of the cities energy use is usually higher for BAU than the current situation and PC 2050. This is typically related to the expected population increase with BAU compared to the current situation, and the expected level of energy reduction and efficiency improvements under PC2050. In some cases, energy use and efficiency improvements are also expected to be quite significant in the BAU scenario.

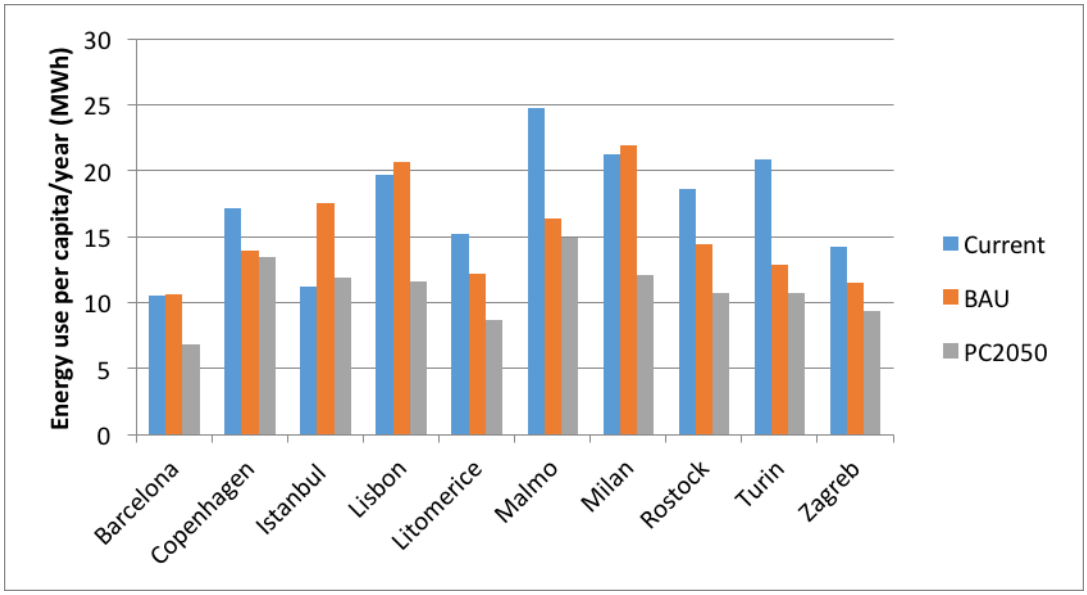
Figure I-4: Energy use of the cities comparing the scenarios against the current levels (POCACITO D.5.2)



Source: POCACITO D.5.2. Quantification of case study cities

A more focused perspective is provided in Figure 4-5 by comparing the energy use per capita, which removes the need to concurrently consider population change. This shows that for 40% of the cities (Barcelona, Istanbul, Lisbon, and Milan) energy use per capita is projected to grow under BAU whilst for the remaining 60% it is expected to drop, in some cases quite significantly. Under PC 2050 the energy use is expected to drop for all of the cities with three: Barcelona, Litoměřice and Zagreb, dropping to under 10 MWh/person/year.

Figure I-5: Energy use per capita comparing the scenarios against the current levels (POCACITO D.5.2)

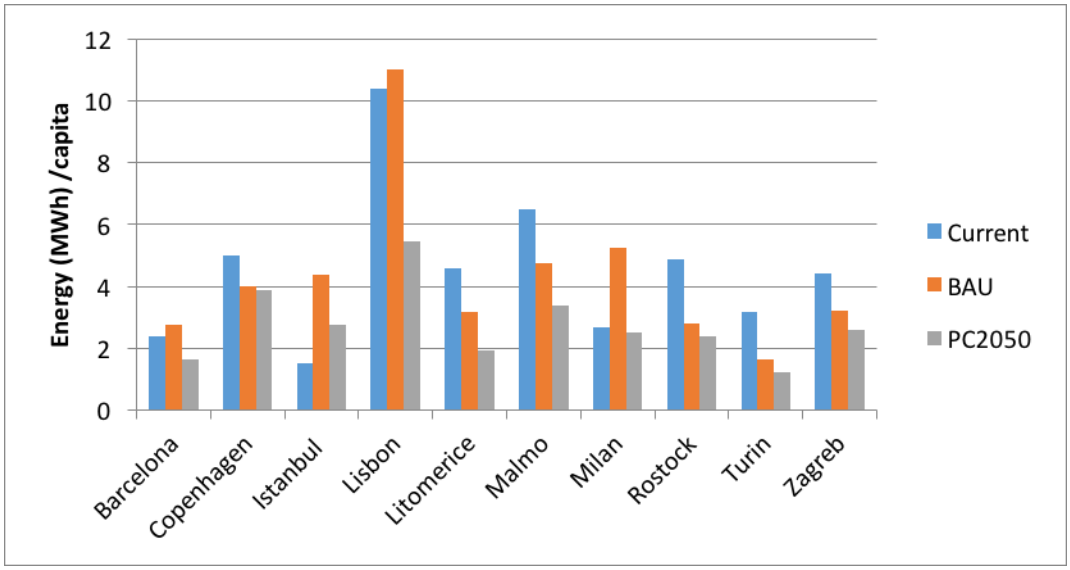


Source: POCACITO D.5.2. Quantification of case study cities

A good indicator of the sustainability of the transport system within cities is the energy used.

Figure *I-6* provides a comparison of energy use per capita of the city transport systems for the scenarios. It clearly shows that Lisbon has the highest per capita energy use, which is indicative of the high car use due to many residents moving away from the city centre. This is shown to fall significantly in the PC2050 scenario with higher densification, improved public transport and higher electric vehicle use. For the large majority of the cities energy use of transport in PC 2050 is much reduced, mainly due to a shift to more sustainable transport modes and electric vehicles.

Figure I-6: Energy per capita for the city transport systems under different scenarios (POCACITO D.5.2)



Source: POCACITO D.5.2. Quantification of case study cities

It is important to bear in mind that the projections given in this report are not intended as a prediction of the future (although BAU is viewed as a reasonable extrapolation and therefore a prediction of what could happen if no focused action is taken). They are developed to learn from possible future scenarios about what might happen in BAU, what the risks are and how this compares to a possible post-carbon route.

The results of the modelling and quantification work to date have shown that nearly all cities are growing. But in many cases energy consumption under BAU is being decoupled, from both population and economic growth. However, this is generally too weak to make significant progress towards becoming post-carbon by 2050. There are generally significant differences in the energy consumption between the BAU and PC2050 scenarios. It is energy production, however, that will be the most critical in determining the climate change impact. Early indications suggest that the PC 2050 scenarios may not reach complete zero-carbon status in many of the case study cities. (POCACITO D.5.2)

II BARCELONA STRATEGY PAPER – TOWARDS A POST-CARBON CITY

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CHALLENGES FACING THE CITY

The POCACITO project has conducted a number of separate studies, starting with an initial assessment of the city to analyse the latest trends over a decade and to see if the city is on a path of decarbonisation with resilient social and economic development.

Barcelona is a leader in the deployment of smart city technology, which is important for sustainable economic growth towards a post-carbon city, but a long-term strategy has to move beyond the technological approach. The city seems to face two challenges that are not currently developing well and may require attention by the city authorities. First is the need to address the challenges of an increased share of the population at risk of exclusion and poverty. The city has focused strongly on the tourism and business attractiveness and is at the forefront of actions in the area of technology and environment. The risk may be a class of marginalised citizens not able to benefit from the advanced city features.

Barcelona is crossing the threshold from being a testing ground for technologies to applying these technologies on a large scale. A greater role for the AMB (Area Metropolitana de Barcelona) as coordinating body for the city may be needed here. The movement is there; the recommendation is to continue, despite the difficulties in the process.

The growing level of municipal indebtedness will require the city to explore new financial models for public procurement and public services, seeking better cost-recovery mechanisms, while ensuring affordability for citizens and positive economic impacts for the city.

Table 11 summarises the global trends for each key performance indicator (KPI) analysed by the project in the *Barcelona case study assessment report (Task 3.2., Nov. 2015),* using statistics from the city and wider region depending on data availability. In red are the indicators in which Barcelona records a negative trend, green for positive; overall Barcelona's trends are all in line with a post-carbon city trend. Negative developments have been caused by external economic shocks rather than a lack of policy action.

Table 3: Summary of KPI's global trends

Dimension	Sub-dimension	INDICATOR	Year	Trend
SOCIAL	Social Inclusion	Variation rate of unemployment level by gender	2003-2015	↗
		Variation rate of poverty level	2004-2014	↗
		Variation rate of tertiary education level by gender	2003-2013	↗
		Variation rate of average life expectancy	2003-2012	↗
	Public services and Infrastructures	Variation rate of green space availability	2004-2013	↗
	Governance effectiveness	Existence of monitoring system for emissions reductions	N/A	yes
ENVIRONMENT AND CLIMATE	Biodiversity	Variation rate of ecosystem protected areas	2009-2013	n/a
	Energy	Energy intensity variation rate	2003- 2012	↘
		Variation rate of energy consumption by sectors	2003- 2012	↘
	Climate and Air Quality	Variation rate of carbon emissions intensity	2003- 2012	↘
		Variation rate of carbon emissions by sector	2003-2012	↘
		Exceedance rate of air quality limit values	2003, 2012	↘
	Transport and mobility	Variation share of sustainable transportation	2004 – 2014	↗
	Waste	Variation rate of urban waste generation	2003- 2014	↘
		Variation rate of urban waste recovery	2006- 2014	↘
	Water	Water losses variation rate	2011-2014	↘
	Buildings and Land Use	Energy-efficient buildings variation rate	2013	n/a
		Urban building density variation rate	2001-2011	↘
ECONOMY	Sustainable economic growth	Level of wealth variation rate	2003-2012	↗
		Variation rate of GDP by sectors	2003-2014	
		Employment by sectors variation rate	2003-2014	
		Business survival variation rate	2009-2014	↘
	Public Finances	Budget deficit variation rate	2003-2015	↘
		Indebtedness level variation rate	2003-2015	↘
	R & I dynamics	R&D intensity variation rate	2004-2012	↗

Source: Own estimations

The municipality of Barcelona has seen a slight fall in population from 1970 to the year 2000, from 1.75 million inhabitants to 1.5 million inhabitants. The population has since increased due to the revalorisation of the centre of the town and is today just over 1.6 million. The metropolitan area has increased strongly in population from 2.74 million inhabitants in 1970 to 3.2 million. The province of Barcelona has seen an increase from 3.9 million to 5.5 million inhabitants. The influx of young immigrants from other parts of Spain and abroad has helped Barcelona to mitigate the impact of the ageing population.

The creation of the AMB as an entity to help develop the city in an integrated and coherent fashion is helping it to develop an efficient transport sector, and this is reflected in a growing use of public transport. Efforts to facilitate cycling and walking are clearly paying off, according to census results.

Barcelona is at the forefront of the Smart City movement and is aiming to retain its position, despite the financial crisis and the difficulties this has created for new investment. The city is still vibrant in initiatives and seems poised to regain any lost ground.

Sustainability strategies from transport to green space protection and waste and water management are being implemented.

The city is also trying to find a balance between the need to maintain it as a tourist centre, while keeping its local character. The modernisation of the city has not changed the strategy of the authorities to retain the local markets and the characters of the city districts with their 'town centre'. There will be a need to balance the pressures created by the tourist and expat community, and the protection of the patrimony and local social structures, which in turn make the city attractive to tourists and investors too.

From the point of view of carbon emissions, Barcelona has several strategies that seem to be impacting on carbon emissions. Emissions intensity and total emissions have been falling, and despite the impact of the financial crisis there is some indication that GDP growth and emissions have been decoupled to some extent as energy intensity was also falling before the crisis hit. The fall in carbon emission per unit of GDP fell by nearly 30% in the last decade.

In the residential sector the advance has been modest at this stage, as the energy efficiency certification of buildings was introduced only recently and there is this little information that can be extracted from the registration process, except that the energy certification of buildings is taking place rapidly and the database of the municipality has issued 150,000 permits.

The city of Barcelona seems to be solidly anchored on a post-carbon path, driven by its objective to remain at the forefront of the smart city movement. This means that Barcelona can be seen as an example of progress. The city needs to pay particular attention to the risk of poverty and social exclusion. Barcelona may recover from the crisis, but some groups in society may well fall into long-term unemployment and poverty.

Barcelona is leading on the path to sustainable economic growth. Two aspects may require the attention of the city authorities. First is the need to address the challenges of an increased share of the population at risk of exclusion and poverty. The city has focused strongly on the tourism and business attractiveness and is at the forefront of actions in the area of technology and environment. The risk may be a class of marginalised citizens not able to benefit from the advanced city features.

Barcelona is crossing the threshold from being a testing ground for technologies to being a large-scale user of these technologies. For this, a stronger role for the AMB as coordinating body for the city may be needed. The movement is there, the recommendation is to continue ahead.

The growing level of municipal indebtedness will require the city to explore new financial models for public procurement and public services, seeking better cost-recovery mechanisms while ensuring affordability for citizens and positive economic impacts for the city.

INSIGHTS FROM THE GAP ANALYSIS FOR THE CITY

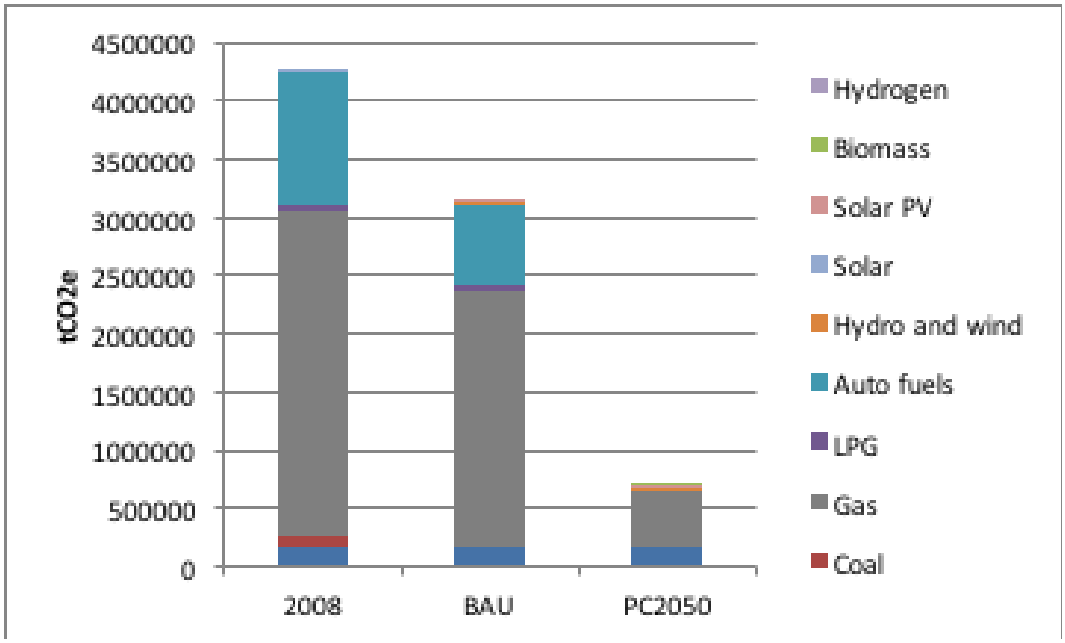
Despite the advances of the city, there are difficult challenges ahead. The 'GAP' to a post-carbon city is large and emissions need to be addressed more vigorously, the business as usual estimations show a very large gap between the objectives and final emissions (see the Barcelona initial assessment D 3.2). The results below on the gap analysis and partially the text are extracted from the quantification of the case study post-carbon city scenarios, as well as the BAU scenarios (D 5.2).

The GHG emissions drop from energy sources required (

Figure 7) for a post-carbon 2050 city (PC2050) is much steeper that the outcome under BAU (based on a continuation of the present trends). This section presents a summary of the figures and results from the sustainability impacts of post-carbon cities in WP5. The majority of emissions in 2008 and BAU are clearly the result of the use of natural gas in heating and electricity production. In BAU the total GHG emissions are reduced by 27% compared to 2008. Emissions from transport are reduced by 40%. It should be noted that these figures do not include emissions from waste and the quantities may be higher in comparison to local estimates due to lifecycle assessment emission factors being used. In the PC2050 scenario total emissions are reduced by 84%, but there is still some use of gas, which accounts for 70.5% of emissions (even though gas use is reduced by almost 91% compared to 2008).

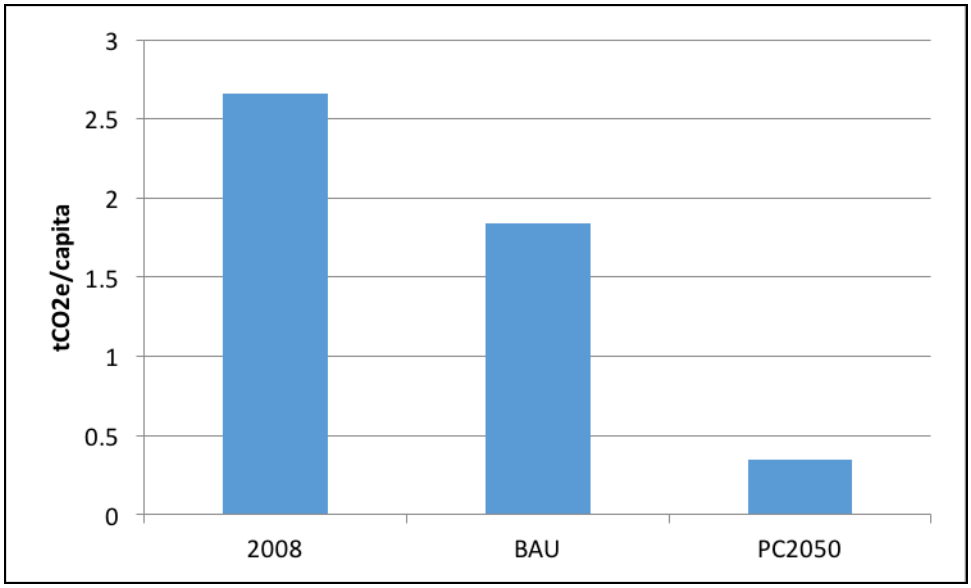
Figure 8 compares the GHG emissions per capita for 2008 and the BAU and PC2050 scenarios. It highlights a considerable drop required in per capita emissions to achieve PC2050 to 350kg compared to over 2.5 tonnes in 2008. Under BAU emissions also drop to 1.84 tCO2e/capita.

Figure 7: GHG emissions associated with energy sources for Barcelona for 2008, BAU and PC2050



Source: POCACITO quantification of case study cities D 5.2.

Figure 8: GHG emissions per capita for Barcelona Municipality for 2005, BAU and PC2050

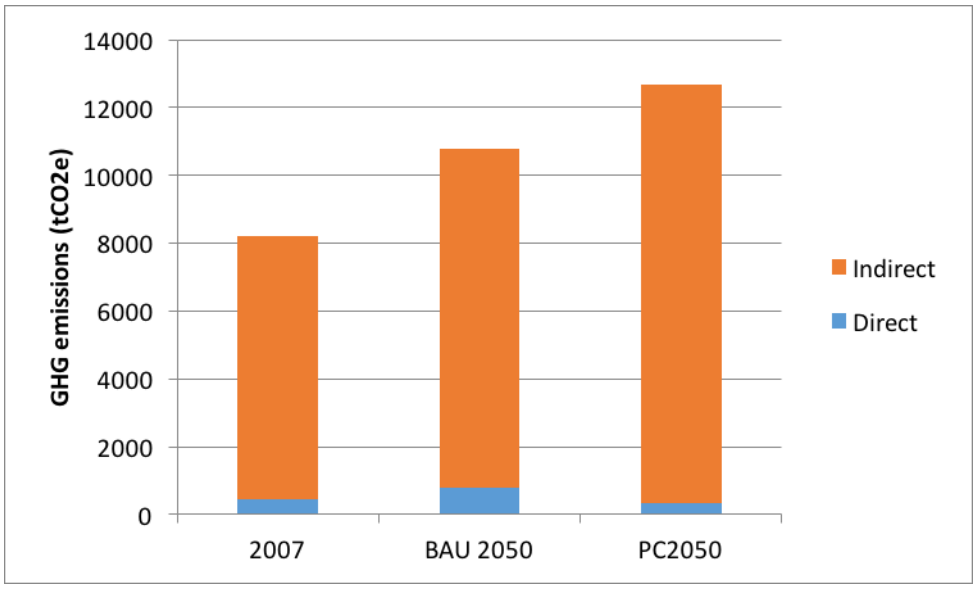


Source: POCACITO quantification of case study cities D 5.2.

Beyond that, the reducing emissions not generated within the city itself, but caused by its activities, will need to be addressed. Barcelona is a large tourist centre, with intensive air traffic and maritime activity. Tourism and environmental sustainability will be a challenge.

In fact, the challenge of the indirect emissions is considerable, because the projections show that even if the city reduces direct emissions successfully under a post-carbon city scenario, this is at the cost of indirect emission increases. This is why a city strategy cannot be successful on its own if global emissions are to be reduced. The sustainability impact analysis shows that while there is a reduction in local emissions from transport and electricity, other goods and services cause increases in consumption, linked to strong growth in GDP, leading to a higher level of emissions than today.

Figure 9: Direct and indirect GHG emissions for Barcelona for 2007, BAU and PC2050



Source: POCACITO quantification of case study cities D 5.2.

SOCIO-ECONOMIC ASSESSMENT

INVESTMENT COSTS

The investment costs for renewable energy and building renovations, over the period 2018 to 2015 for each scenario are shown in the Table below The total costs of PC2050 are €3.6 million compared to €1.3 million for BAU. However, the table also shows that these costs would represent only 0.31% of accumulated GDP (from 2018 to 2050) for the PC2050 scenario.

Table 4: Investment costs for BAU and PC2050 Scenarios

Energy	**MEUR (2016)**
BAU	851
PC2050	2,120
Total costs for fossil free energy	2,599
Building renovations	
BAU	3,617

PC2050	8,441
Total costs (Energy and buildings)	
BAU	4 469
PC2050	10 562
Costs as % of accumulated GDP (2018 to 2050)	
BAU	0.15%
PC2050	0.31%

Source: POCACITO quantification of case study cities D 5.2.

This translates into the following discounted costs as shown in the next table at various discounted rates from 2018 to 2050.

Table 5: Net costs for scenarios investments at different discount rates (MEUR)

DISCOUNT RATE	1%	3%	5%
BAU costs (NPV)	3775	2792	2792
PC2050 Costs (NPV)	8921	6597	5097

Source: POCACITO quantification of case study cities D 5.2.

COSTS/BENEFIT ANALYSIS

In this section we examine the following cost benefits: cost reduction in mortalities due to reduced air pollution, additional jobs due to renewable energy and renovation of buildings and a qualitative examination of reduced energy costs in PC2050.

REDUCTION IN MORTALITIES DUE TO REDUCED AIR POLLUTION

The current costs of air pollution in Barcelona are estimated at EUR 1,882 billion/year based on the 2010 cost of 2.8% of GDP for Spain provided by WHO (WHO Regional Office for Europe and OECD, 2015). In order to estimate the potential benefits of the scenarios compared to today's costs, the cost due to air pollution of the scenarios was subtracted from the cost due to air pollution at the 2010 GDP percentage. This was performed for each year from 2018 to 2050. In this way the benefit of the scenario can be seen as the savings achieved compared to the 2010 cost rate. The cost of the scenarios is based on a linear change from 2018 to the 2050 scenario cost percentage. This is calculated as a ratio of fossil fuels and biomass combusted in the scenarios compared to the current use in GWh.

The net of benefits of BAU and PC2050 at different discount rates are shown in Table 6. The table shows the benefit of the change in mortality due to the change in air pollution. In addition to BAU and PC2050, it also compares the benefits that would be obtained if there was a linear progression from 2018 to no air pollution in 2050.

Table 6: Accumulated cost savings (2018-2050) due to reduced mortality in the scenarios, and for no air pollution by 2050 (EUR millions NPV)

	DISCOUNT RATE		
	0.8%	1.0%	1.2%
BAU	20 037	19 178	18 362
PC2050	37 712	36 063	34 497
No air pollution	38 533	36 881	35 311

INCREASED EMPLOYMENT

The potential for increased employment due to the use of renewable energy and building innovation is summarised in Table 7. Potential jobs for renewable energy are modest with 310 ongoing jobs from operation and maintenance, but contribute to nearly 24,000 from manufacturing through to installation. The number of jobs created from the renovation of buildings is significant at 82,002. It should be noted that the jobs are for the entire supply chain, as well as indirect effects and are based on a figure of 12 jobs per million euro spent. This should be seen as the total number of jobs to 2050, which may not be ongoing in all cases.

Table 7: Benefits of PC2050 scenario compared to BAU for Barcelona

Additional PC2050 Jobs	MCI	O&M
Renewable energy	23665	310
Building renovation	82002	

REDUCTION IN ENERGY COSTS

Due to limitations in data availability and the scope of the project the energy costs of the scenarios could not be compared with the current costs. It is possible to provide a semi-quantitative and qualitative indication of the costs, however.

PC2050 can be expected to have lower costs than BAU as a result of increased energy efficiency meaning that energy consumption is 7.2% lower. Currently (2013) Barcelona has only 3.1% renewables in its energy mix and this is expected to increase to 16.7% in BAU and 58.3% in PC2050. Hence there is the potential for much greater energy security and lower risks due to the volatility of fossil fuel prices.

In summary, there is potential for 7.2% reduction of costs in PC2050 due to reduced energy consumption and a further reduction related to the 41.6% additional renewable energy.

GAPS AND RISKS

The most prominent gaps for Barcelona under the current PC2050 scenario are as follows:

Energy and environment

There is an assumed continued reliance on nuclear power to supply the majority of the electricity. This is due to the challenges of providing enough renewable energy at the city level, but also because nuclear is already a low-carbon option. However, due to the shortfall in developing significant

quantities of renewable energy there is a need for a high input of natural gas, which is responsible for the majority of GHG emissions. The current trends for the self-provision of renewable energy are not big enough to make much impact under BAU.

The projected per capita GHG emissions for PC2050 are among the lowest of the case study cities, at only 340 kgCO2e/capita, but with total emissions of almost 700,000 tonnes it still falls short of absolute zero carbon. This is mainly due to the reliance on gas for some heating and electricity generation. There is still a major shortfall seen in the provision of sufficient quantities of renewable energy (due primarily to a lack of consistent and robust actions and milestones from the scenario workshops).

In order to close this gap there is a need to provide an additional 1102 GWh of energy from renewable energy. This is slightly more than the 953 GWh that were supplied in 2008 from renewable energy.

The data availability to assess biodiversity was low but this was not addressed in the PC2050 vision or actions and hence should be considered in the strategic paper. Although waste reduction was not addressed in the PC2050 vision, there was an ambitious target for waste recovery and recycling. This should be further supported in the strategic paper, along with actions for the circular economy (see below).

Socio-economic

The business survival rate has decreased significantly from 90% to 69% (2008 to 2010), which is of concern, but there are not enough data points to indicate a trend or facilitate modelling to 2050. This is also exacerbated by the fact that Spain was particularly affected by the financial crisis, which is not likely to affect circumstances by 2050.

Unemployment increased dramatically from 60% in 2002 to 23.7% in 2012, leading to some concern, but again it is impossible to project to 2050 from these figures. This is also true for the poverty level, which also increased from 2.4% to 17.7% during 2004 to 2013.

There is some inequality in the tertiary education rates, which are greater for males at 37.7% than for females at 31.9% in 2013. But both have increased from around 27% in 2003.

Urban sprawl

Although the population of Barcelona Province is projected to decrease under BAU by 281,700 or 5.3 %, the use of land for urban development (sprawl) will still increase by 161.0 km² or 19.9 % on the at the expense of non-urban land.

We have assumed within the PC2050 that densification will occur and that there will be no urban sprawl. However, the BAU scenario highlights the potential for significant urban sprawl, which needs addressing in the strategic paper. The paper should therefore address two aspects. First, it should address the potential for an increase in population under PC2050 within the municipality and plan for densification. However, there is also a role for Barcelona Municipality to encourage further movement of the Province population to the municipality. This is in order to reduce the risk of further urban sprawl but also to capitalise on the additional sustainability benefits of densification, such as improved energy efficiency and reduced transport infrastructure and public services.

Circular economy and lifestyles

The potential for improvements in the impact of consumption are currently not well addressed in the PC2050 scenario. Options include increasing the facilities for reuse (e.g. through provision of locations to leave unwanted good for reuse) and repair (such as repair cafes), but also to support businesses and innovation in this area.

STAKEHOLDER CONSULTATION WORK

Three workshops have been held, structured closely to the methodology presented in the training workshop at the partner meeting in Berlin on September 9 and resumed in the deliverable T4.2 *Case study workshop guidelines*. The workshops developed visions of the city and backcasting exercises, initially to identify the long-term interests of the city. Workshop vision and backcasting exercises were repeated twice with different stakeholders and the following sections present the results of the meetings. First, the main objectives for city and concerns are presented followed by the actions over time that resulted from the backcasting.

THE 2050 POST-CARBON VISION FOR BARCELONA

The actual vision of the city is relatively conservative, since all stakeholders wanted to see the city largely preserved there was little discussion on the peripheral areas of the town and the focus was mainly on preserving the town's character. Notable changes proposed were the practical elimination of private transport in the city, the increase in communal spaces and the creation of functional neighbourhoods avoiding the separation of residential, commercial and working areas. The main wishes centred on having not only a clean and sustainable city, but a better educated and a more cohesive society. The concept of mobility was discussed, where the town focuses more on improving the mobility of citizens in a more social sense, reducing the need for transport, but rather facilitating the flow of people and avoiding transport-based social exclusion due to distance (reduced in functional areas). In other words, the 'need' to use private or public transport methods to move around the city should not be a 'necessity' for work, shopping, education, etc.

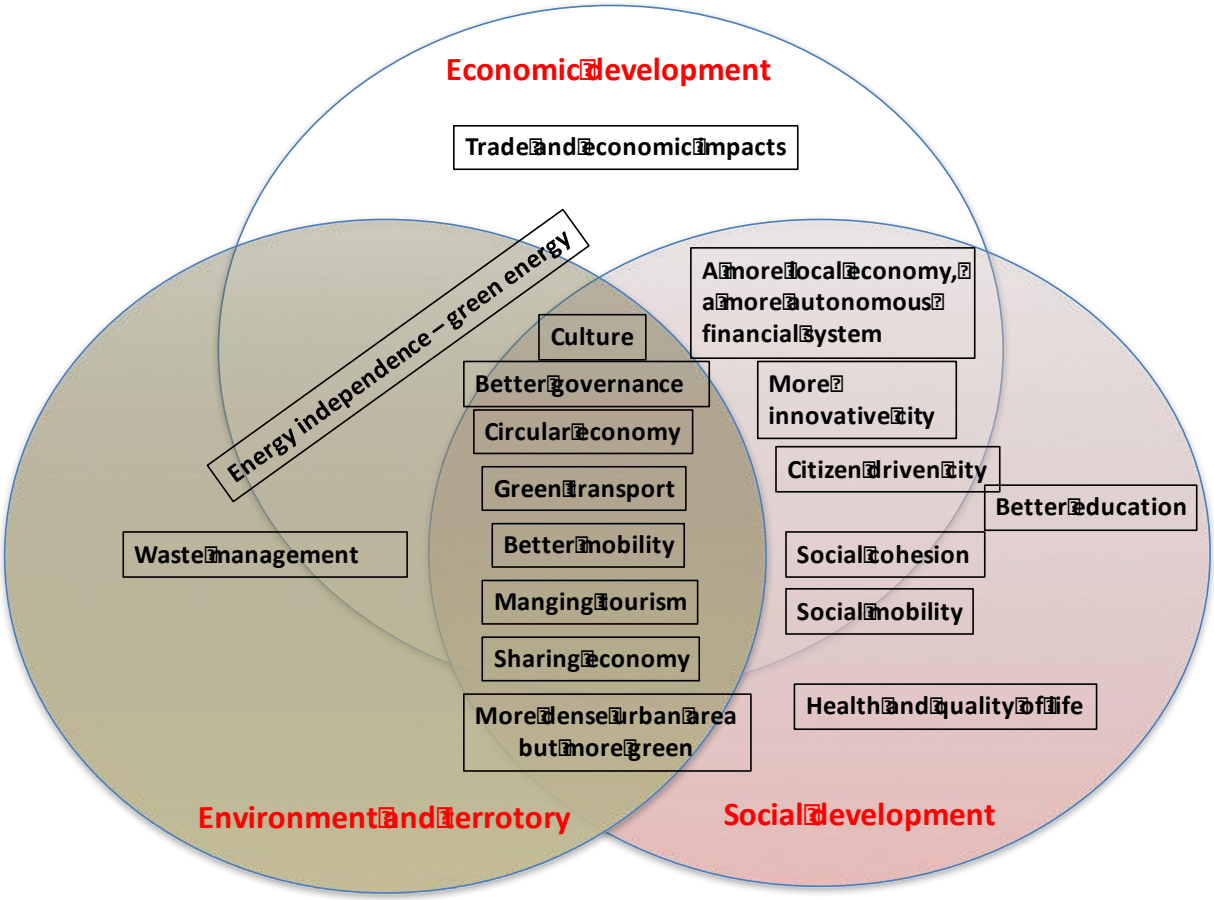
The natural areas should also be more integrated into the city, more in tune with the city, which probably also opens up the possibility of large experimentation on the outskirts of the town. The city should have a full circular economy, eliminating waste and a different way of functioning in terms of taxation and income generation.

MAPPING THE CONCERNS

The discussion produced first mind maps identifying areas to address was used in the meetings. Chart 1 below summarises visually the main areas of discussion for the vision. It presents the key issues to be addressed clustered into three areas: economic development, territorial planning and social development. The challenges and objectives were then debated along these priorities to end with a list of concerns which guided the development of actions and milestones.

