ClairCity: Citizen-inclusive air pollution reduction in cities

D7.6 Final Cross-City Policy Analysis Report

June 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689289

Document Details

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Creation Date	30/04/20
Date of Last Revision	24/06/20
Description	This report is the final report on citizen-inclusive air quality and carbon policy making in ClairCity. It provides a cross-city analysis of the lessons learned and compares policy making in all six European cities and regions examined in the ClairCity project: Bristol (United Kingdom), Amsterdam (Netherlands), Aveiro/ CIRA region (Portugal), Genoa/ Liguria (Italy), Ljubljana (Slovenia) and Sosnowiec (Poland)

Version History

Version	Updated By	Date	Changes / Comments
V1.0	Stephan Slingerland	30/04/2020	Initial structure and document outline
V2.0	Enda Hayes	12/06/2020	Review of content, edits and comments provided.
V3.0	Stephan Slingerland	14/06/2020	Update before EMG and city inputs
Final	Stephan Slingerland	24/06/2020	Final version after ClairCity team comments

Contributions and Acknowledgements

The authors would like to thank the following people for their important contributions used in the preparation of this final document.

Quality Assurance	Enda Hayes (UWE)
Native Language Check	Enda Hayes (UWE)
Project internal comments	ClairCity team, ClairCity policy makers

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Executive Summary

ClairCity establishes a new and unique policy co-creation process
The ClairCity project designed a unique policy co-creation process of ambitious air quality and carbon policy making in cities together with citizens and stakeholders. The process was designed and implemented in six pilot cities and regions: Amsterdam, Aveiro / CIRA, Bristol, Genoa / Liguria, Ljubljana and Sosnowiec.

With several distinctive features
Distinctive features of the ClairCity process design are the establishment of a policy baseline; an extensive and varied engagement process directed at various target groups; a policy-maker check on citizens ambitions to establish challenging but realistically implementable scenarios; assessment of likely impacts of these scenarios in terms of emissions, concentrations, health impacts and costs; and identification of barriers and enabling factors for citizen-inclusive policies by way of policy maker reflections and mutual learning between the cities.

That can be replicated in other cities:
Establishing the policy baseline in the six cities showed that, while the cities and regions are very different in terms of socio-economic and geographical variables, their air quality and carbon policies are in fact very similar: in all cities the same policy measures are applied, although the degree of their implementation varies widely between the cities. This opens possibilities for a replication of the ClairCity process in other cities. The baseline examination also showed that there are various basic policy strategies to promote ambitious air quality and carbon policies in citizens, varying from supporting an active and indendent role of citizens, stressing equality aspects of these policies to promoting them indirectly as a co-benefit of other policies. In all cities, air quality policies in addition were motivated by stressing their health benefits.

1. An engagement process that investigates current and desired future behaviours as well as policy preferences of citizens
The ClairCity engagement process included large and varied samples of citizens in all cities, with in total more than 7,600 direct engagements of citizens and stakeholders, some 115 policy makers and stakeholders involved in policy interviews and more than 80 policy makers involved in workshops. The process suggests that current behavioural practices of citizens contributing to pollution might be very different in each city, pointing to a need for tailored policies to engage citizens in each city. Also it shows that there might be significant gaps in cities between the willingness of citizens to change their own behaviours and the policy ambitions formulated in the city, which suggests that awareness creation and dialogue with citizens are needed in order to close these gaps. Further, the engagement process indicates that the policies that citizens want for their city in general are not very different from what is already envisaged in city policy making. Differences are rather to be found in the higher speed and intensity of implementation desired by citizens. Taking away implementation barriers to current policies and to desired behavioural changes of citizens might therefore be a key element required of future city policies, rather than searching for innovations in fundamental policy designs.

2. A policy-maker check that channels citizen and stakeholder ambitions into implementable scenarios

ClairCity organised policy-maker workshops in all cities in order to identify implementation possibilities, barriers and enabling factors for all citizen policy scenarios produced. It was found that in some cities policy makers were inclined to follow citizens' ambitions to a large extent, whereas in others these ambitions were substantially cut back as a result of the reservations of policy makers. Main implementation barriers identified for the citizens ambitions were assumed costs of measures and technical implementation issues. Also it was remarked that citizens ambitions sometimes were contradictory, e.g. asking for cheaper, greener and more frequent transport at the same time.

3. A careful and, where possible, quantitative assessment of likely impacts of the co-created scenarios in terms of emissions, concentrations, health and costs

In accordance with the extent of reservations to citizens ambitions made by policy makers, the differences between co-created and business-as-usual policy scenarios in terms of emissions, concentrations and health impacts in some cities were found to be larger (Amsterdam, Bristol) or smaller (other cities). In all cities, however, the co-created scenarios resulted in long-term health benefits for citizens. Additional costs of the co-created scenarios turned out to be hard to establish, with some measures desired by citizens difficult to quantify at all and costs of others very much dependent on the way of implementation. However, balancing those costs with new sources of income for cities (levies) in principle seems feasible in all cities. Also, taking into account indirect benefits of these measures in terms of health benefits would probably lead to even more balanced scenarios in terms of costs.

4. An establishment of key enabling factors for ambitious citizen-inclusive policy making

Key enabling and likely success factors for implementing citizens ambitions that were found in the cross-comparison of cities were a consistent application of stick-and-carrot methods for behavioural change (e.g. promotion of active and public transport only together with simultaneous disencouragement of private car use), the creation of local funds for implementation of required infrastructural measures and the provision of a basis for change by a variety of measures directed at awareness (e.g. practical education, visibility of live air quality in the city, expansion of measurements also through citizen science).

After final refinements, the ClairCity method therefore is likely to offer an easily replicable instrument to be applied in other cities for more effective citizen-inclusive air quality and carbon city policies in the future.

In the course of the project, the ClairCity method was refined and perfected after application in each city. In this way it was found to be applicable and managable in all six pilot cities and regions. Final refinements to be made in an upscaling phase include an examination of how the process can be made even more representative of all citizen opinions in a city, and the finetuning of the ClairCity modelling with the variety of local air quality methods found to be applied in the cities. After that phase, a wide-scale, rapidly applicable and affordable replication of the method in other cities seems feasible and is hoped to contribute to better future air quality and carbon policy making in cities by including citizens in their design.

1 Introduction

1.1 ClairCity and its policy context

Environmental and sustainability policy making in Europe and elsewhere is at a cross-roads. Policies have to operate in an increasingly complicated policy nexus of simultaneous globalisation, decentralisation and sometimes increasing nationalism, with key challenges for climate change, air quality and other environmental issues ahead.

Cities have become an important focus point in these arising new policy structures, next to citizens, business, non-governmental organisations and other actors (Thiel et al., 2019; Herschell et al., 2017). Some cities have taken sustainability initiatives that go far beyond their national obligations. They have also partly organised themselves in international city networks that involve mutual learning beyond national contexts (Hughes et al., 2018; Johnson et al., 2018). Further, many cities have adopted policy co-creation processes together with citizens and stakeholders as an important instrument in order to improve policy making and increase public support for city policies (Voorburg et al., 2017; Baptista et al., 2019). For example, the UK has established a citizen Climate Assembly to help achieve the committement to of net zero GHG emissions by 2050[1].

The ClairCity project contributes to such new ways of citizen-inclusive policy making that are currently required in order to respond to the large sustainability challenges in changing times. The project focuses on improving air quality and carbon policy making in cities by putting citizens central in the implementation of a new method to co-design city air quality and carbon policies. Main objectives of the project are listed in Textbox 1-1.

Textbox 1-1 ClairCity Main Project Objectives

1. Putting citizens and their behaviour at the heart of the debate to give them a better understanding of the problem and the effect their activities have on that problem, and subsequently giving them ownership of the solutions.
2. Challenge citizens' perceptions and behaviour to incorporate social dimensions in understanding both current emissions patterns and visions for future change.
3. Raise citizen and stakeholder awareness of their city's air quality and carbon footprint, their exposure to air pollution and subsequent health effects, and their responsibilities in moving to a low carbon-clean air future.

[1] www.climateassembly.uk

4. Development of an integrated quantification toolkit to allow for the apportionment of air quality and carbon not just by source but by 'activity and behaviour' to support citizens understanding of how their decisions and actions impact on air quality, carbon emission, exposure and health.
5. Evaluate the policy interactions and decision-making by businesses, cities, Member States and the EU to discuss and realise ways to make 'desired futures' of citizens come true within the context of overall political, economic and social policies in a city.
6. Development of detailed citizen-led low carbon, clean air future pathways for cities based on innovative integrated modelling, policy evaluation, 'big data' analysis and immersive engagement methods.
7. Dissemination of case study results to other cities in Europe and to city policymakers beyond Europe.
8. Maximise the impact and continued use of the project outputs through embedded strategic innovation during and beyond the life time of the project.

1.2 Purpose of this Report

This cross-city policy report brings together the policy results of the six cities and regions case studies in ClairCity. As such, it provides, in particular, an answer to Objective 5 of the ClairCity project (see Textbox 1-1).

Previously, more detailed policy results per city have been published for all pilot cities in the ClairCity project: Bristol (United Kingdom), Amsterdam (Netherlands), Ljubljana (Slovenia). Sosnowiec (Poland), Aveiro/CIRA Region (Portugal) and Genoa/ Liguria Region (Italy)[2]. In this report, the policy results of these cities are compared, a reflection on the ClairCity process offered and recommendations to other city policy makers are given for successful co-creation of air quality and carbon policies in their city.

The focus of this report is on the method for policy co-creation with citizens and stakeholders developed in ClairCity. How to best organise a citizen engagement process is discussed in the ClairCity Communication Evaluation Report[3]. The overall ClairCity process is discussed in the ClairCity report "Seeing People behind the Data"[4].

Figure 1-1 ClairCity cities/regions Amsterdam, Aveiro/CIRA, Bristol, Genoa/Liguria, Ljubljana, Sosnowiec

[2] See ClairCity reports D7.4 Final City Policy Package Report – First City (Bristol) and D7.5 Final City Policy Package Report – Last City (Other cities and regions), www.claircity.eu
[3] See ClairCity report D2.8 Communication Evaluation Report, www.claircity.eu
[4] All available at www.claircity.eu

2 ClairCity Method

This chapter provides a brief description of the main steps taken in the ClairCity project, as well as its scope and limitations.

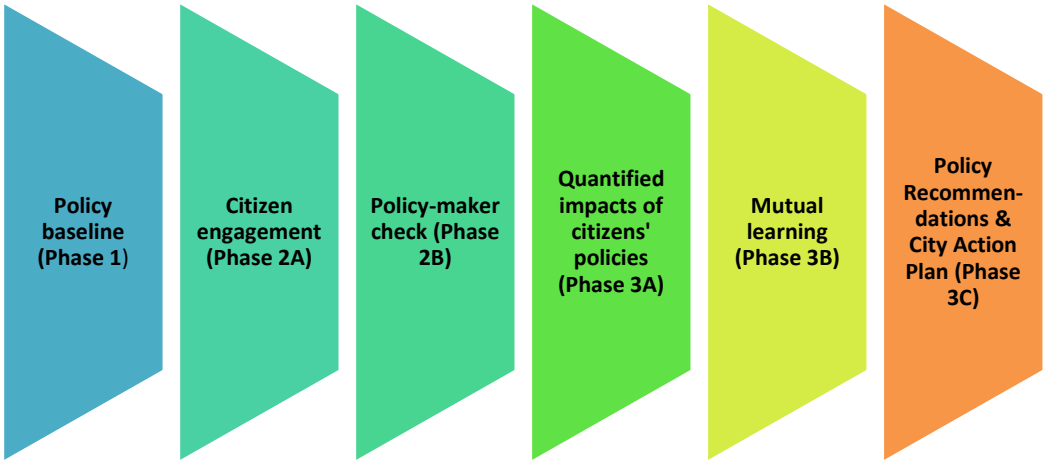
2.1 Main phases

The ClairCity project consists of three main phases:

1. Establishment of the baseline situation in each city,
2. Citizen and Stakeholder Engagement & Co-creation of Scenarios and
3. Quantified Policy Package, Evaluation and Mutual Learning, Policy Recommendations.

In total six policy related activities are carried out in the ClairCity policy process (Figure 2-1).

Figure 2-1 ClairCity policy activities within the three main project phases



In Phase 1, data on city characteristics, demographics, air quality and climate change situation as well as historical and current policy and citizen engagement landscape are collected in order to establish a policy baseline[5].

