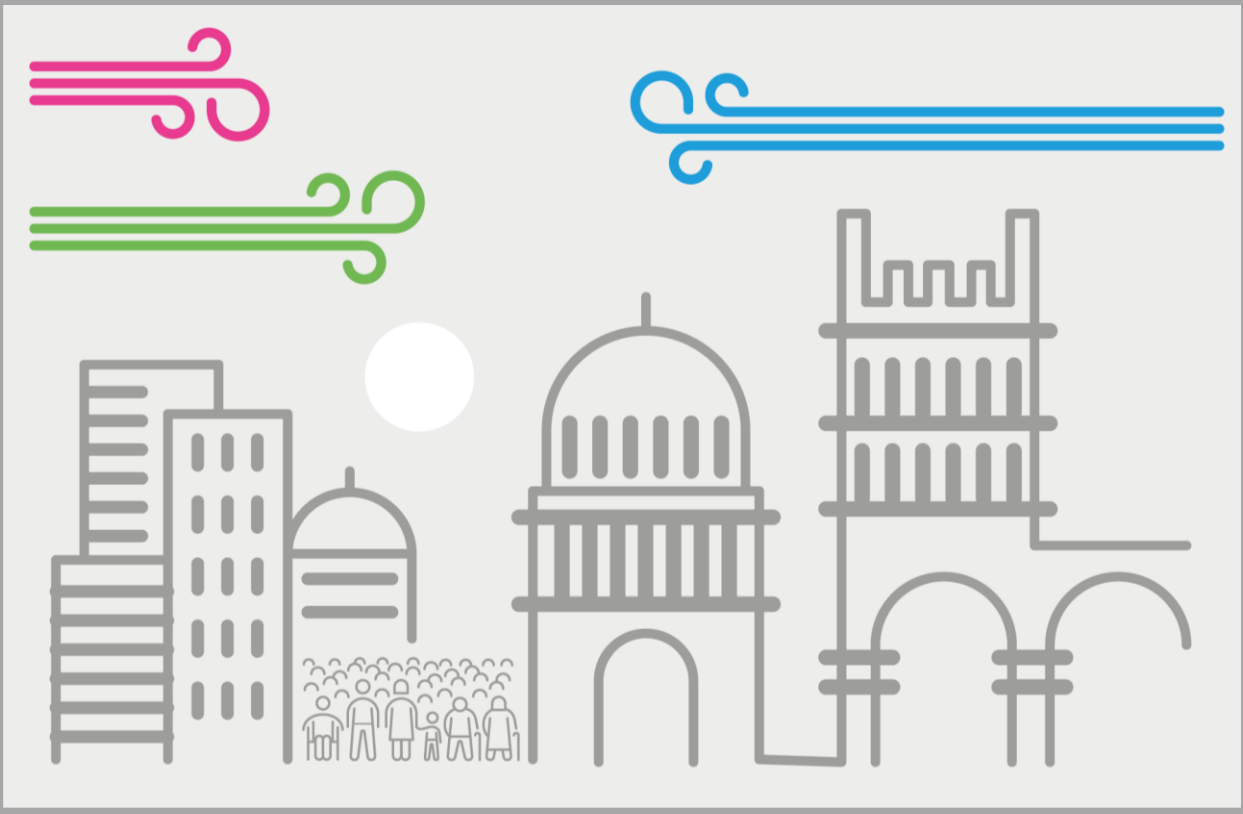
Ref. Ares(2018)5212103 - 10/10/2018

iSCAPE

Challenges and Opportunities in the iSCAPE Cities

WP1 Task 1.1

January 2017



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

Project Acronym and Name	iSCAPE - Improving the Smart Control of Air Pollution in Europe	
Grant Agreement Number	689954	
Document Type	Report	
Document version & WP No.	V 0.4	WP1 Task 1.1
Document Title	Challenges and Opportunities in the iSCAPE Cities	
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Release date	26/02/2017	

The publication reflects the author's views. The European Commission is not liable for any use that may be made of the information contained therein.

Document Control Page	
Short Description	This report outlines the non-technical challenges and opportunities for each of the six cities involved in the iSCAPE project relating to air pollution and climate change. These have been based on a qualitative survey of 22 city stakeholders as well as learnings from a set of best practice case studies on air quality interventions and citizen engagement initiatives. Sixteen city challenges have been identified and split into three overarching 'challenge areas'. These include 'Urban Environment', 'Citizen Perception' and 'Government Policy'.

	The challenges are intended to be used as thought starters for further exploration throughout the rest of the iSCAPE project. Recommendations have also been made for citizen engagement within the iSCAPE Living Labs going forward.		
Review status	**Action**	**Person**	**Date**
	Quality Check	*Coordination Team*	
	Internal Review	Santa Stibe, UCD Achim Drebs, FMI	10/02/2017
Distribution	Public		

Revision history			
Version	**Date**	**Modified by**	**Comments**
V0.1	03/02/2017	Lucy Barrett	The first draft.
V0.2	20/02/2017	Lucy Barrett	Addressed reviewers' comments.
V0.3	26/02/2017	Aakash C. Rai	WP1 leader's edits.

Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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List of abbreviations

AQ: Air Quality

CC: Climate Change

CE: Citizen Engagement

CO_2: Carbon dioxide

DEFRA: Department for Environment, Food and Rural Affairs (UK)

EU: European Union

EV: Electric Vehicle

FCC: Future Cities Catapult

iSCAPE: Improving the Smart Control of Air Pollution in European cities

LBW: Low Boundary Wall

NOx: Nitrogen Oxides

PM: Particulate Matter

WP: Work Package

TCD: Trinity College Dublin

UoS: University of Surrey

TUDO: Technical University Dortmund

UNIBO: University of Bologna

FMI: Finish Meterological Institute

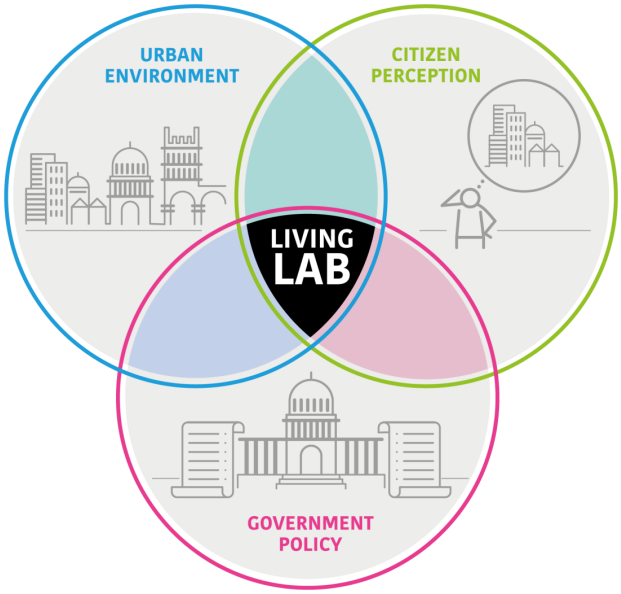
UH: Universiteit Hasselt

1 Executive Summary

This report outlines the non-technical challenges and opportunities for each of the six cities involved in the iSCAPE project around the topics of air pollution and climate change. These have been based on a qualitative survey of 22 city stakeholders conducted in November 2016. Learnings from a set of best practice case studies in air quality interventions and citizen engagement initiatives have also been considered.

Sixteen city challenges have been identified in the report and these have been split into three overarching 'challenge areas'. These include 'Urban Environment', 'Citizen Perception' and 'Government Policy'.

The challenges are intended to be used to spark discussions around the issues of air quality and climate change amongst the partners in the project, city stakeholders and citizens. They should be seen as thought starters for further exploration throughout the rest of the iSCAPE project. With this in mind, efforts have been made to ensure the findings of the report are accessible to non-academic audiences and parts of the deliverable have been designed for use as engagement tools within the iSCAPE Living Labs themselves.



Although no citizens have been consulted as part of this report, as this was out of scope for this deliverable, this is a key focus for the iSCAPE project going forward. Recommendations for the best methods for citizen engagement within the iSCAPE Living Labs have been made and an 'iSCAPE Living Lab Citizen Engagement Manifesto' attempts to summarise the key principles for successful and sustained engagement.

Overall, this report, paves the foundations for the rest of the iSCAPE project by providing a basis for discussion and initial understanding of how some of the challenges identified could be solved. It also provides initial ideas around citizen engagement methods for use within the iSCAPE Living Labs.

2 Introduction to the Report

2.1 Aims and Objectives

This report forms Task 1.1 of the first work package (WP) in the iSCAPE project. Below is a description of the aims for the WP in general as well as the objectives of the task taken from the project proposal.

WP1: Assessment of urban air quality and climate change solutions

Aims:

- To provide a thorough and neutral assessment of existing and future challenges and opportunities for the cities with respect to air quality and climate change, and the role of infrastructural interventions to offer solutions to the corresponding challenges.
- To pave a strong foundation for the rest of the project for selecting (WP2), applying (WP3), assessing (WP4, WP6) and evaluating (WP5) the most attractive intervention measures to reduce impacts of air pollution and climate change for comprehensive experimental and modelling studies.

Task 1.1: **City challenges and opportunities in connection to air quality and climate change**

Objective:

To provide a high-level overview of the challenges cities are currently facing regarding air quality and climate change but also to highlight the opportunities they have in introducing innovative interventions to tackle these challenges.

We have investigated how cities are currently tackling these challenges through two main research activities:

- Direct consultation with city stakeholders through a survey aimed at the six local authorities governing seven target locations hosting the iSCAPE interventions. The responses have been evaluated and recommendations for iSCAPE have been developed.
- Examining several case studies of cities that have introduced innovative solutions such as those planned to be developed in iSCAPE (i.e. behavioural and infrastructural interventions). Lessons learned and respective actions for iSCAPE have been recommended.

2.2 Our Approach

- Exploring the topic of air pollution through desk research.
- Collating and summarised best practice examples in the form of case studies for inspiring air quality interventions and citizen engagement projects.
- Conducting an online survey with city stakeholders to find out about their current challenges and concerns about this topic.
- The learnings from all activities have fed into the city challenges and opportunities, as well as recommendations and next steps for iSCAPE.
- Where possible we have tried to produce materials that can be used in engagement activities with citizens in future work packages.

This report will include the following:

- A summary of the city challenges
- A 'snap shot' of each city to offer a quick overview of the relevant characteristics associated with the area
- A city profile card to provide an overview for each city. This can be used for citizen engagement purposes in the iSCAPE living labs. Nearby Dortmund has been used instead of Bottrop as there was not adequate data to create a comparable profile for this city. (more detail on where we have sourced this information can be found in the appendix at the end of this report)
- An outline of the specific challenges for each city
- Inspiring case studies
- Opportunities and ideas about how to solve these challenges
- Conclusions with recommendations for WP2 and the setting up of the iSCAPE living labs
- A citizen engagement manifesto for the iSCAPE living labs

It is important to note that this report is based on qualitative feedback from city stakeholders and should therefore be considered a high-level introduction into the challenges for each city. These challenges should be used as 'thought-starters' and considered as a foundation for further exploration during the later phases of the iSCAPE project and the living labs themselves. This report is intended to trigger reflection and discussion on the challenges in each city between the different stakeholders involved in the iSCAPE project, as well as provide engaging materials for use with citizens and local businesses in the iSCAPE Living Labs going forward.