The results emerged from two rounds of workshops visioning, which then were used for the backcasting.

Chart 1. Areas identified and overlapping sectors



MAJOR CRITICAL ISSUES IDENTIFIED IN THE VISIONING

The discussion highlighted the main critical issues for the city of Barcelona:

- *Better policy of planning for the metropolitan area:* coherent and integrated coordination of the sources of knowledge and proper civic managements.
- *A city that integrates in all products and services the environmental and social costs, creating a sustainable and healthy city (air, water quality, green spaces, healthier lifestyle) with and circular economy.*
- *A more resilient city:* more microgrids, a better use of local resources, smaller functional units (neighbourhood services, shops, supermarket).
- *Tourism management*: eight million tourists each year in a municipality of 1.5 million inhabitants leads to native depopulation and economic exclusion in the city centre. This affects the quality of life in the most central neighbourhoods and engenders a new economic and social dynamic that tends to exclude the local population. The preservation of traditional

local markets (street markets) needs to be a priority and particular attention should be paid to the effects of tourism on these realities. Tourism is an extremely important resource for the city but in order to reconcile it more with the local population part of the resources derived from tourist activities should be visibly deployed in favour of the residents. A balance between tourism and the quality of life of the local population needs to be sought.

- *Public space management*: closely linked to the tourism point is the issue regarding the valorisation for residents of public spaces (including tourist areas). Barcelona's citizens need to feel ownership of the city's public spaces; in order to do that the characteristic, traditional and local features of the city need to preserved in the development of new initiatives.
- *Renewable energy self-sufficiency*. This requires clarifying which energy models need to be put in place and which are the barriers (regulatory, financial, technological etc.) impeding their implementation. What is the economic impact of developing smart grids projects and of pursuing energy self-sufficiency?
- Reliable and consistent *tools to support public policy need to be developed*. The effectiveness of decisions taken based upon research report findings or cost-benefit analyses of questionable accuracy was often mentioned; there is need for new tools able to evaluate in a rigorous way both private and public interests.
- Effective urban planning needs to be supported by stable and *autonomous local financing*. In this view, the reform of legal barriers that impede appropriate self-financing need to be reformed.
- *Public participation:* A more informed citizenship that participates in decision-making, supported by the development of *social networks*.
- *More egalitarian and cohesive city.*
- A city in tune and *integrated more with nature*.
- *Education*: not only standard and business oriented, but also social.
- *Innovation is needed* – research focus of the city for the city.
- *Public transport* needs to efficient, accessible and clean. The stakeholders went further by not only expanding public transport, but by demanding a new approach based on the concept of 'mobility' rather than transport. Based on a collaborative society with more common spaces and a different use of collective space, the need for transportation can be reduced.
- *The city needs to increase the intensity of the use of its space,* increasing density and reducing urban sprawl.
- *Sharing economy, rather than an owner economy.*

THE DETERMINATION OF MILESTIONES AND ACTIONS

Participants had to transform their visions, objectives and problems into milestones for the city and then identify actions to make them reality in a clear timeline.

Many of the milestones and actions were considered necessary in the short term. Many practical barriers require removing to be able to achieve longer-term goals. Table 8, below, shows the time on the left side to achieve specific milestones. Those for 2050 are generally final full changes that require

constant adaptation from now on. The two right columns show what specific actions need to be undertaken to achieve the milestone and when this change could be 'realistically' implemented.

The table is divided in colour-coded categories of objectives to achieve:

a) Local transversal coordinated public management
b) High level of knowledge, awareness and information
c) Implementing green and sustainable citizen-driven growth model
d) Developing green energy system and a clean low carbon circular economy
e) A fully decarbonised transport system and better mobility
f) Energy efficiency in buildings with 0 or negative emissions
g) Establishing the enabling framework conditions for post-carbon cities to flourish

Table 8: The when and the how of long-term objectives – milestones and actions

Time	Milestones	Actions to achieve milestones	Time action
Local transversal coordinated public management			
2017	Reform of management	Better impact analysis rules by the local authorities of projects, better coordination between services	**2016-17**
2018	Create transversal platforms	Coordinate all-city activities	**2020 onwards**
2018	Concentrate coordination powers in the AMB authority	Law reforming the responsibilities of the Barcelona Metropolitan area authorities (AMB)	**2018**
2020	Create a bigger metropolis vision	Create a metropolis vision with citizens to establish joint management structures	**2017-2020**
2035	Fully integrated territorial/urban/metro-politan management	Laws reforming the responsibilities all area authorities beyond 2020 milestone	**2018 and subsequent rulings**
High level of knowledge, awareness and information			
2018	Launch demographic needs studies	Understand demographic needs better to plan long term	**Now onwards**
2017	Better information loop and feedback	Create a flow of information to citizens and integrated feedback mechanism (use ICT).	**2017 onwards**

		Real time, more personal	
2017	Clear information on the local climate change impacts	More public awareness of the situation	**2017 onwards**
2025	Young generations with better civic education	Education reform	**2017**
Implementing a green and sustainable citizen driven growth model			
2018	Monetised 'good deeds'	Introduce financial recognition system for work beneficial to the city and its citizens	**2018 onwards**
2020	A better work-life balance	A plan for sustainable mobility and teleworking that all businesses have to develop	**2020**
2023	Sharing economy	Legislate on sharing and ownership	**2025 onwards**
2020	Plan to re-sanitise and reuse commercial and residential areas	Reuse of abandoned spaces, incentivise the change of use in the future of residential and commercial areas towards a more sharing and mixed society. Develop necessary actions and regulatory changes with citizen involvement.	**process**
2023	Citizen involvement stronger and incentivised (e.g. through financial mechanisms)	Introduce new systems for citizen participation, ensure that citizens understand repercussions and costs of changes and demands	**2020**
2050	A city with shared spaces, social, work, activities, cultural areas, commerce, etc.	Design of integrated neighbourhoods: Different city management, planning, architectural structures, etc. with citizen involvement	**2020 onwards**
2040	Urban vertical covered greenhouses	Developing vertical farming in cities, new technologies	**From now onwards**
2050	Deeply re-naturalised city	Natural space needs to be part of the fabric of the city	**Constant change**
2050	Having a large SME presence in the city –	Increase training for businesses -	**Constant effort**

	proximity shops and services preserved	entrepreneurship Maintain and expand local services Legal and fiscal reforms to facilitate the creation of SMEs	**2020**
2050	Health system guaranteed for all	Reform health system	**No specific date**
Developing green energy system and a clean low carbon circular economy			
2025	Smart Grid	Legal reforms to allow RES integration and independent entities Smart grid with 80% renewables	**2018** **2040**
2025	All products designed to be recycled or for sustainable destruction	New EU rules on product design and recycling/degradation	**2020**
2025	All waste treated and recycled	New rules on waste and proper plans	**2020**
2050	Full circular economy	Designing full circular economy systems, introduce right incentives and mechanisms (so that falling emissions are not due to shifting emissions to outside the city)	**From now onwards, constant changes**
A fully decarbonised transport system and better mobility			
2017	Public transport is not only designed radially but in the form of a net	Reform of transport planning Coherence between national, regional and urban area transport authorities; infrastructure planning needs to be integrated	**2015-2016**
2020	Reduce emissions from shipping in the port – ships no longer with motors on	Change rules and build energy connections	**2016-2020**
2030	Achieving 'optimal' public transport	Fully electric with a transition period supported by fiscal incentives	**Starting now**
2035	No more fossil fuel transport in city	Law to ban fossil fuel transport and phasing in scheme	**2025**

2035	All private transport driverless	Phasing in driverless transport over 10 years	**2025**
2050	A city with mobility at its core rather than transport	Mobility is not only a question of transport, but a question of easy access to city services. Better, more liveable districts with accessible shops and services enhance mobility without need of transport systems. There is a need to design another structure for the city.	**2020**
Energy efficiency in buildings with 0 or negative emissions			
2030	**All public** buildings renovated and energy efficient		**Now onwards**
2030	**75% of all** buildings renovated and energy efficient	*Fiscal and legal reforms* to incentivise to building renovation, intermediate milestone.	**2022**
2045	**All** buildings renovated and energy efficient	*Fiscal and legal reforms* to incentivise building renovation	**2022**
Establishing an enabling framework for post-carbon cities to flourish			
2022	EU Fiscal decentralisation-division of powers directive	Allocate right competences to the right level of governance to ensure solutions are optimal and effective	**2018**
2030	Reach the 3% investment in R&D for region	Incentivise R&D investment with public funds and facilitate private investment	**From now onwards**
2050	A high 'happiness' index result	Ultimately a city is for citizens, who have to find a way to fulfil their lives in terms of interactions and experience, and should be motivated to be part of the city and give to it	**Constant aim**

Some interesting aspects were clear in the workshop. First, that the participants see that much of what they expect from the future of Barcelona can be achieved in the short and medium term. Second, that all the bases have to be set in the near future. 2050 is much nearer than expected.

The workshop clarified the interrelationship between separate parts of the city. Participants are also aware that reductions in emissions cannot be achieved by increased emissions outside. There was a concern that trade and air transport are increasing external emissions.

STRATEGIC RECOMMENDATIONS

Crucial to achieving many of the milestones is a reform of competences and municipalities. The municipal borders are based on the historical city limits and surrounding villages; today the urban area cannot be run under the present multi-municipal fragmentation of powers. There is a need to have an entity covering the metropolitan area with the appropriate coordination powers. The institution exists, but it lacks the necessary responsibilities and structures, the Area Metropolitana de Barcelona (AMB).

Cooperation with regional authorities needs to be revisited, as many of the emissions and pollution of the city are indirect. Lower environmental impact in the city does not mean lower global impact as projections have shown in the POCACITO impact analysis. A new rational division of powers based on functional subsidiarity is required. This is a problem in all EU member states and may need a decentralisation directive.

A strong concern is the loss of character of the city and the growing disengagement of citizens. A common feeling among participants is that the city needs to find a better balance in catering to citizens and its economic goals by promoting tourism and industry. It seems that the pressure to increase foreign revenue may be causing negative effects – even on the tourism sector itself.

The strategy is presented in terms of milestones and actions. The main concern is that some key needs require political action at levels above the city competencies.

ASSESSMENT OF NEEDS

Challenges cannot be achieved by the actions of city authorities alone. Many enabling conditions have to be created by national and EU rules and regulations, as well as access to financial tools adapted to their needs.

What can the city do?

- Better planning involving stakeholders. This requires realistic scenario building by making stakeholders follow the steps. The POCACITO backcasting approach is such a tool, helping stakeholders consider the stages and understand the needs. A challenge is how to involve as many stakeholders as possible in such a complex approach.
- Integrate better the administration and create functional regional areas to manage services.
- Improve the information to citizens
- Improve social integration with a rational use of common spaces

What should the national authorities do?

- Reform the division of powers, taking into account the need to have an effective functional power distribution, in line with climate, energy, environmental and social needs
- Revisit fiscal decentralisation rules, so that also here the subsidiarity principle prevails, helping local authorities to handle local financial needs
- Clear coordination of national-regional transport systems

- Improve the education system
- Promote R&D and a more advanced knowledge economy

What should the EU do?

- Strict new regulations on car standards leading to 0 emissions and driverless cars
- EU directive on division of powers to promote a better more functional division based on actual needs on the ground
- Build regulation improvements to help increase the adoption of energy efficiency solutions
- Ensure that national energy rules stay in line with the renewable energy targets and help decarbonisation
- Offer support to regions through better exchanges of knowledge and support tools

IMPACT OF THE PROPOSED ACTIONS BY STAKEHOLDERS ON LONG-TERM CITY TRENDS

This section presents an analysis that interprets the results of the workshop's vision and backcasting, introducing the measures stakeholders have proposed. The business as usual (BAU) scenario is primarily developed from a continuation of current trends, with consideration of current projects. The analysis and text is based on the sustainability analysis in D 5.2. The data analysis suffered from limited data, as well as the fact that some data is often present in non-comparable levels of territorial disaggregation, i.e. either region, district, municipality or metropolitan area.

The current energy use trends for Barcelona were used with caution because they closely follow potential fallout from the financial crisis. Energy use was actually growing until 2006. After 2008 the GDP dropped. Within the municipality the energy growth is consistent with the population growth from 2001 until 2006. Data from Oxford Economics shows that GDP returns to steady growth in 2014. Most of the decline comes in the transport and industry sectors, which is probably due to the financial crisis. This is in line with the Province as well. This could also suggest that people travelled less to the city from the provinces.[1]

GDP by sector shows that the service industry has grown by almost 10 percentage points, while industry has declined. From this we deduce that with a recovering GDP, energy consumption could increase again. The transport share could also increase to a level similar to that of the financial crisis.

Due to a lack of data we therefore suggest that BAU energy consumption is similar to 2005, with a greater share covered by the service sector. The service sector has continued to increase GDP while decreasing energy use. At the Province level the population does not grow any further according to projections from Oxford Economics. According to the projections in EU Energy Trends 2050 (Capros,

[1] http://www.diba.cat/documents/471041/24663576/emissions+in+Barcelona_july+14.pdf/34110b21-ca61-4da6-acc2-d4f83695fc2a

2014) the growth in the final energy demand for Spain is in line with population growth, at 14.6% and 14.5% respectively. According to the Barcelona Energy and Climate Plan the electricity share has increased from 37,2% to 44.3%, and we also expect a continuation of this electrification trend.

We therefore assume that the:

- Service sector continues to grow to 2050 but improves efficiency - therefore similar energy in total
- Industry sector recovers to 2005 levels with slightly increased efficiency 5%.
- Residential sectors' increase in electrification cancels out efficiency increases, thus remaining fairly similar.

The next section summarises the result of the analysis on city trends and the need to further refine the milestones and actions to fit the trend to the objectives.

SUMMARY OF THE RESULTS OF THE TREND ANALYSIS

Table 9: Semi quantitative assessment of the POCACITO KPI's under BAU and PC2050 for Barcelona

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
ENVIRONMENT	*Biodiversity*	Variation rate of ecosystem protected areas	*Percentage*	*28% (2012)*	*No data on trend*	*N/a*	*N/a*
	Energy	Energy intensity variation rate	*toe/euro* *toe*	*(2003-2012) 28.47 to 23.83* *1.6 Mtoe to 1.4 Mtoe*	*- 16.3%*	+	++
		Variation rate of energy consumption by sectors	*Percentage*	*From 2003 to 2012*	*Residential 2003 – 2012: - 2.4%* *Services 2003 – 2012: + 1.97%* *Industry 2003 – 2012: - 21.25%* *Transports 2003 – 2012: - 18.16%*		
	Climate and Air Quality	Variation rate of carbon emissions intensity	*ton CO_2/euro* *ton CO_2*	*(2003-2012)* *84.77 to 60.95* *4.72 to 3.69 MT*	*Decrease (-28.1%)* -	+	++
		Carbon intensity per person	*ton CO_2 eq. / capita*	*3.06 to 2.27*	*-25.9%*	+	++
		Variation rate of carbon emissions by sector	*ton CO_2*	From 2003 to 2012	*Residential: - 4,85%* *Services: - 1,86%* *Industry: - 16,78%* *Transports: - 18%*	++	++
		Exceedance rate of air quality limit values	*Nº*	*19-2 (2003-2012), 5 in 2013*	*Annual variations, but still decrease?*	++	++

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
	Transport and mobility	Variation share of sustainable transportation	*Percentage*	From 2004 - 2014	*Public: 34.9% to 39.7% Private: 33.3% to 26.1% Walk and cycle: 31.7% to 34.1%*	*0*	++
	Waste (1)	Variation rate of urban waste generation	*kg/person/day 2003 to 2014*	*1.44-1.26 kg/person and day*	*1.44-1.26 kg/person and day*	++	+
		Variation rate of urban waste recovery	*Percentage*	*Waste to recycling :30.4%-36.11% (2006-2014) Organic waste amounts: 86914-122508 tonnes/year (2007-2012)*	*Waste to recycling :30.4%-36.11% (2006-2014)*	++	++
	Water	Water losses variation rate	*m^3/person/year*	*Data only provided in percent for a single year (17.9% in 2013)*	***Water use** reduced 2001 to 2014 129.6 to 101.1 L/cap/day*	*N/a*	*N/a*
	Buildings and Land Use	Energy-efficient buildings variation rate	*Percentage*	*No data*	-	*N/a*	++
		Urban density variation rate	*N°/km^2*	*No data*	-	*N/a*	*N/a*
ECONOMY	*Sustainable economic growth*	Level of wealth variation rate	*EUR/person*	*23,400-28,300 euro? (2001-2011; peak in 2007; purchasing power standard indicator)*	*Increase, sharp drop during crisis*	++	++
		Variation rate of GDP by sectors	*Percentage*	*Data missing*	*Data missing*	*N/a*	*N/a*
		Employment by sectors variation rate	*Percentage*	*Trend of decline in industry, construction and services (2005-2012). Significant drop in primary section in 2008 which recovered over 2009-2012.*		*N/a*	*N/a*
		Business survival variation rate	*Percentage*	*90%-69% (2008-2010)*	*Limited data points and only effects of financial crisis*	*N/a*	*N/a*
	Public Finances	Budget deficit variation	*Percentage of*	*Data missing*	-	*N/a*	*N/a*

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
		rate	*city's GDP*				
		Indebtedness level variation rate	*Percentage of city's GDP*	*1.19%-1.94% (2008-2010)*	-	*N/a*	*N/a*
	Research & Innovation dynamics	R&D intensity variation rate	*Percentage*	*1.33%-1.51% (2004-2012)*	*Increase, but possibly due to drop in GDP*	*N/a*	*N/a*
SOCIAL	*Social Inclusion*	Variation rate of unemployment level by gender	*Percentage*	*Diagram* *Men: 6.8%-23.7% (2001-2012)* *Women: 12%-22.5% (2001-2012)*	*Large increase in unemployment*	--	*N/a*
		Variation rate of poverty level	*Percentage*	*2.4%-17.7% (2004-2013; share of population in poverty risk)*	*Large increase*	--	*N/a*
		Variation rate of tertiary education level by gender	*Percentage*	*Male: 27.2%-37.7% (2003-2013)* *Female: 26.8%-31.9% (2003-2013)*	*Increase*	+	*N/a*
		Variation rate of average life expectancy	*Average Nº*	*80.0-82.2 (2003-2012)*	*Increase*	++	++
	Public services and Infrastructures	Variation rate of green space availability	*Percentage*	*65.5%-64.4%% (2003-2010)* *59.8%-62.1% (2011-2013; area changed)*	*No significant change?*	+	+
	Governance effectiveness	Existence of monitoring system for emissions reductions	*Yes/No Description*	*Yes*	*Yes*	++	++

(1) The positive development in the area of waste is due to the rapid growth of recycling and composting. But this rapid growth is caused by the recent introduction of this action. Thus the growth rate may fall and the level of recycling and composting may ultimately fail to reach its potential by 2050.

LESSONS FROM THE ANALYSIS

The process proves that there is added-value when stakeholders are asked to think on the long-run, making them realise the following:

- It clarifies the who, when and what of actions
- It gives stakeholders an understanding of the needs of the city and the challenges
- 2050 is not a distant future; changes need to be undertaken today, bearing in mind the long-term objectives. It makes stakeholders understand that actions are needed now.
- It allows us to set a clear timetable and framework for long-term results and shows that many actions can be taken in the very short term.
- It increases the awareness that it is not enough to focus on the reduction of CO_2 emissions. Changing the way energy is produced and used has deep impacts on society. Societal change can be partially directed by linking decarbonisation to societal change.
- Stakeholders become aware that to preserve vital elements of the city in the long run there has to be a coherent approach and that short-term decisions can have long-term repercussions.
- It has made stakeholders who do not work in the energy and transport sector aware that it is in everybody's interest to shape the approach towards a post-carbon city.

This document cannot be used as a strategic recommendation for the city, for this the experimental nature of the exercise is too limited, but it can be the basis for a larger visioning and backcasting process that refines the analysis and approach presented in this document.

III STRATEGY PAPER OF ISTANBUL TOWARDS A POST-CARBON CITY

ITU, Istanbul, June 2016

Tüzin BAYCAN, ITU and Aysun AYGÜN, ITU

CHALLENGES FACING THE CITY

Istanbul's population has reached 13 million and continues to grow rapidly. The increase in urban population causes the city to sprawl towards peripheries, enlarging the settled and built area. This situation brings some problems such as stress on natural protection areas and forests, long travel time in traffic, air and environment pollution. Population increase is the primary challenge for Istanbul.

Over-migration causes transportation, infrastructure, housing, risk management problems. The migration problem should be solved by strengthening the local administration, implementing the national strategies and limiting the migration to Istanbul.

The system for data collection and publishing is a challenge for Turkey to be developed.

Environmental consideration is a new issue for Istanbul, which should have been more of a priority for decision-makers. The impact of urban and economic development on the environment is not considered. While encouraging economic investments, environmental aspects are underestimated. The economic potential of Istanbul should be used in a more sustainable way. New solutions should be created to decrease unemployment and poverty, while protecting the environment.

Istanbul has improving trends on social performance, while unemployment and poverty levels are decreasing. The education level is increasing and urban life expectancy is higher than Turkey's national average.

Economic performance data indicate that the level of wealth is increasing in Istanbul. As the economic centre the city attracts investment, enterprises, and cooperation and thus has a dynamic and developing economic structure. Its geographic location is an advantage in this economic development.

INSIGHTS FROM THE GAP ANALYSIS FOR THE CITY

Istanbul is in the initial stage of post-carbon city development. It has many challenges and advantages to organise a more sustainable and post-carbon city. Istanbul's geographical location, economic attraction, natural values, historical and cultural heritage, tourist attractiveness are the main

advantages. On the other hand, population increase, immigration, urban sprawl and the pressure on natural areas are the major challenges of the city. Development and protection measures should be considered in a sustainable way and regulations should be made by local and national governments for the social, economic and environmental viability of the city.

A STAKEHOLDER VISION FOR THE CITY

The post-carbon vision for Istanbul is for a city that is able to compete on a global level, is dynamic, innovative, self-sufficient, and sustainable, with a high life quality and good governance.
The critical sectors are therefore; quality of life, governance, environment and natural resources, energy, global competitiveness.

ACHIEVING THE VISION

MILESTONE	STARTEGY TOWARDS MILESONE
ENERGY: Developing an energy master plan, increasing renewable energy resources and integrating them to the daily life **(2020)**	Sharing system for information and experiences Open-source data base Determining realistic targets about energy efficiency and renewable energy Determining the potential of renewable energy for Istanbul and updating regularly Adaptation of development plan to energy master plan Determining critical sectors and their related institutions on energy Revealing the current situation with respect to different sectors and identifying gaps Sustaining coordination of institutions that are assigned to prepare energy master plan Legislative arrangement for energy Providing sustainability of energy policies and implementation decisions
ENERGY: Determining of action plans and targets for energy master plan, developing framework for legal governmental regulations **(2025)**	Increasing local government's authority Increasing R&D that has implementation area Determining standards, definitions and terms about energy and efficiency Determining legal aspects of institutions that are

	related to defined incentive areas Management of incentives in terms of sectors Arrangement of legislation in order to enable energy strategies implementation
GOVERNANCE: Generating sustainable urban inventory and city information system and sharing to public (social, economic, environmental data) **(2020)**	Preventing confusion of authorisation between institutions Sustaining collaboration between institutions Surveillance of organisation Generating a common data base Generating a monitoring system for city activities
QUALITY OF LIFE: Generating urban standards considering the identity of the city **(2020)**	Generating identity of the city that is compatible with nature and sustainable Increasing the sense of urbanity
QUALITY OF LIFE: Planning for accessible city **(2020)**	Developing transportation plan that focuses on human Determining areas that have traffic and accessibility problems, generating specific solutions and legislations for those areas Solving parking problem Giving priority to transportation projects (public transportation, railway systems) Integration of public transportation modes Considering disadvantageous groups while planning Increasing public spaces
QUALITY OF LIFE: Monitoring system for quality of life **(2020)**	Monitoring life quality for Istanbul Increasing social facilities that service to all citizens
QUALITY OF LIFE: Increasing urban economy and welfare **(2040)**	Increasing high value added production Generating standards for infrastructure and construction
ENVIRONMENT AND NATURAL RESOURCES: Consensus of stakeholders on valuable natural resources **(2025)**	Determining the existing natural resources Including EU environmental programs to scale development plan as a national policy Encourage innovative and sustainable technology for construction sector Develop effective control and protection

	mechanisms Redevelop legislation and standards Effective waste management Recovery of lost natural resources in developed urban areas Making those who harm nature pay for damages Increasing awareness of nature Encouraging projects and activities that are sensitive to nature Preventing overlapping attributions of institutions on the management of natural areas Create a monitoring system for natural resources Develop long-term plans Make regional development plans comply with environmental plans Generate specific and local standards for Istanbul
GLOBAL COMPETITIVENESS: Preparing economic vision plan **(2020)**	Make staging for long-term and comprehensive development plan based on time and space Protect standards of urban values and develop them (history, culture, quality of service sector, environment, tourism) Use tools that would create brand value within a common decision mechanism Sustain security environment that would attract investors Educate qualified labour for encouraging sectors Increase competitiveness of Istanbul between liveable global cities Create science and art identity for Istanbul Determine competitive sectors for Istanbul's future Define pioneer sectors and institutions that shapes Istanbul's economic structure Define economic vision of Istanbul and its components Develop economic vision in cooperation with related institutions

ASSESSMENT OF NEEDS

LOCAL GOVERNMENT
Include women in local government decision process and projects
Consider different social groups while distribution of resources
Develop local project using pilot projects
Develop common database (open source and available), master plans and promoting sustainable coordination
Create common language on terms
Coordinate implementation stages in cooperation with investors
Transparency
Create a platform bridging local and national government
Increase local government - universities collaboration, using EU funds for applicable projects
Manage finance and resources, activating implementations
NATIONAL GOVERNMENT
Incentive policies for green technologies
Determine the frame for institutions' roles and their collaboration
Generate local administrative standards that are flexible enough for the uniqueness of local values
Establish effective institutions working on technological adaptation
Prepare legislative and administrative framework for energy-efficient projects
Control mechanism for local governments
Transparency for investments and projects in urban scale
Collaboration with local stakeholders
Give priority to national interest for EU collaborations
Implement pilot projects first for the new projects and consult academics
Consider local authorities experiences and knowledge while preparing legislation and standards
Develop economic models and financial resources
Coordinate institutions
EU
Encourage developing countries to work on energy-efficient issues
Have country-specific approach for different countries, their problems and standards

IV STRATEGY PAPER OF LITOMĚŘICE TOWARDS A POST-CARBON CITY

Charles University Environment Center, Prague, July 2016

Hana Škopková, CUNI

ABSTRACT

STATUS QUO AND CHALLENGES FACING THE CITY

Litoměřice is a medium-sized city within the Czech Republic (Czechia), with approximately 25,000 citizens covering an area of 18 km^2. Litoměřice is a district city for a rural and agricultural area of 1,032 km with 119,162 citizens. It lies within one of the poorest NUTS 3 regions, but the city itself is one of the more progressive ones.

The city has a rich history dating back to the 9th century and offers a lot of cultural and natural heritage. The historical city centre has been an urban conservation area since 1950, and since the 17th century the area is called 'the garden of Bohemia' which refers to the rather fertile lowland around the Elbe River. The city area partially overlaps with the natural protected area České středohoří.

Within the POCACITO project, key performance indicators were collected for each of the case study cities to assess the city´s environmental, social and economic status quo. As Litoměřice is the smallest case study city in the POCACITO project, some of the indicators are not available at the city level, but only for higher territorial units (NUTS 2 or NUTS 3) and their informative values is therefore limited. It often indicates the average status quo within the region, which may be in some cases different from the unique situation of Litoměřice city. Details on Litoměřice key performance indicators are available in the project deliverable D3.2 Individual case study assessment report – Litoměřice.

Litoměřice is one of the pioneer cities in Czech Republic aiming at energy efficiency and renewable energy production. Its commitment is manifested in the Strategy development plan and the Energy plan of the city. Currently, strong emphasis is placed on energy consumption and production. The city´s commitment to this issue is shown also in its membership of international network Energy Cities, which is focusing on promoting, supporting and exchanging experience in sustainable energy on the level of cities and towns.

As a member of the National Network of Healthy Towns, Litoměřice targets a lot of activities as well as planning in the social sphere and stresses open communication with its inhabitants and their involvement in the city´s decision-making.

As a rather small city, its main challenge is availability of financial resources for implementation of its goals. The success of its strategy is strongly dependent on the availability of external financial

resources. The city is therefore influenced, to a large extent, by the development of the region's larger territorial units.

A STAKEHOLDER VISION FOR THE CITY

The city of Litoměřice has recently adopted and validated a strategic development plan that sets out the goals for the city´s development until 2030, together with an Action plan that is updated on a yearly basis. The visioning process conducted with city stakeholders within the POCACITO project can be viewed as a complementary and confirmatory bottom-up approach to the rather expert based top-down approach applied to develop the current Strategy development plan.

The thematic areas of both future visions overlap to some degree, in some areas however each of them goes into more detail or presents a slightly different point of view. The topics raised during the POCACITO visioning process have been grouped into five sectors and areas: 1) transport and mobility, 2) energy, 3) urbanism and public spaces, 4) civic society and public services and 5) economy and environment. Each of the sectors comprises more (four to six) detailed subtopics.

In comparison to the current Strategy development plan, the post-carbon 2050 vision lacks focus on the local governance issues, i.e. the quality of the office and financial management, but on the other hand goes more into detail on issues related to local agriculture and production, environmental impacts of industry or waste management, and urbanism and public space related topics. In the area of energy, the post-carbon vision goes a step beyond by articulating the goal of becoming an energy self-sufficient city. Also, it individually stresses issues related to mobility and transport.

The headlines of the post-carbon 2050 vision are the following:

Litoměřice in 2050 will be a city for the people – emission neutral and energy self-sufficient. It will be 1) a clean city with diverse modes of transport, 2) energy self-sufficient and carbon-free, 3) a city of short distances, 4) a city for the people, people for the city – a liveable city and 5) a city attractive and open to investment.

The visioning process, its results and full narrative of the post-carbon 2050 vision are described in detail in the project deliverable D4.2 Report form stakeholder workshop – Litoměřice.

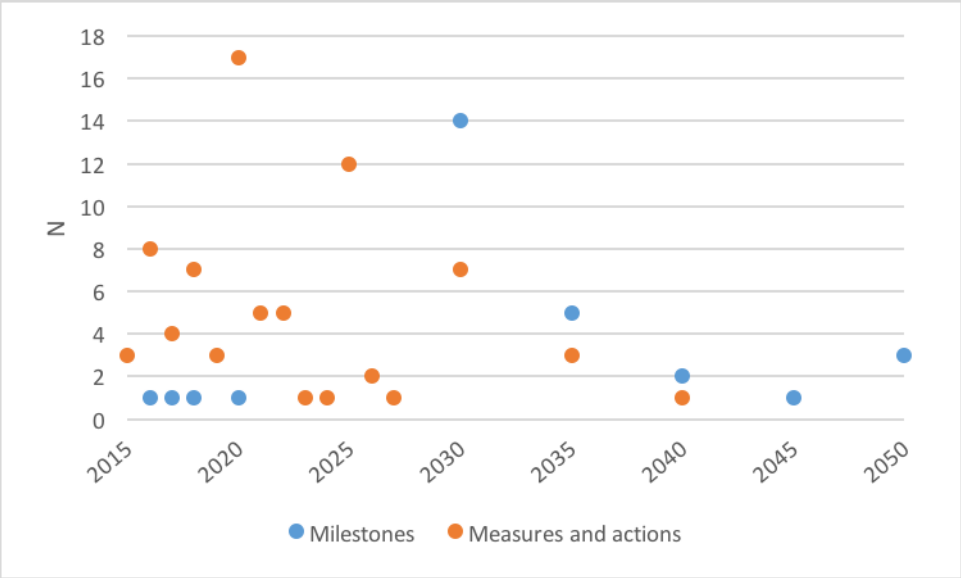
PATH TOWARDS THE VISION – MILESTONES AND ACTIONS

The path towards the post-carbon 2050 vision has been outlined during the participatory backcasting scenario workshop with city stakeholders. The path and measures suggested are not exhaustive and would require further attention, however almost 30 milestones and more than 80 measures and actions have been suggested to reach the vision.

Stakeholders were able to set interim milestones on the pathway to the vision in the short term as well as in the long term, however this was not the case for the suggested measures and actions, where the tendency is clearly to focus on short and possibly medium-term time horizon, but the long-term horizon seems to be elusive. The time span of set milestones and suggested measures and

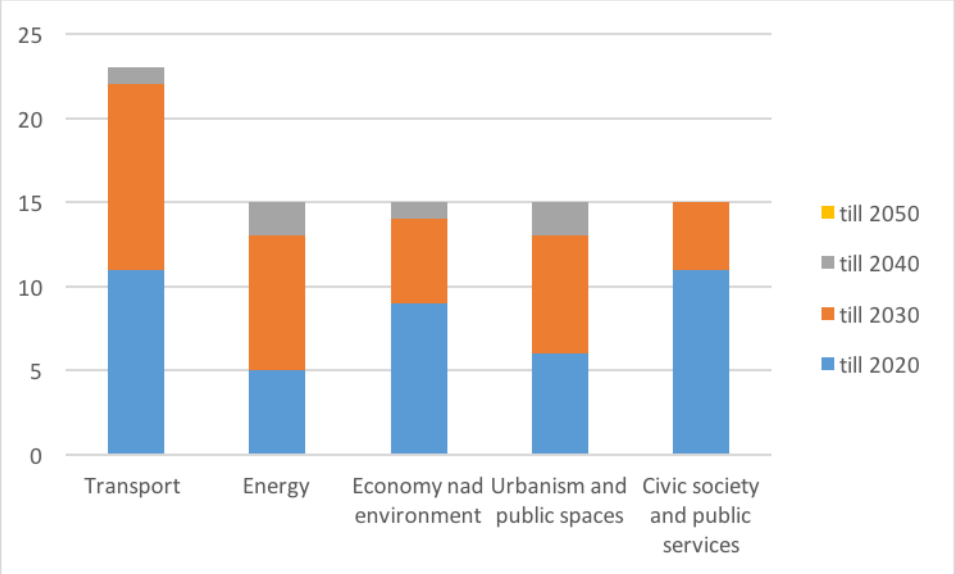
actions is shown in Figure 10. Most of the milestones are formulated in the energy sector (35%) and in transport (28%).