Phase 2 consists of a stepwise citizen engagement and co-creation process. In this phase, citizens and other stakeholders (business, NGO and civil society) are engaged in the project through a variety of methods directed at citizens in general or at specific target groups (youth, elderly). Citizens and stakeholders are asked about their current environmentally relevant behavioural practices (transport, heating) and provide information about desired future behaviours and future policies (Phase 2A). This information is surmised towards achieving consensus and processed into qualitative 'citizen scenarios', which are subsequently discussed in workshops with policy makers regarding opportunities, barriers and limitations to their implementation. As a final result of this phase, a co-created citizen

[5] ClairCity Policy Baseline reports for all cities, www.claircity.eu

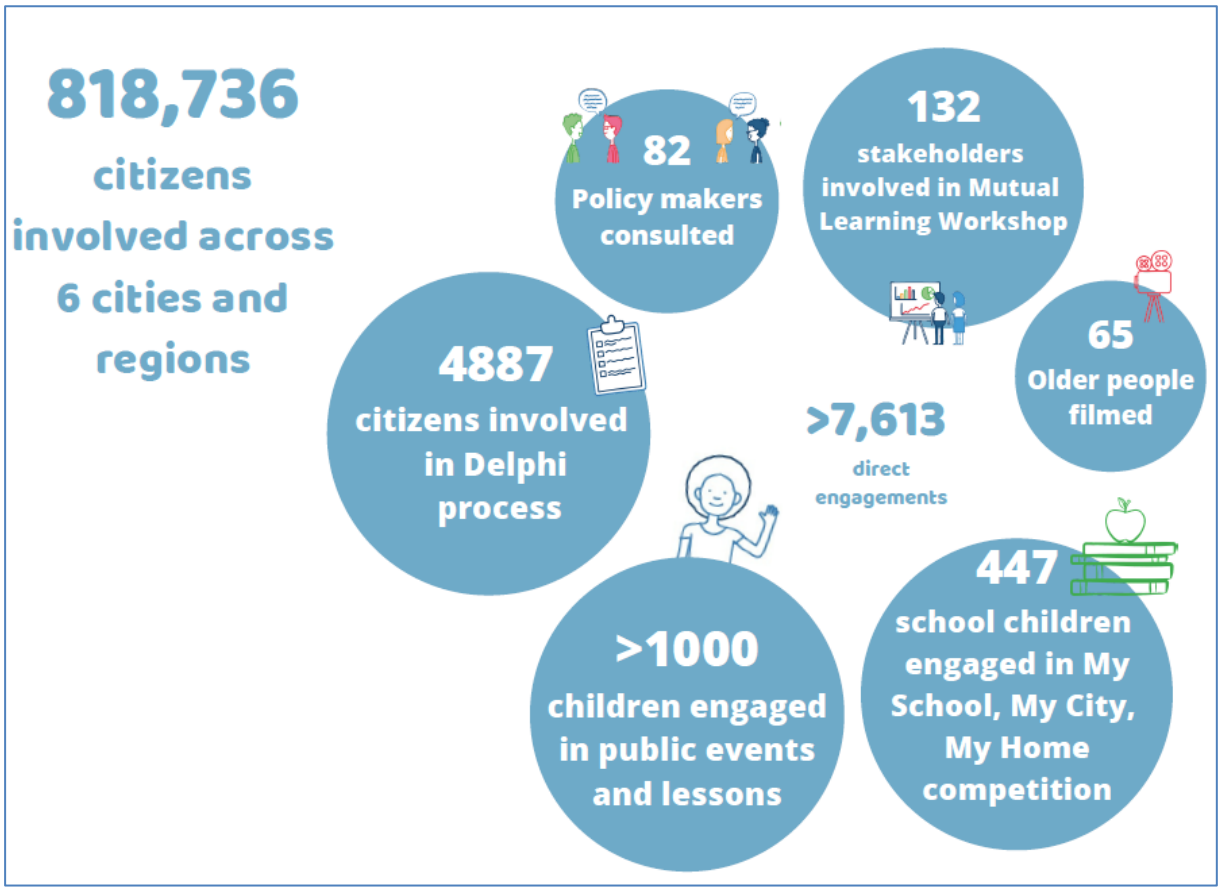
and policy maker scenario for each city ('Unified Policy Scenario' – UPS) is produced (Phase 2B).

Project Phase 3 involves quantification of the UPS in each city and assessment of the emissions, concentrations and health impacts of this scenario compared to a policy baseline scenario (Phase 3A). It also comprises an assessment of city best practices, barriers and enabling factors regarding citizen involvement, as well as mutual learning about these factors between cities (Phase 3B). As a final step in this phase, policy recommendations and a City Action Plan are provided for each city (Phase 3C).

2.2 Project scope

ClairCity was designed as a four-year research project over the period 2016 – 2020. In the project, 16 partner organisations were involved in research in six cities and regions across Europe. In total, there were over 7,600 direct engagements with citizens and stakeholders during the project, with more than 800,000 indirect interactions in e.g. gaming and questionnaires (Figure 2-2).

Figure 2-2 ClairCity in numbers



When interpreting the results of ClairCity, two limitations of the project have to be taken into account:

Throughout the ClairCity project, the utmost has been done to ensure that citizen engagement is representative of the population demographics of each city. For this purpose,

activities have been organised in different neighbourhoods, and people have been asked for basic demographic data such as gender, income, ethnic group and education. Nevertheless, in none of the cities has this led a truly fully representative sample of the city population. Therefore **citizen views as given in this report should be regarded as informative about the views of the total city population.**

Further, in the ClairCity project, state-of-the-art modelling was applied in order to establish policy baseline and Unified Policy Scenarios giving information about emissions and concentrations of air pollutants and greenhouse gases as well as impacts on citizen health. A modelling approach was developed that was applied in all six cities and regions. However, it was beyond the scope of this project to verify the modelling against different local modelling approaches applied by city and national policy makers. Hence **all quantitative figures of ClairCity modelling should be regarded as indicative only. The modelling does not imply any legal consequences for the cities.**

3 City Policy Baselines Compared

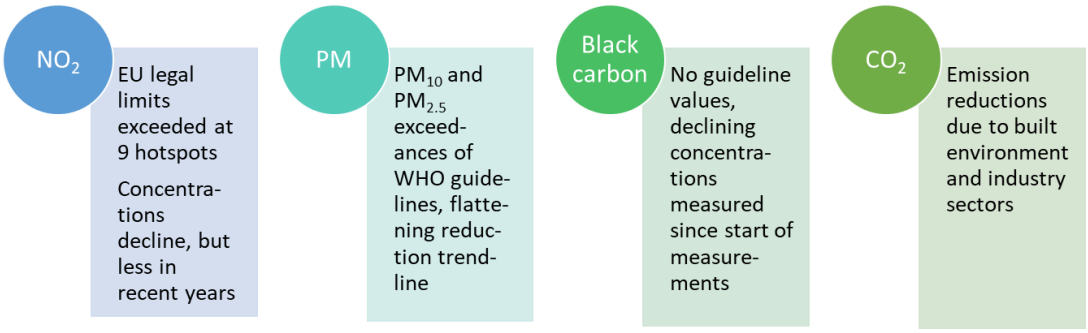
The policy baseline situations for all cities and regions were established by way of literature study and interviews with local stakeholders and policy makers. The baseline assessments consisted of an inventory of the overall air quality and carbon situations in the six cities/regions and an outline of key city policy measures. In total, across the six cities/regions, 115 policy makers and representatives of civil society, science and business were interviewed to better understand the local policy landscape. The baseline year of assessment was 2015 and we are primarily concerned with NO_2, PM_{10} and $PM_{2.5}$ plus carbon emissions.

3.1 Air quality and carbon situation

- **Air quality and carbon emissions situations vary substantially between the six cities/regions. Whereas some cities are struggling to meet some EU legal standards for air quality, others are aiming to meet the stricter WHO guideline values.**
- **Detailed analysis of statistical data of transport behaviour of citizens that were available in Bristol and Amsterdam showed large differences between transport practices of citizens contributing most to air pollution: whereas shopping and leisure were found the most polluting practices in Bristol, commuting was the most polluting transport activity in Amsterdam.**

The six ClairCity cities/regions vary substantially in size, geographical and socio-economic situation. Rather than giving detailed quantitative outlines for all cities/regions (these are available in the baseline reports), this section tries to establish a general view of the main emissions trends. It was found that emissions have decreased in recent years, but air quality and carbon baseline situations are still very different between the cities/region. As an example for the air quality and carbon baseline established in each of the six cities, Figure 3-1 summarises the situation in Amsterdam.

Figure 3-1 Summary of air quality and carbon situation in Amsterdam[6]



[6] Data are updated until 2017, when the Amsterdam policy baseline report was published

Comparing the baseline emissions/concentrations in the six cities/regions, main conclusions are:

- For **NO_2**, road traffic is the main source in most cities, although Aveiro/CIRA and Genoa/Liguria also report ships as a major contributor due to their harbours. Exceedances of EU limit values occur in most cities at specific road hotspots (e.g. Amsterdam, Bristol, Genoa). Ljubljana reports NO_2 not to be a major issue, with no exceedances measured in the whole country since 2014.

- For **PM**, domestic biomass burning is a main source of concern in most cities, partly due to pollution from the surrounding rural areas. Situations vary from widespread coal and biomass burning in Sosnowiec, biomass burning in rural parts of the region Aveiro/CIRA and around Ljubljana, to biomass burning as a more incidental issue at house boats and restaurant terraces in Amsterdam. Where Sosnowiec reports widespread exceedances of EU PM standards (and of BaP standards) due to low-stack burning, Amsterdam is striving to accomplish stricter WHO guideline values also by paying increasingly attention to smaller particles (moving from PM_{10} to $PM_{2.5}$ and soot). In Bristol, PM has re-emerged as a cocern due to local transport and an increase in solid-fuel stoves for recreational heat.

- **CO_2e** emissions are reported to be declining in all cities in recent years, partly due to stricter national legislation stimulating low-carbon energy sources and energy-efficient building regulations in the countries in which the cities are situated. There are no local standards for CO_2e emissions, apart from more general long-term goals to become 'carbon-neutral' e.g. Bristol and Amsterdam.

Two of the ClairCity cities (Bristol and Amsterdam) had suffient data to relate air quality to transport behavioural practices of citizens (Figures 3-2 and 3-3). Shopping and leisure transport showed to have a very large contibution to citizen related transport emissions in Bristol (50% of NO_x and 51% of PM_{10} emissions respectively), while work-related travel was the main source of transport emissions caused by citizens in Amsterdam (24% of NO_x and 30% of PM_{10} emissions respectively).

Figure 3-2 Relative importance of trip motives in citizen-related transport emissions in Bristol in 2015 (Source: ClairCity modelling)

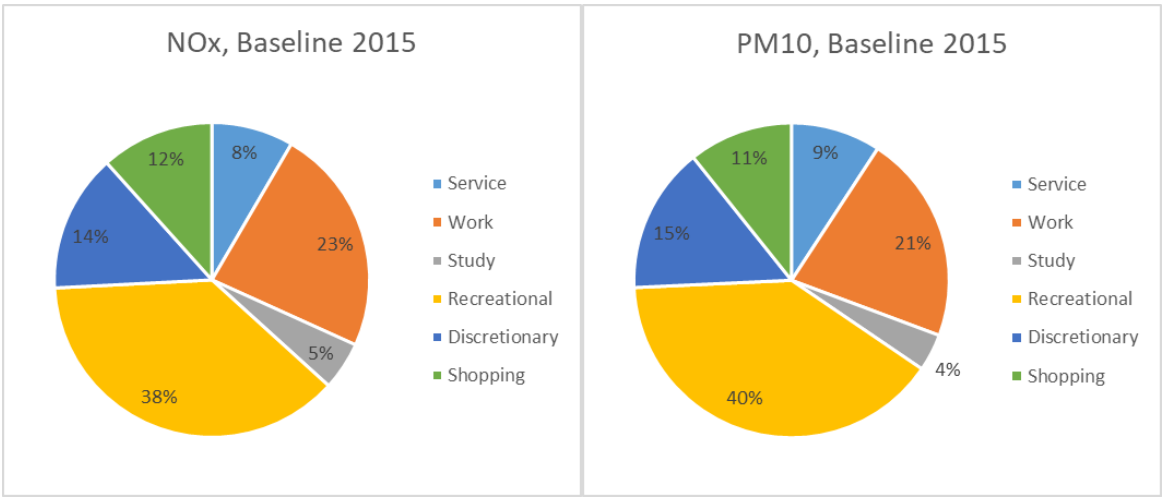
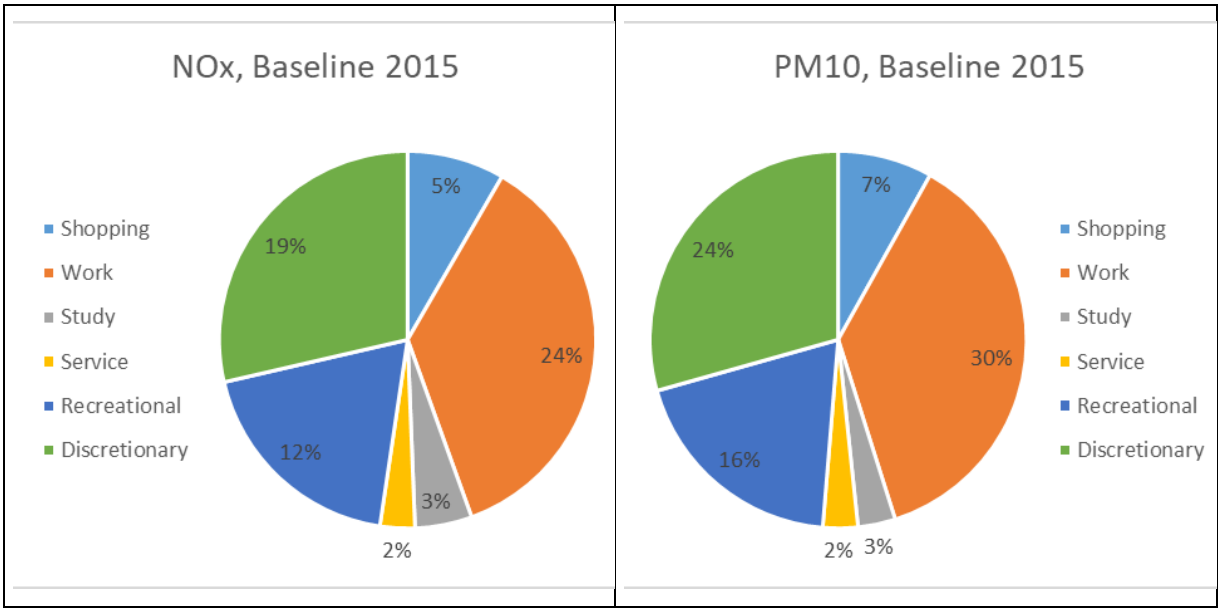