2.3 The Stakeholder Survey

A set of 'City Challenges' have been identified that are present in some or all of the iSCAPE cities. These are the dominant challenges that have emerged from the Stakeholder Survey conducted by Future Cities Catapult (FCC) with the help of the rest of the iSCAPE partners in November 2016.

The stakeholders consulted in this report include a mixture of government and public bodies responsible for environmental policy, urban planning and transport within our six iSCAPE cities. They also include relevant researchers from some of the universities directly involved in the iSCAPE project – Technical University Dortmund (TUDO), University of Bologna (UNIBO), University of Hasselt (UH).

The survey was sent out to stakeholders via an online link and answers were given in English or translated where necessary. All questions were intended to be open ended to gain a rich understanding of the challenges each city is facing (see appendix for survey questions).

The following table shows the number of respondents per city:

	Bologna	Bottrop	Dublin	Guildford	Hasselt	Vantaa	Total
Number of Respondents	5	5	3	4	2	3	22

This report outlines the challenges each city is facing regarding air pollution and climate change. Although many of the challenges relate to citizen perceptions of air pollution, these challenges represent the opinions of those stakeholders consulted and not a wider sample of citizens, as this was out of scope for this report. Given the relatively small sample these challenges should be seen as high level 'thought starters' for further exploration within the living labs and subsequent iSCAPE work packages. The challenges identified in this report will therefore be used to engage citizens on these issues through the living lab activities going forward, and will, through this process, gain further validation/iteration. The challenges have been split into three key sections which represent the key players in the air quality and climate change debate – the urban environment, the perception of citizens and government policy.

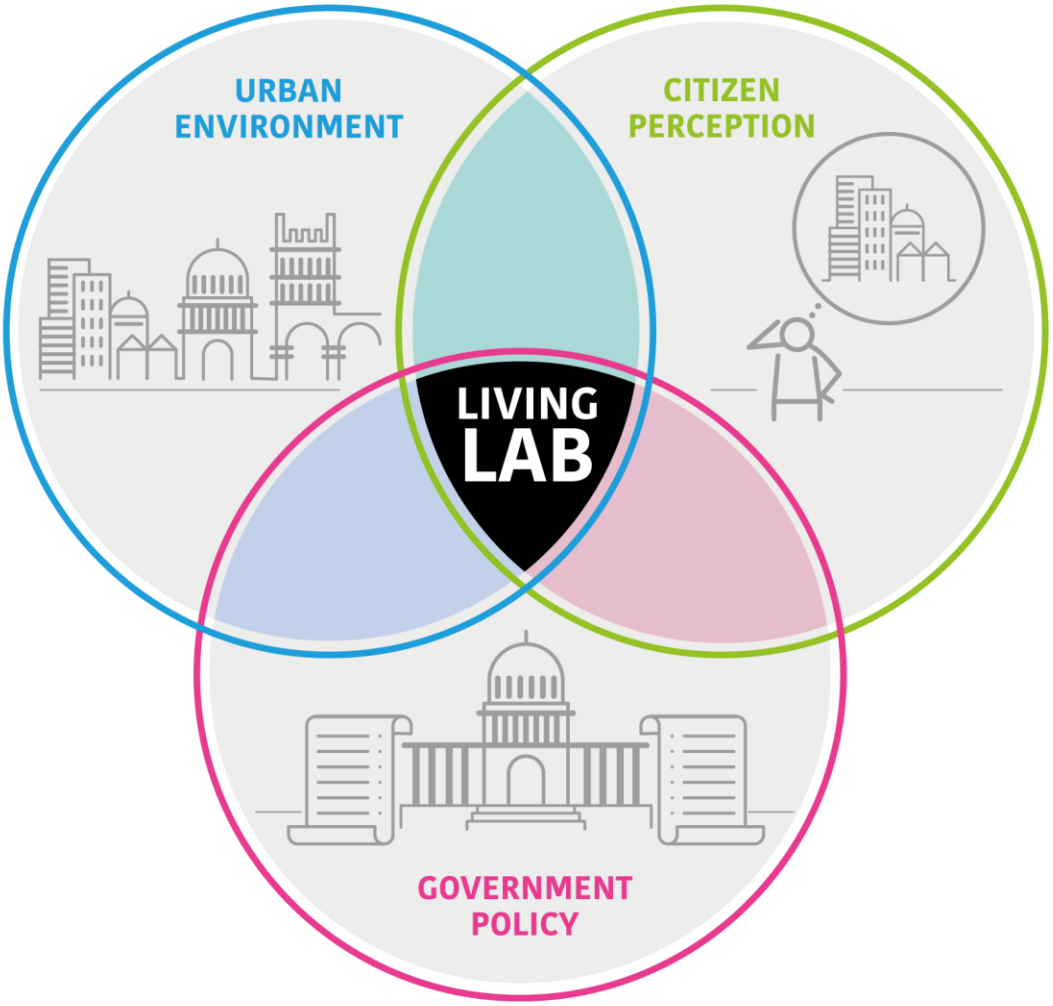
2.4 The Case Studies

Through desk research and consultation with academics in the field we have identified a set of best practice case studies. The case studies have been selected as a mix of interventions to learn from that have had a measureable impact. These have been used in the development of the challenges and opportunities identified in this report, and are also intended for use in the living labs for citizen engagement purposes. There are 12 air quality intervention case studies and 8 citizen engagement case studies. These case studies are not intended as an exhaustive list but rather as inspiration. The other tasks in WP1 will have identified many others as part of their literature reviews and these should ideally be put into the same template in order to collect an ongoing body of case studies that can be used going forward for stakeholder and citizen engagement purposes.