Figure 10: Timespan of interim milestones and suggested measures



The distribution of measures and actions among the individual sectors and vision topics is more balanced, with most actions attributed to transport and then equally to the other remaining four areas.

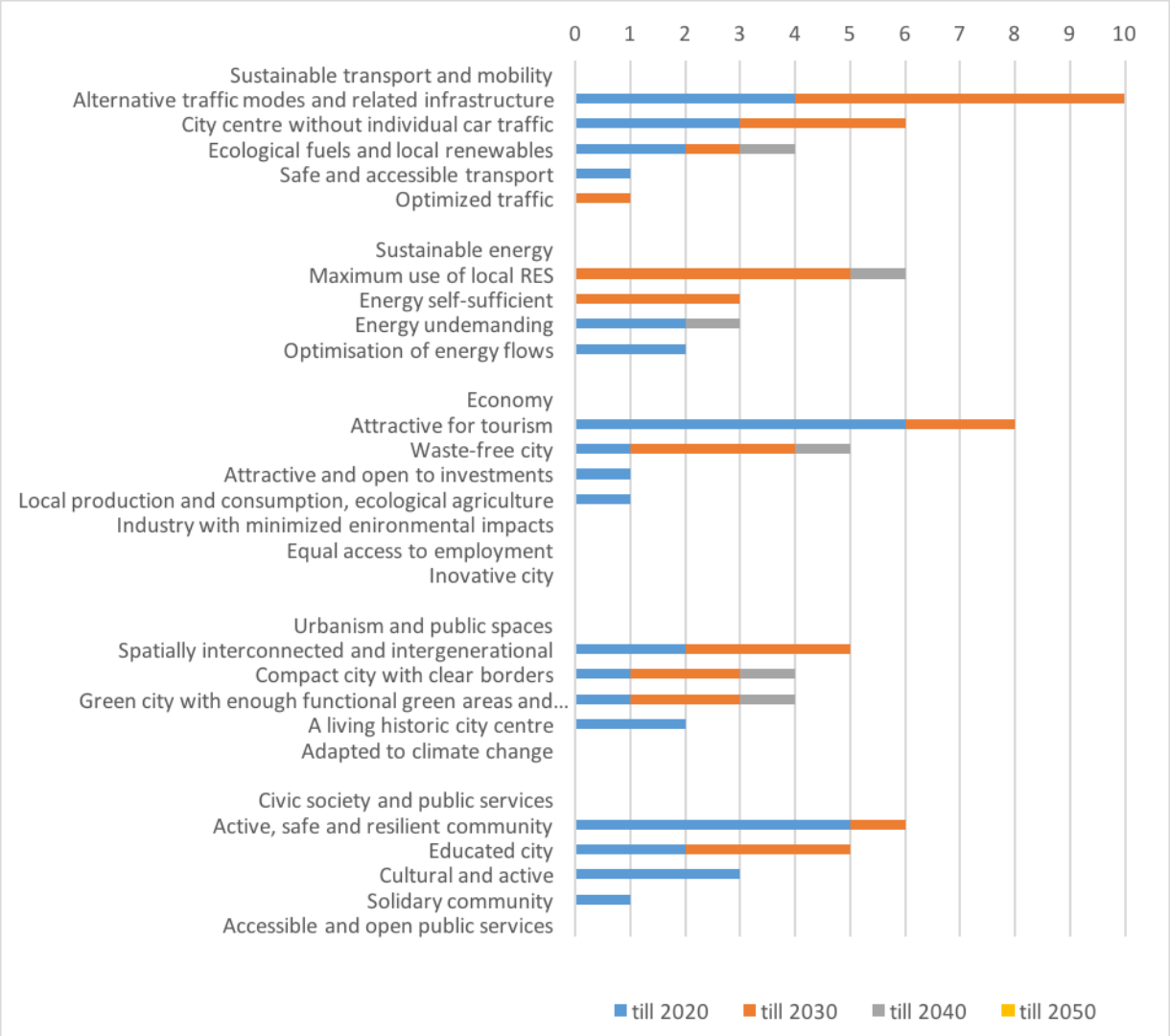
Figure 11: Actions and measures by sectors (N=83)



However, when looking in detail at the coverage of individual subtopics, the picture becomes less clear and we can see that some of the vision subtopics were not addressed at all during the scenario

development process. This may be due to the structure, background and interests of workshop participants, but can also be because it is more straightforward to suggest actions for some goals more than others. In any case, this indicates that in order to reach these set goals, some of them still have to be addressed with more focus. Detailed statistics are shown in Figure 12.

Figure 12: Number of suggested measures and actions by individual vision subtopics



The overview of the scenario development process and the concrete milestones, measures and actions can be found in the project deliverable D4.2 Report form stakeholder workshop – Litoměřice.

SCENARIOS QUANTIFICATION AND GAP ANALYSIS

The post-carbon vision and city scenario was compared in selected parameters with potential city development if current trends continue. Thus two scenarios were compared – post-carbon 2050 (PC2050), which was developed from an interpretation of the vision, actions and milestones

developed in the stakeholder workshops and business as usual (BAU2050), which was primarily developed from a continuation of current trends, taking account of current projects.

The quantitative analysis focused on modelling land use and population changes, on the future energy mix and related GHG emissions, on the calculation of direct and indirect GHG emissions and on the assessment of PC2050 investment costs and a cost-benefit analysis.

The main differences are seen in the population changes, where for BAU2050 a population decrease is estimated, but for PC2050 the population stabilises at the current size, or even slightly increases.

Also, under BAU2050 the current trend of suburbanisation will continue, even though the population will decline, however under the PC2050 the city´s development will be more inclusive and its density will increase within the existing urbanised areas.

A decline in energy consumption and related GHG emissions can be seen under both scenarios, however the PC2050 decreases the amount of energy supply needed by a further 23%. Some GHG emissions remain under the PC2050 (1.23 tCO2e, compared to 2.37 in BAU) which is caused by the continued reliance on natural gas for heating and the small portion of transport that still utilises fossil fuels.

Detailed methodology and results of the analysis can be found in the project deliverable D5.2 Quantification of the case study cities 2050 scenarios.

ASSESSMENT OF NEEDS

The fulfilment of the set goals and visions can be hindered by many factors, internal – the mechanisms and capacities within the city itself as well as external – actions, strategies or policies of the national government or EU. Many of the factors can however be addressed and their negative impact averted. Table 10 lists some of the challenges faced by the city that may hinder the path towards their post-carbon vision and some suggestions on actions at the state or EU level that may prevent the negative impact, or improve cities' capacities to achieve a post-carbon future.

Table 10: Challenges on the way to post-carbon city and actions needed – stakeholders´ perceptions

	Challenges	**Action needed (EU or state level)**
Regulatory framework		
1. Governance	• Low environmental awareness of the government	• Trainings, instructions, education
2. Energy efficiency	• Lack of expertise • Nobody has knowledge about synergy effects and conceptual documents, conceptual approaches in general	• Conceptual support for local/ regional policy • Support in gaining expertise
	• Low energy efficiency of thermal power plants	• Law on increasing the efficiency of thermal power plants
3. Transport	• On local level, only the consequences are addressed, the issues are not addressed as	• Support of conceptual thinking and approaches • Financial resources on purchase of

	complex issues, thus one problem is replaced by another • Lack of conceptual documents • Measures and programmes are not interconnected with other sectors (i.e. energy sector) • Lack of expertise	electric cars (for example) are fine, but the cities don´t know, how many they need. They must know, what they want or should do!
	• Increase of traffic and vehicles, parking issues, transit through city centres (especially heavy vehicles) • Especially in Czech – behaviour of car drivers toward people on bicycles and people walking is rather poor and inconsiderate	
	• Car fleet is old with high emissions • Low or no support of electro mobility	• Laws restricting the use of old vehicles • Financial support on new low emission cars and mobility
4. Resource and waste management		• Support of novel recycling schemes
	• Increase in generation of products that cannot be recycled at the end of their life cycle!	• EU directive on products that must be recyclable at the end of their life cycle
5. Land management	• Unused brownfield land	
	• Appropriation of high quality land	• Significantly restrict land appropriation and favour the use of barren land and unused land
6. Energy sector	• Low awareness of the possibilities and potential of renewable energy sources - cities do not have information about their own potential • Conceptual documents are missing	• Ambitious energy policy on the national level • Pressure of the common European energy policy • Support of alternative energy sources
	• Low share of renewable energy sources	• Support of renewables, especially geothermal energy sources
7. Air quality	• Mix of emissions, particulate matters, sludge burning	• Cooperation of universities, state health institutes etc. in the local air quality and health domains
	• Local fireplaces (coal)	• Significant financial support for greening the local heating and local CNG networks and infrastructure
8. Social development	• Increasing share of seniors • Housing for young people and young families • Lack of financial means	• Activation of seniors • Housing support

Education	• Low level of environmental education and awareness	• Implement environmental education in education curricula and programmes (on all levels)
Health	• Lack of cooperation of involved subjects during the implementation of health plans • Lack of professional staff (doctors and nurses) in local health facilities (city hospital…)	• Health plans and their implementation
Appropriate financial instruments – economic resilience		
9. Public funding and procurement	• Public procurement is evaluated mainly by lowest price → which often means low quality • Lack of experience with qualitative criteria (in procurements) • Lack of knowledge and experience with designing tenders that would count also with other parameters, for example sustainability criteria etc. (for example local companies can bring other co-benefits in other domains interesting for the city like employment etc.) • Transparency, information provision to public	• Methods, manuals, model documentations how to design the tenders with incorporation of qualitative criteria
	• Bad current law on public tenders	• New law enabling inclusion of other criteria (i.e. local companies, even though for higher price)
10. Building economic resilience	• Low share of local production	• Support of local production and services

V STRATEGY PAPER OF LISBON TOWARDS A POST-CARBON CITY

INTELI – Inteligência Em Inovação, Centro De Inovação, Lisbon, 17 August 2016

Catarina Selada, INTELI, Miroslav Havránek Institution, Carla Silva, INTELI and Ana Luísa Almeida, INTELI

CHALLENGES FACING THE CITY

STAKEHOLDER CONSULTATION WORK

POCACITO methodology integrates the organisation of several workshops with stakeholders with a view to collect their ideas and suggestions, namely: assessment workshops; vision building workshops; backcasting scenarios workshops; and strategic papers workshops.

The vision building and backcasting scenarios workshop in Lisbon was held during May (1-15), 2016. The methodology presented in the POCACITO's deliverable "Case Study Workshop Guidelines" was used in the workshops but there was a need of its adaptation to the context of Lisbon, due to the following factors: economic and financial crisis; uncertain period associated to the change of the City Mayor; difficulty in motivating and mobilizing key stakeholders; parallel organization of similar meetings, workshops and seminars in the scope of Portugal2020 (framework program 2014-2020).

The workshop process was organised through the collection of information and direct interviews with the stakeholders. A final meeting was held to share ideas and summarise the results (List of stakeholders consulted – Annex 1).

The meeting was attended by 5 people. It is worth of notice that the energy sector was highly represented, due to the importance of this area for the Lisbon case study. The transports sector was under represented, which was surpassed by the knowledge of INTELI staff in this area.

Visioning process

The main steps were:

- Presentation of the objective of the meeting;
- Overview of the POCACITO project;
- Brief presentation of the results of the initial assessment;
- Discussion of key challenges for the city;
- Presentation of the context scenario and some urban trends;

- Visioning exercise – Imagine the future of Lisbon in 2050 – Identification and discussion of key messages;
- Selection of one narrative for the vision 2050.

A vision 2050 was defined, and the main sectors were identified.

Backcasting process

The main steps were:

- Presentation of the objective of the meeting;
- Brief presentation and discussion of the vision (desirable "end point");
- Brief introduction to the "middle of the road" background scenario;
- Discussion on obstacles and opportunities in reaching the end point;
- Definition of interim objectives and milestones;
- Definition of concrete actions that must be taken to get to the end point.

Milestones and actions were defined, having in mind the obstacles and opportunities identified.

KEY CITY CHALLENGES

Through the initial assessment of the city and the organization of stakeholders' workshops, the key challenges facing Lisbon were identified:

MOBILITY

It is necessary to enhance sustainable mobility in Lisbon. The private car is still the main transport mode used by the population. The results of the assessment exercises are quite disappointing, since the share of sustainable modes, i.e. walking, bus, company or school collective transportation, metro/ underground, train, bicycle and ship, decreased from 59% in 2001 to 51% in 2011. Note that in 2001, the car was responsible for 32% of the modal share and in 2012 it was 34%. Moreover, the lack of synergies between transport modes is also a reality.

Several initiatives have been launched by Lisbon City Council in the area of sustainable mobility (such as electric mobility, car-sharing, bicycle lanes, improvement of public transport, etc.), but with no substantial impact on urban life.

ENERGY

Lisbon needs to both increase its energy efficiency and the use of renewables, and intensify the implementation of smart energy solutions.

The consumption of energy (electricity, fuel and natural gas) in 2008 in Lisbon was 828,751 toe and in 2012 was 927,389 toe, experiencing an increase of 12% during this period. The sector that contributes most to the overall consumption is the transportation sector. Currently the amount of energy

produced locally by a renewable source is insignificant, representing less than 1% of the total energy consumed (Fraunhofer, 2016).

Lisbon has a high solar potential that should be explored. It was one of the results of the 'Lisbon Solar Potential Map' project, which evaluated the potential solar installation of solar systems in the built heritage of Lisbon.

RESILIENCE

Lisbon is a coastal city prone to natural disasters, namely floods. It is also located in an earthquake zone, which is a danger to citizens and infrastructures.

The development of preventive and alert systems geared to anticipating these events and making correct decisions is a priority. There are some technology-based emergency management systems that could be used in these situations.

It is worth noting that Lisbon subscribed to the Mayors Adapt initiative in 2013. Adaptation to climate change is the main objective of this platform with a view to adapting infrastructure and policies to climate impacts.

Air quality is also a problem in the city centre. For this reason, Reduced Emissions Areas were launched, which are zones in which the circulation of more pollutant vehicles is forbidden, due to health reasons and compliance with national and European legislation.

BUILDINGS

There are several buildings in Lisbon that need renovation, especially in terms of energy efficiency. However, the refurbishment rate is less than 1% per year, which is very low compared to the European average of 1.5-2.5% a year (Fraunhofer, 2016).

Currently there are nearly 7,000 buildings in Lisbon with an energy certificate, of which about 1,000 are A or A+ energy efficient buildings. Although this number is likely to grow, it is a matter of concern, because 80% of world's energy is consumed by cities and buildings are responsible for 40% of energy use and 23% of GHG emissions. In this context, it makes more sense to intervene in the existing stock or in building renovation.

One interesting example is the project Eco-Neighborhood – Boavista Ambiente + which aimed to reconvert and qualify public space, implement measures to improve the energy performance of buildings and remodel some equipment in the social neighbourhood.

ATRACTIVENESS

Despite the financial crisis, Lisbon demonstrates high economic development, supported by a dynamic entrepreneurial ecosystem.

However, over a span of 30 years, the city has lost more than 200,000 of its residents, shrinking from 800,000 in 1980 to 550,000 today. Most of these people now live in the metropolitan region, reaching 2.8 million residents. Attracting people (students, talents, entrepreneurs, etc.) to live in the city centre is a challenge. Positioning Lisbon in global networks is also an imperative, with a view to attract investment and business.

Lisbon has also a privileged location in the Atlantic Area which should be explored, namely the relations with Portuguese-speaking countries. The city easily allows access to 750 million consumers.

INCLUSION

Both poverty and unemployment are rising in Lisbon. These problems essentially affect young people, elderly people and other disadvantageous segments of the population. Regarding the level of poverty, the figures are very worrying because between 1989 and 2009 this indicator jumped by 80% in the region of Lisboa and Vale do Tejo (NUT II).

The ageing society is a challenge that Lisbon is also facing, in line with European trends.

In order to meet these challenges the City Council needs to develop an integrated management system based on clear development goals and strong coordination between all departments. In Lisbon there is still very limited coordination between actors in terms of dealing with cross-sectoral issues.

These efforts should be based on a strong digital agenda, namely through the development of an urban management platform oriented to support decision- and policy-making processes.

Table 11 summarises the global trends for each Key Performance Indicator (KPI) analysed by the project in the *"Initial Assessment Report"* using statistics for the municipality level.

Table 11: Summary of KPI's global trends - Lisboa

DIMENSION	SUB-DIMENSION	INDICATOR	Year	Trend
SOCIAL	Social Inclusion	Variation rate of unemployment level by gender	2003-2012	↗
		Variation rate of poverty level	1989, 2009	↗
		Variation rate of tertiary education level by gender	1960, 1981, 2001, 2011	↗
		Variation rate of average life expectancy	2003-2012	↗
	Public services and Infrastructures	Variation rate of green space availability	2004-2008; 2009-2014; >2014	↗
	Governance effectiveness	Existence of monitoring system for emissions reductions	N/A	N/A
ENVIRONMENT	Biodiversity	Variation rate of ecosystem protected areas	2003, 2012	↗
	Energy	Energy intensity variation rate	2003, 2012	↘
		Variation rate of energy consumption by sectors	2008, 2012	↗
	Climate and Air Quality	Variation rate of carbon emissions intensity	2005, 2009	↘
		Variation rate of carbon emissions by sector	N/A	N/A
		Exceedance rate of air quality limit values	2003,2012	↘
	Transport and mobility	Variation share of sustainable transportation	2001, 2011	↘
	Waste	Variation rate of urban waste generation	2002- 2013	↘
		Variation rate of urban waste recovery	2002- 2013	↘

DIMENSION	SUB-DIMENSION	INDICATOR	Year	Trend
ECONOMY	Water	Water losses variation rate	2002- 2013	↘
	Buildings and Land Use	Energy-efficient buildings variation rate	2007, 2012	↗
		Urban building density variation rate	2001, 2011	→
	Sustainable economic growth	Level of wealth variation rate	2004-2012	↗
		Variation rate of GDP by sectors	2004-2012	↗
		Employment by sectors variation rate	2003-2011	→
		Business survival variation rate	2008, 2009, 2010	↗
	Public Finances	Budget deficit variation rate	2009-2013	↘
		Indebtedness level variation rate	2010-2013	↘
	R & I dynamics	R&D intensity variation rate	2003-2010	↗

INSIGHTS FROM THE GAP ANALYSIS

POCACITO has developed and compared two scenarios as possible outcomes for Lisbon in 2050 – 'Business as Usual' (BAU) and 'Post-Carbon 2050', which complements the analysis developed under the initial assessment. BAU is essentially based on an examination and extension of current trends for indicators and physical aspects such as population, energy use, GDP, buildings and transport. PC2050 is a projection of the indicators and physical aspects based on an interpretation of the visions, actions and milestones developed in the stakeholder workshops. A summary of some of these is in Annex 2. It is therefore a judgement based on the consistency and robustness of supporting actions to the desired post-carbon state, and a not a quantification of an idealistic state (WP5 Report).

GENERAL TRENDS

ENVIRONMENTAL

It shows that biodiversity-protected areas have recently increased. The Biodiversity Strategy 2020 suggests that there is good potential for this area to be improved in the future, but no additional measures were suggested in PC2050.

In terms of energy the intensity has decreased –probably aided by the increasing contribution of the service sector to GDP and a decrease in the industrial sectors' contribution. With the increased building efficiency and electrification of cars under PC2050, in addition to an improving national energy mix, this is likely to continue improving considerably.

There is a current trend of decreasing carbon intensity, which can be expected to continue in both the BAU and the PC2050 scenario. However, the local renewable energy contribution in Lisbon has only recently risen to around 1 MW of capacity in solar (in 2013) and progress has been slow. Carbon intensity is therefore predicted to increase much more significantly under PC2050 than BAU but there is still room for improvement under PC2050 to facilitate a move to carbon neutrality.

The air quality trend in Lisbon is positive and the number of exceedance days is decreasing. With further measures in the PC scenario the decrease can be expected to continue.

The recent trend in transport has been quite negative with an increase in transport energy and the use of private cars. City authorities have taken measures that might influence the development of transport, however, neither the BAU scenario nor the PC2050 scenario expects any drastic increase in sustainable transportation.

For waste the current trend shows decreasing waste generation, which can be expected to continue. However, no major additional measures have been suggested, and only minor decreases can be expected in both the BAU and the PC scenario. Surprisingly there has recently been a decrease in waste recovery and no measures have been put forward under PC2050 to improve the situation.

The water loss in Lisbon's distribution system has improved and this can be expected to improve under both scenarios, but water has not been specifically addressed under PC2050.

For buildings the current trend is positive with the number of energy efficient buildings increasing exponentially. In the BAU scenario this increase can be expected to continue. In the PC scenario measures will be taken to reach a target that 100% of all new buildings are "Nearly net zero energy buildings" which, as long as it is reached, will have positive effects.

Urban density in addition to population density appears to be decreasing, the latter of which is an issue for Lisbon's sustainability in general.

ECONOMIC

On the economic front the level of wealth has shown a steady increase and is therefore expected to continue under BAU, while PC2050 is expected to be slightly higher. With the development of the circular economy there is potential for the industry sector to increase under PC2050, with an increase in employment.

There has recently been a high level of indebtedness for Lisbon City Council but this seems to have improved greatly since the financial crisis. This therefore is not seen as a specific concern under either scenario. The R&D intensity was increasing until the financial crisis but was still quite moderate even at its peak of 2.5%.

SOCIAL

For the social indicators one concern is the high level of unemployment particularly for males. There was only national level data available for the poverty level which has increased in the last nine years. Tertiary education has shown a significant decrease for males, which is of concern.

Finally, on a positive note the amount of green space has grown exponentially in the last 5 years and life expectancy continues to grow.

ENERGY QUANTITATIVE ANALYSIS

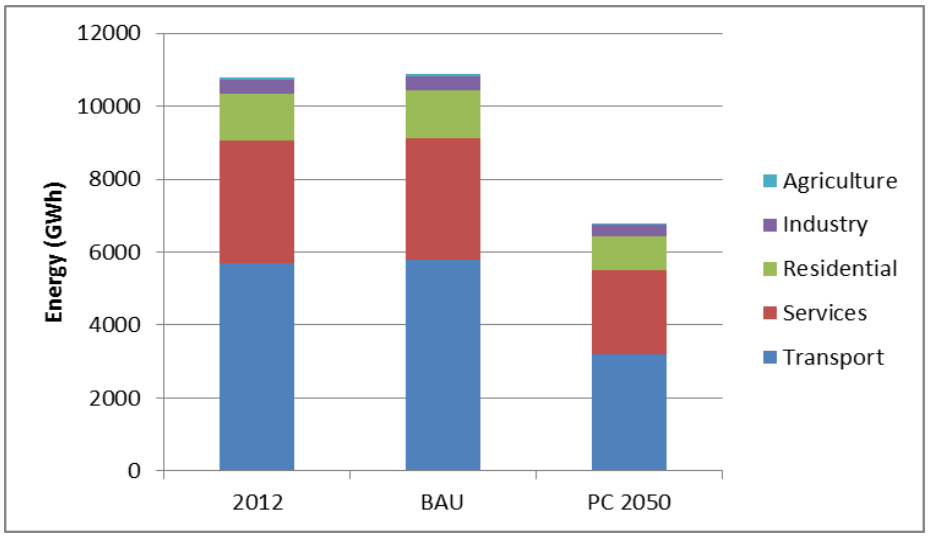
The energy data available for the energy analysis of Lisbon was fairly limited and is based on two main sources: energy data from WP3 and the Sustainable Action Plan for Energy (from the Covenant of Mayors programme (Lisboa E-Nova, 2010). This is supplemented with national data and projections from the EU Energy Trends 2050 report (Capros et al, 2014).

The energy data available for Lisbon, along with the projections for BAU and PC2050, is shown in Table 12. This is further compared in Figure 13 highlighting the decrease in energy use under PC2050 due to improvements in energy efficiency in buildings and transport.

Table 12: Energy by sector for 2008, 2012 and the scenarios

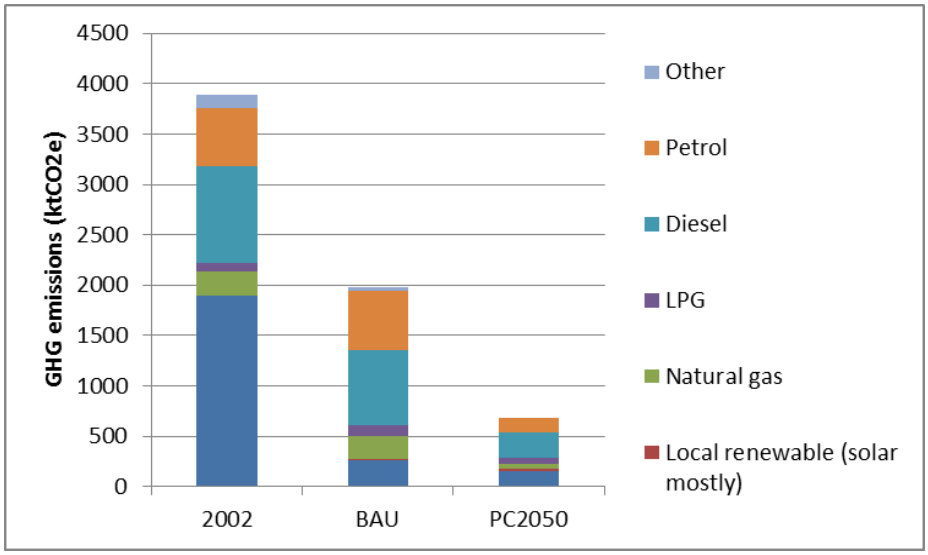
(GWH)	2008	2012	BAU	PC 2050
Transport	4536	5688	5794	3187
Services	3354	3369	3320	2324
Residential	1448	1296	1308	916
Industry	258	377	391	312
Agriculture	43	56	56	56
Total	**9638**	**10786**	**10869**	**6795**

Figure 13: Energy use by sector for 2012, BAU and PC2050



The GHG emissions by energy source for 2002 [from Lisboa E-Nova, (2010)] and the projected emissions for the BAU and PC2050 scenarios are shown in Figure 14. It shows a marked improvement under BAU, but a very significant reduction under PC2050.

Figure 14: GHG emissions by fuel source for Lisbon for 2002, BAU and PC2050



This is primarily due to an increased amount of local renewable energy under PC2050 (from 5.5% under BAU to 41.2% in PC2050) supported by a move to more electric transport. There is also a general electrification of the energy system, with electricity accounting for 70% of the energy. This is highlighted in Figure 15, which compares the energy source profile for 2002, BAU and PC2050. In PC2050 there is a significant drop in the amount of petrol and diesel used for transport. However, fossil fuel transport still accounts for 18.2% of the total energy and this translates into 46% of the total GHG emissions. To further enhance the move to a low carbon city, there is therefore a need for effective policies that further reduce or eradicate the use of fossil-fuelled transport.

The changes in GHG emissions for sectors are shown in Figure 16, emphasising the importance of the transport sector under both BAU and PC2050.

Figure 15: Energy source profile for 2002, BAU and PC2050

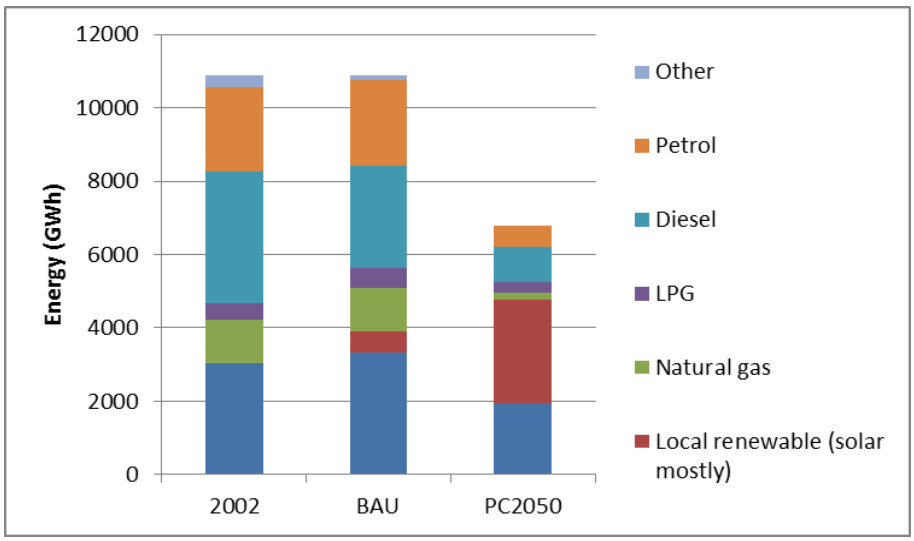
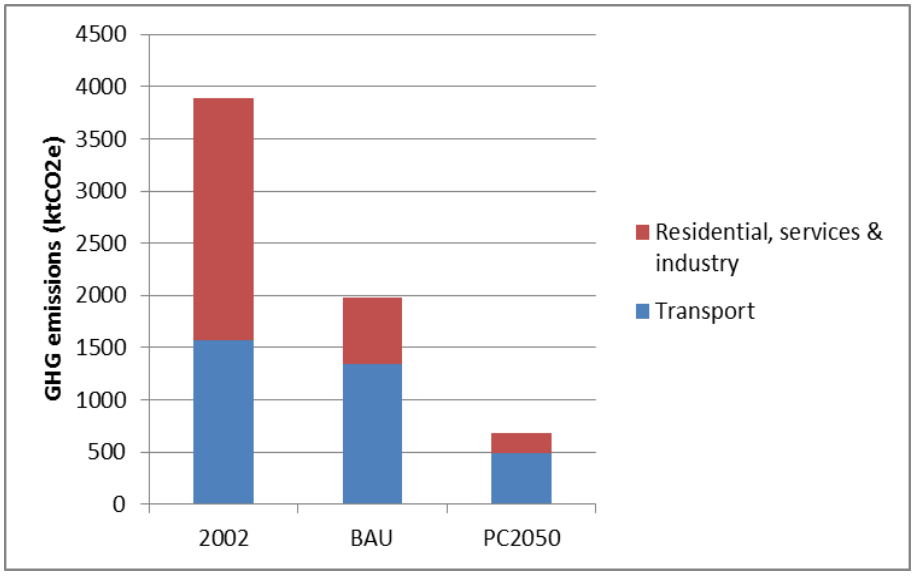


Figure 16: GHG emissions by sector for Lisbon for 2002, BAU and PC2050


4500
4000
3500
3000
2500
2000
1500
1000
500
0
GHG emissions (ktCO2e)
2002
BAU
PC2050
Residential, services & industry
Transport

A STAKEHOLDER VISION FOR THE CITY

VISION

The 2050 post-carbon vision for Lisbon is:

LISBON. A SMART CITY with more people, more jobs and better quality of life

In line with the key challenges facing the city, the main sectors identified in visioning a future for Lisbon were: **mobility, buildings, energy, resilience, attractiveness, and inclusion**.

MOBILITY – PROMOTING SMART AND SUSTAINABLE MOBILITY

Sustainable transport is the main transport mode in Lisbon (but it was impossible to achieve a share of 100%). Electric mobility is very important for the city, being adopted by the municipality, service operators' and companies' fleets. The use of driverless cars is also a reality (6 million autonomous cars are expected to be in use in Europe in 2030).

The shared mobility model increased exponentially, with the current use of electric car-sharing and bike-sharing systems by the population. Moreover, the biking lane network encourages biking for all citizens, both for work and leisure purposes.

On-demand mobility organises urban transport around user needs and offers new service solutions in the city. Furthermore, electric cargo bikes are facilitating micro-logistics in Lisbon and its surroundings.

Cars have been forbidden in the historic city centre, contributing to reduced carbon emissions and improving air quality, and providing pedestrian areas and shared public spaces to citizens.

Synergies between transport modes have been created, through the adoption of a holistic view of urban mobility including all the cities located in the metropolitan area and considering commuting movements.

A Mobility Operations Centre has been created, providing real-time information on traffic (and other areas such as civil protection) to the city authority, services' operators and citizens. The objective is to support decision-making processes and anticipate urban disasters.

BUILDINGS – PROMOTING SUSTAINABLE URBAN REGENERATION

Several smart and green neighbourhoods have been created in the city centre. The pilot initiative was the rehabilitation of the downtown area supported by the European lighthouse project 'Sharing Cities' 2016-2020 (in partnership with London and Milan). The zone was completely renewed in terms of sustainable mobility, energy efficiency and urban rehabilitation. In this context, urban districts are generating more energy than necessary without additional costs, and new decentralised energy grids have been established.

For new constructions, the share of 100% Nearly-Zero Energy Buildings (NZEB) has been achieved, contributing to promoting energy efficiency and carbon emissions' reduction. Energy management systems are implemented in several buildings, as well as other smart technologies and solutions (integration with electric vehicles, intelligent water and waste management, remote control of basic functions, etc.).

Green roofs are installed in some buildings such as public buildings, industry and retail, supplying residents daily with fresh vegetables and other food. Urban agriculture has increased, as well as small farms and micro-producers.

The involvement of citizens in urban planning has increased. Collaborative urbanism actions are being implemented with a view to transforming public spaces (parklets, public art, etc.).

ENERGY – PROMOTING SUSTAINABLE ENERGY

Almost 100% of the city's energy comes from renewable energy. Thermal and solar PV systems have been installed in buildings all over the city, potential that was identified by the 'Lisbon Solar Potential Map'. Public lighting is totally controlled by intelligent systems and LED.