Figure 3-3 Relative importance of trip motives in citizen-related transport emissions in Amsterdam in 2015 (Source: ClairCity modelling)[7]



3.2 Existing air quality and carbon policy measures

- **The kind of policy measures applied in all cities is very similar, thus providing basic or consistent conditions for the application of the ClairCity process in other cities. However, the ambition and degree of implementation of these measures, spatially and temporally is very different between the cities.**
- **The extent of involvement of citizens and the way of framing air quality and carbon policies vary substantially between the cities. Next to health, 'active environmental citizenship', 'equality' or 'environment as a co-benefit of other policies' are main frames for engaging citizens.**

3.2.1 Policy measures – common themes

Focusing on transport and heating policies as main areas where citizen behaviours are relevant, the ClairCity baseline analysis showed that the overall framework for air quality and carbon policy measures is very similar in all the cities. The stimulation of public and active transport and the discouragement of private car use were found to be the main ingredients for influencing citizen transport behaviours. Promoting renewable and less carbon-intensive energy sources, district-heating, energy-efficient building investments and energy-efficient heating behaviours were identified as main measures for influencing energy behaviours (Table 3-1). This stability of the basic policy framework for citizen-related air quality and carbon policies throughout cities suggests that in other cities the same framework should be

[7] Based on data of Centraal Bureau voor de Statistiek (CBS); Rijkswaterstaat (RWS) (2016): Onderzoek Verplaatsingen in Nederland 2015 - OViN 2015. DANS. https://doi.org/10.17026/dans-z38-prz4

found as well – thereby providing a basic on consistent condition for applying the ClairCity method in these cities as well.

Table 3-1 Main city policy measures to infuence citizen transport and heating behaviours

Air quality and carbon policy area	Main measures influencing citizen behaviours
Transport	– Stimulation of public transport – Promotion of active transport (walking, cycling) – Disencouraging private car use
Energy	– Promotion of low-carbon energy sources – Stimulation of district-heating – Stimulation of energy-efficient building investments – Encouraging energy-efficient heating behaviours

In each ClairCity case study, other parts of this framework were found to be more prominent in policy making. Regarding public transport, **improving the integration of rural and urban transport** was found to be an important issue for instance in Bristol, Aveiro/CIRA and Ljubljana. Expansion of train transport infrastructure in addition was found an issue in Ljubljana. All cities were investigating possibilities for increasing the frequency of public transport.

Active transport stimulation in the six cities varied between expanding the already wide-spread bike use in Amsterdam to the first steps in constructing an independent cycling infrastructure e.g. Sosnowiec. The stimulation of walking as a separate active transport measure was not found to be a very prominent policy issue in any of the cities apart from Ljubljana, where the city centre is dominated by a large pedestrian zone that was gradually expanded in the past decades.

Disencouraging private car use showed to be a particularly sensitive issue in the ClairCity cities. The Clean Air Zone limiting access of polluting private cars and charging other categories of transport was found a key policy issue in Bristol, with Amsterdam also expanding its 'Environmental Zone' to encompass private cars in recent years. Amsterdam also disencourages private car use by very high parking tariffs throughout the whole city centre and limiting physical parking places. Other cities and regions, e.g. Aveiro/CIRA and Sosnowiec, showed much less activity in providing such incentives for reducing private car use.

Regarding energy, **promoting low-carbon energy sources** in the cities was found to vary between massive stimulation of solar panels on private roofs in Amsterdam to the stimulation of, in particular, the transition from coal to gas heating in Sosnowiec. The expansion of district-heating networks was considered in several of the ClairCity cities (e.g. Bristol, Amsterdam, Ljubljana). Encouraging energy-efficiency investments and behavioural change of citizens was not found to be a high-profile topic in any of the cities, although some activities were ongoing e.g. Amsterdam.

3.2.2 Policy framing for citizen engagement

The ClairCity policy baseline analysis also examined the framing of air quality and carbon policies in all cities, i.e. the main motivation provided by policy makers for active engagement of citizens in air quality and carbon policies. 'Health' was found to be a framing for air quality policies in all cities to some extent e.g. Amsterdam framing health in terms of 'number of cigarettes passively smoked'. Number of life-years lost and premature deaths were other framings of health impacts found to be used in the six cities. Apart from that, Amsterdam, Bristol and Ljubljana appeared to have more clearly recognizable approaches to citizen engagement, Aveiro/CIRA, Genoa/Liguria and Sosnowiec less so (Table 3-2).

Table 3-2 Different framings for citizen engagement in the ClairCity cites

City	Framing citizen engagement
Amsterdam	Active environmental citizenship in an 'energetic society', supporting citizens to become active themselves individually and with collective action.
Aveiro / CIRA	Less engagement in activating citizens for environmental policies
Bristol	Equality of citizens, environmental action being 'just' also for less affluent citizens and ethnic minorities.
Genoa / Liguria	Less engagement in activating citizens for environmental policies
Ljubljana	Direct policy engagement in stimulating behavioural change, partly in EU projects
Sosnowiec	Less engagement in activating citizens for environmental policies

Looking into the role of civil society in air quality and carbon policies, in Sosnowiec it was found that an NGO also active on a national scale but with a local branch had a key role in pushing environmental policy making towards more ambitious targets. In other cities, various degrees of NGO activities were found, with legal NGO action on a local or national level playing a role air quality and carbon policies in Amsterdam and Bristol e.g. ClientEarth in the UK. In Ljubljana, with one political party for a long time in power in the city, there were some concerns of NGOs that different voices to official policies were suffiently heard.

4 Citizens views on cleaner air quality and carbon policies compared

In the ClairCity engagement process, citizens were asked for their current transport and heating behaviours, their willingness to change those behaviours in the future, and for their preferences regarding future air quality and carbon policy measures for their city. The first round of the engagement process, involving a large-scale questionnaire to a mixed sample of respondents throughout each city, led to some 3,000 responses of citizens in the six cities (Table 4-1).

Table 4-1 Number of ClairCity respondents in each city (first round engagement)

City/region	Number of Round 1 respondents
Amsterdam	638
Aveiro / CIRA	794
Bristol	500
Genoa / Liguria	646
Ljubljana	198
Sosnowiec	283
TOTAL	**3059**

Despite extensive attention paid to involving mixed samples in terms of neighbourhoods, gender, income, ethnicity and education, in none of the cities the samples were fully respresentative for the whole city population[8]. The citizens' views expressed here therefore should be regarded as informative and not as representative, nevertheless giving a well-informed indication of opinions of the city population as a whole[9].

4.1 Views of citizens on their transport and heating behaviour, now and in the future

- **There is a high willingness to change transport behaviour in the future in all ClairCity cities. On average, 28 to 34% of respondents in all cities currently using a private car part-time or full-time for commuting, shopping and leisure transport expect to change to other modes of transport in the future but many feel entrenched in their current patterns of behaviour.**
- **The results indicate that there is a gap between policy aims and citizen willingness to change behaviours e.g. Amsterdam, where many citizens still expect to heat their houses with gas and to drive into the city centre by car, despite city policies to reduce these activities to zero in the future.**

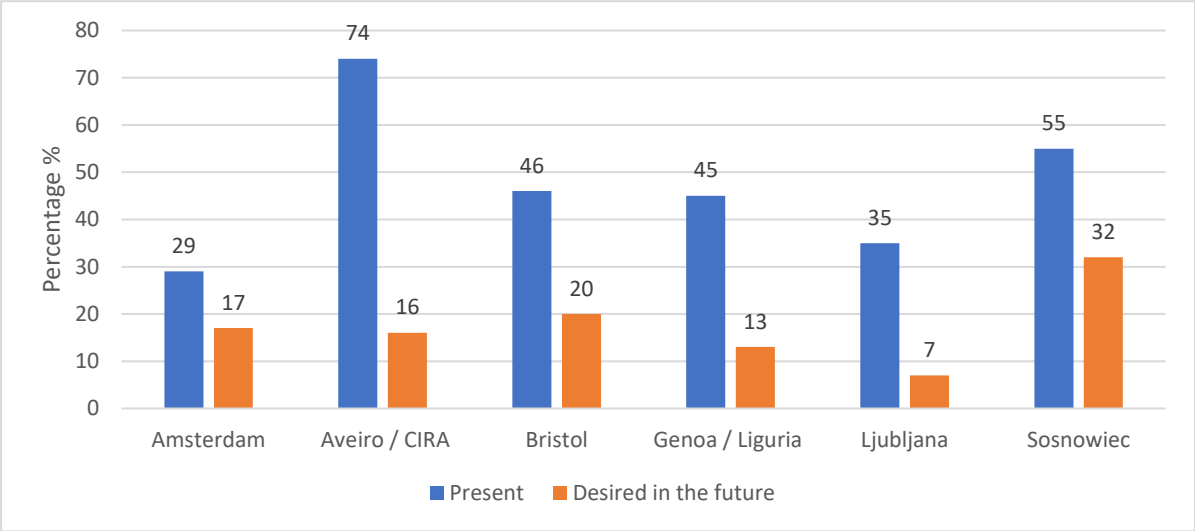
[8] See ClairCity Delphi reports, www.claircity.eu One main bias found throughout all cities was that citizens were generally higher educated than the average city population.
[9] The number of answers varied per question asked, with a maximum number of answers given as indicated in Table 3-1

- **More detailed results also point to the relative low popularity of district heating with citizens in all cities, which overall indicate that they want to reduce the share of district heating by 9%, even despite the fact that it could contribute to reducing emissions if it would switch to renewables.**

4.1.1 Commuting transport behaviour

Figure 4-1 shows the percentage of part- and full-time car users in the group of respondents in each city, using either their private car together with other modes of transport, or car only. In the more rural region of Aveiro/CIRA, the number of current car users is clearly the highest (74%). In Sosnowiec, more than half of the respondents use a private car (55%), while in Amsterdam the number of current car users is the lowest (29%). Willingness to change their behaviour to non-car modes for commuting is high in all cities (on average 30%). A relatively low willingness to change by current car users was found in Sosnowiec (23%) and in Amsterdam (12%). The latter could perhaps be explained by the already low number of car users in that city. In Ljubljana, the number of respondents indicating to continue using their conventional car in the future was found the lowest (7%).