3 The City Challenges: Overview

The stakeholder survey has identified sixteen city challenges in total. These challenges sit in three categories;

1. Urban Environment - including the geographical elements and design of the city.
2. Citizen Perception - including the thoughts and behaviours of the citizens who live in each city (note, these are based on the opinions, experience and research conducted by the stakeholders consulted).
3. Government Policy - including the organisation of government bodies and legislation they introduce.



3.1 Urban Environment Challenges

THE CITY IS DESIGNED FOR THE CAR

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

INNOVATING WITHIN A HISTORIC CITY CAN BE DIFFICULT

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

THE CITY IS CLOSE TO THE AIRPORT

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

THE CITY'S LOCATION CAN MAKE AIR POLLUTION WORSE

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

THE CITY STRUCTURE IS DENSE OR OVERCROWDED

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

THE CITY HAS AN INDUSTRIAL HERITAGE

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

3.2 Citizen Perception Challenges

A CULTURE OF CAR USERS

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

AIR POLLUTION IS OFTEN INVISIBLE

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

THE LINK BETWEEN AIR QUALITY & CLIMATE CHANGE IS POORLY UNDERSTOOD

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

PEOPLE HAVE A VERY BASIC KNOWLEDGE OF THE HEALTH IMPACT OF AIR POLLUTION

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

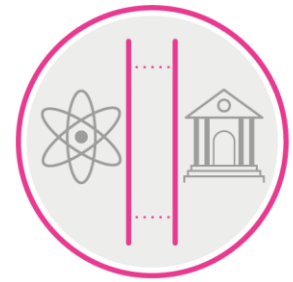
THERE ARE MANY MISCONCEPTIONS ABOUT GOOD & BAD BEHAVIOUR IN RELATION TO AIR POLLUTION

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

PEOPLE DON'T SEE AIR QUALITY AS SOMETHING THEY CAN (OR ARE WILLING TO) CHANGE

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

3.3 Government Policy Challenges



GAP BETWEEN SCIENTIFIC RESEARCH & GOVERNMENT LEGISLATION

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

LACK OF SUPPORT FROM CENTRAL GOVERNMENT

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

DISAGREEMENT & LACK OF CO-ORDINATION AMONG GOVERNMENT BODIES

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

MISLEADING OR UNRELIABLE MEASUREMENT OF AIR QUALITY

BOLOGNA
BOTTROP
DUBLIN
GUILDFORD
HASSELT
VANTAA

4 The iSCAPE Cities

There are 6 cities included in the iSCAPE project; Bologna (Italy), Bottrop (Germany), Dublin (Ireland), Guildford (UK), Hasselt (Belgium) and Vantaa (Finland). All of these cities are introducing one or more air quality interventions as part of the project. The interventions vary from the introduction of green infrastructure (Bottrop, Guildford, Vantaa) to built interventions such as low boundary walls (Dublin), and also encouraging citizen behaviour change (Hasselt) (see appendix for further details on specific interventions). Alongside each of these interventions the city will host a living lab to engage citizens in the iSCAPE project and air quality debate more broadly.

This report will address each city in turn with regards to the dominant challenges each city is facing regarding air pollution and climate change. All information has been taken from the Stakeholder Survey results as well as broader desk research.

4.1 Bologna

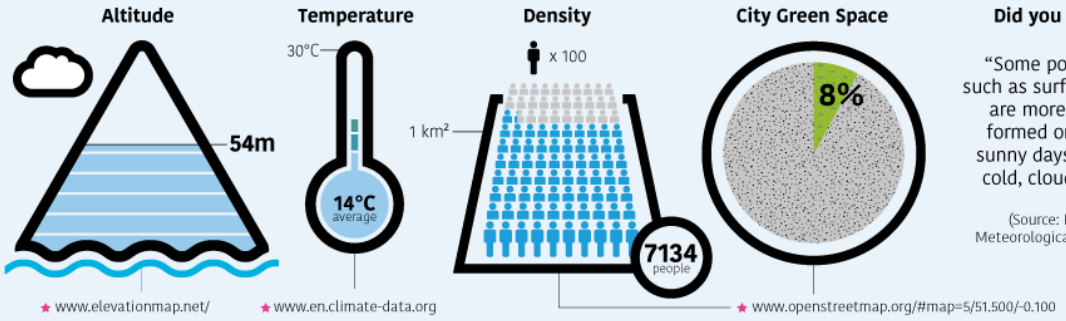
4.1.1 City Snapshot

Capital and largest city of the Emilia-Romagna Region in Northern Italy.

Bologna is the seventh most populated city and one of the wealthiest cities in Italy. It is situated in the Po Valley in Northern Italy. It is a historic city with a variety of monuments, medieval towers, antique buildings and churches, its town centre is largely pedestrianised and follows a grid pattern common to many Roman settlements.
Bologna is an important transportation crossroad for both road and train. Its main railway station, Bologna Centrale, is one of the most important train hubs in Italy. Many big companies including a number of luxury car and motorcycle manufacturers such as Lamborghini, Ferrari and Maserati have their headquarters in Bologna and the surrounding area.