A smart grids project was implemented in Lisbon allowing a two-way energy flow where many users supply the grid at high demand times through electric cars and renewable energy production.

Urban gardens are increasingly popular in Lisbon, promoting the reduction of city's carbon footprint and enhancing healthy lifestyles.

Lisbon won the European Green Capital Award in 2020, an award given to cities with a consistent record of achieving high environmental standards; committed to ongoing and ambitious goals for further environmental improvement and sustainable development; and showing the ability as a role model to inspire other cities and promote best practices to all other European cities.

RESILIENCE – IMPROVING RESILIENCE

Lisbon is a resilient city. Solutions have been developed to respond to its resilience challenges, namely ageing infrastructure, declining or ageing population, earthquakes, flooding (coastal and rainfall), landslide, and rising sea level and coastal erosion. The strategy 'Resilient Lisbon' is being implemented and a Chief Resilience Officer has been appointed.

Lisbon is member of the '100 Resilient Cities' network, pioneered by the Rockefeller Foundation. The network is dedicated to helping cities around the world become more resilient to the physical, social and economic challenges that are a growing part of the 21st century.

The city has become member of C40, a network to empower cities to connect with each other and share technical expertise on best practices in the area of climate change.

Moreover, public safety is being assured through the use of video surveillance and drones.

Air quality has been improved in Lisbon's city centre, but not as much as desirable. A monitoring centre was installed in order to collect real-time information on air quality and to produce knowledge intended to support decision-making processes.

ATTRACTIVENESS – PROMOTING INNOVATION AND INTERNATIONALISATION

Lisbon is an important economic and financial hub, the services sector being the predominant (about 80%) activity sector and the one that holds the largest share of GVA (Gross Value Added). Key urban clusters are ICT, web and mobile, creative industries, the maritime economy, tourism and health and wellbeing.

It is a city open to the world and a European Atlantic Hub, in close relation with Latin America, Africa and Asia countries and regions. Allowing access to 1 billion consumers from Europe and Portuguese-speaking countries, Lisbon has been attracting companies wishing to manage and prepare its exports or investment ventures in these markets.

The capital has also been the place for the location of Competence and Research Centres of multinational companies and high value shared services centres. In fact, Lisbon can guarantee human resources with availability, qualifications, flexibility, creativity and multilingual skills.

Moreover, Lisbon has been attracting students, talent, entrepreneurs and businesses, due to a strong entrepreneurship policy, namely the creation of incubators, co-working spaces and' fab labs' and launching incentive programs (funding, contests, coaching, etc.). For example, a fab lab is installed in each city neighbourhood.

Lisbon won the European Capital of Innovation (iCapital) award in 2020, due to its holistic vision of innovation related to four areas of urban life: governance, economics, social inclusion, and quality of life.

INCLUSION – PROMOTING QUALITY OF LIFE FOR ALL

Lisbon is promoting itself as a healthy and age-friendly city, providing adequate facilities for elderly people, such as ICT home care and telemedicine. Technology is also used to support emergency management systems and to prevent and fight criminality and natural disasters.

Open governance is a characteristic of Lisbon. Several instruments are at the disposal of citizens to promote their involvement in the resolution of urban problems and in the definition of the city's future (participatory budgeting, open data, digital platforms, etc.).

Sharing economy is growing in different areas, such as working, housing and transport. Information and communication technologies and social networks are supporting this movement.

The contribution of social economy to GDP and employment is increasing, and social and civic entrepreneurship is being supported by public incentives.

Migrants and refugees are socially integrated into urban daily life; Lisbon is characterised by cultural diversity.

In Lisbon, local government and citizens collaborate intensively in solving urban problems and defining the city's future, under a model of open **governance**. An Urban Sharing Platform has been created in order to collect, analyse and integrate real time data and information to support decision- and policy-making processes.

ACHIEVING THE VISION

The milestones and actions defined to achieve the vision are summarised in the following table. The majority of these measures will be implemented in a pilot district (living lab), and then will be scaled up to the entire city.

OBJECTIVES	ACTIONS & MILESTONES
Promote smart and sustainable mobility (2020-2050)	Creation of more pedestrian areas and shared public spaces Awareness campaigns about the benefits of walking and cycling (soft modes) Increase and extension of bicycle lanes Launch of public incentives to the acquisition of electric vehicles and electric bicycles Modernisation of electric vehicles charging points according to European standards and installation of new ones (36 new charging points + 1 fast charging station – Sharing Cities project) Launching a bike-sharing system with electric and non-electric modes (at least 30 e-bikes + 2 e-bike stations – Sharing Cities project) Integration of electric cars in the car-sharing system Acquisition of electric vehicles to the municipal and services' operators fleets (114 new e-vehicles – Sharing Cities project) Launch of electric cargo-bikes (micro-logistics) Launch of on-demand mobility systems Installation of smart parking sensors (30 sensors – Sharing Cities project) Launch of free Wi-Fi in public transports Creation of an Operations Centre on Mobility Imposition of tolls for entering in the city centre (historic centre without cars) Promoted use of autonomous cars (6 million autonomous cars in Europe in 2030) Promoted use of virtual technologies to avoid travel

OBJECTIVES	ACTIONS & MILESTONES
Promote sustainable urban regeneration (2020-2050)	Launch of a huge urban renewal program centred on promoting energy efficiency in buildings (starting from public buildings and integrating social housing and private buildings) Implementation and maintenance of an online interoperable Sustainable Energy Management System (SEMS), a Building Energy Management System (BEMS) and a Home Energy Management System (HEMS) Transformation of the historic centre into a smart and sustainable neighbourhood (living lab) Creation of green roofs/facades in buildings Launch of a program for co-creation of urban furniture with strong citizens' involvement (with the help of 3D printing) Supporting participatory urbanism actions (ex.: 'parklets', public art) Transformation of the most relevant neighbourhoods into smart and sustainable spaces Promote 100% of NZEB – Nearly net zero energy buildings (new constructions)
Promote sustainable energy (2020-2050)	Raising the share of energy consumption produced from renewable sources (100%) Installation of thermal and solar PV systems in buildings all over the city Creation of 100% intelligent public lighting systems (LED, remote control) (100 light automation sensors – Sharing Cities project) Expansion of urban gardens Installation of 10 environmental sensors (noise and air quality) – Sharing Cities project Adoption of smart grids in the city through the intervention of EDP and City Council Launching of Neighbourhood Sustainability Contests (City lab Lisbon project) Presentation of the application bid to European Green Capital Award
Improve resilience (2020-2050)	Implementation of the Climate Change Adaptation Plan Implementation of the drainage master plan Elaboration of 'Resilient Lisbon' strategy and action plan Integration of Lisbon in relevant international networks on climate change (C40) Launching preventive and alert systems oriented to anticipate natural disasters (technology-based emergency management systems) Installation of video surveillance all over the city Use of drones to ensure public safety

OBJECTIVES	ACTIONS & MILESTONES
Promote social and cultural inclusion (2020-2050)	Launching a support program for civic entrepreneurship Creation of interactive panels with cultural (and other relevant) information for citizens Expansion of telemedicine Launching of co-housing initiatives Creation of a Social Innovation Hub (City Lab Lisbon project)
Promote attractiveness and economic growth (2020-2050)	Expansion of the Lisbon Network of Incubators and Co-working Spaces Creation of a fab lab in each neighbourhood Emergence of more creative hubs in the city Attraction of two important international Research Centres to Lisbon Presentation of the application bid to European Innovation Capital Award
Supporting Objectives: Governance and ICT (2020-2050)	Installation of 250 wifi sensors (Sharing Cities project) Improvement of the open data portal Creation of an urban sharing platform (Sharing Cities project) Co-creation and co-design of digital services and interfaces by and for citizens and companies Launching of calls for ideas, app contests, acceleration events and mentoring Creation of Lisbon Sustainability Forum (think-tank) (City lab Lisbon project)

It is important to stress the approval of the lighthouse project **'Sharing Cities'** under **Horizon 2020 – 'Smart Cities and Communities'** (2016-20). Lisbon is one of the lighthouse cities in partnership with London and Milan. The follower cities are Bordeaux, Burgas, and Warsaw. The global budget is around €28 million.

Project's vision is of a "more agile and more collaborative smart cities market that dramatically increases the speed and scale at which we implement smart solutions across European cities, engaging society in new ways to cause them to play an active role in the transformation of their communities – delivering more vibrant, liveable, economically active, and resource efficient cities".

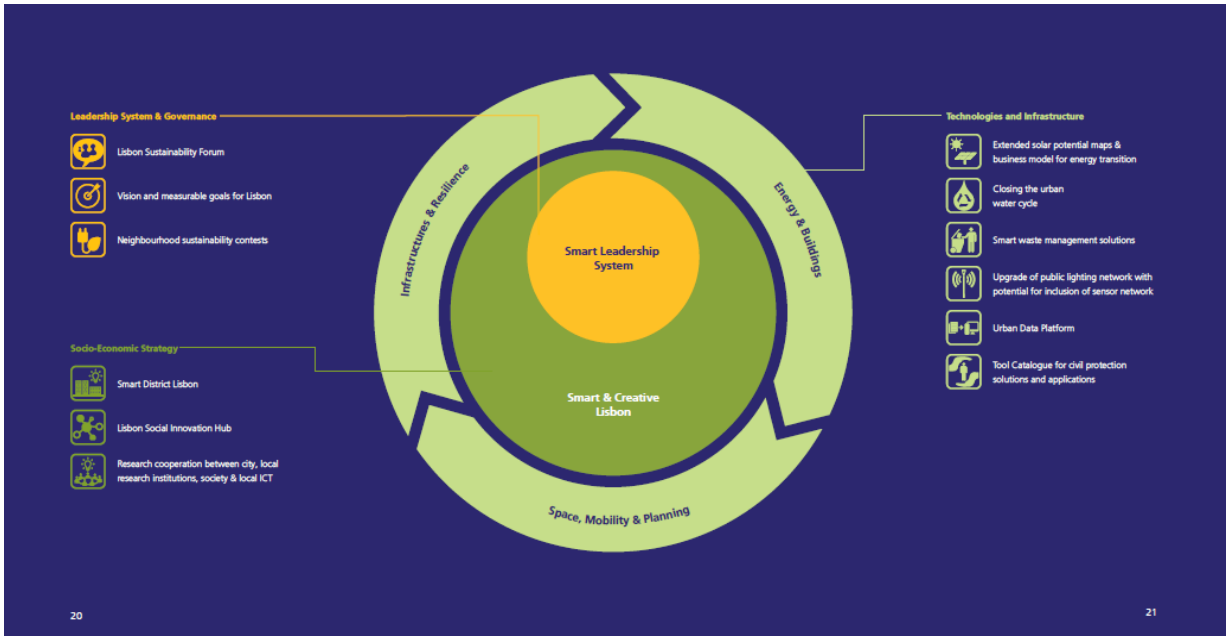
Specific objectives are:

- Aggregate demand and achieve wide scale deployment of smart city solutions;
- Deliver highly relevant common and replicable innovative solutions;
- Attract quantum external investment;
- Make acceleration in uptake of smart city solutions real;
- Deliver 3 role-model low energy efficient districts;
- Shift the thinking irreversibly to decarbonised/ local renewables;

- Shift the thinking irreversibly to new models of eMobility in the districts;
- Make real the notion of citizen participation;
- Exploit 'city data' to genuinely prove its value;
- Strengthen local scale-up businesses in (at least) the 3 cities.

Other relevant project is **'City Lab Lisbon'** developed within the initiative 'Morgenstad – City of the Future' led by Fraunhofer Institute. The purpose of the City Lab was to identify the strengths and weaknesses of the city across several sectors, as well as key areas of intervention for smart and sustainable development.

The results of the City Lab research have led to an integrated set of innovative projects constituting a comprehensive roadmap going into the future. The projects are tailored to Lisbon's unique needs and are meant to support Lisbon in addressing specific challenges. When the proposed projects are combined with the already ongoing activities, Lisbon can further strengthen its position as a southern European lighthouse city.



ASSESSMENT OF NEEDS

Challenges cannot be achieved by actions of the city authorities alone. Many enabling conditions have to be created by national and EU rules and regulations, as well as access to financial tools adapted to their needs. There is also a need to improve stakeholders' participation.

How can we improve the bottom-up approach to stakeholder consultation?

Consultation tools

- Adoption of open digital platforms to enhance the participation of stakeholders in the definition of local roadmaps (crowdsourcing, crowdfunding);

- Creation of Local Support Groups (as proposed by URBACT and INTERREG) and/or Smart City Commissions (ex.: Birmingham) - https://birminghamsmartcity.wordpress.com/;

- Participation of stakeholders in the collection of data and information on environmental issues (through smartphones, self-made sensors, etc.) – for ex. Smart Citizens Lab (Amsterdam) - https://waag.org/en/project/amsterdam-smart-citizens-lab;

- Launching of neighbourhood contests to reduce energy consumption or to improve sustainable mobility (reduce the use of private car);

- Creation of Living Labs as open innovation and co-creation spaces, with a strong user involvement in testing sustainable urban solutions.

Stakeholder groups

- Empowerment of citizens and communities to participate in the decision- and policy-making processes (importance of the neighbourhood level);

- Consideration of a quadruple-helix innovation model (municipalities, companies, universities and knowledge centres, and civil society).

- Consideration of creative and cultural actors, and not only scientific and technological actors in the stakeholder groups.

What should national authorities and the EU do?

Governance

- Reinforcement of local authorities' competencies.

Financing

- Revision of public procurement rules, facilitating the acquisition of sustainable and intelligent solutions by municipalities (pre-commercial public procurement of innovation; green public procurement; etc.);

- Dissemination of funding programs (articulation between national and European funds – ex.: Portugal2020, Horizon2020, Cohesion Fund, JESSICA, etc.) – red tape reduction.

Regulation

- Incentives for the acquisition of electric and green vehicles (ex.: German program – Public incentives for the acquisition of electric vehicles with a discount of €5,000);

- Regulation and harmonization of renewable energy cooperatives framework (legal context, support mechanisms) – ex.: http://www.coopernico.org/ (Portugal);

- Consideration of crowdfunding legal frameworks (national frameworks?; European level policy action?).

Standardisation

- Definition of common standards in the area of smart and sustainable cities (considering the work that is being developed by ITU, ISO, City Protocol, etc.).

Metrics

- Definition of a common set of indicators in the area of sustainability with a geographic level equivalent to 'Municipality' (considering the work that is being developed by WCCD and other organisations);

- Definition and harmonisation of national (and European) monitoring systems to evaluate the level of accomplishment of national and European targets in the area of environment;

- Launching of open data platforms.

Knowledge sharing

- Sharing of good practices and experiences between municipalities.

APPENDIX. SEMI-QUANTITATIVE ASSESSMENT OF KPI'S - BAU AND PC2050

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
ENVIRONMENT	*Biodiversity*	Variation rate of ecosystem protected areas	*Percentage* *Geographical level: Municipality* *Source: Lisbon City Council*	*Calculated to be 0.0% - 1.5% (2003-2012)*	*+1.5 points*	+	+
	Energy	Energy intensity variation rate	*toe/euro* *toe* *Geographical level: NUT III* *Source: INE, DGGE*	*$5.922*10^{-5}$ – $5.334*10^{-5}$ (2003-2012)* *2.339 Mtoe – 2.441 Mtoe (2003-2012)*	*-9.9%* *+4.3%*	+	++
		Variation rate of energy consumption by sectors	*Percentage* *Geographical level: Municipality* *Source: INE; DGGE*	*Industry: +45.8%* *Agriculture: +31.8%* *Services: +0.5%* *Transport: +25.4%* *Residential: -10.5%* *(2008-2012)*	*Increases in three sectors. No change in services, and residential decreased*		
	Climate and Air Quality	Variation rate of carbon emissions intensity	*ton CO_2/euro* *ton CO_2* *Geographical level: NUT III* *Source: INE; APA (www.apambiente.pt/)*	*$151.8*10^{-6}$ – $118.1*10^{-6}$ (2005-2009)* *Greater Lisbon – 7.507.507,70 Ton CO_2 (2005)* *Greater Lisbon – 6.366.261,01 Ton CO_2 (2009)*	*-22,2%* *-15,20%*	+	+
		Carbon intensity per person	*ton CO_2/per capita* *Geographical level: NUT III* *Source: INE; APA*	*3,76 Ton CO_2/per capita (2005)* *3,13 Ton CO_2/per capita (2009)*	*-16,76%*	+	+
		Variation rate of carbon emissions by sector	*ton CO_2*	**No data available**	*No data available*	+	+

SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
	Exceedance rate of air quality limit values	*Nº* *Geographical level: Municipality* *Source: APA*	*O_3: 11.8 – 5.3 (2003-2012)* *PM10: 76.3 – 25.4 (2003-2012)* *Only the pollutants that recorded exceedance rates on air quality limit values were considered in this indicator.* *Other pollutants (NO_2, SO_2 and $PM_{2.5}$) did not registered exceedance rates for air quality limit values.*	*O_3: -55.1% (2003-2012)* *PM_{10}: -66.7% (2003-2012)* *Other pollutants (NO_2, SO_2 and $PM_{2.5}$) remain null values in terms of exceedance rates.*	+	++
Transport and mobility	Variation share of sustainable transportation	*Percentage* *Geographical level: Municipality* *Source: INE, Census,*	**59% - 51% (2001-2011)**	*-8.0%*	*0*	+
Waste	Variation rate of urban waste generation	*kg/person/year* *Geographical level: Municipality* *Source: INE*	*648.6 - 561.4 (2009-2013)*	*-13% (2009-2013)*	+	+
	Variation rate of urban waste recovery	*Percentage* *Geographical level: Municipality* *Source: INE*	*92.2 – 72.6 kg (2009-2013)*	*-21% (2009-2013)*	-	-
Water	Water losses variation rate	*m^3/person/year* *Geographical level: Municipality* *Source: INE; EPAL*	*27.98 – 15.75 (2009-2013)*	*-43.7% (2009-2013)*	+	*N/a*
Buildings and Land Use	Energy-efficient buildings variation rate	*Percentage* *Geographical level:*	*The rate of buildings with A+ and A energy class was null in 2007*	*Since the beginning of the certification process (2007), an exponential increase was*	+	++

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
			Municipality *Source: ADENE*	*14% (2012)*	*observed in 2009, even in higher efficiency classes A and A+.* *In evolutive terms between 2007 and 2012, there has been a significant evolution until 2009 and then a slight decrease.*		
		Urban density variation rate	*N°/km²* *Geographical level: Municipality* *Source: INE*	*628.08 – 617.82 (2001-2011)*	*-1.63% (2001-2011)*	+	+
ECONOMY	*Sustainable economic growth*	Level of wealth variation rate	*EUR/person* *Geographical level: NUT III* *Source: INE*	*About 18,400 – 19,500 (2004-2012)*	*No clear trend – maximum in 2008 and 2010, reduced since.*	+	+
		Variation rate of GDP by sectors	*Percentage* *Geographical level: NUT III* *Source: INE*	*Agriculture/Industry/Services (2003-2012):* *0.21%/17%/83% -* *0.20%/14%/86%*	*Share of services increases somewhat in Greater Lisbon, while industry decreases somewhat.*	+	+
		Employment by sectors variation rate	*Percentage* *Geographical level: NUT III* *Source: INE*	*Agriculture (2003-2011) – 0.70% - 0.46%* *Industry (2003-2011) – 18.99% - 13.92%* *Services (2003-2011) – 80.32% - 85.61%*	*Agriculture: - 0.24%* *Industry: - 5.07%* *Services: + 5.29%* *Number of people working in services increases, working in industry registered a slight decrease*	+	+
		Business survival variation rate	*Percentage* *Geographical level: NUT III* *Source: INE*	*5.7% – 6.7% (2008-2010)*	*+1 points*	+	+
	Public Finances	Budget deficit variation rate	*Percentage of city's GDP* *Geographical level:*	*Extremely volatile rates that goes from +200% in 2010 to -*	*Significant annual variation – 2012 was an extraordinary year of revenues.*	+	+

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
			Municipality *Source: PORDATA*	*96% in 2013, achieving an average of +78% under this period.*			
		Indebtedness level variation rate	*Percentage of city's GDP* *Geographical level: Municipality* *Source: Management Report 2013, Lisbon City Council*	*79.3% - 4.5% (2010-2013)*	*Significant drop*	+	+
	Research & Innovation dynamics	R&D intensity variation rate	*Percentage* *Geographical level: NUT III* *Source: INE*	*1.1% - 2.5% (2003-2010)*	*Significant annual variation*	+	+
SOCIAL	*Social Inclusion*	Variation rate of unemployment level by gender	*Percentage* *Geographical level: NUT II* *Source: INE*	*Male 4% – 10% (2003-2012)* *Female 4% – 7.5% (2003-2012)*	*Increase in unemployment.*	-	*N/a*
		Variation rate of poverty level	*Percentage* *Geographical level: NUT I* *Source: Economic Inequality in Portugal, Carlos Farinha Rodrigues, 2012*	*5.0% - 12.0% (2003-2012)*	*Variation rate only available at national level and with negative fluctuations in 2005, 2007 and 2009.*	+	+
		Variation rate of tertiary education level by gender	*Percentage* *Geographical level: Municipality* *Source: INE, Census*	*About 21% - 32% (2001-2011)* *Male 33.2% - 11.0% (2005-2012)* *Female 10.3% - 9.4% (2005-2012)* *No data available for 2003-2005*	*+ 11% (2001-2011)* *A significant drop on male – 22.2%* *A slight decrease on female – 0.9%*	-	*0*
		Variation rate of average life expectancy	*Average Nº* *Geographical level: NUT III*	*77.8 – 79.9 (2003-2012)*	*+2.1 years*	+	+

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
			Source: INE				
	Public services and Infrastructures	Variation rate of green space availability	*Percentage* *Geographical level: Municipality* *Source: Lisbon City Council*	*+ 27.88% medium rate 2004-2014 (including new or refurbished green spaces, and urban gardens)* *-0.72% medium rate > 2014 (including new or refurbished green spaces, and urban gardens)*	*+413% (2004-2008) Exponential increase of new and refurbished green spaces in the period 2009-2014*	++	*N/a*
	Governance effectiveness	Existence of monitoring system for emissions reductions	*Yes/No Description* *Geographical level: Municipality* *Source: Lisbon City Council*	*No*	-	*0*	*0*

Legend	Explanation for scenario projection compared to current situation
++	Likely very positive
+	Likely progress
0	Likely neutral or similar to current situation
-	Likely negative
--	Likely very negative

VI STRATEGY PAPER OF MALMÖ TOWARDS A POST-CARBON CITY

IVL Swedish Environmental Research Institute, Gothenburg, 2016-05-24

Steve Harris, Hanna Ljungkvist, IVL Swedish Environmental Research Institute

CHALLENGES FACING THE CITY

The main challenges identified in the sustainability assessment that the city is facing are summarised as follows:

- Segregation, unemployment and social inclusion (recent developments).
- Renewable energy production capacity.
- Carbon reporting including consumption footprint.
- Urban sprawl.

All of these challenges are framed within the context of a consistently growing population that is expected to reach around 500,000 people by 2050.

The main areas of interest identified in the vision and backcasting workshops are:

- Local fossil free food production.
- Renewable and decentralised energy production.
- Dependence of national policies (i.e. tax reforms).
- Sharing economy (products, logistics and public transports).
- Consumption based carbon reporting.

From the PCIA workshop the following variables were identified as particularly important due to the high influence they have on other factors in the city and its development:

- National policies
- Segregation of housing
- Robust economy
- Resource /environmental tax and charges

An initial assessment of Malmö was made using a set of KPI's developed within POCACITO (Work Package 3). From the data available trends were established for each of the KPI's and these have since

been assessed and projected in the sustainability assessment. Data for this was obtained from various reports, websites and information and the outcome can be found in Annex 1.

DESCRIPTION OF THE STAKEHOLDER CONSULTATION WORK

Three workshops involving city stakeholders were held during 2014 and 2015.

In the first workshop the aim was to create inspiring visions for a post-carbon Malmö 2050. The participants worked in groups, starting by drawing pictures and then step by step formulating their vision for the city.

The second workshop used backcasting methodology to list obstacles and opportunities, milestones and activities related to reaching a normative endpoint goal. The goal set by the stakeholders was:

"In 2050, the citizens of Malmö only emit 1-2 tons of carbon dioxide per person and year, including the carbon footprint of their consumption."

The milestones and activities in different areas were then positioned on a timeline to reach the 2050 goal.

In preparation for the third PCIA (Pocacito Critical Influences Assessment) workshop, IVL used the results from visioning and backcasting to develop a set of variables influencing the city system. During the workshop, participants used the variables in an impact matrix to try to describe what impacts they had on each other and how strong this impact was. They also suggested a number of additional variables. Based on the results, IVL made an assessment using the sensitivity model, and the top five variables for the Malmö city system were selected.

More detailed descriptions of the workshops and outcomes can be found in the Stakeholder workshop report (D4.2) and the PCIA report for Malmö (D5.1), both available at www.pocacito.eu.

INSIGHTS FROM THE GAP ANALYSIS FOR THE CITY

Under most indicators Malmö is performing exceptionally well as the economy has recovered in recent years and continues to prosper and grow. As in many European cities there is a move towards the service sector, which has a lower energy intensity (or energy use per economic output) and facilitates the move to a post-carbon society. Recent developments in Malmö such as Västra Hamnen and Hyllie represent some cutting edge examples of sustainable development.

POCACITO has developed and compared two scenarios as possible outcomes for Malmö in 2050: 'Business as Usual' (BAU) and 'Post-Carbon 2050'. BAU is essentially based on an examination and extension of current trends for indicators and physical aspects such as population, energy use, GDP, buildings and transport. PC2050 is a projection of the indicators and physical aspects based on an interpretation of the visions, actions and milestones developed in the stakeholder workshops. A summary of some of these is in Table 13. It is therefore a judgement based on the consistency and

robustness of supporting actions to the desired post-carbon state, and not a quantification of an idealistic state (for further information see Harris et al, 2016).

Table 13: Quantification of the main elements of the scenarios for Malmo

Element	Current trend (up to 2013)	Scenario BAU 2050	Scenario PC 2050
Population	313,000	500,000	500,000
Energy	**Energy use** 7259 GWh (2013) (produced) 8230 GWh 7196 Gwh (2008). Therefore, 2003-2013, +8.8%.	**Energy use** 8175 GWh (produced 9044 GWh) **Energy production** - Electricity from grid 26% (hydro 44%, nuclear 40.5%) - Wind and solar – 12% - Gas – 18% - Avfall – 14% - Waste heat – 2% - Biofuel – 8% - Oil – 0.1% - Diesel/petrol 19.6% Renewables therefore provide 40.7% of Malmo's energy.	**Energy use** 7440 GWh (produced 8230 GWh) **Energy production** - Electricity from grid 27.9% - Wind and solar – 40% - Gas – 5% - Avfall – 7% - Waste heat – 2% - Biofuel – 8% - Oil – 0.1% - Diesel/petrol - 10% Renewables therefore provide 62.8% of Malmo's energy
Transport	Modal share change (2003-13) (%) 2003 2013 % Change Car 52 40 -12% Bus 10 14 +4% Train 3 7 +4% Bicycle 20 22 +2% Walking 14 15 +1% Other 1 2 +1%	Modal share is projected as: Car: 32% Bus: 15% Train: 9% Bicycle: 24% Walking: 18% Other: 2%	Modal share: Car 32% Bus 15% Train 9% Bicycle 24% Walking 18% Other 2%
GDP	45,400 EUR (2011)	98,700 EUR	101,600 EUR

The GHG emissions and energy use of the scenarios is compared with 2013 in Figure 17. It shows that under BAU the energy use increases (due to population growth and taking into account improvements in energy efficiency) whilst the GHG emissions decrease slightly. In PC2050 there is improved energy efficiency and electric transport is increased to about 60% of the transport. Figure 18 illustrates the GHG emissions per capita showing that in both scenarios per capita emissions are much reduced at 2.97 t CO_2e/capita for BAU and 1.37 t CO_2e/capita for PC2050.

Figure 17: GHG emissions and energy use comparing 2013 with BAU and PC2050

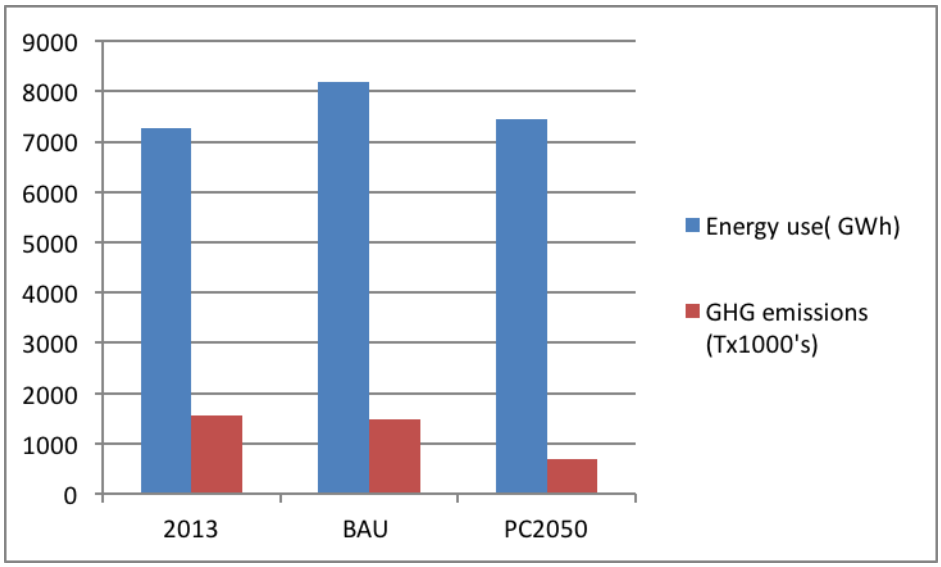
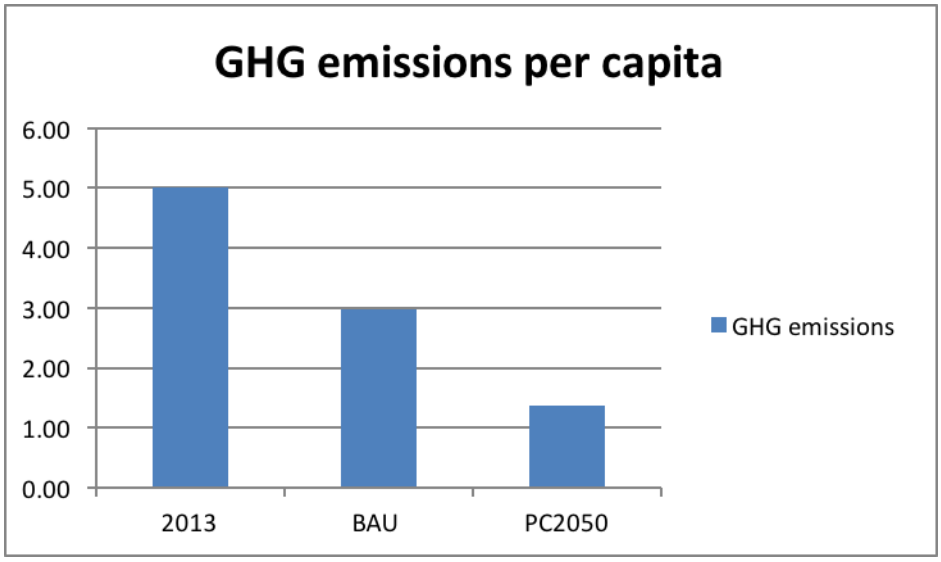


Figure 18: GHG emissions per capita for 2013 and the scenarios for Malmö



The energy production under PC2050 obtains 27.9% of electricity from the grid and an additional 40% energy from local wind and solar. Considering the low carbon national electricity supply projected for 2050[2] (although Sweden's electricity is already very low in carbon) this brings the total renewable energy supply to 62.8%. It was not considered possible to achieve a 100% local renewable energy supply by 2050, given the current set of actions and milestones developed in the vision workshop. One of the main contributors to GHG is fossil fuels used for transport which still account for 50% of the transport energy (see Figure 20). Therefore although this transport energy only accounts for 10% of the energy supply, it contributes 36.2% of the GHG emissions.

[2] Energy projections for 2050 are taken from EU Energy, Transport and GHG Emissions, Trends to 2050 (Capros P, et al. 2014).