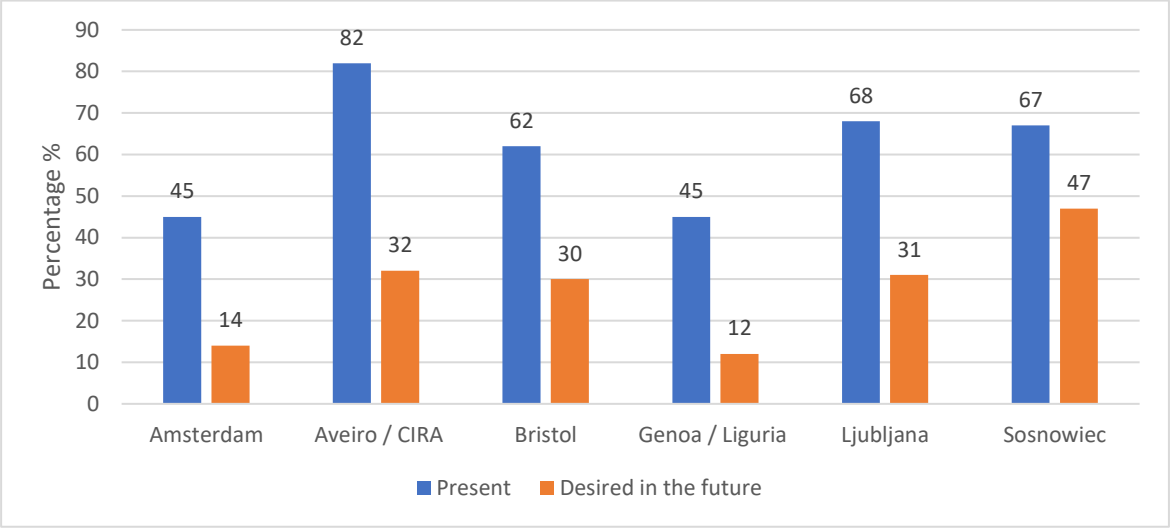
Figure 4-1 Share of part- and full-time conventional car users in total commuter transport within group of respondents (%) (Source: ClairCity Delphi process)



4.1.2 Shopping transport behaviour

Figure 4-2 shows the number of respondents using a conventional private car for shopping, either part- or full-time. Percentages of car users for shopping in all cities are higher than for commuting, indicating that the car is generally seen as a convenient way of transporting any goods bought. The willingness to change shopping behaviours is generally similar to that for commuting. As the initial percentages of car users are higher, also the number of respondents that will continue to use their car for shopping in the future will be higher. Exeption is Amsterdam, where the willingness to change shopping behaviour (31%) is much higher than that to change commuting behaviour (12%). The lowest number of car users for shopping in the future is found in Genoa/Liguria (12%).

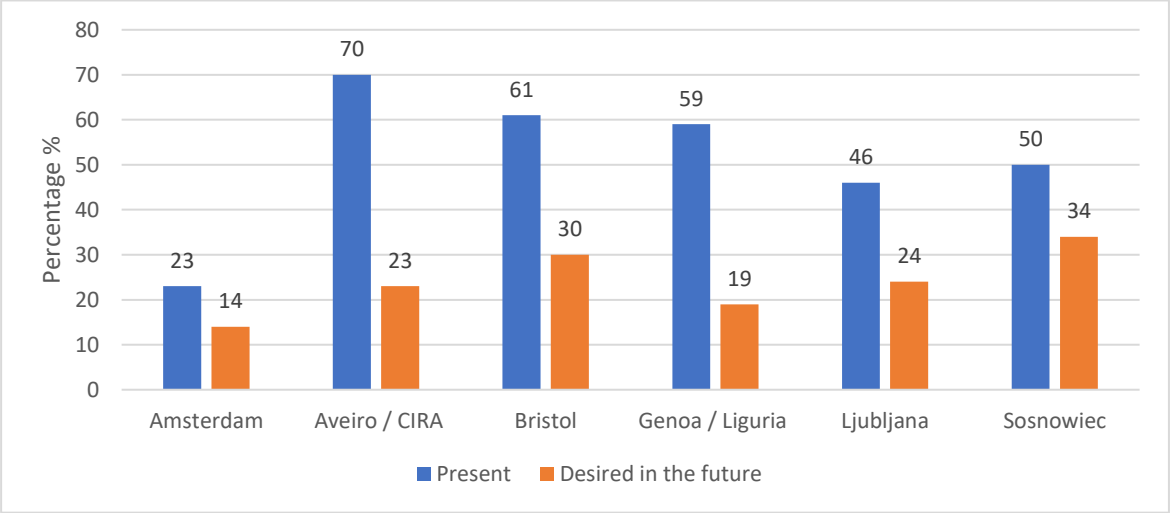
Figure 4-2 Share of part- and full-time conventional car users in total shopping transport within group of respondents (%) (Source: ClairCity engagement process)



4.1.3 Leisure transport behaviour

Average willingness to change leisure transport behaviour in the ClairCity cities is in lower than willingness to change commuting or shopping behaviour (28%, compared to 30% and 34% respectively) (Figure 4-3). Again, willingness to change behaviour is lowest in Amsterdam (9%), but due to the low number of present car users for leisure transport the resulting number of car users for leisure in the future is nevertheless the lowest of all cities. The highest number of future car users for leisure is found in Sosnowiec (47%).

Figure 4-3 Share of part- and full-time conventional car users in leisure transport within group of respondents (%) (Source: ClairCity engagement process)

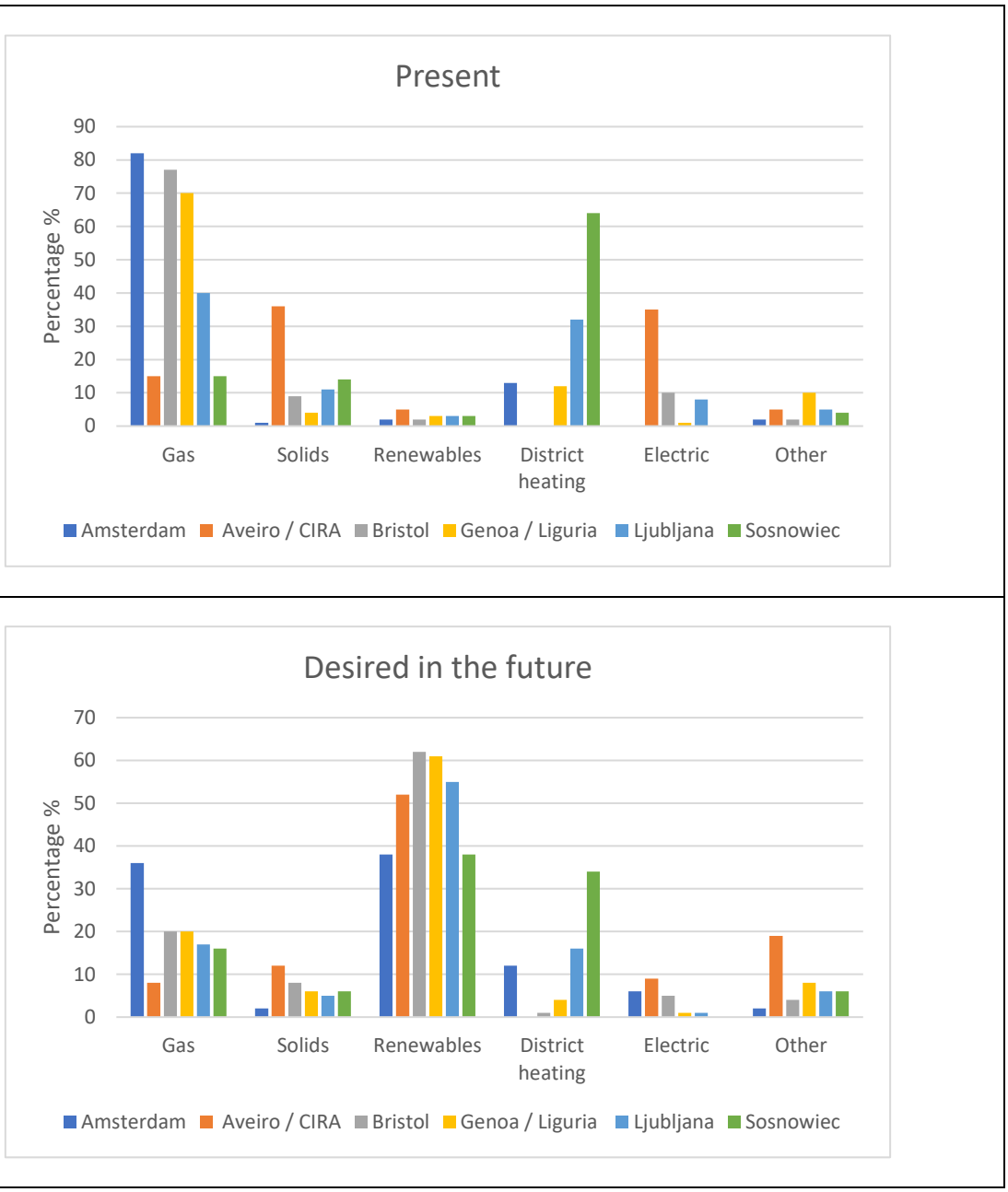


4.1.4 Heating behaviour

Figure 4-4 gives the current shares of energy sources for heating under respondents in the cities. In many cities gas is currently the main source of home heating. District heating has a particularly high share in Sosnowiec, and electric and solids in Aveiro/CIRA. Many

respondents indicate that they want to change to renewables in the future (average change over all cities 48%). Gas and district heating shares will be reduced substantially (-30% and -9%), despite the fact that district heating could very well be an environmentally sound way of heating if its main energy source would be renewables. Solids use on average will only decrease by 6%. In Amsterdam, some 36% of respondents expect to continue heating their houses with natural gas, despite city policies to reduce natural gas use in the built environment to zero.

Figure 4-4 Shares of energy sources for home heating – at present and desired in the future (%)



4.2 Views of citizens on future policies in their city or region

- **Citizens' views often reflect the general policy discussion in the city. Proposed measures differ from existing policy in particular in the implementation speed or the desired ambition.**
- **Measures desired by citizens sometimes seem contradictory, e.g. 'more free car parking' and 'prohibit cars in the city centre'.**

ClairCity respondents were asked about their preferred air quality and carbon policies for their city.That resulted in overviews like the one in Figure 4-5 for Genoa / Liguria. Table 4-2 gives the top-5 preferred policy measures by citizens in all cities. Measures seem to reflect actual policy discussions in the city, like the measure to "*prohibit scooters on bike paths*" in Amsterdam, which was a much debated topic when the questionnaire was conducted. Some of the preferred measures are also contradicting each other, like the top-2 in Ljubljana to "*create segregated cycle lanes*" and to "*scrap cycle lanes*". These contractions illustrate the challenge for policy makers to reach concensus but also an important opportunity to gauge citizens perceptions and attitudes of specific policies.

Figure 4-5 Views of citizens on the impact that proposed policy options would have on their city: example Genoa / Liguria (source: ClairCity engagement process)

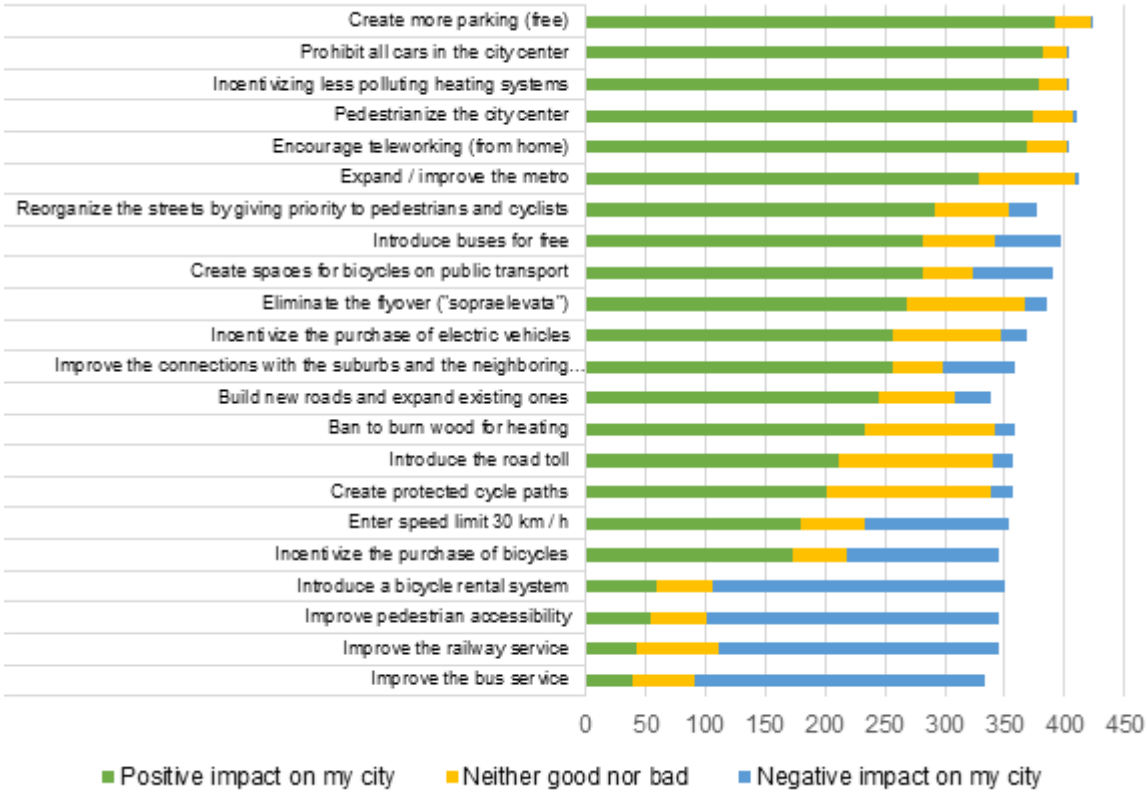


Table 4-2 Top-5 desired policies for their city according to ClairCity respondents (Source: ClairCity Policy Reports)