BOLOGNA

GEOGRAPHY



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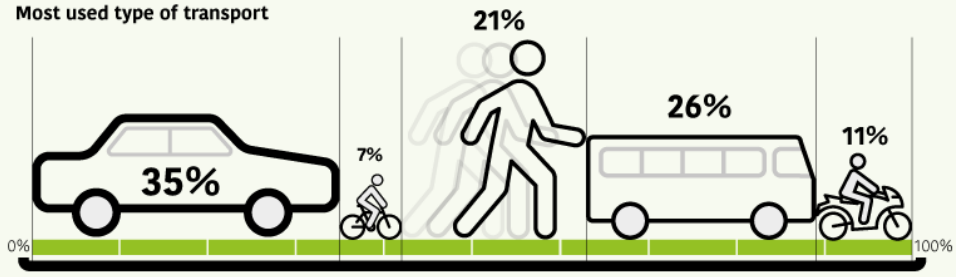
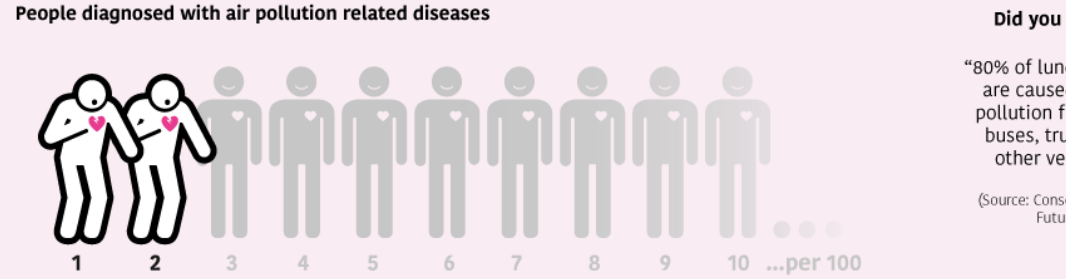
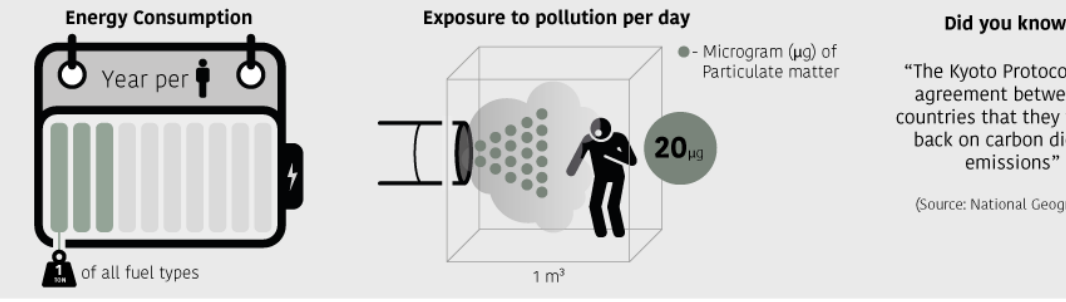