Figure 19: GHG emissions by sector

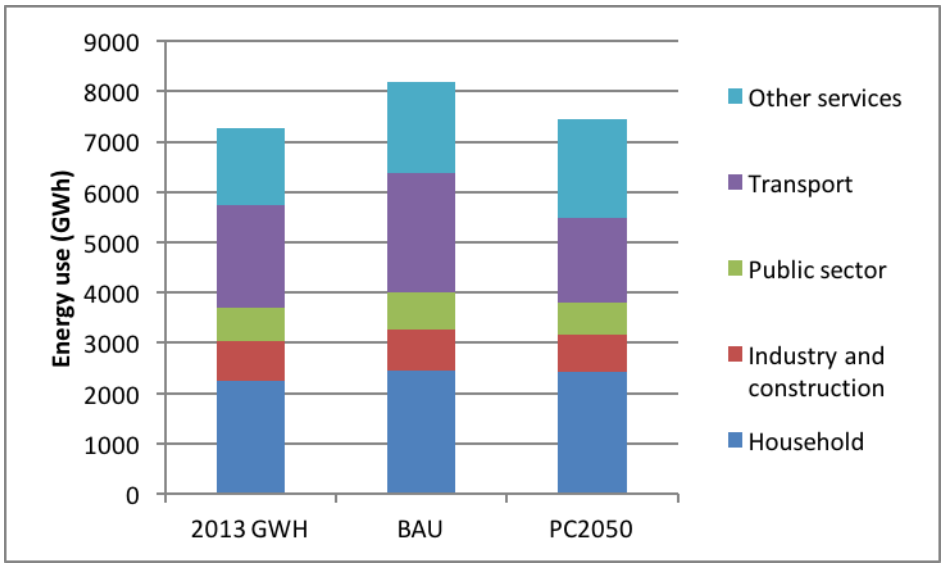
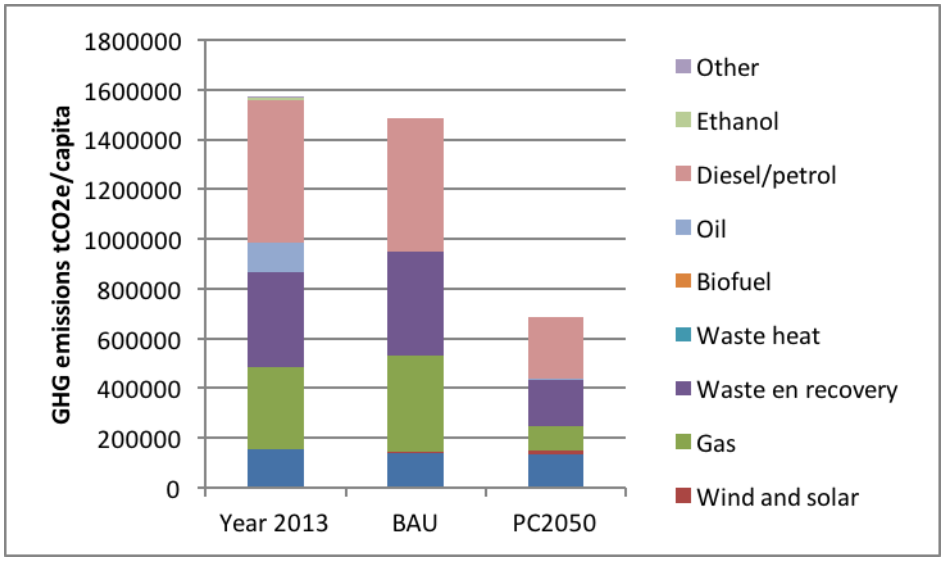


Figure 20: GHG emissions by energy source



In fact, even achieving the 40% of local renewable energy in PC2050 is an enormous challenge considering the quantities required and historical progress in local renewable energy.

The amount of additional renewable energy required for each scenario is shown in Table 14. To put this into context the amount required under PC2050 is equivalent to 8 wind farms the size of Lilligrund, which at 110 MW is Sweden's largest offshore wind farm.

Table 14: Additional wind energy and capacity requirements for the scenarios

	BAU 2050	PC 2050
Wind energy (GWh)	785	2995
Net wind capacity required (MW)	**243**	**869**

In order to replace all remaining fossil fuels under PC2050 with renewable energy an additional 830 GWh of energy is required. This is equivalent to 241 MW or about 2 further Lilligrunds. Hence there is also a requirement to investigate further options for major energy use reduction through energy efficiency measures.

Solar energy of course is a complementary option to supplement the wind energy. According to our initial calculations, about 0.834 MW of solar capacity is needed for each GWh required. This means the comparable costs are: wind 2.46 EUR/kW and solar 2.06 EUR/kW.

SUMMARY OF KEY GAPS

In addition, to the energy analysis, the main gaps identified in the sustainability assessment are summarised below.

ENERGY

Under BAU energy use continues to climb, but even under PC2050 total energy use rises slightly (due to population growth), although is less per capita. In addition, the total emissions for PC2050 are 687,000 tonnes of CO2e or 1.37 tonnes per capita, therefore falling short of post carbon status.

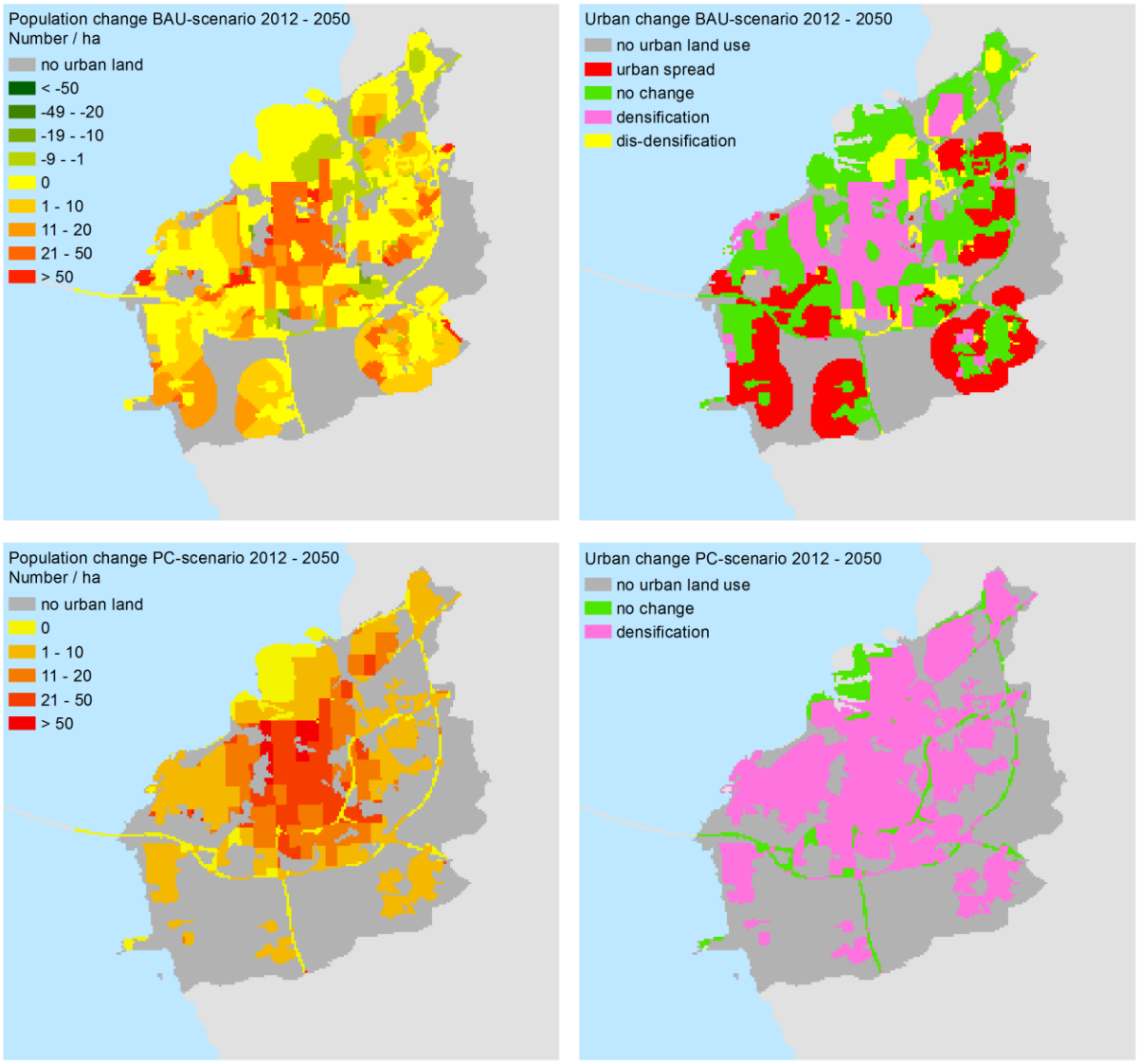
In order to completely remove all fossil fuels from the energy profile enough additional renewable energy capacity is needed to supply 2995 GWh (this is assuming further energy efficiency measures are not taken). If this were all supplied by wind energy then 869 MW of capacity would be required which the equivalent of 8 Lilligrunds. Therefore measures to reduce energy use through energy efficiency measures should be high on the agenda to reduce the investment and effort required to supply adequate energy.

Transport and the cessation of using fossil fuels is probably one of the biggest challenges. Under PC2050 currently, transport accounts for 36% of GHG emissions, due to 50% of the transport still being powered by fossil fuels.

URBAN SPRAWL

Under BAU urban sprawl covers an additional 37.4 km^2, which is of concern, and although we have assumed no urban sprawl occurs under PC2050, this aspect needs careful attention in strategic planning. This also has ramifications for private and public transport, which could increase more than projected in the scenarios if urban sprawl remains unchecked.

Figure 21: Urban change and population change in BAU and PC scenarios 2012-2050.



INEQUALITY

Currently the PC2050 scenario fails to adequately address segregation and the dangers of inequality. The poverty level of 14% is also high. Inequality is a growing challenge in many cities and hence needs an adequate strategy, actions and indicators to monitor progress.

CIRCULAR ECONOMY

Within the PC2050 scenario there is an emphasis on the circular economy and local produce. Hence there is a requirement to plan for urban gardens and agricultural space, as well as space and opportunities for facilities for the circular economy (for reuse, repair, refurbishment and remanufacturing). This should include supporting innovative local businesses that seek to facilitate reuse, repair and remanufacturing. It should include working closely with the national government to ensure policies on trade, industry, innovation and the environment align with the goals of a circular city.

A STAKEHOLDER VISION FOR THE CITY

The storyline of the main stakeholder vision was as follows:

> ”We are on our way home in Malmö, a city of networking and cooperation. We travel on our bike while dinner is being delivered to our home by a company using cluster logistic services. We have ordered pick up of our children with the ‘bicycle bus’, while the teenager uses the driverless taxi that also picks up the ecological laundry at the local drycleaner.
>
> Our new job as ‘Transformation coach’ takes us to a common workshop with city actors in the democratic roofed outdoor meeting place.
>
> We optimise 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. This enhances green space in the city. The excess energy from large scale and resource efficient industrial production is taken care of and generates new services like greenhouse growing of energy demanding crops. Apart from farming, green plants have taken over roofs, walls and public spaces and help reduce noise in our quiet city.
>
> The city is dense, green and diverse and used around the clock. There is reduced demand for individual travel and car ownership. Travels take place in driverless electric vehicles that are coordinated with transport of goods and take us to nodes for rail bound traffic. These station nodes have become the backbone of the city, enabling meeting places, investment in new housing and services. The biking lane network has a high priority and invites to biking for all citizens year round since the lanes are roofed.
>
> By sharing our consumption and standardizing our products we have reduced the input of virgin resources. We use open grid solutions with standardized connections and input of renewable energy where all excess resources are used and recycled.
>
> All this new development creates new jobs that are distributed equally among the citizens. We work less and hence have more time for meeting each other. The growing numbers of roofed outdoor meeting places improve social integration in all climates. They also encourage consumption and development of culture, which becomes the meaning of life in the new including social space. Everyone *are friendly and encourage each other to grow and develop.”*

The following sectors/topics were covered in the city vision:

- Energy, with focus on renewables
- Transport sharing & smart logistics
- Food production
- Efficient, ecologic consumption
- Circular and sharing economy
- Green areas including city farming, green roofs and walls
- Social inclusion, safety and networking

- Dense city structure
- Quality of life, the value of time, outdoor activities and culture
- Smart technology and open grid solutions

ACHIEVING THE VISION

Below is a list of milestones, in some cases connected to existing or suggested strategies/plans, to achieve post carbon in Malmö by 2050. The table is a combination of results from the backcasting workshop and suggestions based on the gap analysis. It was further developed by stakeholders during the roadmap workshop. It is divided into four main areas.

SECTOR/MILESTONE (MS)	TARGET DATE	STRATEGY TOWARDS MILESONE
ENERGY, CARBON AND TRANSPORT		
MS I: Fossil free district heating system	**2025**	**Updated energy strategy/action plan for Malmö** Shift to biofuels?
MS II: Malmo City Municipality operations carbon neutral	**2025**	**Updated energy strategy/ action plan for Malmö (ongoing)**
MS III: Transport 40% electric	**2030**	Offshore wind park inaugurated 2030. Carbon Rationing per person introduced 2040. Updated traffic program for Malmö (current program expires 2017)
MS IV: Fossil fuelled transport reduced to 50%	**2035**	Large biogas plant inaugurated 2020
MS V: Average building energy reduced to 50 kWh/m^2	**2035**	Energy consumption tax is introduced per m^2 of living space and person. Reduce the amount of bought energy.
MS VI: Fossil fuelled transport reduced to 10% within outer city and 0% in city centre.	**2050**	Trams and subway + Malmö ring inaugurated 2020 – 2025, or probably later; 2030?. Residents use car pools/ mobility pools more.
SOCIAL		
Rejuvenation and revitalisation plan for segregated/socially challenged areas	**2025**	Already existing plans/programs: Strategic Development Plan for Anti-Discrimination Work in the City of Malmö Security program Cultural strategy

		Malmö Commission report on health, welfare and justice[4]
Child poverty level halved by 2020	**2020**	Target from the Malmö Commission report.
Tertiary level education of culturally diverse/segregated areas within 3% of average	**2035**	To reduce segregation in housing, two large demonstration projects are suggested in the Malmö Commission report.
Health and life expectancy in Segregated areas within 5% of rest of Malmo	**2035**	
Tackle homelessness	**2016**	300 apartments dedicated to homeless people (target from the Malmö Commission report, now probably outdated due to the immigration situation)
Poverty level reduced to 2% for all residents	**2050**	
Tertiary level education of culturally diverse/segregated areas within 3% of average	**2050**	
Health and life expectancy in segregated areas within 2% of rest of Malmo	**2050**	Addressed in the Malmö commission report [4]
Population size 500 000 and constant	**2050**	400 000 inhabitants by 2035. This target was questioned in the roadmap workshop, in the light of recent high immigration numbers. It was also stated that the quality of life is more important than the number of inhabitants.
LAND USE		
No new land is built on	**2035**	Regulated today by Malmö comprehensive plan (targets to 2030) and Malmö green plan (updated plan under development) Important to focus on densification in businesses as much as in housing!
35% increase in recreational value per ha at municipality level * (240.000sek/ha)	**2050**	This target was questioned by the roadmap workshop since they did not understand the basis for valuation. The issue as such could be handled by the plan for green and blue environment in Malmö.
CIRCULAR ECONOMY		
Circular Economy strategy	**2020**	Carbon footprint calculation including consumption

Collection points and logistic systems for reuse and remanufacturing in place	**2030**	Resource management plan (part of CE strategy)
Local produce accounts for 20% of food sold	**2050**	Government subsidy of fossil-free and sustainable agriculture is introduced 2025
Local reuse, refurbishment and remanufacturing companies recover 75% of collected materials/products for which there is a market.	**2050**	Resource management plan (part of CE strategy) Support entrepreneurs with new business models.
Reduce the amount of waste to incineration	**2020**	The municipal waste management company (SYSAV) has a waste plan that should govern this[3].

**Transferred site values of today range from 177.000SEK per ha in Malmö municipality to 6.000 SEK per ha in Skurup municipality.*

ASSESSMENT OF NEEDS

The following section should also be further developed during the roadmap workshop. It outlines stakeholders' assessment of the next steps. What can the city administration do, what should the national authorities do and what should the EU do to achieve post carbon in Malmö and other European cities?

CITY ADMINISTRATION:

The administration should develop and follow up strategies, targets and KPIs for the areas:

- Energy: the energy strategy document is under revision...
- Public transport: this is governed by the local traffic- and mobility plan. It is important to define how transport efficiency should be measured: as fuel per person km or in other terms?
- Goods transport is also important to measure with the aim to develop more efficient logistic solutions. The goods transport plan is an important document for this.
- Local food production.
- Social sustainability: the report from the "Malmö commission on social sustainability"[4] governs many of the social issues relating to the gaps in health due to differences in education, housing standards, income and employment etc. It suggests a number of actions related to these areas that need to be followed up continuously.

[3] SYSAV (2015).Kretsloppsplan 2016 - 2020
http://www.sysav.se/Om-oss/Om-foretaget/Regionens-avfallsplanering/kretsloppsplan-2016-2020/
[4] The Malmö Commission, 2013. "Malmös väg mot en hållbar framtid – hälsa, välfärd och rättvisa"
http://www.slideshare.net/fullscreen/rodaberget/malmkommissionen-slutrapport-digital130225/5

- Green and blue space: there is ongoing work on a plan for the green and blue environment in Malmö. This is an important document with regard to recreational values and urban sprawl.
- Circular economy – this should include supporting local innovative businesses that seek to reuse, refurbish, repair and remanufacture products. This could involve capturing some emerging technologies and techniques such as 3D printing, product 'hacking' (combining components from products to form innovative new products) and using the internet for increased knowledge of product design and engineering. It should include working closely with the national government to ensure policies on trade, industry, innovation and the environment align with the goals of a circular city.

The city administration should also continue to showcase good examples, e.g. demonstration projects of different kinds.

NATIONAL AUTHORITIES AND GOVERNMENT:

The national authorities need to provide clear, consistent and long-term economic incentives to promote post carbon activities. Some examples of incentives are:

- Tax shifts
- Higher energy prices
- Carbon rationing
- Investment support for new business models
- Refund systems for new fractions

There is also a need for clear national goals/targets for environmental and social development.

Furthermore, the national government has a key role in setting clear and ambitious policies that support and foster the circular economy in cities. This requires ensuring that the many sectors and areas that are related to the circular economy, including trade, industry, innovation and environment. It also requires that the government works with industry and sets policies to support business models that facilitate the circular economy. But also that it encourages product design and knowledge transfer that provides SME's with the ability and knowledge to perform circular functions such as repair and remanufacturing.

EU:

The EU governs much of national legislation in the member states today. There is a need to operationalise legislation that leads to a more circular and less carbon intensive economy. Examples of such legislation include:

- The waste directive and end of waste criteria (and their national implementation)
- Standards for recycled materials
- Incentives for resource efficiency (such as reuse and use of secondary raw materials)
- Incentives for energy efficiency that makes it possible to overcome the barrier of high investment costs
- Higher ETS (European Trading System) prices for carbon

- Policy connected to new, innovative business models

The Malmö stakeholders emphasised the need for a clear long-term vision to work towards, and clarity on policies and incentives that provide the framework for their authority. The Malmö stakeholders emphasised that some nations should be allowed to be 'forerunners' and set goals that exceed EU levels. Individual countries should be able to develop and advance from their own level.

INDUSTRY/BUSINESS:

The industry should act as forerunners and make investments in renewables and circular business models wherever possible. These early adapters act as inspiration and show cases for the rest of society on how to progress towards a sustainable society.

APPENDIX

This section utilises the indicators developed within WP3 of POCACITO to provide a semi-quantitative and qualitative assessment of how Malmö performs under both BAU and PC2050.

The qualitative assessment is indicated by both a colour and simple scoring system with green and "++" indicating a very likely positive performance and improvement. Whilst red and "--" indicate a very poor or negative performance, as shown in the table below.

Legend	Explanation for scenario projection compared to current situation
++	Likely very positive
+	Likely progress
0	Likely neutral or similar to current situation
-	Likely negative
--	Likely very negative

Table 15 summarises the current trends of the KPI and provides a projection of the likely outcome and performance under each of the scenarios (where possible and applicable).

It shows that Malmö is performing quite well for most indicators under the BAU scenario but performs noticeably better under the PC2050 scenario.

Table 15: Semi quantitative assessment of the POCACITO KPI's under BAU and PC2050 for Malmo

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
ENVIRONMENT	*Biodiversity*	Variation rate of ecosystem protected areas	*2007 2013*	*2.1% 4.5%*	*Doubled in 6 years*	+	++
	Energy	Energy intensity variation rate	*Toe/euro (000) 2003-2013 Toe (000)*	*0.06 -0.45 561-616*	*-25% +9.7%*	+	++
		Variation rate of energy consumption by sectors	*Percentage Total 2003-2012= 571.7-618.8 KToe (9,5% increase)*	*2003-2012 % Household 33-31 Building industry 11-11 Ag, forestry & fish 0-0 Public sector 9-9 Transport 27-28 Other services 20-21*	*Household -2% Building industry 0 Ag, forestry & fish 0-0 Public sector 0 Transport +1 Other services +1*	*0*	+
	Climate and Air Quality	Variation rate of carbon emissions intensity	*2000-2011 Ton CO_2 Ton $CO_2(x10^{-3})$/ euro*		*1.38M-1.75M: +26.8% 0.166-0.127: -23.5%*	+	+
		Carbon intensity per person	*Population: 262,000 (check for 2002) 313,000*	*5.62 t/cap 5.59 t/cap*	*0% change*	+	++
		Variation rate of carbon emissions by sector	*Ton CO_2 Total 2000-2012 1319-1606 kton (22% increase)*	2000-2012 Total (up 22%) Work machines and tools: 4-5% Industry and energy 56-72% Road transport: 37-22% Transport, other: 3-2%	*Work machines and tools: +48.0% Industry and energy +57.8% Road transport: -28.8% Transport, other: -44.5%*	*See below*	*See below*
		Exceedance rate of air quality limit values	*Nº*	*No notable change*	-	+	+

	SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
	Transport and mobility	Variation share of sustainable transportation	*Percentage (2003-2008-2013)*	(2003-2008-2013) Car: 52-41-40 Bus: 10-10-14 Train: 3-4-7 Bicycle: 20-23-22 Walking: 14-20-15 Other: 1- 2-2	*Car: -12% Bus: +4% Train: +4% Bicycle: +2% Walking: +1% Other: +1%*	+	+
	Waste	Variation rate of urban waste generation	*Kg/person/year*	*2007: 370.2 2012: 329.3*	*- 11%*	+	++
		Variation rate of urban waste recovery	*Percentage*	*2011, 2012 and 2013 27%, 36% and 38%*	*Positive improvement*	++	++
	Water	Water losses variation rate	*m^3/person/year*	*Not available*	*Not available*	*N/A*	*N/A*
	Buildings and Land Use	Energy-efficient buildings variation rate	*Percentage*	*Not available*	*Not available*	*N/A*	*N/A*
		Urban density variation rate (population)	*Nº/ km^2 (2005-2010)*	*3458-3527*[5]	*+ 1.97%*	+	+
ECONOMY	*Sustainable economic growth*	Level of wealth variation rate	*eur/person*	*2003-2011 35990-45400 Euro*	*+26.1%*	++	++
		Variation rate of GDP by sectors	*Percentage*	*Pg 22 Malmo snapshot*	*A positive long-term development can be noted within business services, IT and computer consultancies, hotels and restaurants, education and commerce*	*N/A*	*N/A*

[5] http://www.scb.se/Statistik/MI/MI0810/2010A01Z/01_Localities2010_land_area_pop_density_2005_2010.xls

SUB-DIMENSION		INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
					´A downward trend can be seen within manufacturing and agriculture/forestry/fishing		
		Employment by sectors variation rate	Percentage	Pg 22 Malmo snapshot	From 09-2013 Largest were: Hotels and restaurants Law, econ, sci and tech Civil author. and defence >10% were Healthcare & social services Transport and warehouse	N/A	N/A
		Business survival variation rate	Percentage		68%	N/A	N/A
	Public Finances	Budget deficit variation rate	Percentage of city's GDP	2003=2.8% down to 1.9% in 2006 and then up to 2.8% 2011 Is equalised by tax finance	No change	++	++
		Indebtedness level variation rate	Percentage of city's GDP	2003=4-4% 2006=3.3% 2011=4.1%	No change	++	++
	Research & Innovation dynamics	R&D intensity variation rate	Percentage	Data only for 2011 for Malmo.	4.5% (2011) For Skåne: 3.6-3.3%	++	++
SOCIAL	Social Inclusion	Variation rate of unemployment level by gender	Percentage 1996-2014 2008-2014	Male / Female -5% / -4.5% +6,5 / + 4,8	Male / Female -5% / -4.5% +6,5 / + 4,8	++	++
		Variation rate of poverty level	Percentage	14%	0%		
		Variation rate of tertiary education level by gender	Percentage (2003-2012)	Men: 32%-40% Women: 34.5-44.5%	Men: 8% Women: +10%	+	+
		Variation rate of average life expectancy	Average Nº (2003-2011)	80.2-81,7	+1.5	++	++

SUB-DIMENSION	INDICATOR	UNIT/INFO	Quantity	Trend	BAU 2050	PC 2050
Public services and Infrastructures	Variation rate of green space availability	*Percentage*	*2000-2005 55-55%*	*+5%*	++	++
Governance effectiveness	Existence of monitoring system for emissions reductions	*Yes/No Description*	*Yes*		++	++

Table 16: Semi quantitative assessment of the POCACITO PCIA (Sensitivity Model) indicators

PCIA indicators	Current trend/situation	BAU	PC2050	BAU	PC 2050
Segregation of housing /inequality	Currently there are pockets of cultural segregation within Malmo, as well as	Malmo currently has projects to reduce segregation by opening up corridors to increase connectability. But this may not be enough to reduce social and cultural segregation and inequality. However, the social aspects were a prominent feature of the 2014 Comprehensive Plan for Malmö and so there is good potential for a positive outcome, with improved social spaces, meeting points and consideration of experiences and needs of people in urban planning.	Currently the PC2050 scenario also fails to adequately address segregation and the dangers of inequality.	+	+
Land use	This concerns the balance between urban development, green space and agriculture. With a high population growth there is a risk of urban sprawl.	There is some urban sprawl notable under the BAU scenario (see land use section below).	Within the PC2050 scenario there is an emphasis on the circular economy and local produce. Under the PC2050 there is assumed no urban sprawl. But there is a requirement to plan for urban gardens and agricultural space, as well as space and	+	++

			opportunities for facilities for the circular economy (for reuse, refurbishment and remanufacturing).		
Public transport and bike network	The last ten years have seen a reduction in car use and an increase in public transport, by modal balance.	Under BAU total car use is expected to rise although the overall modal balance will reduce. Bicycle use rises only 1-2%.	An increased emphasis on electric mobility could improve the transport energy outlook.	0	+

VII STRATEGY PAPER OF MILAN TOWARDS A POST-CARBON CITY

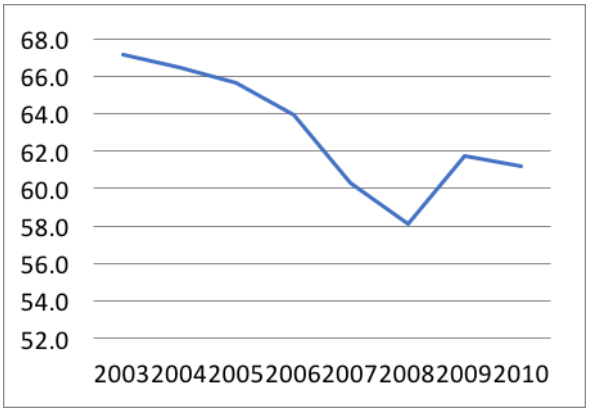
FEEM, Milan, 2016

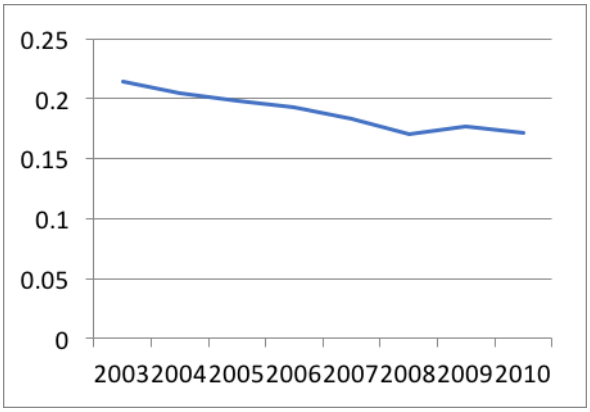
Katie Johnson, Cristina Cattaneo & Margaretha Breil, FEEM

CHALLENGES FACING THE CITY

Based on the Key Performance Indicators (KPI) analysed in at the beginning of the project (Work Package 3), and on trends derived from a comparison of indicator values from the years 2003 to 2010, Milan is currently a leading city as far as both innovation and wealth are concerned, yet progress on environmental issues is considerably lower. In terms of environmental issues and efforts towards post-carbon solutions, Milan has an advantage over most other Italian cities, yet lags far behind northern European cities, and still has much work to do to achieve average European standards. This finding is furthermore confirmed by the European City Ranking conducted for the "Soot-free for the Climate!" campaign, which ranked 17 cities located in western Europe according to nine environmental indicators, and placed Milan near the bottom, together with Rome. During the first decade of the century **energy intensity** in the province of Milan declined until 2008, which was .the growth of GDP, more than the decline in energy consumption, is responsible for the overall declining trend of the index. The largest reduction in energy intensity occurred between 2006 and 2007, with the 2007 index being 6% lower than the index in 2006. (Figure 1, left panel). In 2008 the energy intensity computed for Italy was 108.7, while the index for the Lombardia region was 93.8. Only a few regions in Italy display a lower energy intensity than Lombardia. The declining trend in energy intensity is reflected in a declining trend in **carbon intensity**. Except for the year 2009, when the index displayed an increase compared to the previous year, the index declined every year on average by 4% (Figure 1, right panel).

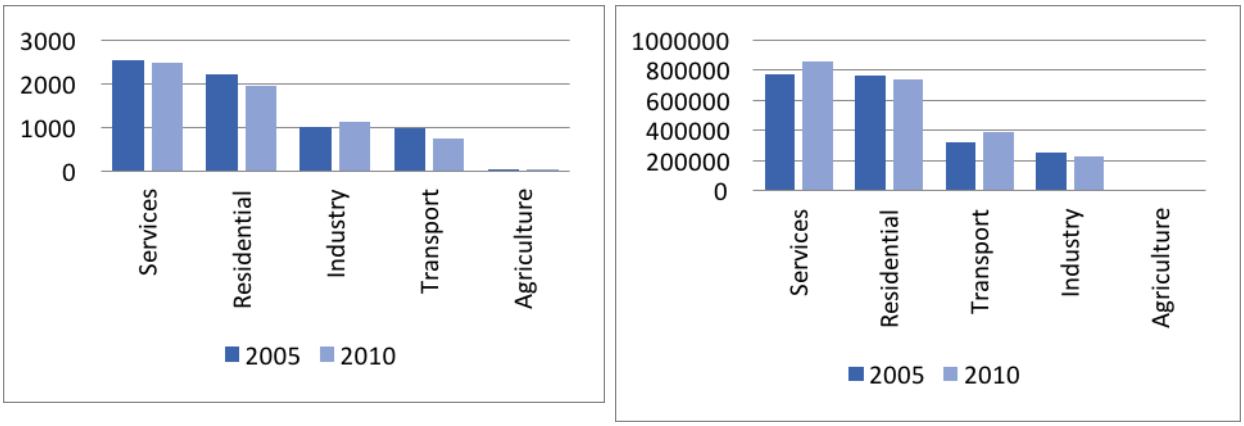
Figure 1: Energy intensity (left panel) and carbon intensity (right panel)





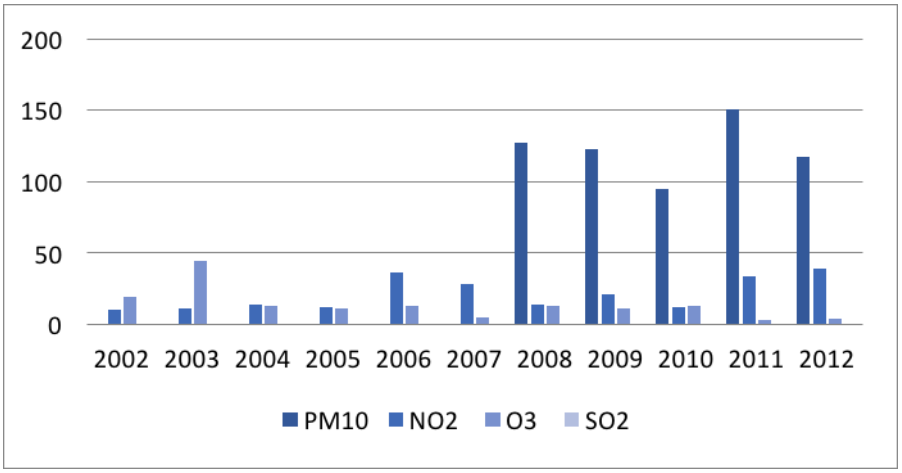
The service sector is the largest emitter of **greenhouse gases** in the city, followed by the residential, industrial, the transport and the agriculture sectors (Figure 2, left panel). All sectors except industry display lower emissions in 2010 compared to 2005. Services and residential are the sectors that contribute the most to the total energy consumption (Figure 2, right panel). While the residential sector displayed a reduction in energy consumption between 2005 and 2010, the energy consumption of the services sector grew in this period. The transport sector increased consumption between 2005 and 2010, the industry sector slightly decreased, while consumption in the agricultural sector remained constant. Services contributed to 36.6 and 38.9% of total energy consumption in 2005 and 2010, respectively. The residential sector contributed 36.1 and 33.3% in the two years respectively. Transport contributed 15.2 and 17.5; industry 12 and 10.3%. Finally agricultural share was 0.04% in both years.

Figure 2: Carbon emission in KT (left panel) and energy consumption in TOE (right panel)



Air quality in Milan is a critical issue, as the city is situated in the Po valley, where air stagnates and pollution concentrates at high levels due to the position of the Alps (Figure 3). In particular, PM10 is an issue. The concentration of PM10 exceeded the threshold limits established by Directive 2008/50/CE on 127 days in 2008. In 2009, 2010, 2011, and 2012, the numbers of days of exceedance were 123, 95, 151, and 117, respectively. Lack of a clear trend in these numbers indicates that much has still to be done to solve the problem of PM10 in Milan. Additionally, exceedance of the threshold limits for both NO2 and O3 have been registered several times over the years. Yet while the peak of exceedance for S02 traces back to 2002, the highest recorded concentration of O3 in the previous 10 years was in 2012, indicating that sources of air pollution are shifting.