	Amsterdam	Aveiro / CIRA	Bristol*)	Genoa / Liguria	Ljubljana	Sosnowiec
1	Introduce clean buses	Improve enforcement of parking restrictions	Improve bus services	Create more free parking	Create segregated cycle lanes	Introduce free bus service
2	Improve road safety	Ban cars from city centre	Create segregated cycle lanes	Prohibit all cars in the city centre	Scrap cycle lanes	Subsidise bike purchase
3	Prohibit scooters on bike paths	Create more cycling infrastructure	Open closed railway lines	Incentivise less polluting heating	Ban wood burning stoves	Create segregated cycle lanes
4	Improve bus and tram services	Incentivise electric vehicles	Make buses free	Pedestrianise the city centre	Improve pedestrian access	Improve pedestrian access
5	Sustainable heat services by housing corporations	Reduce the number of car parks	Introduce trams	Encourage working from home	More road space for cyclists and pedestrians	Build more / widen existing roads

*) As a first city, the method for determining the priority measures of citizens was slightly different in Bristol than in the other cities. After team selection, 'banning most polluting vehicles', 'making buses cleaner & greener', 'making public transport cheaper' and 'providing good alternatives to car use (walking and cycling)' were used as final inputs for the Bristol policy workshop

4.3 Reflections from policy makers on citizens' views

- **In several cities, policy makers substantially reduce ambition levels preferred by citizens. Amsterdam policy makers seem most ambtious, Sosnowiec policy makers least ambitous.**
- **Costs and technical limitations to achieve implementation speeds and ambitions desired by citizens are main motives for these restrictions.**
- **The ClairCity method results in policy ambitions of citizens being dampened, but also in more realistic and, according to policy makers, implementable scenarios.**

The ClairCity co-creation process included a policy workshop in each city to give policy makers the opportunity to reflect on the citizens' ambitions. Policy makers could choose between "high" and "low" ambition levels for each of the policy measures selected by citizens (Table 4-3). They could also comment on barriers and enabling factors for each of the policies. The result was a "Unified Policy Scenario (UPS)" for each city that was used in the next step of the ClairCity process to examine likely impacts compared to a "Business-As-Usual (BAU)" policy scenario. As an example, Table 4-4 gives the UPS scenario for Sosnowiec.

Comparing the policy maker review of the citizen choices in all cities, it was found that policy makers in Amsterdam and Aveiro/CIRA backed more high ambition options than low ambition options and in Sosnowiec and Ljubljana the lowest ambition level was chosen more often. In addition, Ljubljana defined a "medium" ambition level for the city and Liguria chose the current policy level as "low" level. Bristol didn't have a quantified high v low ambition option during their workshop but policy makers did predominantly agree with the ambition levels of the citizens and in some cases went higher.

Table 4-3 Ambition levels of policies chosen by policy makers

City/Region*	Total measures (#)	# of LOW ambition policies chosen	# of HIGH ambition policies chosen
Amsterdam	11	3	8
Aveiro/CIRA	10	4	6
Genoa/ Liguria* **	6	3	3
Ljubljana**	10	6	4
Sosnowiec	10	7	3
Total	48	24	24

***The design of the Bristol Policy Workshop did not include choosing ambition levels for policies – Refer to D6.5 Policy Workshop – First City for the Bristol Policy Workshop design.*
*** Ljubljana defined a MEDIUM ambition level, which is considered here as LOW for comparison purposes*
****Genoa/Liguria worked with a CURRENT vs HIGH scenario (instead of a LOW & HIGH scenario) where CURRENT ambition means existing/planned policy ambition. For the sake of comparison the CURRENT has been considered the LOW ambition scenario.*

Cheaper / subsidised public transport as a policy measure selected by citizens in several cities did not get back up from policy makers in any of the cases. At the same time Ljubljana was the only city that had a policy option to make transport more 'expensive'. Also *cleaner public transport* scored the "low" ambition in all cases. Generally, the reasons for opting for a "low" ambition level (in these two cases but also for the rest) were the cost of measures and the fact that the timeframe proposed in the "high" option was considered as unrealistic for technical reasons. Amsterdam, Ljubljana and Genoa/Liguria were found to be ambitious in discouraging car use; Sosnowiec and Aveiro/CIRA less so.

Overall, the process of creation of policy scenarios by citizens and commenting them by policy makers as implemented and refined in the six cities worked well and turned out to be feasible in practice. Policy makers found the measures presented reasonable, and discrepancies between citizens' and policy maker ambitions were found mostly regarding timeframe and ambition level. Therefore it is concluded that:

1. the co-creation model of policy making provided by ClairCity between citizens and policy makers seems feasible to be implemented in other cities as well, and
2. the ClairCity process funnels and refines policies from citizens to policy makers. This filters out the most radical / innovative policies of citizens, but also results in a policy scenario that may be challenging but realistic to be implemented in a city.

Table 4-4 Proposed Policy Workshop Unified Scenario in Sosnowiec based on Policy Workshop outputs and current policy baseline

#	Measure	Low option	High option	Chosen	Comments ('Main barriers to be overcome, ways to overcome these barriers = 'implementation plan')
1	Make public transport free/cheaper	Free public transport on days with high level of air pollution by 2020	Free public transport by 2025	Low option	• Too big of a financial barrier. The local government is not able to cover the costs of implementing free public transport from its own budget. For transport enterprises and for the metropolis, which is responsible for organizing the public transportation in the whole region, it will be too much financial burden. • Ticket prices are not high plus there are already discounts for youth, free transfers for senior citizens, monthly and quarterly passes. • Free public transport passes will probably not increase the number of people who use it.
2	Reduce emissions from public transport	Replace 10% public transport fleet with zero-emission vehicles by 2030	Replace 50% public transport fleet with zero-emission vehicles by 2022	Low option	• The biggest constraints are the lack of charging stations (plan being prepared at the moment) and the financial barrier. • When it comes to the individual vehicles, the barrier is also economic – it is hard to induce inhabitants to replace their diesel cars with very expensive electric cars.
3	Improve the public transport service/connectivity	90% public transport journeys on schedule and most areas catered for by 2020	100% public transport journeys on schedule and most areas catered for by 2020	Low option	• Low scenario has been chosen because the timeframe proposed by citizens is too short for implementing this measure. To reach 100% of journeys that are on schedule and with connections in most areas, it needs a longer time perspective than 2020.
4	Create/increase cycle lanes and infrastructure (storage, security)		20 km of new cycle lanes and 15 new cycle parking spaces by 2020	High option	• No barriers. The program of bicycle lanes expansion in Sosnowiec is developing very good, at present, the city is almost reaching the ambitious measure established by this scenario.
5	Encourage/incentivise electric vehicles	Replace 10% cars with EVs and 100 EV charging points installed by 2025	Replace 50% cars with EVs and 500 EV charging points installed by 2030	Low option	• Financial barrier – high costs of buying electric cars for individuals – it needs government subsidy for purchase as well as for the construction of charging points enabling traveling on longer distances.
6	Restrict (polluting) vehicles	Ban diesel cars from the city centre on days with level of air pollution by 2050	100% ban on fossil fuelled vehicles by 2025	Low option	• Participants have chosen the low option, but they would like to ban diesel cars from the city centre on days with level of air pollution in a faster perspective – by 2025, except for public transport – because the transport company has just bought new diesel buses). • The way to overcome the barrier is education of residents, consulting the plans for introducing the ban with them and gradually convincing them to such solution.
7	Raise public awareness of health/environmental impacts of air pollution	10% modal shift from private to public transport or active travel by 2030	80% modal shift from private to public transport or active travel by 2025	High option	• The main barrier is the lack of support from residents, who do not want to give up the convenience of driving their cars. • Another obstacle is poor quality of public transport – low frequency, bad accessibility in some areas. • The city intends to allocate funds for social campaigns aimed at convincing residents to give up driving a car and and more frequently use of public transport, cycling or walking.
8	Reduce emissions from domestic heating	Ban on domestic coal heating in districts with the highest concentration of air pollution by 2025	100% ban on domestic coal heating by 2020	Low option	• A low scenario has been chosen because 2020 is too short for implementing this measure. • Participants decided, however, that it should be possible to introduce such a ban sooner than the low scenario assumes. • The ban should cover the entire city. Introducing it only in specific districts, where the greatest emission of pollutants from coal-fired households occurs, will not bring the expected results, because the wind transfers pollution.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689289

					• The main barriers relate to finance - as already mentioned earlier, the costs of installation and subsequent exploitation are high - and the associated resistance of residents. In addition, from the next year, co-financing from the municipal budget for replacement of the furnace will not include coal-fired furnaces (currently old coal stoves are replaced with newer-generation coal stoves). The municipal financing program will be continued on changed conditions. • Another barrier is the fact that heating networks are not available everywhere.
9	Replace old domestic heating systems	Replace 75% heating systems > 10 years old by 2025	Replace 100% heating systems > 10 years old by 2021	High option	• The high scenario has been chosen because the measures contained in it are imposed by the binding anti-smog resolution. • Obstacles hindering the implementation of this scenario is social resistance and associated financial barrier (financial situation of both residents and municipality) - stoves replacement is in 80% co-financed by the city. • Ways to overcome barriers: through an educational campaign, convincing residents of the benefits of such a solution for their health and quality of life, and the introduction of a control system and penalties for residents polluting the air – municipality will continue activities related to the control of stoves exchange and enforce it from residents.
10	Reduce industrial emissions	Reduce industrial emissions by 25% by 2025	Reduce industrial emissions by 50% by 2025	Low option	• The low option has been chosen because the high one is unrealistic. Currently industrial plants are concerned with increasing their production, which causes more pollution. In addition, Sosnowiec is also polluted by plants from other cities that are in the immediate vicinity of Sosnowiec. • A legal barrier has been recognized - the municipality does not have legal means to enforce the reduction of emissions. We cannot impose on the plants greater reduction of emissions than the legal provisions regulate.

5 Impacts of Implementing Citizen Views Compared

ClairCity has modelled the impacts of the Unified Policy Scenarios on emissions and concentrations of the air pollutants NO_2, PM_{10} and $PM_{2.5}$, the resulting health impacts, and the impacts on CO_2e emissions. The project has also assessed, qualitatively, the possible costs of some measures in these scenarios. More specifically, in the modelling, a comparison was made between likely impacts until 2050 of the 'Unified Policy Scenarios' (UPSs), co-created from the citizens' policy ambitions and the reflections of the policy makers on these, and 'Business-As-Usual' (BAU) scenarios extrapolating policies that were envisaged in the base year 2015[10].

The ClairCity modelling has been verified against local monitoring but has not been verified with local air quality models in each city and therefore should be regarded as indicative only.

5.1 Impacts on air quality

- **The improvement of air quality until 2050 as a result of the co-created citizen and policy maker scenarios is likely to be highest in Amsterdam and Bristol. In these cities, policy makers also reduced the citizen ambitions the least.**
- **In all cities, apart from Sosnowiec, until 2050, all EU legal limit values for air pollutants are likely to be achieved. Achievement of stricter WHO guideline values might still be an issue, in particular for $PM_{2.5}$.**

For each city, air quality spatial and temporal maps were prepared as shown in Figure 5-1 for Bristol. The main conclusions of this mapping are presented in Table 5-1. It has be taken into account that voluntary WHO guideline values that exist for PM_{10} and $PM_{2.5}$ are stricter than EU limit values[11]. In summary, it can be concluded that

- Differences between BAU and UPS scenarios are particularly pronounced in Amsterdam and Bristol, in which cities UPS scenarios might lead to compliance with legal limit values for NO_2 significantly earlier than the BAU.

- The air quality situation in 2050 is likely to be the best in Aveiro/CIRA and worst in Sosnowiec. Even in 2050, Sosnowiec will not comply with EU legal limit values for NO_2, PM_{10} and $PM_{2.5}$ in neither BAU nor UPS scenarios.

- WHO guideline values for NO_2, PM_{10} and $PM_{2.5}$ might only be met in 2050 in Aveiro/CIRA and Ljubljana for NO_2 and PM_{10}. This is particularly important for Amsterdam, where achievement of WHO values is an official city policy goal.

- $PM_{2.5}$ is the air pollutant that still needs most attention, as in none of the cities the WHO guideline values are likely to be met.