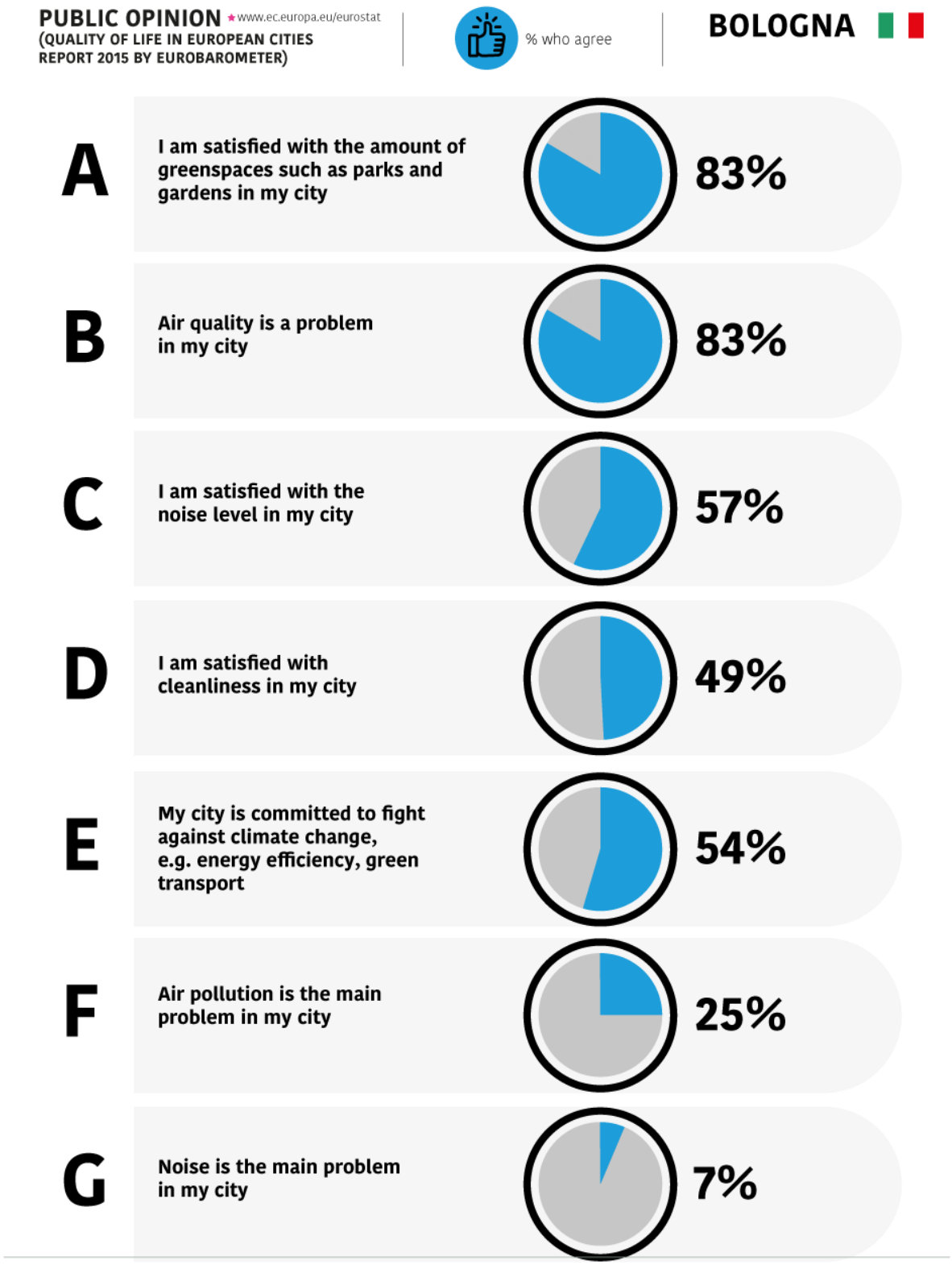
HEALTH ★www.ec.europa.eu/eurostat



POLLUTION ★www.ec.europa.eu/eurostat



★Data sources



The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

4.1.2 City Challenges

The following challenges are based on the qualitative responses of the five city stakeholders who filled in the survey for Bologna. The challenges should be considered as high-level 'thought-starters' and used as a foundation for further exploration during the later phases of the iSCAPE project and the living labs themselves.

Urban Environment

1. The city is designed for the car

As with most of the iSCAPE cities, Bologna has a high level of traffic congestion. The bus system is also slow and cycle lanes too few. Current policies are attempting to tackle these issue by improving public and shared vehicles as well as introducing e-bikes, but there is debate as to whether this is sufficient to effectively reduce the number of vehicles on the road. Events such as 'car-free days' have also attempted to help on a short-term basis.

2. The city's location can make air pollution worse

Bologna is in a wide valley where pollution is not easily dispersed due to typically low winds and high humidity. Due to its geographical location, the city suffers from inverse weather conditions and high pressure, which can lead to sinking air meaning pollution becomes trapped in the area. Levels of Particulate Matter (PM) often exceed EU regulations during the winter months.

3. Innovating within a historic city can be difficult

Bologna is a historic city with many famous landmarks including the oldest university in the world and a number of medieval towers. The majority of the city is also built from terracotta giving it an iconic red colour. Any new infrastructure will need to fit in to these unique surroundings. The covered walkways or porticoes that line the streets can also reduce air circulation and trap pollution inside them, increasing exposure for pedestrians.

Citizen Perception

1. A culture of car users

Citizens in Bologna are described as having 'a big attachment to cars' and many see them as the only way to get around. This is likely to be reinforced by the prominence of car manufacturers in the area who often provide discounts to employees. An annual automotive trade fair 'Autopromotec' also takes place in the city.

2. The link between air quality and climate change is poorly understood

Our stakeholders in Bologna report a long-standing effort towards citizen engagement including several air quality initiatives. Although this is likely to have raised citizen awareness of air pollution, most initiatives have focused on how pollution links to either traffic or health, rather than broader climate change issues. Instead citizens link climate change to changing weather conditions and

flooding. This suggests citizens could benefit from a clearer understanding of the relationship between air quality and climate change.

3. People don't see air quality as something they can (or are willing) to change

Despite a greater level of awareness of air quality and climate change issues in Bologna, many citizens still don't change their behaviour when it comes to commuting and are not prepared to make the necessary steps towards a more sustainable lifestyle.

> *"Citizens are aware of the risks connected with climate change and air pollution. I would say that thanks to events, projects and surveys Bologna's citizens are conscious of what is happening to our environment. However, I also think that they're still convinced that a concrete transition to a sustainable lifestyle means more expense and effort and most of them are still not prepared to face that challenge."* Urban Centre Bologna