Figure 3: Exceedance of air quality limit (days)

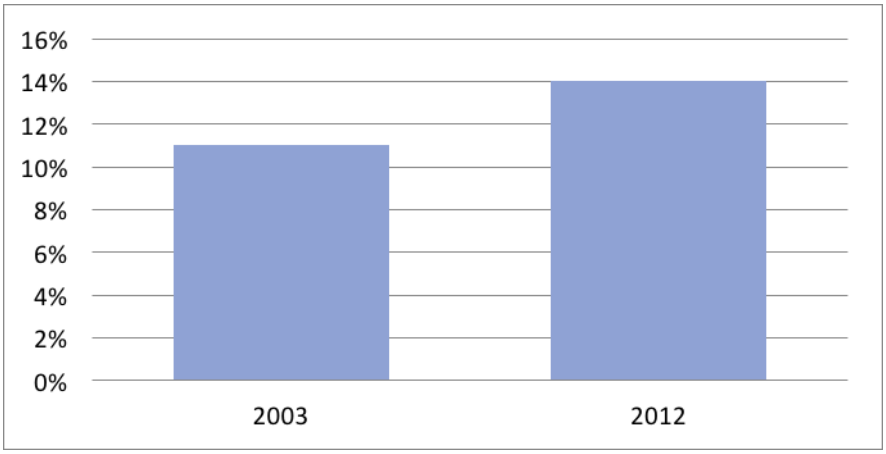


According to the most recent report on environmental quality in Italian cities, Milan ranks 78th out of 83 cities with regards to the concentration of PM 10, and 59th out of 86 cities with regards to the

number of days in which the threshold for O3 (120 µg/mc) was exceeded in 2013.[6] Recent local strategies for traffic limitations have yielded some improvements in terms of reducing PM 2.5 or PM 10; and some improvements with regards to the generation of black carbon within the LEZ zone have been observed.

Leaking water is another major issue in Milan (Figure 4). The city lost 14% of water due to leakage in 2012, and the values shown in the statistics increased between 2012 and 2014. Throughout Italy the problem is quite severe, and Milan is actually one of the Italian cities where leaks are most contained. There are cities, in particular in the southern part of Italy, where leaks represent more than 60% of total water inflows.

Figure 4: Water losses (%)



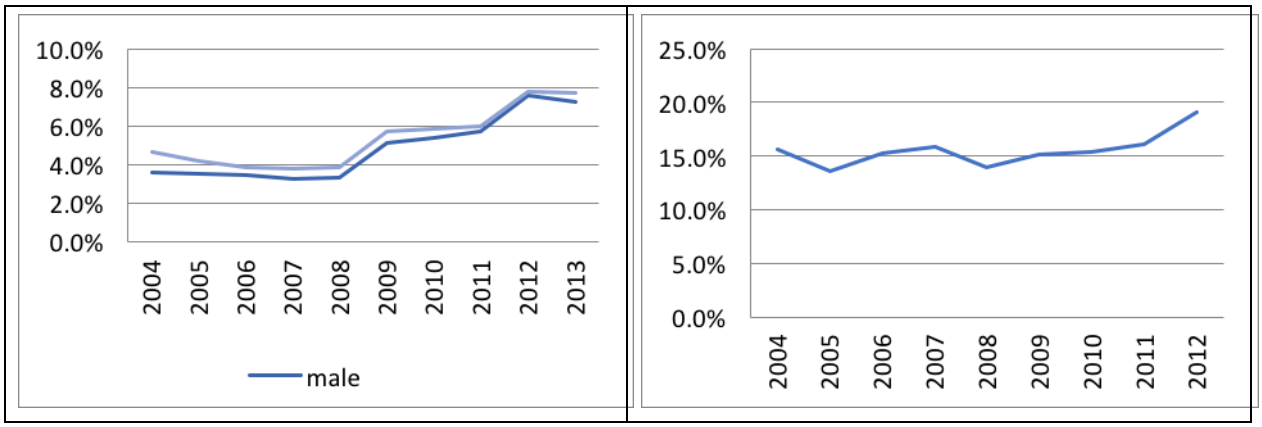
In terms of the socio-economic situation in Milan, unemployment and poverty are amongst the greatest concerns. The **unemployment** rate both for men and women has increased gradually from 2004 onward (Figure 5, left panel). Men are better off than women, even if the gender gap has decreased during this same period. In 2004, the male unemployment rate was 2.4 percentage points lower than the female rate, while in 2012 it was only 0.4 of a percentage point lower. Despite the rising trend, the unemployment rate in the province of Milan was much lower than the average national rate in Italy in 2013, when 11.5% of males and 13.1% of females were unemployed. Despite these quite high rates of unemployment, there are actually few provinces in Italy that have lower unemployment rates than the province of Milan.

The level of **poverty** has also been gradually increasing in the Lombardia region (NUTS2). From 2004 to 2008, the trend was not monotonic, with some years experiencing growth and some years experiencing a decline in the percentage of people at risk of poverty (Figure 5, right panel). However, the rate has been increasing since 2008. From 2011 to 2012, the rate displayed the largest positive growth, with the 2012 rate 3 percentage points higher than the rate in 2011. The increasing trend in poverty creates particular concern, alongside the unemployment rate, meaning that improvements in

[6] Ambiente Italia (2014) Ecosistema Urbano; XXI Rapporto sulla qualità ambientale dei comuni capoluogo di provincia, pp. 29-30.

the employment situation not necessarily contribute to a reduction of poverty rates. Although it needs to be observed that the level of poverty in the Lombardia region is low compared to the rest of Italy. The average national poverty rate was 30% in 2012, and only few regions display lower rates than in Lombardia the numbers nevertheless indicate that there is a consistent group of citizens who are not able to participate in the city's increasing wealth.

Figure 5: Unemployment rate (left panel) and people at risk of poverty in % (right panel)



DESCRIPTION OF THE STAKEHOLDER CONSULTATION WORK

A series of workshops on Milan's post-carbon transition have been conducted. These workshops were conducted following a participatory approach with a strong focus on the inclusion of stakeholders. Stakeholders participating in the meeting represented the municipal environmental agency, an energy company, the national institute of urban planning, a transport consulting firm, a regional environmental organisation, a financial development agency, and the local association of architects and planners. The first two workshops followed a three-step approach consisting of an initial assessment, and vision-building and backcasting exercises. The starting point used in the approach consists of the creation of a common view on the baseline and objectives to be established among participants. The description of the actual situation of the city was made using the common set of indicators (Silva et al., 2014), intended to assess and monitor the post-carbon city transition process. The discussion of the indicator data set with stakeholders represented the starting point for the second step, building a local vision, during which elements for a post-carbon vision were designed and discussed by stakeholders. Creative brainstorming was employed to induce stakeholders to first envision the future of their city, and then in the third step, develop qualitative scenarios describing how the ***transition*** to reach their post-carbon vision might be translated into single actions. Multiple background scenarios were proposed in order to allow for a first form of sensitivity analysis, verifying

whether the external development factors described in these scenarios would have compromised the achievement of the goals defined in the city vision.

In a first meeting, stakeholders and researchers discussed the results of the initial assessment and proceeded immediately to the building of a local vision. Combining the two, the main challenges the city is facing in terms of social, economic, and environmental indicators. Stakeholders offered their local knowledge, which added further information to what researchers had concluded from the data sources used for the initial assessment, and discussion of current strengths and weakness helped clarify what municipal competencies are and where progress can be made and is needed most. Discussions on the initial assessment furthermore served as the starting points from which the vision was projected.

Within the visioning process activated by the POCACITO Project, the vision represents the normative end point, different than the one that would be reached without specific dedicated action. Stakeholders imagined how Milan should look in 2050 as a post-carbon city. To do this, they divided into smaller groups and started to collectively draw images visualising their vision. This creative activity encouraged expressiveness and facilitated the disconnect from daily policy discourse, thereby encouraging less formal interaction. 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.

While the purpose of the first workshop was to imagine what a post-carbon future could look like, the second focused on what steps should be taken to get there. The backcasting workshop was based on the visioning process and developed the pathway from the current situation towards the post-carbon vision. Specifically, the aim was to engage stakeholders to conceive of the intermediate steps of future actions, measures and strategies for urban management in achieving the vision. The qualitative scenario was intended to reflect local challenges identified through the initial assessment of Milan.

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

During the second meeting, the vision created previously was briefly discussed again, spending some time talking about the importance of municipal decision supporting the work, and of the availability of funding for the actions proposed to meet the vision. One of the participants recalled that the city already has an extensive catalogue of projects/planned actions that would support the shift to a post-

carbon city, to be included in the roadmap[7] The discussion produced further ideas regarding actions, milestones, and obstacles.

The third stakeholder workshop was held as a combined event, together with Milan's joint case study city - Turin. The purpose of the workshop was to apply the POCACITO Critical Influences Assessment (PCIA) sensitivity model to understand the influence that different factors/variables have on each other in the cities development, and to identify specific important factors for both cities. The outcome feeds directly into the quantitative assessment, where the most important factors/areas are modelled for 2050 for two scenarios: business as usual (BAU) and Post Carbon (PC). Quantification identifies gaps between what is desired and the projected outcome so that further measures that are required to meet PC goals can be identified. The PCIA process helps to identify further measures that are necessary to achieve PC and the associated costs and benefits.

INSIGHTS FROM THE GAP ANALYSIS FOR THE CITY

The Post Carbon Scenario to 2050 (PC2050) is developed from an interpretation of the vision, action and milestones developed in the stakeholder workshops. It is therefore a judgement based on the consistency and robustness of supporting actions and on their ability to foster the desired post-carbon state. It is not a quantification of an idealistic state. Beside these assumptions, the post-carbon scenario for 2050 is built upon some general assumptions that have been made for population increase and urban change. In particular, under the PC scenario, population will increase by 665,300 (or 17.1 %). The main assumptions for the sectors' energy efficiency increases are shown in Table 1.

Table 1: Main assumption for the sectors' energy efficiency under the PC2050 scenario

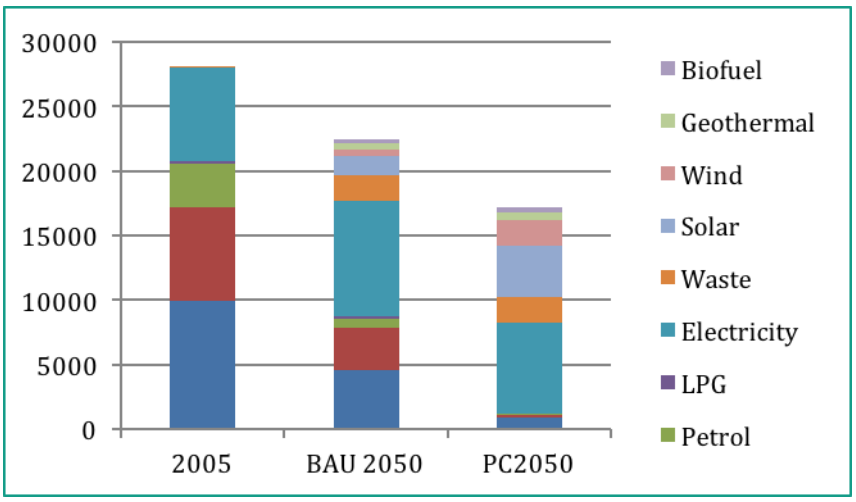
Domestic uses	31% more new people, 40% less energy use
Domestic heating	Existing buildings becomes 40% more efficiency whilst new dwellings use only 40% of energy as before
Industry and tertiary	Efficiency improves 30%
Public lighting	No change
Private transport	Private transport uses 20% of total energy and efficiency of electric cars is 60%
Public transport	10% more efficient than BAU due to focus on electric and smart technology, but requires 27% more volume

The vision, actions and milestones have been translated into actions to quantify energy, environmental, economic and social indicators. A full list of actions quantified can be found in Deliverable 5.2, while other assumptions can be found in Deliverable 5.3. These include milestones/actions in the areas of transport, housing, building, and air quality. No notable actions are quantified for water use, food and consumption, or waste. In the post-carbon vision for 2050, Milan is expected to be dense, spacious, green and rich in biodiversity, suitable for pedestrians, and uses

[7] This catalogue had already been taken into account by the POCACITO team during the initial assessment.

carbon-free transport. The energy sources are renewable, with energy-efficient technologies widely employed. People are sensitive to environmental issues and use accessible services with a low carbon footprint. The city has experienced a general change in direction from previous patterns of carbon intensive consumption and emissions. Milan has a green economy, with continuously enhancing economic, environmental, and social well-being. This success has been achieved by setting short-term goals – once one is achieved, the next goal is set, to limit costs and maintain momentum.

Figure 6: Energy Consumption in 2005 and in 2050 according to the BAU and the post-carbon scenario (GWh)

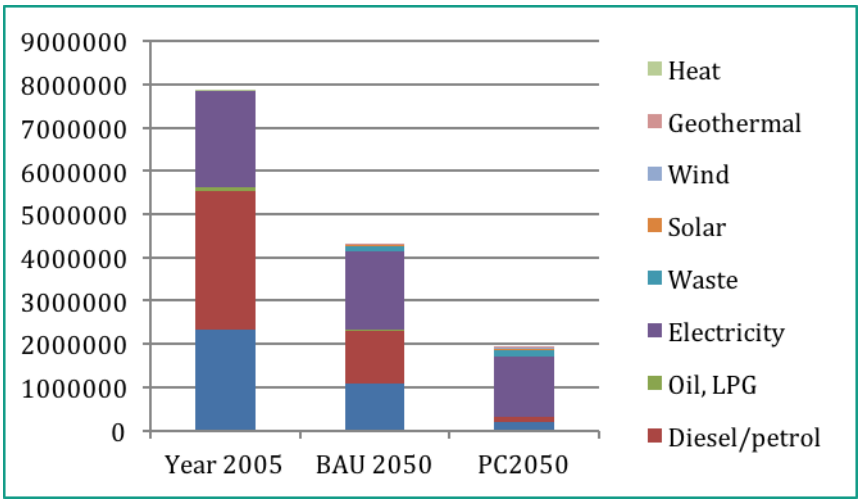


As indicated in Figure 6, these visions and actions resulted in a reduction in the overall consumption of energy of approx. 40% with respect to 2005 data and of 23% with respect to BAU (17,199 GWh in PC 2050 instead of 28,168 GWh in 2005 and 22,422 GWh under BAU) and a reduction of GHG emissions by well 76% and 56% with respect to 2005 and BAU, respectively (1,906,095 tCO_2 instead of 7,881,386 in 2005 and 4,284,609 under BAU, thanks to a more pronounced conversion to renewable energy sources like geothermal, wind, and solar energy[8] (Figure 7).

Under the PC2050 scenario all public transport is electric (or similarly low-emission) and 50% of private transport is fossil fuelled. By interpreting the actions and milestones developed in the stakeholder workshops, it seems that there is room for improvement in the development of local renewable energy. In fact, comparing the GHG emissions for 2005 and under BAU with the PC2050 scenario (Figure 7), it can be seen that the major portion of GHG emissions in PC2050 arises from the electricity (national supply).

[8] The contributions by renewable energy sources to the overall GHG emissions calculated are due to GHG emissions based on a lifecycle assessment, related to the production of transformation devices (solar panels, etc.) which correspond to approx. 3% of the overall GHG emissions in the PC Scenario.

Figure 7: GHG emissions for Milan Municipality for 2005 in 2050 according to the BaU and the Post carbon scenario (tCO_2)

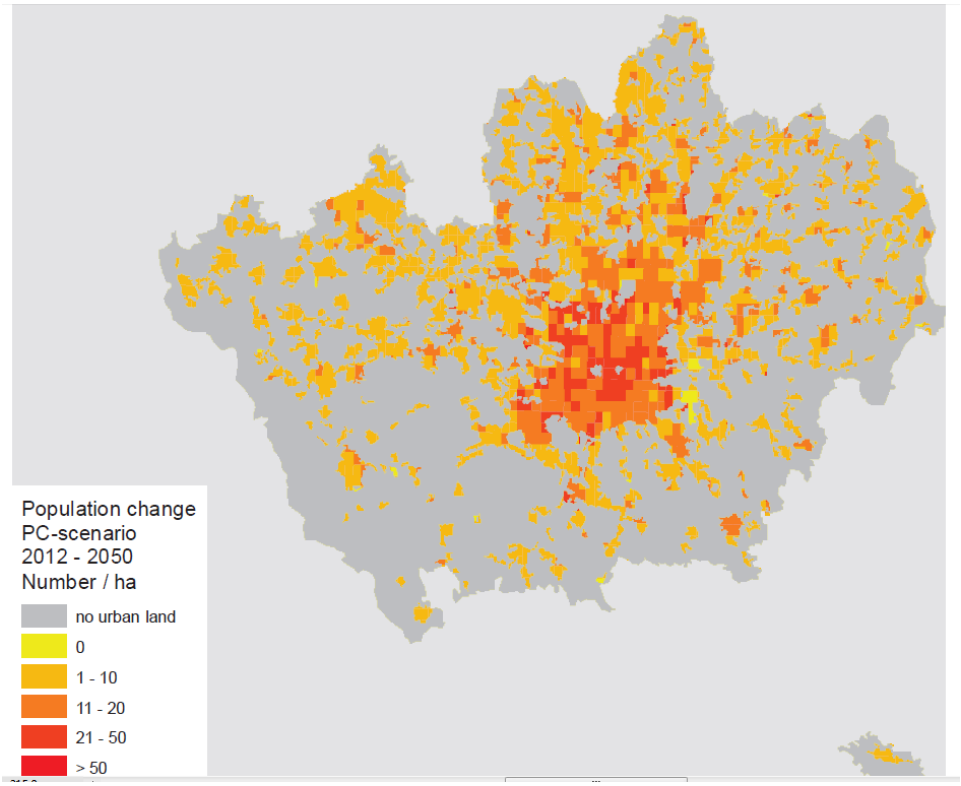


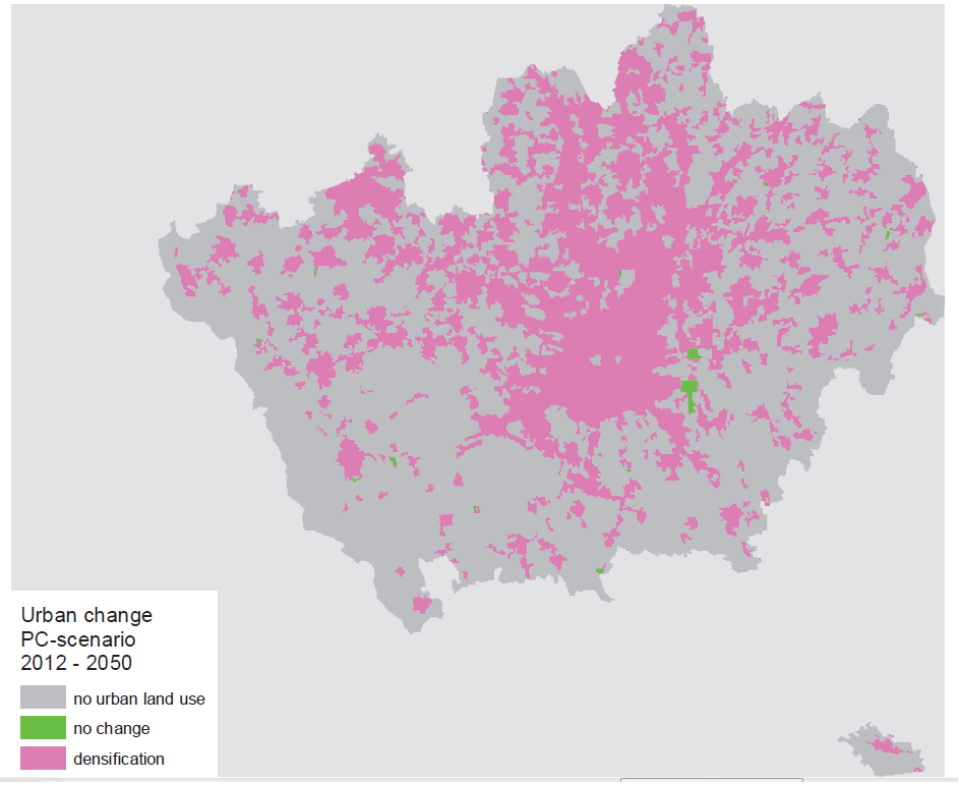
The post-carbon scenario did not only produce estimates of energy consumption and GHS emission, but also for spatial development in the Province of Milan. Within the post-carbon scenario, the estimated population increase for the PC scenario is assumed to take place exclusively within areas that are already urbanised, as one assumption of the post-carbon scenario is that population increase would not result in urban spread, but only lead to densification. No de-densification would occur. Table 2 summarises results from the historical and the scenario analyses in more detail. Results are shown as change in km^2 of urbanised land and in population numbers for existing areas which remain unchanged, for expansion areas (urban spread) and for areas which would undergo further densification. Observations for the period from 2000 to 2012 show mixed trends: while urban spread is ongoing, also some existing urban areas experience population growth, resulting in densification, and other areas lose population resulting in 'de-densification'. For the PC 2050 scenario, densification tendencies will be most significant for central zones, but will involve, to some extent, all areas that are urbanised at present, except areas under environmental protection.

Table 2: Spatial extension and changes in population densities under the PC2050 scenario

	Change 2000-2012		BAU scenario		PC scenario	
Type of urban change	**km²**	**population**	**km²**	**population**	km²	population
Urban spread	61.0	190,267	40.4	126,094	0	0
Urban no change	107.2	0	117.4	0	5	0
Population densification	396.0	1,231,740	432.7	609,981	710.4	665,255
Population de-densification	151.2	-1,106,862	165.3	-526,632	0	0
Non-urban	-61.0	0	-40.4	0	0	0
Total population		**315,145**		**209,443**		**665,255**
Total urbanised area	**715.4**		**755.7**		**715.4**	

Figure 8: Changes 2012 - 2050 Scenario PC for population density (above) and land use change (below)





According to the Gap Analysis carried out in Work Package 5, the most prominent gaps that remain for Milan under the proposed PC2050 scenario are as follows:

Energy

The projected per capita GHG emissions for PC2050 are low by current standards, but the current gaps in actions result in total emissions of 1.9 million tCO_2e per year. The main cause of this is the inadequate supply of local renewable energy and a reliance on national grid supplied electricity (a large portion of which is still projected to be based on fossil fuels in 2050).

Under the current PC2050, renewable energy should reach 8.962 GWh (or be just under 7000 GWh, if energy generation from waste is not included). To further remove the reliance on grid electricity, an additional 7000 GWh would need to be supplied with renewable energy, using local off-grid solutions like, for example, co-generation. However, given that a city like Milan relies on the national energy generation to meet its entire energy needs, changes in the national energy generation system will be necessary to further reduce GHG emissions.

It is also true that the role of increased energy efficiency should not be ignored in further reducing overall energy use. There is more potential to reduce energy use in the residential and services sectors.

Social

There is some concern regarding the poverty level, which has increased to a very high 21%. As this is still a level that is well below the national average, stakeholders were initially not aware about this problem in Milan. The argument entered the discussion because poverty levels in Turin are higher, in a situation of less economic growth. This indicates that, despite the city's economic growth, the problem will continue to cause concern, and should be addressed in a vision for a post-carbon Milan.

Urban sprawl

Under BAU urban sprawl is projected to increase by 40.4 km^2 due to a population increase of 315,000. Currently, the potential for urban sprawl and increased densification is not adequately addressed within the PC2050 scenario. With a projected increase of 665,300 people by 2050 under PC2050 (due to the assumption of densification of the city), there is still a need for a clear series of milestones and strategies to ensure that urban sprawl is contained. This also has ramifications for energy use, infrastructure investment, and transport.

Circular economy and lifestyles

The potential for improvements in the impact of consumption are not well addressed in the PC2050 scenario. Options for improving consumption patterns in the post-carbon transition include increasing the number of facilities for reuse (e.g. through provision of locations to leave unwanted goods for reuse) and repair (such as repair cafes), as well as supporting businesses and innovation in this area.

Some further gaps emerge looking at the indicators developed within the initial assessment made for Milan in the early phase of POCACITO. Based on these indicators, a semi-quantitative and qualitative assessment of how Milan performs under both BaU and PC2050 is developed (Table 4).

The qualitative assessment is indicated by both a colour and simple scoring system with green and "++" indicating a very likely positive performance and improvement. Whilst red and "--" indicate a very poor or negative performance, as shown in the Table 3 below.

Table 3: Legend for scoring

+	Likely very positive
+	Likely progress
0	Likely neutral or similar to current situation
-	Likely negative
--	Likely very negative

Table 4: Semi-quantitative assessment of the POCACITO KPI's under BAU and PC2050 for Milan

ENVIRONMENT	Biodiversity	Variation rate of ecosystem protected areas	0	+
	Energy	Energy intensity variation rate	+	++
		Variation rate of energy consumption by sectors	N/a	N/a
	Climate and Air	Variation rate of carbon emissions intensity	+	+

	Quality	Carbon intensity per person	+	++
		Variation rate of carbon emissions by sector	N/a	N/a
		Exceedance rate of air quality limit values	+	++
	Transport and mobility	Variation share of sustainable transportation	+	++
	Waste	Variation rate of urban waste generation	+	+
		Variation rate of urban waste recovery	+	+
	Water	Water losses variation rate	-	-
	Buildings and Land Use	Energy-efficient buildings variation rate	0	++
		Urban density variation rate (population)		+
ECONOMY	Sustainable economic growth	Level of wealth variation rate	++	++
		Variation rate of GDP by sectors	N/a	N/a
		Employment by sectors variation rate	N/a	N/a
		Business survival variation rate	N/a	N/a
	Public Finances	Budget deficit variation rate	N/a	N/a
		Indebtedness level variation rate	++	++
	Research & Innovation dynamics	R&D intensity variation rate	+	+
	Social Inclusion	Variation rate of unemployment level by gender	-	+
		Variation rate of poverty level	-	-
		Variation rate of tertiary education level by gender	++	++
SOCIAL		Variation rate of average life expectancy	++	++
	Public services and Infrastructures	Variation rate of green space availability	0	+
	Governance effectiveness	Existence of monitoring system for emissions reductions	++	++

Workshop 4 provided an opportunity for stakeholders to reassess and amend the list of proposed actions and milestones in achieving a post-carbon transition to address the gaps described herein.

A STAKEHOLDER VISION FOR THE CITY

The post-carbon vision for Milan is an output from the first stakeholder workshop, which covers a wide range of issues. Because of the long timeframe, the vision is rather holistic and explorative. The

2050 post-carbon vision for Milan sees a city that is dense, spacious, green and rich in biodiversity, suitable for pedestrians, and uses carbon-free transport. The energy sources are renewable, with energy-efficient technologies employed. In Milan, people are sensitive to environmental issues and use accessible services with a low carbon footprint. The city has experienced a general change in direction from previous patterns of carbon-intensive consumption and emissions. Milan has a green economy, with continuously improving economic, environmental, and social well-being. This success has been achieved by setting short-term goals – once one is achieved, the next goal is set, to limit costs and maintain momentum.

The six primary sectors identified in the 2050 vision for Milan include social issues, mobility and transport, environment, land use, energy, and innovation and technology:

SOCIAL ISSUES

- Sensitive to environmental and energy issues, where citizens have reached a high awareness of their consumption and behaviour
- Services nearby, with greater reach and usability
- Participative city society that is open to the world and thereby richer
- More liveable city for all

MOBILITY AND TRANSPORT

- 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

ENVIRONMENT

- Reuse and recycling of materials
- Endowment of green space, which helps to create a micro-climate that reduces the heat island effect; green is integrated into the urban fabric and connects to the territory
- Rich in biodiversity

LAND USE

- Dense, spacious, and highly populated city
- More permeable surfaces

ENERGY

- Very high energy efficiency
- Energy needed for the city to function is produced from renewable sources
- Low energy buildings, in the direction of the passive house
- Many buildings able to produce energy feed it back into the system through the smart grid

INNOVATION AND TECHNOLOGY

- Integrated technology systems and networks that clearly and effectively support all aspects of daily life; promote telecommuting, access to services, and reduce the need to travel
- Milan / Turin drivers of innovation

ACHIEVING THE VISION

Milestones and actions proposed during the second stakeholder workshops,[9] as related to transport, energy, social issues, and consumption include:

TRANSPORT MILESTONES	TIMEFRAME	STARTEGY TOWARDS MILESONE
Integration, connection, multimodality		
Creation of an integrated public transport system	2030	Create a new policy framework with incentives, parking and congestion implications, and modal shift
		Make sustainable accessibility to new areas of urban transformation
		Make the parking system more efficient
		Organise and develop the logistics of the last mile for the distribution of goods in the city
		Overcome barriers and make the city more accessible for everyone
		Promote the development of a new urban freight logistics.
		Rationalise the use of motor vehicles, i.e. Area C sharing systems and smart solutions
		Urban car park programme
		Urban traffic plan
		Enact road pricing to support more efficient distribution of goods within the city

[9] See Report on Stakeholder Workshops, POCACITO Deliverable 4.2, available at http://pocacito.eu/content/report-stakeholder-workshops

		Develop informatics infrastructure including smart stops and smart times for public transportation on busses, trains, and trams
Changes in transport Infrastructures		
A more widespread network of public transport, including extension of the circular lines to connect outlying areas.	2050	Create park and ride parking lots
		Enhance rail service
		Raise levels of security, spreading pedestrian areas and environmental islands
		Set a vision for the subway system
		Create pedestrian areas in the periphery of the city, especially to link the centre to surrounding suburbs
		Develop infrastructure for public transport
		Limit car use through extension of pedestrian areas, speed limit zones, parking payment
		Facilitate and support cycling. Create bike, also electric bike, sharing projects to provide alternative options to taking one's own car
		Extend road pricing to encourage use of public transport and discourage private car use
		Make preferential lanes for people who are carpooling
Quality of public transport		
Public transport becomes faster and less expensive than private transport	2020	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
		Triennial programme of local public transport services
		Strengthen and make public transport services more efficient, and encourage sustainable mobility (e.g. bicycle, electric, car sharing) (PAES)
CO2 free transport		
All (or a certain percentage of) cars are electric	2030	Marketing and communication, and education and awareness-raising on the benefits of electric vehicles
		Create incentives for buying electric rather than gasoline-fuelled vehicles
		Substitute municipal vehicle fleets with new ones that use clean technologies
There are a sufficient number of electric car charging points inside and outside the city	2020	Increase number of charging points for electric cars

Electric transport used for the distribution of a certain percentage of goods throughout and within the city	2020	No specific measures have been indicated
10% transport consumption met by renewable energy	2020	-

ENERGY MILESTONES	TIMEFRAME	STARTEGY TOWARDS MILESONE
Reform of energy generation and distribution		
17% final consumption of energy through renewable sources	2020	Promote and encourage the use of solar thermal, photovoltaics and geothermal heat pumps (PAES)
The city is using more renewable energy than carbon energy sources	2030	
The number or percentage of households or the city connected to the district heating/cooling network can be used to measure progress	2050	Build smart grids
		Develop decentralised system of power/heating/cooling plants
		Develop new technologically innovative applications that will support co-generation and tri-generation
		Create a co-generation (heat and electricity produced from same energy source) network to use excess heat from industry to heat residential/commercial properties through the district heating/cooling network
		Create micro tri-generation (heating, cooling, and energy production) plants as pilot projects for big public and private energy users (hospitals, schools, etc.)
Overall Concepts and plans, improvements of energy performance		
Goals for emission reduction reached in time (PAES target: 20% by 2020, compared to the baseline year 2005)	2020	Identify necessary regulations, incentives, and training in order to trigger actions for energy improvement and the reduction of electricity consumption and emissions in the business sector (PAES)
		Give incentives for carbon-free energy production and consumption
		Set electric energy standards
20% final consumption met with renewable sources (use electrical, thermal and transport)	2020	Communicate the economic benefits derived from equipment conversion toward district heating, heat pumps, and solar and thermal energy
20% reduction in	2020	Measures of energy recovery from the integrated water cycle

ENERGY MILESTONES	TIMEFRAME	STARTEGY TOWARDS MILESONE
consumption of primary sources compared to the forecast trend, by increasing efficiency		using heat pumps to heat buildings near (or in) industrial wastewater treatment plants
		Power public lighting with lost energy consumption
13% reduction in GHG emissions in non-ETS sectors compared to 2005	2020	No specific measures proposed
Energy efficient/energy producing buildings		
Overall national energy savings of 9.6% by 2016 in accordance with the National Action Plan for Energy Efficiency (*Piano d'Azione Nazionale per l'Efficienza Energetica – PAEE*)	2020	Create regulations for increasing energy efficiency for buildings taking into account characteristics of existing buildings
		Develop smart infrastructure and buildings to consume less energy
		Identify regulatory measures, create incentives, and train citizens to reduce electricity consumption and emissions in public and private buildings (PAES)
		Create a network for district heating and cooling
One hundred percent of new buildings are zero energy or carbon neutral	2030	-

LAND USE MILESTONES	TIMEFRAME	STARTEGY TOWARDS MILESONE
Quality of the urban environment		
The number of parks opened, percentage of permeable surfaces, and waterways re-opened increase	2020	Re-open some of the city's waterways
		Increase the concentration of production/industrial areas and structures, as this allows for better organisation of transport logistics
		Rehabilitate deprived areas by creating eco-districts
Acoustic classification of the Territory (*Classificazione acustica del Territorio – Zonizzazione acustica*): safeguard areas not yet hit by noise pollution, and identify areas that require recovery plans because detectable acoustic levels exceed the limits identified to risk to public health	2020	Acoustic classification of the territory
Pedestrian areas in the	2020	Construct 'green mile'

periphery of the city, especially to link the centre to surrounding suburbs (make sub-centres in the periphery more attractive)		

SOCIAL MILESTONES	TIMEFRAME	STARTEGY TOWARDS MILESONE
Citizens change their lifestyles and become more sensitive	2030	Educate citizens on their role and responsibilities as 'members' of the city

CONSUMPTION MILESTONES	TIMEFRAME	STARTEGY TOWARDS MILESONE
High percentage of waste reduced and high percentage of materials recycled	2020	Increase waste sorting (PAES). Make the separation of waste and recyclables more user-friendly and more efficient
		If waste cannot be prevented, it should be reused or prepared for reuse, recycled, incinerated with energy recovery, or disposed of in landfill, if no other option is available (EU Waste Framework Directive)
Effective waste management	2020	Increase the efficient energy recovery of residual waste (PAES). 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 (e.g. paper)

Milestones and actions modelled in the quantification of PC2050 (as noted in Deliverable 5.2) include:

ELEMENT	ACTIONS & MILESTONES FROM PC2050
Transport	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 Carbon-free integrated transport systems Public transport faster, cheaper and more convenient than private transport Creation of an integrated public transport system A more widespread network of public transport, including extension of the circular lines to connect outlying areas Bike network – bike sharing Smart park and ride facilities

	New urban freight logistics Extend road pricing to encourage use of public transport and discourage private car use Electric cars Substitute municipal vehicle fleets with new ones that use clean technologies Add more electric car charging points (serviced by renewably produced energy)
Housing	Low-energy buildings, in the direction of the passive house District heating and cooling with renewable energy sources for all households
Building	High energy efficiency Energy needed for the city to function is produced from renewable sources Low-energy buildings, in the direction of the passive house Many buildings able to produce energy to feed it back into the system through the smart grid District heating and cooling with renewable energy sources for all households Linked with CHP network with industry so that waste heat is utilised Micro tri-generation (heating, cooling, and energy production) plants as pilot projects for big public and private energy users (hospitals, schools, etc.) Measures of energy recovery from the integrated water cycle using heat pumps to heat buildings near (or in) industrial wastewater treatment plants Goal of 100% of new buildings are zero energy or carbon neutral

ASSESSMENT OF NEEDS

The stakeholders discussed the assessment of gaps in relation to the planned actions presented by the POCACITO researchers and confronted them with the current status and ongoing trends in Milan. They concluded that several aspects of Milan's post-carbon development require further consideration. In particular, they highlighted the need to:

- Increase the supply of local renewable energy and decrease the reliance on national grid supplied electricity;
- Increase energy efficiency;
- Reduce social inequality;
- Limit urban sprawl and address implications for energy use, infrastructure investment, and transport;
- Improve consumption habits and the impacts of consumption; and
- Decrease water losses.