[10] Since 2015, policies in several of the ClairCity cities changed. However, in order to allow for a comparison of data between the cities 2015 had to be taken as a base year.
[11] Legal EU limit values and voluntary WHO guideline values are for NO_2: 40 / 40 µg m^{-3}; PM_{10}: 40 / 20 µg m^{-3}; and for $PM_{2.5}$: 25 / 10 µg m^{-3} annual mean respectively.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689289

Figure 5-1 NO_2, PM_{10} and $PM_{2.5}$ concentrations in the BAU and UPS scenario in 2050 for Bristol

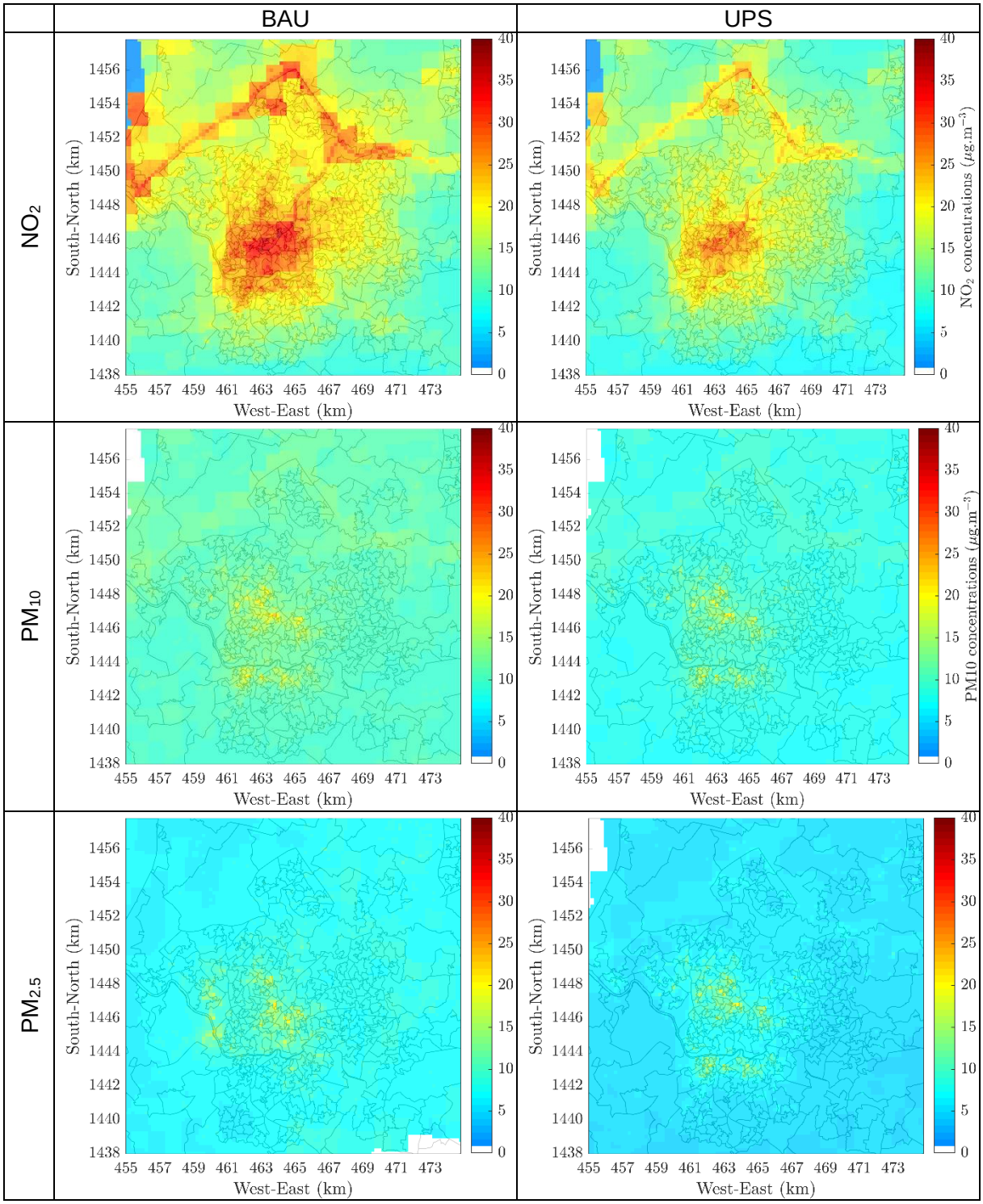


Table 5-1 Main conclusions regarding air quality impacts in 2050 comparing UPS and BAU scenarios (NO_2, PM_{10} and $PM_{2.5}$)

City	
Amsterdam	– **NO_2:** The BAU scenario still shows NO_2 concentrations around the legal limit values at some spots in 2050, whereas the UPS scenario reduces concentrations to values well below those limits everywhere. – **PM_{10}:** For PM_{10}, the BAU and UPS scenario comply with the legal limit values from 2025 on, but neither BAU nor UPS result in compliance with WHO guidelines even in 2050. – **$PM_{2.5}$:** For $PM_{2.5}$, BAU and UPS scenarios comply with legal limit values, but even in the UPS scenario there will be still significant exceedances of WHO guideline values in 2050.
Aveiro / CIRA	– **NO_2:** Both BAU and UPS scenarios lead to compliance with legal NO_2 limit values already in 2025. – **PM_{10}:** For PM_{10}, the BAU and UPS scenario comply with the EU legal limit values, as well as with the WHO guidelines. – **$PM_{2.5}$:** For $PM_{2.5}$, BAU and UPS scenarios comply with EU legal limit values, but even in the UPS scenario there are still significant exceedances of WHO guideline values in 2050.
Bristol	– **NO_2:** The UPS scenario leads to compliance with legal NO_2 limit values much earlier than the BAU scenario (around 2025). – **PM_{10}:** For PM_{10}, the BAU and UPS scenario are likely to comply with the legal limit values from about 2025 on. Neither BAU nor UPS result in full compliance with WHO guidelines in 2050, but the UPS scenario reduces concentrations more than BAU. – **$PM_{2.5}$:** For $PM_{2.5}$, BAU and UPS scenarios comply with legal limit values, but even in the UPS scenario there are still significant exceedances of WHO guideline values in 2050.
Genoa / Liguria	– **NO_2:** Both the BAU scenario and the UPS will nearly lead to compliance with legal NO_2 EU limit values in 2050. EU limit values will be exceeded only in two grid cells where people live. – **PM_{10}:** The BAU scenario and the UPS will both comply with the EU legal limit values for PM_{10}, but not with the stricter (albeit voluntary) WHO guidelines in 2050. – **$PM_{2.5}$:** Both the BAU scenario and the UPS scenario will comply with EU legal limit values for $PM_{2.5}$, in 2050. Nonetheless, in 2050, the entire population could potentially be exposed to $PM_{2.5}$ concentrations above WHO guideline values.
Ljubljana	– **NO_2:** Both BAU and UPS scenarios lead to compliance with EU legal NO_2 limit values in 2050 . – **PM_{10}:** For PM_{10}, the BAU and UPS scenario comply with the EU legal limit values as well as with the WHO guidelines in 2025 and 2050 . – **$PM_{2.5}$:** For $PM_{2.5}$, BAU and UPS scenarios comply with EU legal limit values, but even in the UPS scenario there are still significant exceedances of WHO guideline values for $PM_{2.5}$ in 2050 .
Sosnowiec	– **NO_2:** Neither the BAU nor the UPS scenarios will lead to compliance of legal NO_2 limit values, not even by 2050. – **PM_{10}:** Neither the BAU nor the UPS scenarios will lead to compliance of EU legal PM_{10} limit values, not even by 2050. – **$PM_{2.5}$:** For $PM_{2.5}$, even in the UPS scenario there are still significant exceedances of the EU legal limit values in 2050.

5.2 Impacts on health

- **In line with the modelled reductions of air pollutant concentrations in each city, the health impacts of the co-created scenarios are likely to be highest in Amsterdam and Bristol.**
- **The health improvements are in particular the result of reductions in NO_2 concentrations.**

Based on the modelled concentrations of air pollutants in the six cities, possible impacts of the UPS scenarios on health were also estimated. Table 5-3 shows that all UPS scenarios

result in health benefits compared to the BAU scenarios. However, in line with the modelled reductions of air pollutants in each city in particular in Amsterdam and Bristol there are substantial health benefits of the UPS to be expected (up to 26% extra benefits of UPS due to NO_2 related health effects). In the other cities the additional health effects of UPS are likely to be more limited.

Looking into health benefits to be expected from reduction of the concentrations of each of the pollutants, the likely health benefits as a result of $PM_{2.5}$ concentration reductions are lowest (between 2% and 59%) and as a result of NO_2 concentration reduction highest (up to almost complete elimination of health effects in Aveiro/CIRA). A possible explanation for the higher concentration reductions of NO_2 is that measures in all UPS scenarios focus on the transport sector.

ClairCity has also modelled likely health impacts on a grid cell level. The highest reductions of concentrations might occur in grid cells were less population lives (e.g. harbours, motorways)[12]. Concentration reductions of air pollutants and health improvements in the city therefore are not linearly related.

Table 5-2 Health benefits of BAU and UPS scenarios in 2050 compared to baseline in 2015 (=100%) (Combined health benefits in terms of life-years lost (YLL) and preliminary death rate (PD))

Combined health benefits (YLL and PD)		Benefit analysis for 2050 (%)		
		$PM_{2.5}$	PM_{10}	NO_2
Amsterdam	**BAU**	-8	-10	-27
	UPS	-23	-17	-53
Aveiro / CIRA	**BAU**	-2	-5	-100
	UPS	-3	-7	-100
Bristol	**BAU**	-49	-9	-27
	UPS	-59	-28	-53
Genoa / Liguria	**BAU**	-6	-10	-79
	UPS	-6	-11	-79
Ljubljana	**BAU**	-3	-5	-67
	UPS	-3	-5	-64
Sosnowiec	**BAU**	-18	-21	-40
	UPS	-19	-21	-41

[12] The results of this grid cell modelling have not been included here, due to the very high uncertainty margins to be expected for such detailed modelling on the longer term. However, the results of the grid cell modelling can be found in the individual city policy package reports. See www.claircity.eu

5.3 Impacts on carbon emissions

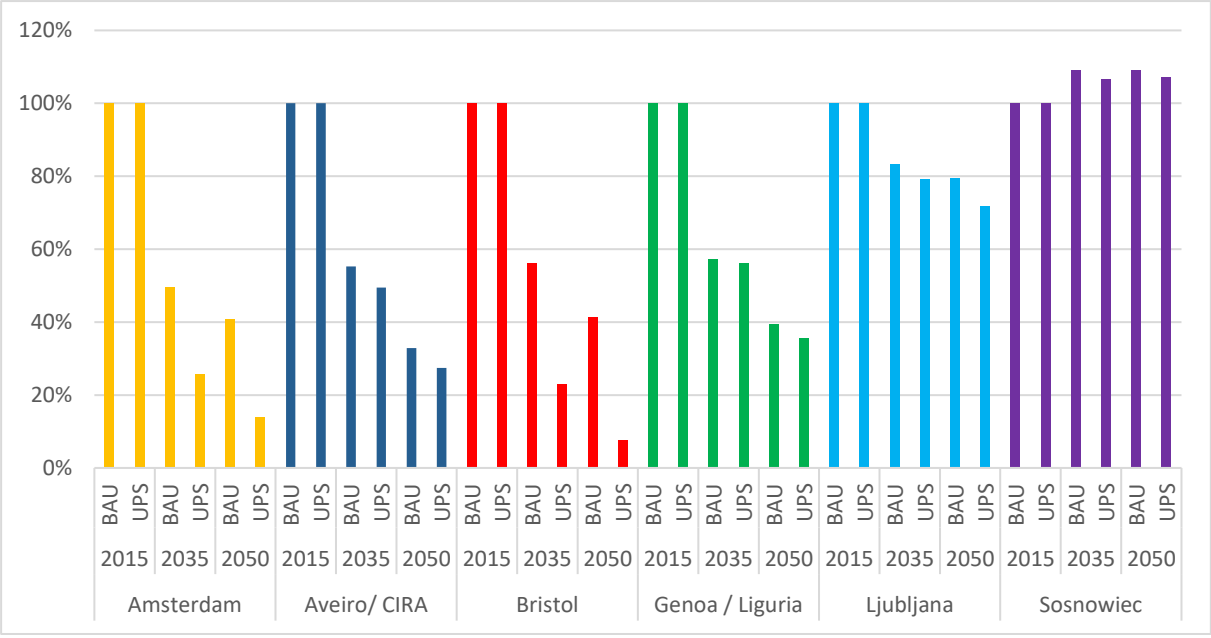
- **CO_2e emissions are likely to decline substantially in 2050 compared to 2015 in Amsterdam, Aveiro/CIRA, Bristol and Genoa/Liguria. Differences in emissions between UPS and BAU would be largest in Amsterdam and Bristol.**
- **The increase of industrial emissions modelled in Ljubljana and in particular Sosnowiec might well offset most of the citizen related reductions achieved in the residential and transport sectors in these cities.**

ClairCity also modelled the relative impacts of UPS and BAU scenarios on CO_2e emissions in each city. It was found that in 2050 in all cities the UPS results in slightly lower CO_2e emissions than the BAU scenario. Again there are large variations between the cities: very large differences between UPS and BAU in 2050 are found in Amsterdam and Bristol, much smaller differences in the other cities.