Government Policy

1. Gap between scientific research and government legislation

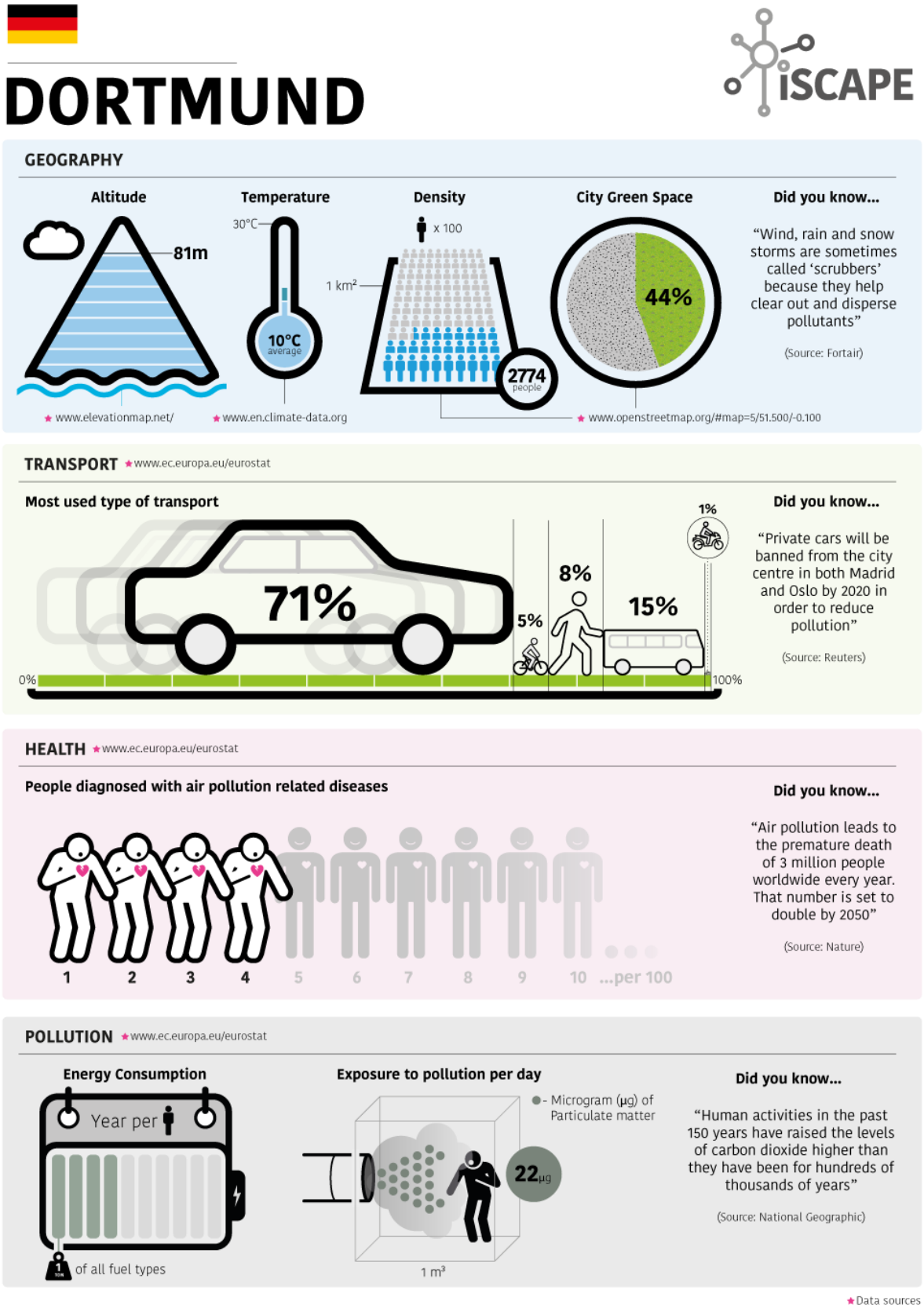
It seems that Bologna is leading the way in Italy both in terms of air quality initiatives and citizen participation. The city has been used as a pilot city for a number Italian policy initiatives (e.g. the Sustainable Energy Action Plan 2012 and the Local Climate Change Adaptation Strategy 2015). They have also held a host of citizen focused events and several citizen led groups have developed. However, despite these strengths there is still reportedly a gap between scientific research and its influence on government policy.