In the fourth workshop, held jointly with representatives from Turin, stakeholders analysed the results from the quantification of the PC2050 scenarios to assess these remaining needs. The main conclusion for Milan was that the biggest gap in terms of the use of renewable energy is attributable to the use of electricity from the national grid, considering that the major gap in relation to CO_2 emissions calculated corresponded to the emissions from energy generation for the national grid and

consumed inside Milan. Stakeholders determined that a solution would require political competencies beyond the municipal level. Addressing this issue of renewable energy requires national policies of de-carbonisation, which can take advantage of the potential of innovation developed in recent years. Furthermore, stakeholders noted that ambition and concrete investments can continue to support the trend towards a higher share of renewable energy, also within the city.

In relation to the necessary investments, legislation and fiscal security is needed in the medium to long term, which is currently discouraged by frequent regulatory changes. A financial security mechanism for the duration of capital depreciation is needed, for example regulations for installations for the use of the geothermal energy. In the case of Italy, this assurance has not always existed, as with subsidies for photovoltaic systems. A second issue brought forward by participants is related to the need for proper resources related as a basic condition for autonomous local de-carbonisation policies. Beyond the legal and fiscal security of investments used for the implementation of local policies for de-carbonisation, there is indeed a need for human resources to create projects, follow their implementation, and monitor their actual effectiveness. Currently, Italian municipalities are not able to devote the necessary resources to these tasks. Some stakeholders even expressed doubt about the effective local capacities for implementing local plans for energy-saving projects due to lack of personnel to drive the implementation or mainstreaming of these plans.

In a period where local authorities struggle to maintain essential local services, the implementation of de-carbonisation projects suffers from a lack of resources and long-term perspectives. The stakeholders call on the European Commission for European strategies to safeguard local authorities' autonomy and allow the implementation of autonomous local policies.

The implementation of a **carbon tax** might provide local authorities with such targeted financial resources, provided that the implementation follows principles of transparency, communication and monitoring of resources, to ensure their re-use for de-carbonisation strategies.

Besides these national level measures needed to realise a complete de-carbonisation by 2050, stakeholders identified some further strategic measures to be implemented at the city level. For example, an important measure that has been discussed is the complete ban of cars that use fossil fuels by 2025. This measure is actually under discussion in Norway.

Stakeholders did not identify any new measures for energy generation strategies for Milan or Turin.

With regards to the issues connected to urban sprawl at the expense of agricultural or natural areas, stakeholders discussed the potential efficiency of measures already in place, such as maintaining fixed definitions of expanding areas in master plans of municipalities. Stakeholders agreed that Milan's growth period was over and as a consequence the need for new buildings could be satisfied by replacing existing underused buildings and using internal derelict areas. The use of existing areas was also connected, in the discussion among stakeholders, with the creation of new spaces for new enterprises closing links in the circular economy; this was seen at the same time as a potential measure for social inclusion, as recycling initiatives are already now frequently connected to the third sector and provides occupation for less qualified persons. Stabilising these initiatives by providing them with public support and space was seen as a cross-cutting measure to promote the circular

economy by re-using underused areas in the city and reducing social exclusion and urban poverty. Most measures and strategies supporting a post-carbon transition under the themes of urban society, sprawl, and circular economy and lifestyles that were discussed potentially serve more than one of the gaps identified, especially those related to circular economy and lifestyles which would, at the same time, serve also for closing social gaps, promoting social and spatial inclusion:

MILESTONE	STRATEGY TOWARDS MILESTONE
Improved access to new technologies, to create knowledge and reduce the generational gap and the gap between social groups	Implement open data structures, infrastructures and networks, and open innovation
Urban regeneration projects	Economic development, reduce social inequalities, balance environment and urban design, stop soil consumption
Eliminate food waste	Agricultural policies for food security

Urban society

- Cohesion - besides increased interaction between public and private spheres, expand the space of the third sector in urban areas (with organisational interventions and the provision of physical and virtual spaces); this would enlarge spaces for circular economy, creating physical and logistic spaces for new economic activities, and new occupation;
- The accessibility to networks, services and goods – creating new networks for sharing resources and opportunities ; would provide the infrastructure for a circular economy and
- Equitability – support for the weaker sections of society in the participation and access to the energy reduction tools (i.e. purchases and investment in energy efficiency and renewable energies supporting the necessary investment for low income households).

Circular economy and lifestyles

- The aim is to obtain a more continuous circular economy chain to facilitate the connection and the relationship between 'supply and demand' – extend the use of existing elements (e.g. via used market, sales and recycling of used items, etc.) and create physical space (at the neighbourhood level) and economic space (by eliminating obstacles in this sector and for small professionals) for the exchange of goods and non-professional services: further to the measures mentioned in relation to social inclusion and a more inclusive urban society,
    - Facilitate and support the bureaucracy of processes with the aim of facilitating exchange and new economic activities in this sector;
    - Promote access and the relationship between supply and the offering of second-hand goods by creating physical and logistic spaces for exchange for both professional and non-professional services and
    - Make the management of start-up of activities and professions less bureaucratic.

Urban sprawl

Stakeholders agreed that the city's expansion phase has come to an end and the increase in population of more than 600,000 people (as proposed in the POCACITO Post Carbon Scenario in 2050) seems unrealistic given the low birth rate and the expected trend in immigration in the city. However, some considerations on strategies to be enforced for avoiding further urban sprawl were made with the aim of supporting planning policies for 'zero' consumption of land for urban expansion in the territory;

- Analyse existing urban plans and currently unused existing building volumes to be exploited and
- Encourage urban regeneration in building replacement creating spaces also for new economic activities, for instance promoting activities for a circular economy.

VIII STRATEGY PAPER OF TURIN TOWARDS A POST-CARBON CITY

POLITECNICO DI TORINO, Turin, June 2016

Patrizia Lombardi & Luca Staricco, Politecnico di Torino

CHALLENGES FACING THE CITY

The present economic crisis has hit the city of Turin and its metropolitan area very hard, mainly because of the persistent strong specialisation in the industrial sector: since 2008 GDP has decreased and unemployment has increased; at the same time, Piedmont is the Italian region which invests the largest share of its GDP in R&D. Social inclusion must deal with severe problems: the stock of debt is high (with consequent difficulties in granting services for population), 20 people out of 100 being at risk of poverty. From the environmental point of view, the city offers a relevant share of green areas, some of them are natural reserves; but air quality is still very poor, and it is improving too slowly, and energy efficiency of buildings must be enhanced.

Table 11 summarises the global trends for each key performance indicator (KPI) analysed by the project in the *initial assessment document* (Nov. 2015) using statistics from the city and wider region. In red are the indicators in which Turin records a negative trend, green for positive; overall Turin's trends are all in line with a post-carbon city trend.

Table 17: Summary of KPI's global trends

Dimension	*Sub-dimension*	*INDICATOR*	*Year*	*Trend*
SOCIAL	*Social Inclusion*	Variation rate of unemployment level by gender	*2004-2013*	↗
		Variation rate of poverty level	*2004-2012*	↗
		Variation rate of tertiary education level by gender	*2004-2013*	↗
		Variation rate of average life expectancy	*2003-2012*	↗
	Public services and infrastructures	Variation rate of green space availability	*2000-2009*	↗
	Governance effectiveness	Existence of monitoring system for emissions reductions	*N/A*	*yes*
ENVIRONMENT AND CLIMATE	*Biodiversity*	Variation rate of ecosystem protected areas	*2008-2011*	=
	Energy	Energy intensity variation rate	*2002-2011*	↘

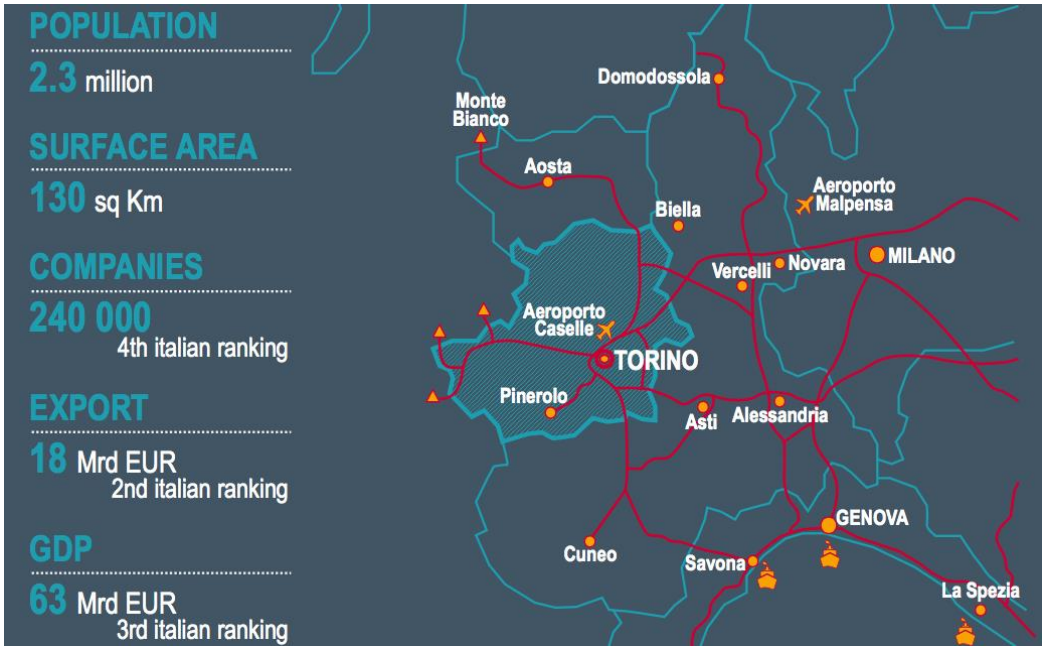
Dimension	Sub-dimension	INDICATOR	Year	Trend
ECONOMY	Climate and Air Quality	Variation rate of energy consumption by sectors	2003-2011	↘
		Variation rate of carbon emissions intensity	2002-2011	↘
		Variation rate of carbon emissions by sector	2002-2011	↘
		Exceedance rate of air quality limit values	2004-2013	↘
	Transport and mobility	Variation share of sustainable transportation	1998-2013	=
	Waste	Variation rate of urban waste generation	2002-2012	↘
		Variation rate of urban waste recovery	2002-2012	↗
	Water	Water losses variation rate	2003-2012	↘
	Buildings and Land Use	Energy-efficient buildings variation rate	2014	n/a
		Urban building density variation rate	2001-2011	↘
	Sustainable economic growth	Level of wealth variation rate	2002-2011	↗
	Public Finances	Indebtedness level variation rate	2007-2013	↘
	R & I dynamics	R&D intensity variation rate	2003-2011	↗

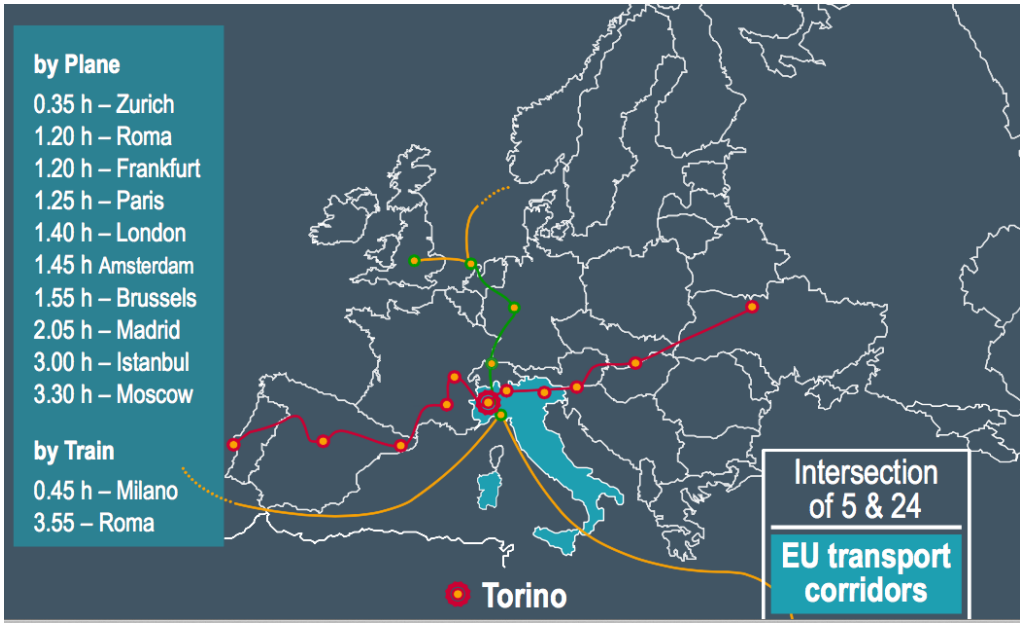
Source: Turin Initial Assessment (D.3.2).

The population of Turin fell between 1970 and 2000 from 1.2 million inhabitants to about 900,000 inhabitants. In the last 15 years it has been stable despite a negative birth rate, thanks to the migration rate: foreign-born immigrants are now 15% of the whole population (most of them come from Romania, 39%, and Morocco, 14%), and their integration represents a significant goal. Inhabitants aged 65 or older are 25% of the total population, while only 13% of the whole population is aged 15 or less: ageing is another key challenge for this area.

Formerly a typical 'one-company town' focused on the automotive sector, in the last 20 years Turin has greatly diversified its economy; it has maintained its industrial specialisation, but at the same time it has increased its role as a cultural and tourist attraction in Italy. The industrial sector contribution decreased between 2000 and 2011 from 30% to 25%, but it is still the most relevant in Italy. The city has hosted the Winter Olympic Games in 2006, valorised its artistic heritage (in particular baroque monuments, and XIX century urban buildings when Turin was the first administrative capital of the unified Italian Kingdom), increased its centrality as an international pole in contemporary arts. It hosts several fairs and events on food, books, arts. Moreover, Piedmont is the region with the largest percentage of GDP used to finance R&D in Italy, namely 1.88 in 2011. Despite these efforts, the metropolitan area has suffered the severe impacts of the global crisis of 2008. The weight of the province of Turin's GDP on the national GDP is now 4.3%, it was 4.7% in 1996. The 'new' economic specialisation of the city is not yet sufficient to compensate the decreasing role of industry: for

example, considering the European 'premier league' cities in the *Benchmarking report 2013-14* by the European cities marketing (i.e. 44 major European cities, having at least 1.5 million bednights per year), Turin shows the greatest growth index of international visitors in the period 2009-13, but in terms of density (tourists per inhabitants) the city is still in the last position of the ranking.





From a social point of view, the unemployment rate in Turin slightly decreased from 2004 to 2006, then gradually increased to 11.1% for males and 11.7% for females: these are very high values, similar to those of most cities in southern Italy. The gender gap dropped from 2.3 percentage points in 2004 to 0.6 points in 2013. Among young people, the unemployment rate reaches almost 50%. Between

2008 and 2012, the average income decreased by 15.7%. The level of poverty in Piedmont was quite stable from 2004 to 2009, then increased over 20%: in 2012 21% of people were at risk of poverty.

As regards energy consumption, between 2002 and 2011 it declined in the province of Turin by 13%, while GDP increased by 20%. The decreasing weight of the industrial sector in the local economy is the main cause of the increasing efficiency in energy consumption: energy consumption increased in agriculture (+18%) and in the tertiary sector (+14%), remained stable for the residential sector and decreased in industry (-32%) and transport (-16%). The declining trend in energy intensity is reflected in a declining trend in carbon intensity: between 2002 and 2011, emissions were reduced by 21%, but because of the contemporary growth of GDP, carbon intensity in the same years decreased by one third. One major challenge is atmospheric pollution, also because of Turin's position in the Po valleys, where air stagnates because of the Alps and pollution concentrates at a high level. Air quality is generally improving, but the situation is still critical: during 2013, 126 days (instead of 35) were detected in which the concentration of PM10 exceeded the threshold limits established by the Directive 2008/50/CE; the days were 31 (instead of 18) for N02 and 38 (instead of 25) for O3 (in this case, calculated as the average of the last three years). According to the European Airbase, Turin is one of the most polluted great cities in Europe; according to Ecosistema Urbano, Turin ranks 81 out of 83 cities considered with regards to the concentration of PM 10, 81 out of 82 for NO2, and 69 out of 86 for O3.

Finally, probably the most difficult challenge for the city, and for its ability to solve the above-mentioned problems, is its indebtedness level: the stock of debt of the municipality of Turin is the highest in Italy per person (over 3.500 euros per inhabitant) and the second after Milan in absolute terms, nearly €3.500 million.

DESCRIPTION OF THE STAKEHOLDER CONSULTATION WORK

According to the general methodology defined in the project, four workshops were organised to involve local stakeholders in drawing up a roadmap toward a post-carbon Turin.

The first workshop included both the presentation of the initial assessment results, and the definition of the 2050 post-carbon vision for Turin (in its relations with Milan). The results of the Initial assessment for Milan and Turin were illustrated through a Powerpoint and participants' feedback was gathered. Data were agreed; some stakeholders suggested to integrate them with further indicators about demographic trends (as they can have major impacts on carbon consumption patterns), presence and investments of multination companies, and passenger journeys between Milan and Turin. The vision-building exercise was implemented according to the three envisaged phases: 1) drawing, 2) identifying key words describing drawings, 3) structuring them in mental maps. Participants were split into three groups; each group was asked to turn around three tables to interact with other groups' work. Afterwards, each group tried to interpret and describe the three final drawings through key words; these key words were then structured in mental maps, according to main themes (described in the next paragraph) that were chosen by each group autonomously. One member of each group orally illustrated to the others the vision schematised through the mental

map, and the three visions were collectively discussed. Finally, the FEEM member illustrated the vision that emerged in the previous workshop 1 held in Milan. In term of results, it should be noted that the final vision is mainly focused on socioeconomic issues, while environmental aspects have been quite neglected; in particular, energy themes were not considered as fundamental by the workshop participants in building the vision of a *post-carbon* city. A short-medium term vision was predominant, and stakeholders seemed to have a hard time imagining how the city should be in 35 years' time.

The second workshop aimed to identify obstacles, milestones and actions in the road towards the vision, as the normative desired end point. SSP scenarios were illustrated, with a main focus on the 'middle of the road' SSP2 (which was chosen as the background reference scenario) and the two alternative scenarios (the 'sustainability' SSP1 and the 'fragmentation' SSP3) for the sensitivity analysis. Participants were split into two groups, and asked to make a list of obstacles and opportunities until 2050 in achieving the vision. The members of the groups discussed their ideas and wrote them down on post-its; then, one member from each group described to the other the proposed obstacles and opportunities, and placed them on a drawn timeline. The same approach was used for milestones and actions: participants discussed them, wrote them down on post-its, then pinned them on a timeline. The final step was the robustness check: stakeholders were asked to assess if the proposed pathway would work – or need changes – also under the two alternative scenarios.

The third workshop was aimed to apply the POCACITO Critical Influences Assessment (PCIA) sensitivity model to understand the influence that different factors/variables have on each other in the cities development, and to identify specific important factors for the evolution toward a post-carbon status. It was organised as an 'integrated' Turin-Milan workshop: it was held in Turin but stakeholders were invited from both Turin and Milan, so to have a 'mutual learning process' in defining the Impact Matrix. The PCIA methodology was described to the participants. Then the preliminary variable set built by the city case study coordinators in the pre-workshop phase was illustrated; participants were randomly split into three groups and asked to discuss this set and to select the ten variables they considered most important to describe the integrated case study. One member of each group presented the ten selected variables; the ten most quoted variables by the three groups were introduced in a new Impact Matrix. Participants were then divided again into three groups; this time, the division was organised to have one group composed only of stakeholders from Milan, one only from Turin, and one mixed of stakeholders from both Milan and Turin. This approach was meant to compare different views for the two cities. Each group filled in the Impact matrix, performed the analysis of the systemic role of the variables and then showed the results to the other groups. Finally, the PCIA tool and methodology, the output of the exercise and the implications for the two cities were discussed in a plenary session. In general, the most active variables were 'Policies and incentives for resource efficiency', 'R&D, funding and policies for innovation', 'Soil consumption'. 'Strategic planning and measures for energy efficiency' turned out to be very active for Turin, less so for Milan; the opposite was true for 'Economic specialisation'. 'Accessibility of urban services', 'Valorisation of cultural heritage and landscape, rehabilitation of derelict areas' and 'Policies and infrastructures for no-fossil fuel mobility' turned out to be the most passive variables.

Finally, the fourth workshop was aimed at revising the visions, the milestones and the actions identified in the previous workshop, according to the results of the GAP analysis, which allowed the recognition of which measures were not sufficient to reach the 2050 post carbon vision. Also this workshop was organised in common for the two cities: it was held in Milan, but stakeholders both from Turin and Milan were invited, in order to search together for new solutions to improve the consistency and robustness of supporting actions to the desired post-carbon state.

INSIGHTS FROM THE GAP ANALYSIS FOR THE CITY

The business as usual (BAU) and post-carbon (PC 2050) scenarios for Turin were modelled and compared.

Under the BAU scenario Turin in 2050 has recovered from a three-decade decline to one of rising economic growth. Despite an increase in population to 1.1 million the energy use of the city has the business as usual (BAU) and post-carbon (PC 2050) scenarios for Istanbul and quantifying the impacts declined. Car use is still high and represents a larger modal share than public transport. However, electric vehicle use is increasing. Many buildings have undergone energy efficiency renovations and solar cells are common, resulting in lower energy use in the residential sector, despite a population increase.

In the PC2050 scenario, Turin has expanded to 1,215,000 people whilst total energy use has been reduced by 30%. However, progress in local renewable energy has been slow and this only accounts for 25% of the energy. Fossil fuel transport still accounts for 50% of the transport energy, and combustible fuels still provide 45% of Turin's total energy.

More specifically, the basic efficiency assumptions were applied to the sectors as shown in the following tables (the structure is in line with the structure of the Turin Action Plan for Energy, where the best available data was obtained). The energy use calculations were obtained by applying these efficiency improvements, and a population factor to the projected emissions for 2020 of the Turin Action Plan for Energy efficiency.

PC2050

1.1 Municipal	25% efficiency improvement
1.2 Tertiary	50% efficiency improvement
1.3 Residential	60% efficiency improvement
1.4 Lighting public	25% efficiency improvement
2. Industry	20% efficiency improvement
3. Transport.	40% efficiency improvement

Table 18 summarises the current trends of the KPI and provides a projection of the likely outcome and performance under each of the scenarios (where possible and applicable). The qualitative assessment is indicated by both a colour and simple scoring system with green and "++" indicating a very likely positive performance and improvement. Whilst red and "--" indicate a very poor or negative performance, as shown in the table below.

Legend	Explanation for scenario projection compared to current situation
++	Likely very positive
+	Likely progress
0	Likely neutral or similar to current situation
-	Likely negative
--	Likely very negative

Table 18: Semi-quantitative assessment of the POCACITO KPI's under BAU and PC2050 for Turin

	SUB-DIMENSION	*INDICATOR*	*UNIT/INFO*	*BAU 2050*	*PC 2050*
ENVIRONMENT	*Biodiversity*	Variation rate of ecosystem protected areas	*2008 2012*	*0*	*0*
	Energy	Energy intensity variation rate	*Toe/Meuro 2001-2011 Toe (000)*	+	++
		Variation rate of energy consumption by sectors	*Percentage Total 2005-2010= 4861-4294 KToe (11.7% decrease)*	*N/A*	*N/A*
	Climate and Air Quality	Variation rate of carbon emissions intensity	*2002-2011 KTon CO_2 KTon CO_2/M euro*	+	+
		Carbon intensity per person	*Population (Province) : 2002: 2,171,000 2013: 2,294,000*	+	+
		Variation rate of carbon emissions by	*Ton CO_2 Total 2005-2010*	+	+

	SUB-DIMENSION	INDICATOR	UNIT/INFO	BAU 2050	PC 2050
		sector	*14945-11852 kton (20.7% decrease)*		
		Exceedance rate of air quality limit values	*Nº of days 2004-2013 PM10 NO2 O3*	++	++
	Transport and mobility	Variation share of sustainable transportation	*Percentage (2000-2010)*	-	+
	Waste	Variation rate of urban waste generation	*Kg/person/year*	+	+
		Variation rate of urban waste recovery	*Percentage*	++	++
	Water	Water losses variation rate	*m^3/person/year*	+	+
	Buildings and Land Use	Energy-efficient buildings variation rate	*Percentage*	+	+
		Urban density variation rate (population)	*Buildings/ km^2 (2001-2011)*		+
ECONOMY	*Sustainable economic growth*	Level of wealth variation rate	*eur/person*	+	+
		Variation rate of GDP by sectors	*Percentage 2000-2011*	*N/A*	*N/A*
		Employment by sectors variation rate	*Percentage 2000-2011*	*N/A*	*N/A*
		Business survival variation rate	*Percentage*	+	+
	Public Finances	Budget deficit variation rate	*Percentage of city's GDP*	*ND*	*ND*
		Indebtedness level variation rate	*Percentage of city's GDP*	*0*	*0*
	Research & Innovation dynamics	R&D intensity variation rate	*Percentage*	++	++
SOCIAL	*Social Inclusion*	Variation rate of unemployment level by gender	*Percentage 2004-2013*	-	*0*
		Variation rate of poverty level	*Percentage*	-	-
		Variation rate of tertiary education level by gender	*Percentage (2004-2013)*	+	+
		Variation rate of average life expectancy	*Average Nº (2003-2012)*	++	++
	Public services and Infrastructures	Variation rate of green space availability	*Percentage*	+	++
	Governance effectiveness	Existence of monitoring system for emissions reductions	*Yes/No Description*	*N/A*	*N/A*

The most prominent gaps for Turin under the current PC2050 scenario are as follows:

Energy

Currently the PC2050 still has high (although reduced) GHG emissions of 2.7 MTCO2e or 2.26 tCO2e per capita. This is due to the interpretation of the limited actions and milestones that addressed these aspects in the first set of stakeholder workshops.

Hence the current energy mix of 30% grid electricity, 45% combustible fossil and 25% renewable energy sources can be greatly improved through increased actions. This essentially means that there is a gap of almost 10,000 GWh in renewable energy if the combustible fuels and grid electricity are to be replaced by renewable energy (in addition to the 3251 GWh assumed under PC2050 currently).

Social

There is some concern about the poverty level, which has increased to 21% which is very high. This indicates a high level of inequality that has not been addressed in either scenario.

Urban sprawl

Under BAU urban sprawl will increase by 32.6 km^2 despite a reduction in population of 29,000 (for the Province area). Currently the potential for urban sprawl and increased densification is not adequately addressed within the PC2050 scenario. With a projected increase of 203,300 people by 2050 under PC2050, there is a need for the strategic paper to develop a clear series of milestones and strategies to ensure urban sprawl is contained. This obviously also has ramifications for energy use, infrastructure investment and transport.

Circular economy and lifestyles

The potential for improvements in the impact of consumption are currently not well addressed in the PC2050 scenario. Options include increase the facilities for reuse (e.g. through provision of locations to leave unwanted goods for reuse) and repair (such as repair cafes), but also to support businesses and innovation in this area.

Biodiversity

The level of biodiversity protected areas in Turin is relatively low and how to improve the increase of green spaces and green corridors (for wildlife) could be addressed in the strategic document.

A STAKEHOLDER VISION FOR THE CITY

The 2050 post-carbon vision for Turin that emerged in the participatory workshops is built around the following three key concepts:

DIFFERENTIATION

- The economic base is structured in a few specialised sectors (for example, automotive, tourism, ICT etc.); they represent the strengths that make the city competitive and more resilient to economic crisis;
- The mobility system at metropolitan level is organised to be multimodal; people (residents, tourists, businessmen) are less dependent on private motorisation and can easily move by more sustainable modes. Emissions from transport are reduced by introducing a congestion charge, fostering telecommuting, and cutting the use of private cars by promoting more sustainable mode of transport.

IDENTITY

- Even if deeply differentiated, Turin will keep and enhance its identity thanks to strong social integration, high quality of life, promotion of young people's initiatives and start-ups. Ageing problems are faced by enhancing social housing, developing user-friendly technologies, and improving welfare through ICT;
- Spatial resources, cultural heritage and landscape are recognised and developed as a crucial value. Soil consumption is reduced by preserving natural and agricultural soils, re-naturalising abandoned built areas, promoting instruments for moving and concentrating building rights in the empty spaces inside the existing city.

SMARTNESS

- Technology is systematically developed to connect people, both inside the city and between the city and the global world. New green tech jobs are created, thanks to cooperation between universities and local companies, innovative financial tools for R&D and start-ups, the promotion of renewable energy sources, enhancement of tertiary education in scientific issues. Emissions from buildings are reduced through spread adoption of certifications of energy performance and incentives to building renovation;
- Sharing is a new key paradigm, for granting services (first of all, mobility) but also as an opportunity for economic innovation and new business. New models of education and training are defined, as well as innovative tools and resources for welfare.

ACHIEVING THE VISION

The milestones and actions proposed in the second workshop, and revised in the fourth one, are summarised in the following table 2.

Table 2: Milestones and actions towards the 2050 post-carbon vision for Turin

MILESTONE	STARTEGY TOWARDS MILESONE
Reduction of soil consumption (2020)	Preserve natural and agricultural soils

	Re-naturalise abandoned built areas Promote instruments for moving and concentrating building rights in the empty spaces inside the existing city
Facing the ageing society (2020)	Enhance social housing Develop user-friendly technologies Improve welfare through ICT
Turin as a touristic city (2020)	Create innovative offers and holiday packages for tourists
20% reduction of emissions from buildings (2025)	Adopt certifications of energy performance Adopt incentives to building renovation
New jobs from green tech (2030)	Increase cooperation between universities and local companies Innovate financial tools for R&D and start-ups Promote renewable energy sources Enhance tertiary education in scientific issues
50% reduction of emissions from transport (2035)	Introduce congestion charge Foster telecommuting Halve use of private cars through promotion of more sustainable mode of transport
Turin as an inclusive and "shared" city (2040)	Define new models of education and training Innovate tools and resources for welfare

ASSESSMENT OF NEEDS

In the fourth workshop, the discussion about the results of the GAP analysis led the stakeholder to propose further actions, to integrate the set identified in the second workshop.

At the local level, the main measures proposed were:

- improve access to new technologies, reduce the digital divide and generational and social gaps, through open data, digital platforms, networks, etc.;
- increase the role of the third sector for circular economy, creating physical and logistic spaces for new economic activities;
- promote new programmes of urban regeneration, whose impacts should at the same time reduce social inequalities, increase building energy efficiency and avoid further consumption of soil;
- simplify the creation of new start-ups in sectors of the sharing economy;
- reduce food and water waste;
- guarantee the presence of the monitoring-assessing-reporting chain, in order to keep under control the effectiveness of the post-carbon strategy in the long term.

In the workshop, not all the actors seemed to be fully aware that a post-carbon strategy has to be interdisciplinary and integrated in environmental, social and economic terms. In particular, it was conceived by some stakeholders as a mainly energetic/environmental strategy, while its economic opportunities and social benefits had been overlooked. A greater dissemination of the complexity and multi-faceted characterisation of the post-carbon approach could broaden the audience of potential stakeholders interested to post-carbon measures.

As regards the national and EU level, an issue that emerged in the last Turin-Milan integrated workshop is that local actors often believe not to have the requested skill and knowledge to define and implement a complex and interdisciplinary strategy, such as the post-carbon roadmap. Support from the EU and national levels could offer training opportunities and life-long learning to urban and metropolitan public administrators.

Another issue is clarity in national strategy. For example, in the case of Turin and Milan stakeholders put in evidence that the effective 'post-carbon' evolution of the cities in energetic terms will significantly depend on the weight of renewable sources that will be used to produce electricity at the national level: it is then important that national policies and strategies are as clear as possible in defining their targets and impacts.

Again at the national level, Italy lacks the legislation and fiscal security for the investments necessary for promoting post-carbon trends in the medium to long term, which are further hampered by frequent regulatory changes. A security system for the duration of depreciation period of the capital is needed, as the subsidies for photovoltaic systems.