In Amsterdam, Aveiro/CIRA, Bristol and Genoa/Liguria the total CO_2e emissions are likely to have substantially decreased in 2050 in the BAU as well as in the UPS scenario. In Ljubljana this total reduction is much smaller, and in Sosnowiec CO_2e emissions would even increase in 2050 compared to 2015 in BAU as well as in UPS. This is due to a projected large growth of industry emissions in Ljubljana as well as in Genoa/Liguria.

Looking therefore only at combined residential and transport sector emissions in all cities (as relevant for citizen behaviours), in all cities the UPS emissions in 2050 would be lower than the BAU emissions in 2015, with UPS-2050 emissions varying between 4% (Bristol) and 84% (Sosnowiec) of BAU-2015 emissions.

Figure 5-2 Total CO_2e emissions in BAU and UPS scenarios in the six cities (CO_2e equivalent emissions over lifetime, BAU 2015 = 100%)



5.4 Impacts on costs

- **Direct costs of some measures in the co-created scenarios were assessed qualitatively only. While the costs of these measures will very much depend on the way of implementation, a balance of long-term costs and benefits might well be possible, even more if local funds are generated by way of levies and if also indirect health benefits are included in the equation.**

A qualitative assessment of possible costs of some measures in the co-created scenarios was made. In general, three types of measures were found (Table 5-3):

1. infrastructural measures with likely higher costs,
2. other measures with likely lower costs or even net long-run benefits, and
3. measures of which a cost assessment was not possible

Table 5-3 Qualitative assessment of costs of measures in the six cities

	Examples of measures
Measures likely to be more expensive on the long run	– Cleaner buses – Better public transport – Subsidise public transport tickets / free public transport
Measures likely to be less expensive, or possibly having net long-run benefits	– Energy efficient housing renovation – Accelerated uptake of renewables in the built environment
Measures of which it was not possible to qualitatively assess costs	– Property developers to consider air quality and climate change – Transfer part of road freight traffic to railway – Create cycle lanes and infrastructure – Ban diesel cars from city centres

Table 5-4 gives an example of a qualitative cost estimate made in one of the ClairCity cities (Amsterdam). In this estimate, a distinction was made between likely direct monetary costs for citizens and direct costs for the city council/government (thereby not distinguising between different levels of government). Both costs were summed and resulting net direct costs for 'society' were estimated.

The qualitative assessment suggests that net monetary cost effects of the UPS measures vary substantially and will sometimes result in additional costs and other times in net benefits for citizens and for city councils. Exact costs will also depend on how measures are designed in detail.

However, the overall balance of direct costs and benefits of all measures together also indicates that a cost effective execution of the UPS for citizens and city council / government might well be possible, as measures with a net direct cost to society could be balanced by measures with net revenues. This balance would be even more positive if also the indirect health benefits of improved health of citizens would also be included in the equation. Direct costs for city councils could also be partly compensated by measures creating benefits for them, e.g. higher parking tariffs, clean air zone levies, etc.

Table 5-4 Estimated cost impacts of citizen measures that are part of the UPS scenario in Amsterdam

#	Policy measure	Citizens	City Council/ Government	Society
1	Cleaner buses	0	-	-
2	Better public transport	+	-	-
3	More bike paths and bike parkings	n/a	n/a	n/a
4	Cheaper public transport	n/a	n/a	n/a
5	Environmental zone for polluting cars	-	0	-
6	Less parking for cars	-	+	0
7	Reducing car traffic in the centre	0	0	0
8	Accelerate energy efficient renovations	+	+	+
9	Ban wood stoves and fireplaces in houses and bars & restaurants (terraces)	0	0	0
10	Accelerate the uptake of solar panels in the built environment	++	-	+
11	Amsterdam (natural) gas-free	+	-	?

(+) = assumed net positive direct effect/ benefits for target group;
(-) = assumed net negative direct effect / costs for target group;
n/a = effect of measure cannot be assessed

6 Discussion – Mutual Learning

During the ClairCity process a variety of lessons were learned for citizen-inclusive air quality and carbon policy making that are summarised in this chapter. These lessons concern:

- the roles of stakeholders other than city councils and citizens in citizen-inclusive city policy making,
- lessons regarding specific policies, and
- overall lessons learned from City Policy Action Plans prepared for each city.

6.1 Other stakeholders

- **Citizen-inclusive air quality and carbon policies in cities have to be implemented within the framework of a large variety of relevant actors. European, national, regional policy levels as well as business and civil society have to be included as important actors in such policies.**

Air quality and carbon policy making in the ClairCity cities showed to be substantially influenced by the **European policy level**. Direct influence was found in particular through financing of projects and overarching initiatives like the 'green capital' initiative or the 'European mobility week'. Indirect influence was found to be exerted via overarching EU air quality legislation and climate policy goals that had to be transposed into national policies. Infringement procedures for not meeting EU air quality targets played an important role in many of the countries in which the ClairCity cities are situated. The commonality in the policies across all cities may also be a reflection of the top down role of EU policy as the overarching management frameworks has resulted in a consistent direction of Member States and cities.

National policy targets also were found to play a role in the ClairCity cities, although some cities formulated more ambitious policy targets than the national level. Also, financing mechanisms between national and local level showed to be important for the continuity of local policy making, e.g. Bristol. **Regional policies** showed necessary for integration of transport and energy measures between cities and the surrounding areas. In some cases, regional showed to be restrictive for local iniatives, e.g. Amsterdam wind turbine developments. **Local politics** may also have an impact on the ambition levels set where the need for economic growth is not matched by environmental management. This divergence in ambition may be as a consequence of a disconnection between local politicians and citizens voices – ClairCity offers a platform to close this gap.

Local **business** was found to be important as an ally in local policy making, for instance to influence shopping or commuting behaviours of citizens by stimulating public transport use or active transport to reach their premises or by considering to implement workplace parking levies, working at home and flexible working hours.

NGOs and civil society were found to be particularly important in several cities, for instance in Sosnowiec, where an NGO active on the local and national level had important influence on stricter air quality legislation. In other cities, NGOs were found to influence local policy

making by legal action (e.g. ClientEarth in UK) or by engaging citizens in citizen science action to monitor local air quality.

6.2 Lessons for specific policies

- **Detailed lessons for a successful implementation of specific citizen-inclusive air quality and carbon policies can be found in all ClairCity cities.**

Regarding implementation of policy measures, ClairCity identified several lessons to be learned from the cities for specific policies.

Environmental zone / clean air zone

A pedestrian zone in a city contributes to a pleasant and green city with cleaner air and invites active transport such as walking and cycling. Several types of Clean Air Zones and bans of different kinds of vehicles were found being implemented (or unconsideration) in the ClairCity cities. None of the cities had a congestion management or charging system. Evidence from other ClairCity cities suggests that a gradual introduction, some political courage to overcome initial resistance and alternatives for the part of population that do need motorised vehicles (e.g. elderly) could contribute to a successful implementation of a Clean Air Zone.

Textbox 6-1 Relevant experiences from ClairCity for implementation of an environmental zone / clear air zone

- In **Amsterdam**, the environmental zone was introduced gradually for different types of vehicles, initially not implementing a ban for private cars. Now that citizens are familiar with the zones for mopeds, buses, taxis and freight transport and these zones are more or less accepted, also a ban for polluting private cars will be implemented, making the city centre 'emission free' by 2030.
- **Ljubljana** has converted the inner city centre into a pedestrian zone, including a free biking scheme and electrical short-distance taxis. Initial resistance of citizens and business against the pedestrianisation has now turned into massive support as living quality and economic development in the form of tourism have substantially increased over recent years. Initial concerns of local commerce over potential reduced business were proved wrong, as the pedestrian zone has actually contributed to a large increase in tourism and business in recent years. Electric taxis within the zone and a free biking scheme further provide alternative modes of transport within the zone, also for the disabled and elderly.
- **Genoa** wanted to introduce a clean air zone ban of older Vespas. Strong resistance against this ban from Vespa-drivers in the city of origin of the Vespas meant that the proposed ban was withdrawn. Only recently has it been reconsidered.
- **Bristol** is exploring the implementation of two Clean Air Zones. The smaller city centre Diesel Ban Zone will include private diesel cars while the larger Clean Air Zone will charge non-compliant commercial vehicles to enter. A major concern for the zones is social equity and the ability of lower socio-economic communities to adapt to the new regulations**.**

Encouraging cycling

The experiences in ClairCity cities suggest that effective modal shift policies towards cycling tend to consist of a combination of education and awareness-raising starting at schools, accompanied by large-scale infrastructural adaptations such as the building of bike parking and increasing road space for cycling to ensure safety and comfort.

Textbox 6-2 Relevant experiences from ClairCity for stimulating active transport

- In **Aveiro/CIRA**, cycling workshops and practice are included in school education. Cycling from and to home is encouraged.
- In **Amsterdam**, cycling is a central part of city transport culture. Cycling traffic lights, bike lanes and paths as well as an integrated train and bike-rent system are already implemented since several years. Providing sufficient bike parkings, reducing car road space in favour of bikes, and spatial planning for short as well as long-distance biking are now central elements in further scaling up of cycling in Amsterdam.
- In **Sosnowiec**, where biking is not a typical mode of transport, a municipal bike-sharing scheme was introduced in April 2018. A first network of bycicle paths was built for its launch.
- In **Bristol**, people that have not cycled for a time can get a one-month bike loan free of charge.

Public transport improvement

In particular, for smaller cities surrounded by a rural area, infrastructure investments for a wide transport network and frequent connections are costly and less efficient. In turn public transport does often not currently offer the comfort the car does. Effective linking of urban and rural transport systems in these cases are essential. A few experiences in the ClairCity case study cities show what integration opportunities can be created, for instance buy one ticket for all public transport and integration of the public transport ticket with bike rent as a first step to making public transport convenient.

Textbox 6-3 Relevant experiences from ClairCity for stimulating public transport

- **Ljubljana** has integrated its city and regional transport, which can now be travelled with one ticket. According to interviewees, commuting by public transport into the city has been much facilitated in this way.
- **Amsterdam** and the Netherlands have a popular integrated train, bus and bike-rent system that can be travelled with one ticket, which facilitates door-to-door transport.
- **Bristol** has recently implemented large-scale improvements of public transport to connect the city and the metropolitan area: the MetroBus (a bus service for the larger Bristol area which works with ‘buy before you board‘ ticketing to ensure limited stopping, faster boarding and shorter journey times) and MetroWest (project that improves rail connections in the region).

Discouraging private car use

Key for modal shift is that besides making active transport and public transport more attractive (for example by reducing space for cars in the city and making more room for pedestrians, bikes and buses, as previously mentioned), private car use is made less attractive. This can be done by increasing parking tariffs or by reducing the number of residents’ parking permits. Parking tariffs do not only discourage car use but, as additional revenue, also can support investments in active mobility and public transport.

Textbox 6-4 Relevant experiences from ClairCity for stimulating active transport

- In **Amsterdam**, through high parking tariffs for the city centre (7 euros an hour) and reducing the number of residents’ parking permits, access to the city by car is made less attractive.
- In **Bristol**, limiting access for cars to the historical city centre during working hours is part of the public discussion going on early 2020 related to the implementation of Clean Air Zones.

Cleaner private transport

Cleaner cars policies e.g. tax deductions for electric vehicles, are mainly competence of central governments. However ClairCity evidence suggests that cities can also take action in this regard. Facilitating public parking (space, free parking etc) for electrical vehicles can contribute to the attractiveness of electric cars.

Textbox 6-5 Relevant experiences from ClairCity for stimulating cleaner private transport

- In the case of **Amsterdam,** where car parking space has been made scarce and expensive, parking space reserved for electrical car recharging has led to some car owners to switch to an electrical car**.**

Energy measures

There are good practices in ClairCity case studies that can be relevant for expanding collective heating systems as a way towards sustainable energy systems. Cities such as Sosnowiec, Ljubljana and Amsterdam have substantial experience with district heating and are also considering expansion of their heating networks. All ClairCity cities are working on expanding energy efficiency of their housing stock. Development of rooftop PV is expanding particularly rapid in Amsterdam. Biomass burning is a policy measure that deserves attention in the future, as it is assumed to be positive for climate change targets but has also negative impacts for air pollution.

Textbox 6-6 Relevant experiences from ClairCity for stimulating energy measures

- **Sosnowiec** and **Ljubljana** show that wood and waste burning – partly from the surroundings (Ljubljana) can have strong detrimental impacts on air quality. This has to be taken into account in particular as wood burning is now often seen as a positive measure from a climate policy point of view.
- **Sosnowiec – public air pollution information** In the Polish city of Sosnowiec, winter smog due to air pollution caused in particular by low-quality fuels for home heating is a serious health risk. In order to increase awareness about health risks related to air quality, the bus company publishes up-to-date air quality data on public transport information screens.
- **Bristol** is now developing a heat network starting within the inner city centre.