Also benchmarking to other European (but also non-European) cities is considered useful to stay on track about best practices and measures to be adopted.

Finally, some consideration about the opportunity of interurban coordinated post-carbon policies, as emerged (or not) in the integrated Pocacito case study of Turin and Milan. During the workshops, although explicitly asked and stimulated to keep in mind the relation between the two cities, participants tended to focus on their own city as a separate territorial object. In particular, participants did not consider a major integration of the two cities as an opportunity for the vision, either for promoting post-carbon policies, or for improving local competitiveness.

Asked to think over the right territorial and institutional level to implement post-carbon policies and actions, stakeholders recognised that the city level is in general not sufficient (for example for policies against pollution, waste etc.) and policies have to be conceived at a wider level (for example to develop the area between Turin and Milan). But this wider level does not necessarily correspond to the two cities: according to stakeholders, most of the post-carbon policies that cannot be implemented at the city level have to be proposed at a metropolitan or even at a regional level (for example for the whole Piedmont region, or the whole north-west Italy), rather than through cooperation between Milan and Turin.

According to the stakeholders, this cooperation can only really be effective in the context of policies for R&D and tertiary education: Milan and Turin have universities which are important at the European level, but they have to cooperate to compete in the global context. Moreover, the two cities have different economic specialisations, which can be complementary for promoting technological research and development.

IX ROSTOCK AS A POST-CARBON CITY 2050 - STRATEGY DOCUMENT, ENGLISH SUMMARY

ECOLOGIC INSTITUT, Berlin, August 2016

Susanne Langsdorf, Ecologic Institut

SUMMARY

This strategy paper aims to support the efforts undertaken by Rostock on its way to a post-carbon city in 2050. It presents the results of a participation process undertaken and the analyses of selected measures regarding their effectiveness to achieve a 2050 post-carbon city. Furthermore, in an excursus the measures that the EU and the national level – from the viewpoint of stakeholders in Rostock – can implement to support cities are summarised.

A key component of Rostock's climate protection activities is the so called 'Masterplan-process' (Masterplan 100% Klimaschutz), which was conducted in Rostock from 2012-16. The objective of the Masterplan is the reduction of energy demand by 50% by 2050 and of CO_2 emissions by 95% compared to 1990 levels. It includes measures in the public, private and household domain. The participation process conducted as part of the POCACITO process built on this masterplan process and on the goals and measures already set. In total four POCACITO workshops (WS) were held in Rostock between December 2014 and May 2016:

- **Visioning**: in the first WS a vision "Rostock 2050" was developed
- **Backcasting**: in the second WS the way to reach this vision was elaborated
- **Sensitivity**: in the third WS the measures to reach the vision were discussed in more depth
- **Next steps**: in the final WS the results of the POCACITO modelling exercise and the next steps of the Rostock post-carbon process were discussed.

The most important action fields identified were: economy/jobs, mobility, consumption and waste, quality of life for all, demographic change/old age poverty, affordable housing vs. public green space, energy sources/efficiency and connection to the surrounding region.

The main actors working towards these goals are the 'climate protection control centre' ('Klimaschutzsleitstelle') of the Agency for the Environment in Rostock and the energy alliance ('Energiebündnis'). In the alliance actors from the energy sector and energy consumers (e.g. the municipal utilities; WIRO, the biggest local residential building cooperative; RSAG, the local provider of public transport) cooperate to support the so called 'Energiewende' (energy transition).

The main tool for achieving the vision is the 'Masterplan 100%' which was further developed as part of the POCACITO participation process. Within the Masterplan almost 50 measures were set of which a number are already finalised, while the majority is ongoing. With regard to the action fields described above, broader goals have been set. The *economy/jobs* field shall be fostered with a focus on the assembly sector and on the already strong economic sectors fisheries and harbour, tourism and agriculture as well as research and development. In order to reduce energy consumption of the *mobility* sector Rostock will become more compact and a city of short distances. Regarding *consumption and waste* a change in diets will be supported. Also a number of milestones on the way to a post-carbon city have been set.

The existing and planned measures have been modelled in the POCACITO project, using two modelling approaches. One approach focused on the city level. The other included the footprint of the inhabitants of Rostock, i.e. the emissions produced and energy used outside Rostock through the consumption generated in Rostock. The latter was calculated using a multi-regional input output model.

Two scenarios were calculated: one *business-as-usual 2050 scenario* (BAU), in which the running and agreed upon measures were included, and the existing trends extrapolated. The second scenario was a *post-carbon 2050 scenario* (PC2050), in which the indicators that have been developed in the participation process and the measures of the 'ambitious version' of the Masterplan were included and projected into the future. The most important results include the following:

In the BAU scenario most indicators show a positive trajectory. Nevertheless, energy consumption declines only marginally, due to a rising population and increased electricity consumption. The biggest reductions are achieved in the transport sector. In the PC2050 scenario the development is significantly better, despite an even bigger increase in population. Energy consumption in the PC2050 scenario is 22.2% lower than in the BAU scenario, in both scenarios most energy is consumed in heating. Greenhouse gas emissions are 693,000 tCO_2e in the BAU2050 scenario and 346,700 CO_2e in the PC2050 scenario. This corresponds to 3.22 tCO_2e and 1.58 tCO_2e per capita respectively. While in the city limits of Rostock great reductions can be achieved in the PC2050 scenario, calculations of the 'footprint' show a very different picture. Already today a major part of Rostock's emissions don't materialise within Rostock, but outside through consumption. This share is to rise considerably in the future: if the consumption of private households and the public sector is taken together, the emissions of Rostock are even expected to rise!

Drawing on these results the paper closes with the most relevant action fields to achieve a post-carbon Rostock 2050. Within the city limits of Rostock these are: heating (efficiency, renewable heat), electricity, transport (consequences of e-mobility) and realising a compact city.

As 90% of the environmental effects of Rostock are expected to materialise outside Rostock, consumption needs to be a major focus to truly achieve a post-carbon city. Important measures include: fostering the local economy and a circular economy, reducing the environmental effects of e-mobility and changing diets, and lowering the impact of food consumption and production.

X STRATEGY PAPER OF ZAGREB TOWARDS A POST-CARBON CITY

UNDP Croatia, Zagreb, August 2016

Zoran Kordic, UNDP Croatia

ENGLISH SUMMARY

CHALLENGES FACING THE CITY

After conducting an initial assessment of Zagreb, through which the physical, ecological, social and economic analysis was given, along with analysis of city's development strategies designed by the local government and valuable inputs given by the workshop attendants from variety of professional backgrounds, several challenges preventing city's low-carbon development emerged. Here is the summary of the most frequently mentioned and discussed challenges preventing development of the city:

- Urban sprawl - the amount of forest has decreased significantly from 168.8 km2 to 92.9, a reduction of 45%, over 6 years from 2006 to 2012;
- Eco system protected areas - there has been a significant decrease in the number of eco-system protected areas;
- Waste management - the current trend shows a decrease in production of communal waste, but only 1% of communal waste is collected separately;
- Carbon emission intensity - slow progress in implementation of energy efficiency and lack of usage of renewable energy sources;
- Water loses - water losses have been unchanged during the last ten years and current levels are high;
- Transport infrastructure - favouring private motorised over non-motorised and public transport modes, cycling makes up only 3% of all travel;
- Youth unemployment- 28% of total unemployed are aged between 20 and 29;
- High level of poverty - The poverty level is quite high at 20.5% and has increased over the last 5 years;
- Weak local economy - depends too much on imports.

STAKEHOLDER CONSULTATION GROUP

The process started with the vision-building workshop. The technique presented in the training workshop was followed. Stakeholders drawing their visions after which they summarised the drawings and organised them in the form of mind map. Stakeholders accepted the proposed process methodology. The drawings phase ensured a relaxed atmosphere among participants so they were able to freely express their ideas.

This was followed by a scenario-building workshop. The technique presented in the training workshop was followed. The transition timeline was posted on the wall. It showed a line running from 2015 to 2050 with four main areas representing the years 2015, 2020, 2030 and 2050. Participants were invited to write down opportunities, challenges, milestones and objectives on post-its and post it on the transition timeline.

THE 2050 POST-CARBON VISION FOR ZAGREB

The narratives of the vision are as following:

- A city that produces zero waste and pollution, where every by-product is a raw material or energy product for other activities. At the same time, the economy is largely localised, with a neutral ecological footprint or better. Looking at maximizing the use of certain resources, and minimising the number of mediators between producers and consumers, all consumers are producers of something else.
- A city which is planned in an integrated way, intended with the aim of activation public spaces, with decentralised activities and polycentricism through the civil participation.
- A city that is compact, planned in accordance with demographic predictions, which recycles its spaces, encourages multi-functional and energy-efficient construction connected with a quality infrastructure which, among other things, allows sustainable mobility.
- A city that keeps its natural environment and natural resources encourages the symbiosis of urban and rural areas inside the preserved green zone.
- A city that is a leading healthy city with happy and long lived citizens with available: healthy adequate water for drink highly standardised organic food, good air quality and waste management systems.
- A city in which long-life, free, critical, creative and holistic education is available for everybody, producing active citizens.

IDENTIFYING MILESTONES AND ACTIONS

Time	Milestones	Actions to achieve milestones
2016-2020	Research of local resources and new technologies	Establishment of centres for research of local resources and new technologies
2016-2020	Social entrepreneurship	Encouraging development of small and medium-sized social entrepreneurship
2016-2020	Reuse and recycle centres	Establishment of the centres for reuse
2016-2020	Low carbon strategy and action plan	Development of a strategy and action plan to reduce greenhouse gas emissions
2016-2020	Increasing share of renewable energy in energy production	Incentivising investment in renewable energy and energy efficiency for local use
2016-2020	Urban agriculture	Providing more spaces for local food production and their permanent designation in spatial plans
2016-2020	Utilisation of EU funds	Participation in large number of EU and international projects
2016-2020	Communication and coordination with citizens	Establishment of the centre for communication and coordination with citizens and civic initiatives
2016-2020	Urban regeneration	Conversion of existing unused urban spaces into business incubators
2016-2020	Monitoring the quality of all components of environment	Setting up systems for monitoring the quality of all components of environment
2016-2020	Climate Change Adaptation Plan	Adaptation of the strategy
2020-2030	Resource efficiency	Use of social innovation to achieve resource efficiency
2020-2030	Reducing the use of motorised vehicles	Implementation of new cycling infrastructure
2020-2030	Food in public spaces	Growing edible plants in public spaces

2020-2030	Sustainable consumption	Implementation of educational and information campaigns on sustainable consumption
2020-2030	Decentralised and democratised energy production of renewable energy sources	Increasing the supply of renewable energy
2020-2030	All existing buildings renovated and energy efficient	Implementation of energy efficiency measures in public buildings and private households
2020-2030	Food donation programs	Establishment of a sustainable system of donation and distribution of food from the supermarket chains
2020-2030	Better food quality	Introduction of an effective system to control the quality of food
2020-2030	Transparency in public administration	Development of a culture of transparency in public administration
2020-2030	Public spaces	Optimisation and planning the use of spaces in accordance with the needs of community
2020-2030	Lifelong learning	Introduction of civic education as a basis for involvement and participation of citizens; promoting non-formal education
2020-2030	Critical thinking	Development of comprehensive schools and kindergartens
2020-2030	Participative budgeting	Co-decision and participation of citizens in the management of the city budget
2020-2030	Active citizens	Creating a connected active neighbourhood that participate in local self-governance
2020-2030	Sustainable transportation of goods	Introduction of obligation to use sustainable means of transportation for transportation of goods and delivery
2020-2030	Living streets	Revitalisation of public spaces and streets to encourage social inclusion and outdoor activities
2020-2030	Efficient public transport system	Development of a public transport system with transport hubs that allows easy transition from one mode of transport to another; introduction of obligatory basic public services within a short distance of all places of

		residence
2030-2050	Introduction of low-carbon urban areas	Strengthening neighbourhood identities
2030-2050	Circular economy	Development of a local plan to introduce circular economy and concept of 'life cycle of products and services', which follows the environmental footprint of products and services
2030-2050	All production of energy in the city and surrounding areas	Development of central heating system, Introduction of obligation of setting photovoltaics or green roofs on all new buildings
2030-2050	Soil regeneration	Using principles of restoring agriculture
2030-2050	Local food production	Short food supply chains; developing a network of small producers to exchange locally produced food, Eco markets, stimulating the development of family farms and agricultural production around the town
2030-2050	Social inclusion	Development of wide range of measures aimed at social inclusion of marginalised citizens
2030-2050	Governance reform	Encouraging new governance and communication models to engage citizens
2030-2050	Healthy lifestyle	Broad implementation of measures for preventive medicine and increased number of health care
2030-2050	E-vehicles	Popularization of ecological vehicles and development of e-filling station

ASSESSMENT OF NEEDS

What can the city do?

- develop and ensure stable long-term vision
- develop more specialised strategies and actions plans and work on their execution
- setting more ambitious targets than the national targets and frameworks are set
- considering small scale projects can have bigger impacts on citizens life that big projects
- give more attention to citizens initiatives and grassroots ideas

- start using incentives and taxes as a mode of award for sustainable projects
- develop a continuous dialogue with citizens
- reform of the governance structure - make if more flexible, collaborative and inter-sectoral
- start accepting social innovations in urban governance and financing
- develop better dissemination networks with foreign cities
- prepare a sufficient project pipeline and be involved in more EU projects
- prepare more capital investments eligible for EU funding
- work much harder on dissemination and education related to sustainable development
- give more power to neighbourhood councils and community organisations as they have a great role in transition
- include citizens in decision-making process

What can national government do?

- develop more efficient public administration system on national, regional and local level as it has a huge influence on program development and project implementation
- consider the use of innovation in order to simplify some processes and adapt them to the needs of today's society and thus speed up the transition
- accelerate the development of national strategies that provide a framework for post/low carbon transition as in many cases local governments have to wait for national government to start defining their own development strategies which are often a precondition for implementation of projects
- accelerate the enactment of laws and regulations that allow implementation of projects related to post/low carbon transition. Include citizens or groups that demonstrate interest or provide new solutions in decision-making process
- enable faster implementation of large-scale projects that have a significant impact on local community by giving more power to local authorities in project execution
- accept or develop more financial instruments targeting communities (territorial communities or specific interest communities) or NGOs which have a substantial role in development
- national government is completely in charge of some sectors (e.g. education, health, pension systems) but maybe should give some flexibility to the regional and local governments to introduce their own systems or solutions (in case those are more ambitious)
- allow some changes in policies related to energy, start-ups, cooperatives, NGOs
- start ranking cities according to their post-carbon development index
- ensure better cooperation between the cities and give more visibility to examples of good practices

What can EU do?

- make EU funding system simpler by skipping the national level as it sometimes takes too long and is complicated for national governments to make all adjustments and documents which should be also transposed to regional and local levels
- provide more financial sources for urban development and deploy more financial instruments intended for urban areas
- engage local level while developing policies and involving cities in decision-making process (as they are working the most on implementation of EU targets into concrete actions)
- monitor the achievement of targets within the urban areas and identify obstacles that appear exactly in the implementation of EU goals within urban of areas
- set more ambitious or specific targets for urban areas in general
- take into account the specificities of some states or cities when setting binding targets and allow tailor-made approach (e.g. growing/shrinking cities).
- ensure visibility and scaling-up of successful small-scale projects and initiatives that can sometimes even influence EU policies. Stimulate demo and pilot projects that aim to solve problems in urban areas
- Urban Innovative Actions are a good tool to support and institutionalise experiments in the urban areas. As well as URBACT they contribute to capacity building and the acceptance of innovations. UIA and URBACT budget should be increased to allow more cities to participate
- develop more programs or instruments like CLLD or LEADER which directly serve the needs of community and self-organised groups within some territory
- start ranking cities according to their post/low carbon development index and publish the results regularly
- continue Urban Audit with improved accuracy of the data collected
- support development of initiatives and dissemination networks for low-carbon urban development. Improve cooperation between countries and cities in the field of urban development.

IMPACT OF THE PROPOSED MEASURES ON CITY DEVELOPMENT

This part consolidates the work on modelling the business as usual (BAU) and post-carbon (PC 2050) scenarios for Zagreb and quantifying the impacts. It should be noted that the BAU scenario is primarily developed from a continuation of current trends with consideration of current projects. Whilst PC2050 is developed from an interpretation of the vision, action and milestones developed in the stakeholder workshops. A summary of the KPI's current trends and the expected outcomes under the scenarios is given below.

ENVIRONMENTAL

In the PC scenario effort will be put into energy efficiency, whereby one can expect a reduction in energy intensity. In the BAU scenario the renewable part of the energy mix is expected to increase, which will contribute to a reduction in the carbon emission intensity.

In the PC scenario several measures will be taken, such as a high level of energy production on a household level, which will decrease the carbon intensity significantly.

A small increase in the share of transportation can be observed in the energy consumption by sector. In the future the industry is expected to lower its share. The trends in air quality can also not be observed so it is difficult to project the trend for BAU. However, we would generally expect air quality to be greatly improved by 2050 with improved transport emissions. This is not only due to hybrid and electric vehicles but also to improvements, also in emission technology for fossil fuels.

However, the current trend shows a slight increase in cycling, which is expected to continue in the BAU scenario. In the PC scenario a new biking network will be put in place resulting in an increase in the share of cycling with a corresponding reduction in car traffic.

For waste generation, the current trend shows a decrease, but since the data is limited the trend is uncertain. In the BAU scenario a minor decrease in waste generation can be expected. In the PC scenario, focus will be put on the circular economy which could improve waste recovery and generation.

Water losses have been unchanged for the last ten years. The current levels are high and the issue has not been dealt with in either the BAU scenario or in the PC scenario. Water losses are thus expected to be a future problem, especially combined with the effects of climate change.

There is no data available on energy efficient buildings but due to investments in energy efficiency, improvements can be expected in both the BAU scenario and in the PC scenario.

ECONOMIC

The trend for sustainable economic growth is positive, with the level of wealth showing an increase of 61% from 2003 to 2010. This trend is expected to continue and will be slightly higher in the PC scenario. As is the case in most European cities, the service sector share of GDP and employment is growing and this will continue under both scenarios, with an associated fall in the contribution by industry.

SOCIAL

In terms of equality the indicators are positive, with a very low unemployment rate and a high rate of tertiary education for both sexes. The male rate of tertiary education is however 9% lower, at 45.6% compared to the 54.4% for females. No significant changes are expected for either the PC or the BAU scenario.

The poverty level is quite high at 20.5% (2013) and has increased over the last 5 years, which is of some concern. However, in both scenarios and particularly for PC2050 a decrease can be expected as a result of economic development. Life expectancy has improved considerably from 2003 to 2012, but is still low at 78.8 years by European standards.

In terms of green space there is strong cause for concern as the amount of forest has decreased significantly from 168.8 km^2 to 92.9, a reduction of 45%, over 6 years from 2006 to 2012. This suggests either considerable urban sprawl and/or deforestation for another cause.

	SUB-DIMENSION	INDICATOR	Trend	BAU 2050	PC 2050
ENVIRONMENT	Biodiversity	Variation rate of ecosystem protected areas	Decrease.	-	0
	Energy	Energy intensity variation rate	Too short time span for trend No data	+	++
		Variation rate of energy consumption by sectors	Small increase in share of transport?		
	Climate and Air Quality	Variation rate of carbon emissions intensity	Short time period Short time period	+	++
		Carbon intensity per person	-	+	++
		Variation rate of carbon emissions by sector	No data on trend		
		Exceedance rate of air quality limit values	No data?	0	+
	Transport and mobility	Variation share of sustainable transportation	Little difference, share of bicycling increased slightly?	+	+
	Waste	Variation rate of urban waste generation	Too short time period?	+	++
		Variation rate of urban waste recovery	Increasing, but low levels?	+	++
	Water	Water losses variation rate	Small change?	0	0
	Buildings and Land Use	Energy-efficient buildings variation rate	No data available	+	+
		Urban density variation rate	+1%	0	+
ECONOMY	Sustainable economic growth	Level of wealth variation rate	+61%	++	++
		Variation rate of GDP by sectors	Industry->Business?	N/A	N/A
		Employment by sectors variation rate	Industry->Services?	N/A	N/A
		Business survival variation rate	No data	ND	ND
	Public Finances	Budget deficit variation rate	No data	ND	ND
		Indebtedness level variation rate	No data	ND	ND
	Research & Innovation dynamics	R&D intensity variation rate	No data	ND	ND
SOCIAL	Social Inclusion	Variation rate of unemployment level by gender	Annual variations	ND	ND

	SUB-DIMENSION	INDICATOR	Trend	BAU 2050	PC 2050
		Variation rate of poverty level	Increase	+	+
		Variation rate of tertiary education level by gender	Different trends	+	+
		Variation rate of average life expectancy	+2.2 years	+	+
	Public services and Infrastructures	Variation rate of green space availability	Large reduction in forest area	--	0
	Governance effectiveness	Existence of monitoring system for emissions reductions	-	N/A	N/A

ANNEX. STAKEHOLDERS

Barcelona

Surname	First Name	Organisation
Alcantud	Ana	Anteverti
Alguacil	Alan	Màster oficial en Planificació Territorial i Gestió Ambiental
Ariño	Josep	Transports Metropolitans de Barcelona (TMB)
Bayarri Valcárcel	Pascual	Consell Econòmic i Social de Barcelona (CESB)
Bohigas Segarra	Salvador	MSI (Manteniment Sostenible Integral)
Cuixart Tomos	Marta	*Estratègia i Cultura de Sostenibilitat. Ecologia Urbana,* Ajuntament de Barcelona
De Sarraga Mateo	Francesc	Oficina Tècnica de Canvi Climàtic i Sostenibilitat - Àrea de Territori i Sostenibilitat - Diputació de Barcelona
Devesa Vilalta	Miguel	Confederació de Comerç de Catalunya
Franquesa I Codinach	Teresa	Hàbitat Urbà
Fortuny	Jaume	Observatory of Globalisation, University of Barcelona
Giró	Joan	Col·legi d'Enginyers Tècnics i Pèrits de Telecomunicació de Catalunya
de Gispert Irigoyen	Gustavo	UPC-EPSEB
Junyent	Cristina	Fundació Ciència en Societat
Rodríguez Cantalapiedra	Inmaculada	Ampliació de Competències en Impacte Ambienta, Universitat Politècnica de Catalunya
Sanmarti	Manel	Institut de Recerca en Energia de Catalunya (IREC)
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Istanbul

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Istanbul Metropolitan Municipality, Transportation Planning Dept.	Hakan AKÇA
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İstanbul Water and Sewage Administration	Şeyma CİNGÖZ
İstanbul Water and Sewage Administration	İhsan Mustafa DOĞAN
İstanbul Water and Sewage Administration	Erhan KAYAOĞLU
İstanbul Water and Sewage Administration	Onur MOR
Housing Development Administration	Sıdıka LÖK
Housing Development Administration	Timuçin KURT
Istanbul Metropolitan Planning Office	Ulaş AKIN
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Istanbul Development Agency	Nesrin BEDELOĞLU
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Istanbul Metropolitan Municipality, Urban Renewal Dept.	Aylin ÖZDENİZ
Istanbul Metropolitan Municipality, Urban Renewal Dept.	Melahat BİÇEN
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Housing Development Administration	Timuçin KURT
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Litomerice

Name and Surname	Institution
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Jaroslav Klusák	Litoměřice city, Energy manager
Miroslav Kopecký	Litoměřice city, Department of spatial development
Anna Matulová	Tourism centre
Antonín Tym	Litoměřice city, Strategies department
Rita Vlčková	Litoměřice city, Strategies department, Agenda 21
Petr Hermann	Litoměřice city, city council
Milan Čigiáš	Litoměřice city, secretary
Hana Škopková	CUNI
Jan Weinzettel	CUNI

Lisbon

WORKSHOP 1, 2

Institution	Name and Surname
Lisbon City Council	Paulo Carvalho
Lisbon City Council	Teresa Almeida
CCDR-LVT – Regional Agency	Eduardo Henriques
Invest Lisboa	Diogo Ivo Cruz
APA – Portuguese Environment Agency	Nuno Lacasta
DGEG – General Direction of Energy and Geology	Carlos Almeida
LNEG - Portuguese National Laboratory for Energy and Geology	Helder Gonçalves
IMT – Institute for Transports and Mobility I.P.	João Carvalho
IN+ Centre for Innovation, Technology and Policy Research	Paulo Ferrão
AMB3E - Portuguese Association for Waste Management	Pedro Nazareth
ADENE - National Energy Agency	Luís Silva
APREN - Portuguese Association for Renewable Energies	Sá da Costa

Energy IN (cluster)	José Paulo Oliveira
Lisboa E-Nova (Municipal Energy Agency)	Miguel Águas
Start-up Lisboa (incubator)	João Vasconcelos

WORKSHOP 3

Institution	**Name and Surname**
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APA – Portuguese Environment Agency	Nuno Lacasta
DGEG – General Direction of Energy and Geology	Carlos Almeida
LNEG - Portuguese National Laboratory for Energy and Geology	Helder Gonçalves
IMT – Institute for Transports and Mobility I.P.	João Carvalho
AMB3E - Portuguese Association for Waste Management	Pedro Nazareth
ADENE - National Energy Agency	Luís Silva
APREN - Portuguese Association for Renewable Energies	Sá da Costa
Lisboa E-Nova (Municipal Energy Agency)	Miguel Águas

Malmö

WORKSHOP 1: Vision

Name and Surname	Institution
Per-Arne Nilsson	Malmö city, Head of Environmental dep.
Kerstin Rubenson	Malmö city, Environmental dep.
Tor Fossum	Malmö city, Energy strategy
Jan Rosenlöf	City building council, city planning
Mattias Zaunders	Sigma IT and management, Business manager
Johan Bergström	Sigma Civil AB, Head of department for planning, landscape and traffic
Hans Söderling	NCC Construction Sverige AB, Project leader
Annika Hansson	NCC Construction Sverige AB, Project leader
Yuliya Voytenko	International Institute for Industrial Environmental Economics, Lund University, Postdoc PhD
Boel Lagerwall	Pågen AB (bakery company), Communication manager
Iris Rehnström	Skånetrafiken AB (public transport) Environment- and sustainability strategy
Hanna Ljungkvist	IVL
Jeanette Green	IVL

WORKSHOP2: Back casting

Name and Surname	Institution
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Kerstin Rubenson	Malmö city, Environmental dep.
Tor Fossum	Malmö city, Energy strategy
Mattias Zaunders	Sigma IT and management, Business manager
Hanna Ljungkvist	IVL
Jeanette Green	IVL

WORSHOP 3: PCIA

Name and Surname	Institution
Jan Rosenlöf	City building council, city planning
Tor Fossum	Malmö city, Energy strategy
Jenny Holmquist	MKB real estate, Environmental strategy
Sara Pettersson	Thesis worker, IVL (food banks)
Annika Hansson	NCC Construction Sverige AB, Project leader
Hanna Ljungkvist	IVL
Jeanette Green	IVL

WORSHOP 4: Roadmap

Name and Surname	Institution
Kerstin Rubenson	Malmö city, Environmental dep.
Tor Fossum	Malmö city, Energy strategy
Annika Hansson	NCC Construction Sverige AB, Project leader
Helena Tillborg	Energy council Skåne
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Milan

Institution	Name	Workshop 1 - Vision building	Workshop 2 Backcasting	Workshop 3 Critical Influences	Workshop 4 Roadmap
Milan Stakeholders					
A2A	Riccardo Fornaro	•		•	•
Agenzia Mobilità Ambiente Territorio (AMAT)	Maria Berrini	•			
	Marta Papetti	•			•
Finlombarda S.p.A., Direzione Energia	Dino De Simone	•		•	
Fondazione Lombardia per l'Ambiente	Mita Lapi		•	•	•
IEFE Università Bocconi	Edoardo Croci		•		
	Tania Molteni			•	•
Istituto Nazionale di Urbanistica Lombardia (INU Lombardia)	Luca Imberti	•	•	•	•
Legambiente Lombardia	Damiano Di Simine	•			
Ordine Degli Architetti, Pianificatori, Paesaggisti e Conservatori Della Provincia di Milano	Alessandro Trivelli	•			•
Politecnico di Milano	Stefano Caserini		•		•
TRT Trasporti e Territorio	Patrizia Malgieri	•			

Institution	Name	Workshop 1 - Vision building	Workshop 2 Backcasting	Workshop 3 Critical Influences	Workshop 4 Roadmap
Turin Stakeholders participating in joint Milan-Turin workshops					
Agenzia per la Mobilità Metropolitana Torino	Andrea Stanghellini			•	•
ARPA Piemonte	Cuviello Maria				•
Collegio Costruttori Edili	Paolo Peris			•	
Confindustria	Cristina Manara				•
Dislivelli	Federica Corrado			•	
Politecnico di Torino	Luigi Buzzacchi			•	
	Stefania Guarini				•
Torino Strategica	Riccardo Saraco			•	•
Turin Municipality – Environment Department	Enrico Bayma			•	
	Mirella Iacono			•	
Turin Municipality – Transport Department	Giuseppe Estivo			•	
Turin Municipality – Urban planning Department	Liliana Mazza			•	
Unione Industriali Torino	Elisa Merlo			•	

Turin

WORKSHOP 1

Institution	Name and Surname
Municipality – Department of Transport	Giuseppe Estivo
Torino Strategica	Riccardo Saraco
Fondazione Torino Wireless	Chiara Ferroni
Turin Action Plan for Energy	Gianfranco Presutti
Confindustria Piemonte	Cristina Manara
Collegio Costruttori Edili	Paolo Peris
SiTI	Chiara Casalino
Università Bocconi	Giuseppe Berta
Politecnico di Milano	Andrea Rolando
Alta Scuola Politecnica	Emilio Paolucci
Agenzia per la Mobilità Metropolitana	Andrea Stanghellini
RFI – Rete Ferroviaria Italiana	Natalia Picco
Car City Club	Tiziano Schiavon
FEEM	Andrea Bigano
Politecnico di Torino	Patrizia Lombardi
Politecnico di Torino	Stefania Guarini
Politecnico di Torino	Giulia Sonetti
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WORKSHOP2

Institution	Name and Surname
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Torino Strategica	Riccardo Saraco
SiTI	Chiara Casalino
SiTI	Francesca Abastante
Alta Scuola Politecnica	Alberto Uberto
Agenzia per la Mobilità Metropolitana	Andrea Stanghellini
DIST - Politecnico di Torino	Luigi Buzzacchi
Associazione Dislivelli	Federica Corrado
FEEM	Cristina Cattaneo
Politecnico di Torino	Patrizia Lombardi
Politecnico di Torino	Stefania Guarini
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WORSHOP 3

Institution	Name and Surname
Turin Municipality – Transport Department	Giuseppe Estivo
Turin Municipality – Urban planning Department	Liliana Mazza
Turin Municipality – Environment Department	Enrico Bayma
Turin Municipality – Environment Department	Mirella Iacono
Torino Strategica	Riccardo Saraco
Unione industriale di Torino	Elisa Merlo
Collegio Costruttori Edili	Paolo Peris
Dislivelli	Federica Corrado
Agenzia per la Mobilità Metropolitana	Andrea Stanghellini
Politecnico di Torino	Luigi Buzzacchi
Università Bocconi	Tania Molteni
INU Lombardia	Luca Imberti
Fondazione Lombardia per l'Ambiente	Mita Lapi
Finlombarda	Dino De Simone
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FEEM	Cristina Cattaneo
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WORSHOP 4

Institution	Name and Surname
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Torino Strategica	Riccardo Saraco
Agenzia per la Mobilità Metropolitana	Andrea Stanghellini
ARPA Piemonte	Maria Cuviello
Politecnico di Milano	Stefano Caserini
A2A	Riccardo Fornaro
INU Lombardia	Luca Imberti
Fondazione Lombardia per l'Ambiente	Mita Lapi
Università Bocconi	Tania Molteni
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FEEM	Margaretha Breil
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Rostock

Workshop1

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Retzlaff Kai	IHK zu Rostock
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Schulmann Peggy	Rostocker Straßenbahn AG
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Weber Harald	Uni Rostock, Inst. f. Elektrische Energietechnik
Zander Kerry	Amt für Umweltschutz

Workshop2

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Workshop 3

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Workshop 4

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Riedner Klaus	VDI-MV
Ritter Werner	VDI AK EuT
Schnauer Arvid	Agenda-21 Rat
Söffker Ulrich	BUND-Projekte Energiewende
Wickboldt Peter	Universität Rostock
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Zagreb

Name of the participant	Organisation
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Sonja Sočivica	Zagreb City, City Office for Strategic Planning and Development of the City
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Jelena Puđak	Institute of Social Sciences Ivo Pilar
Tomislav Tomašević	Institute for Political Ecology
Tena Petrović	Safege Consulting

Lidija Srnec	Croatian Meteorological and Hydrological Service
Željka Fištrek	Energy Institute Hrvoje Požar
Željko Jurić	Energy Institute Hrvoje Požar
Gordana Dragičević	Permaculture Croatia
Vladimir Halgota	Cyclists Union
Vera Đokaj	Cluster for Eco-Social Innovation and Development CEDRA
Marko Gregović	Social enterprise, Brodoto
Edo Jerkić	Green Energy Cooperative
Maja Božičević Vrhovčak	Society for Sustainable Development Design
Žana Barišić	Political Party Za grad
Lin Herenčić	Energy and Environmental Protection Institute
Kata Marunica	NFO, Architects office
Matijana Jergović	Health public institute Andrija Štampar
Goran Krajačić	Faculty of mechanical engineering and naval architecture
Ivan Kardum	Cooperative for ethical financing
Goran Jeras	Cooperative for ethical financing
Rene Lisac	Society of Architects Zagreb
Kristina Careva	Society of Architects Zagreb
Cvijeta Biščević	Permaculture Croatia
Marina Kelava	Association for Independent Media Culture
Neven Višić	Student association, e-Student