Other measures

Other best practices found in ClairCity case studies include new ways of providing air quality feedback to citizens, engaging citizens in air quality measurement and specific attention to deprived groups. In addition, ClairCity has found that NGOs are a very important intermediate in engaging citizens. Hence, maintaining good relationships with, and support for these NGOs seems to be an important way to stimulate citizen-inclusive policies.

Textbox 6-7 Other relevant experiences from ClairCity for air quality and carbon policies

- **Sosnowiec** provides real-time air quality information to citizens through the electronic transport information system in the city. In this way, awareness of changes in air quality in the city is increased.
- In **Amsterdam**, an active network of citzens measure air quality at home with low-cost equipment. These measurements supplement the official air quality measurements in the city.
- In **Bristol** specific attention is given to deprived groups in air quality and carbon policy making.

6.3 Policy Action Plans compared

- **Based on the ClairCity project findings, detailed action plans for citizen-inclusive air quality and carbon policy making were prepared for all case study cities.**

For each case study city in the ClairCity project, detailed recommendations for future action were given based on the project findings in that city. These Policy Action Plans for each city are summarised here and can be found in more detail on the ClairCity website[13].

Figure 6-1 Three of the ClairCity City Action Plans

In **Amsterdam**, the action plan focuses on bringing citizens' willingness to change their own behaviours in line with the very ambitious city policies. While citizens indicate substantial willingness to change, this is not yet sufficient to meet the city policy goals. Commuting is a main transport behavioural practice of citizens found in Amsterdam to contribute to air pollution, therefore it is recommended to pay more attention to this practice. Also, expansion of district heating is seen as an important means to decarbonise the housing sector, but is not very popular with citizens. Awareness creation of the potential of district heating is therefore needed. Particulate matter emissions deserve particular attention in the city, as these emissions so far are not decreasing sufficiently. Citizen related behavioural practices here are burning of wood stoves at home and in house boats, barbecueing and wood burning at restaurant terraces. Finally, visibility of live air quality data in the city could be increased in the city, for instance by information included in public transport information panels like in Sosnowiec.

[13] www.claircity.eu

In **Aveiro / CIRA region**, it is recommended to further facilitate cycling by infrastructural measures combined with simultaneously making car use less attractive via reducing parking space and introducing paid parking in city centres. This could also generate revenues for the city for the infrastructural measures required. The integration of cycling education and workshops into pupils education, as a particularly positive measure in the region, could be further expanded. Regarding the improvement of public transport, the CIRA region could look at the experiences in other ClairCity cities (Bristol, Ljubljana, Amsterdam) with the integration of rural and urban transport as well as the integration of public transport with cycling facilities to create door-to-door transport. Public procurement could be used more actively to set environmental conditions to public transport. Improving transport facilities, rather than health, could be a particularly useful framing for engaging citizens in air quality and carbon policies in the CIRA region.

In **Bristol**, main recommended policy activities are to focus more on leisure and shopping behaviour next to commuting, as these practices were found to contribute substantially to air pollution in the city. A city transport plan should further promote alternatives to private car use and address car use as a status symbol. Renewable energy could be stimulated via expansion of support for rooftop solar PV, increasing PV on public buildings and stimulation of local citizen renewable energy cooperatives (like in Amsterdam). An even stronger health framing of policies could contribute to further citizen support, and methods should be sought to create local funding for infrastructural measures (e.g. parking permits, workplace levy, congestion fees).

In **Genoa / Liguria**, integrated action to simultaneously improve public transport and discourage car and polluting scooter use is recommended. This could go along with stimulation of (electric-)biking and integration of public transport with biking. Electric vehicles offer in particular possibilities, given the hilly character of many parts of the city and region. More awareness of the need for change could be created starting with primary school education. More intensive cooperation and support for environmental NGOs could also help to create such awareness. Framing of policies through ‘improving quality of life’ and ‘improving the Ligurian environment’ seems useful for these awareness related activities. Further, possibilities for stimulation of district heating and renewables should be examined. Most importantly, however, a long-term policy regional and local vision on air quality and carbon policy should integrate all policy activities and make the relation to citizens explicit.

In **Ljubljana**, shopping appears to be a practice where behavioural change seems difficult to citizen. More awareness activities together with shopping malls and other shopping destinations therefore are recommended. Expansion of the existing district heating network seems also promising, but not very popular with citizens. More measuring facilities in Ljubljana, possibly supported by citizen-science measurements, could improve the basis of air quality measurements next to modelling activities. Further integration of ambitious activities in Ljubljana with those in the region could improve regional impacts. Also, further improvement of public transport facilities by expanding the train network seems

useful. Here the experiences in several other ClairCity cities could provide useful implementation lessons. Next to the already ambitious citizen engagement methods applied by the city council, also further support for NGOs could contribute to the diversity of opinions heard in the city.

In **Sosnowiec**, it is recommended that reducing coal, biomass and waste burning by citizens should be a priority city action. While it was demonstrated by ClairCity that there is willingness of citizens to change behaviour, costs are a main obstacle to change. Improving the quality of the existing large-scale district heating network and promoting such changes could further contribute to air quality and reducing carbon emissions. Health framing of policies is an important way to improve awareness of citizens, given that health impacts of winter smog in Sosnowiec are still substantial. Given that private car use shows very popular in the city and there seems little willingness to change, gradually discouraging car use should go hand in hand with, or should be preceded by measures that make the alternatives (public and active transport) more attractive. Air quality monitoring could be expanded, although the system of displaying live air quality information on public transport panels in Sosnowiec is already very innovative. NGOs, as an important vehicle for change in the city, should be more supported by the city council.

7 Conclusions and Recommendations

This chapter provides the final conclusions and recommendations that follow from the design and implementation of the ClairCity method for co-creation of citizen-inclusive air quality and carbon policies in cities.

7.1 Conclusions

7.1.1 Baseline for citizen-inclusive air quality and carbon policies

The policy baseline examinination showed that, while the ClairCity cities differ substantially in emissions, concentrations and overall socio-economic and physical context, the basic frameworks for air quality and carbon policies that affect citizens in all cities are very similar.

Main differences between the cities are rather found in the degree of implementation of those frameworks and in the framing of policies. ‘Active citizens’, ‘equality’, ‘health’ or just treating air quality and carbon emissions reductions as co-benefits of other policies (‘better transport’) are different ways of framing citizen-inclusive policies that were found in the six cities.

7.1.2 Citizens’ current behaviours and stated willingness to change

Regarding citizens’ current behaviours, ClairCity found that the detailed examination of citizens’ behavioural practices can give new insights as to what practices actually contribute most to pollution. For instance, research in Bristol revealed that shopping and leisure transport behaviour would be important practices to address next to commuting in terms of their contribution to pollution.

Stated willingness to change behaviours in an environmentally positive direction, e.g. by switching to public or active transport, was found substantial in all ClairCity cities. The research therefore indicates that in all cities there is a substantial base of citizens that will intend to contribute to policy making in their city by adapting their own behaviours. However, in the case of very high environmental ambitions, such as in Amsterdam, it was also found there might still be a substantial gap between what policy makers want and the own contribution that citizens are willing to make by changing their behaviour.

In more detail, district heating was identified as one particular measure that, while offering substantial potential for emission reduction, was not very popular with citizens. Also, citizens’ views that were collected reflected an ongoing debate in several cities on the benefits and limitations of biomass application.

7.1.3 Citizens’ views on future policies in their city and considerations of policy makers

ClairCity asked citizens what futures they envisaged for their city and what policies they would like to see implemented. The answers were generally in line with overall policy plans in the cities. Differences were particularly found in the implementation speed of policies aimed at (often faster than foreseen by current policies) or in the degree of implementation (higher implementation rates than in existing policies).

Policy makers that were confronted with the ideas of citizens could generally understand their views and also often supported these. In the cases that policy makers were hesitant about citizens' ambitions, cost was often given as a main barrier for realisation of these ambitions. Other barriers given by policy makers included technical limitations to realise implementation speeds wanted by citizens (e.g. for installing recharging points for electrical cars) or responsibility for policies not laying at the city level (e.g. cleaner diesel cars). Policy makers also pointed to seemingly contradictory wishes of citizens, e.g. improving public transport and making it cheaper at the same time.

7.1.4 Impacts of co-created policy scenarios

Based on the ambitions of citizens and the remarks made by policy makers, ClairCity prepared co-created 'Unified Policy Scenarios' and modelled their impacts compared tobaseline policy scenarios. It was found in all cities that the co-created scenarios would lead to environmental improvements in terms of air quality, carbon emissions and citizens' health compared to the baselines. Benefits were found to be highest in Amsterdam and Bristol.

Also very rough qualitative cost estimates were made of the co-creation scenarios. While in particular additional infrastructural measures would imply higher direct costs of policies, it was also concluded that these costs could be at least partly compensated by new financial benefits created (in particular levies for private cars). Taking into account indirect benefits of these scenarios (saved public health costs) would lead to further cost reductions in comparison to the policy baseline scenarios.

7.1.5 Mutual learning

In the six ClairCity cities, many examples of citizen-inclusive policies were found that could inspire other cities. These refer to several aspects of such policies, such as awareness creation, facilitating behavioural change and other factors enabling citizen-inclusive policies. Some relevant aspects that were found are

- Making live air quality information visible in the city (e.g. by integrating them into public transport information panels)
- Facilitating shift from private car to other modes of transport by integrated door-to-door solutions (e.g. bike rent facilities at bus and train stations, one ticket for urban and rural transport or for public transport and bike rent)
- Realising sufficient local air quality measurements to complement modelling. Citizen science measurements could add to official measurements and at the same time create additional awareness in the city.
- Examining possibilities for local levies to finance infrastructural and other measures to facilitate behavioural change.

7.2 Recommendations for citizen-inclusive city policy making

While design and improvement of the ClairCity method as a Horizon2020 research project was relatively time and resource intensive, it is believed that in the future, given the learning from the project, that the method can be replicated quickly and at significantly lower costs for other cities and regions. In that way, the ClairCity method could become an easily applicable

quick-scan method for citizen-inclusive city policy making in the fields of air quality and carbon policy, and perhaps in other sustainability policy fields as well.

However, before the ClairCity method is directly replicable in other cities it is suggested to apply an upscaling phase in which the method can be further perfected. Two specific aspects to be examined in that phase are a verification of the ClairCity modelling to local city air quality models, and a further examination of the ways in which the ClairCity engagement process can be made even more representative of the views of all citizens in the city.

After this upscaling phase, we believe that the ClairCity method is particularly suited to help any city aiming for ambitious citizen-inclusive policies to

- **Finetune and direct policies to the most promising areas;**
- **Identify gaps between policy ambitions and citizens' intended behavioural change;**
- **Identify main barriers and enabling factors for citizen-inclusive policies; and to**
- **Create awareness and support for ambitious city air quality and carbon policies in the future.**

Finally, as a brief summary and check-list for the way in which ClairCity can support cities in their way towards ambitious citizen-inclusive air quality and carbon policies, it is recommended that cities follow the steps of the "ClairCity Action Plan for Citizen-inclusive Air Quality and Carbon Policies":

ClairCity Action Plan for Citizen-inclusive Air Quality and Carbon Policies in Cities

- **Prepare a baseline for implementation of citizen-inclusive policies**
  - Examine the current status quo of policy making and of emissions and concentrations trends in the city
  - Analyse to what extent existing policies in the city overlap with the overall framework for citizen-inclusive air quality and carbon policies established by ClairCity
  - Examine what framing for policy making is used towards citizens and choose an appropriate framing from the several possibilities identified in ClairCity
- **Identify current behavioural practices of citizens and desired behavioural change in the future**
  - Analyse in detail current behavioural practices of citizens and their environmental impacts
  - Finetune policy making to those practices
  - Find out what is the willingness to change behaviours of citizens in the city
  - In case of a gap found between policy ambitions and citizens' willingness to change, consider what to do in order to close that gap.
  - Identify policy options that do seem to have relatively little popular support or that are subject to public debate. Consider if implementation of such options should be pursued and, if so, what should be done to increase support for them.
- **Identify citizens' preferences for future city policies**

  - Examine what are citizens' most desired policies for the future of their city
  - Analyse to what extent these coincide with existing policies in the city
- **Examine implementation possibilities of desired policies together with policy makers and prepare co-created policy scenarios**
  - Present the citizen scenarios to policy makers and provide different ambition levels for these measures that the policy makers can choose from
  - Discuss implementation barriers and enabling factors for the citizen scenarios
  - Prepare final scenarios co-created by citizens and policy makers
- **Assess possible impacts of the co-created scenarios**
  - Model impacts of the co-created scenarions against business-as-usual policy scenarios
  - Analyse these impacts in terms of emissions, concentrations, health impacts and costs
- **Analyse other detailed policy lessons learned during the ClairCity process**
  - Next to overall policy lessons, also examine policy lessons on detailed policies and interactions with other actors collected during the ClairCity process
- **Prepare final recommendations for city policies in an Policy Action Plan**
  - Bring together overall and detailed lessons and recommendations for co-creation of policies in a concise Action Plan

8 Literature

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