4.2 Bottrop

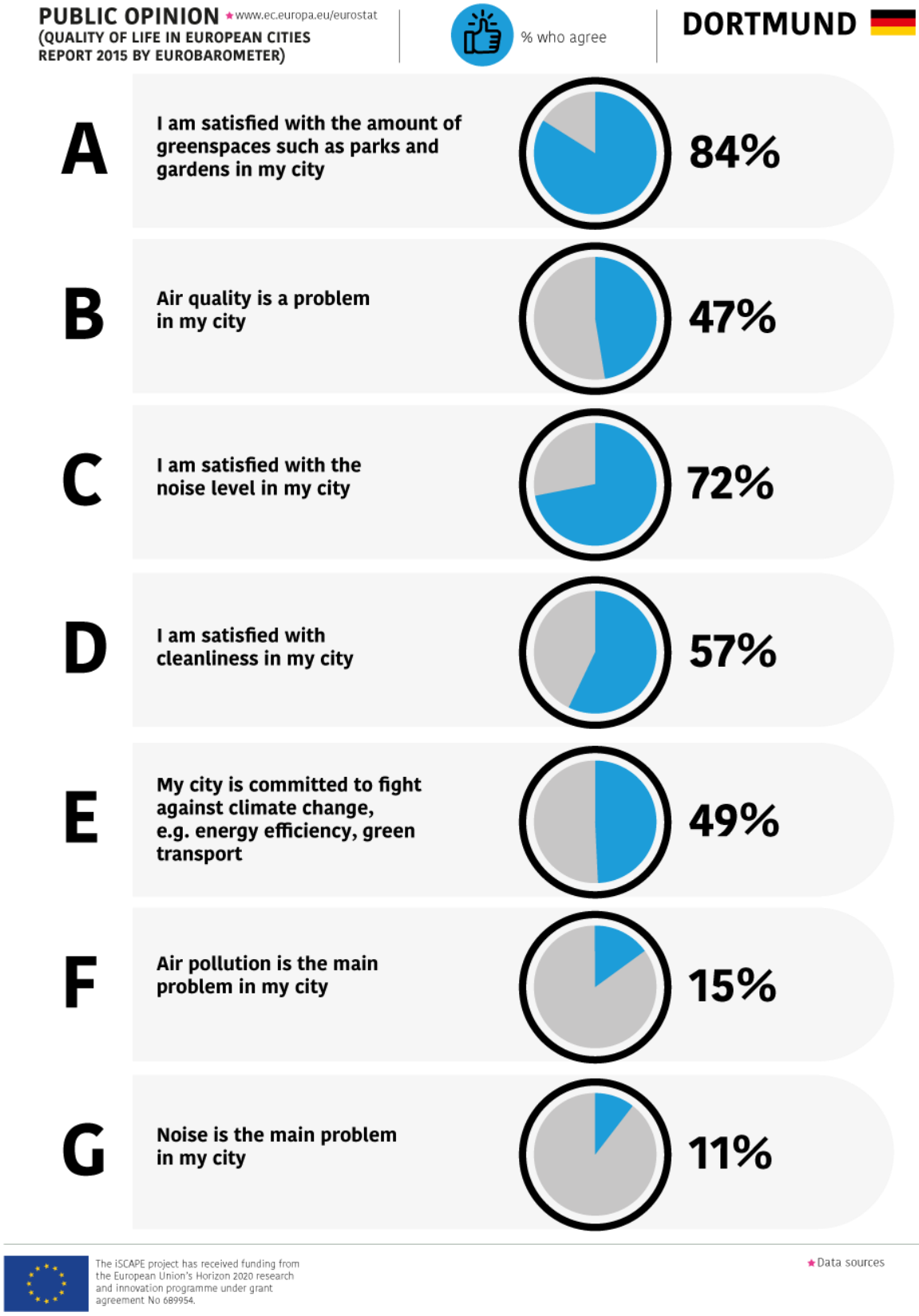
4.2.1 City Snapshot

Bottrop is in North Rhine-Westphalia in west central Germany, on the Rhine-Herne Canal.

Located at the heart of the wider Ruhr industrial area, Bottrop has historically been a coal-mining centre and contains factories producing coal-tar derivatives, chemicals, textiles, and machinery. General awareness about climate change is already high in the city with the creation of 'Modelstadt Bottrop' within the initiative Innovation City Ruhr. As part of this initiative Bottrop has worked with its citizens on a vision for their city for 2030.



N.B. Data was not available for Bottrop so Dortmund has been used as a nearby city with similar attributes



N.B. Data was not available for Bottrop so Dortmund has been used as a nearby city with similar attributes

4.2.2 City Challenges

The following challenges are based on the qualitative responses of the five city stakeholders who filled in the survey for Bottrop. The challenges should be considered as high-level 'thought-starters' and used as a foundation for further exploration during the later phases of the iSCAPE project and the living labs themselves.

Urban Environment

1. **The city has an industrial heritage**

Historically the Ruhr district was a mining area and the Bottrop coking plant remains a big source of air pollution in the area.

2. The city is designed for the car

The Ruhr has one of the densest motorway networks in all of Europe meaning travelling by car is often the easiest option. Bottrop also has many "suburbs" which have built up around the coal mining industry. Although the city centre is well catered for in terms of buses and some train networks, these do not reach many of the sprawling suburbs, particularly to the north of the city.

3. The city structure is dense or overcrowded

The built environment in Bottrop and the surrounding area is very densely packed together and over 90% of the ground in the city is 'sealed' by paving stones or concrete. This causes two main issues in relation to weather. Firstly, it creates an 'urban heat island effect' in summer meaning the density of the buildings results in a 'bubble of heat' in the city. Secondly, the sealed ground means that the recent flash floods that the city has been experiencing have caused major issues as the water has nowhere to go. Pumps have been installed to try and reduce flooding and government bodies have also invested in crisis management in the event of an emergency.

Citizen Perception

1. A culture of car users

Taxes on purchasing and driving cars in Germany are relatively low and while fuel is cheap and public transport is expensive, people tend to use private vehicles as their preferred means of transport.

2. The link between air quality and climate change is poorly understood

Recent weather events have directly impacted citizens and spurred a process of 'climate friendly planning' within the city, including public events encouraging citizens to get involved. This has increased awareness of climate change. However, the topic of air pollution is less explicitly communicated and citizens tend to associate it mainly with traffic.

3. **Air pollution is often invisible**

Many older generations who grew up in the Bottrop area when the main industry was mining perceive it as very clean in comparison to previous decades when 'smog' could often be seen in the air. Although much of the pollution in the air nowadays is invisible, it is possible to notice the soot residue from the nearby coking plant on white surfaces (depending on weather conditions and neighbourhood).

Government Policy

1. Lack of support from central government

Stakeholders report that the need for personal transport often seems to come before the health of citizens as a driver of traffic and environmental policy. However, both the 'Air Pollution Control Plan' and the introduction of a number of 'Climate Adaptation Measures' show that these topics have been pushed further up the political agenda. Stakeholders also report that there are increased funding opportunities for projects in this area.

2. Disagreement and lack of coordination among government bodies

The Ruhr area consists of many different cities situated very close together. Responsibility for these areas lies with many different government bodies and they often don't join up as well as they could do, for example, transport systems between cities are not well interlinked.

4.3 Dublin

4.3.1 City Snapshot

Capital and largest city of Ireland.

Dublin has many landmarks and monuments dating back hundreds of years. One of the oldest is Dublin Castle. The city also has more green spaces per square kilometre than any other European capital city, with 97% of city residents living within 300 metres of a park area (The Times Business City Guide, 2017). Dublin is situated at the mouth of the River Liffey which divides the city by North and South. The city's sheltered location on the east coast makes it the driest place in Ireland, receiving only about half the rainfall of the west coast (Met Office, 2016).

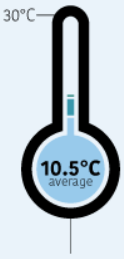
DUBLIN

GEOGRAPHY

Altitude

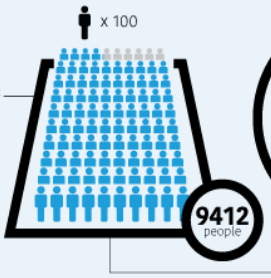
★ www.elevationmap.net/

Temperature



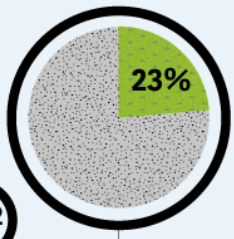
★ www.en.climate-data.org

Density



★ www.openstreetmap.org/#map=5/51.500/-0.100

City Green Space



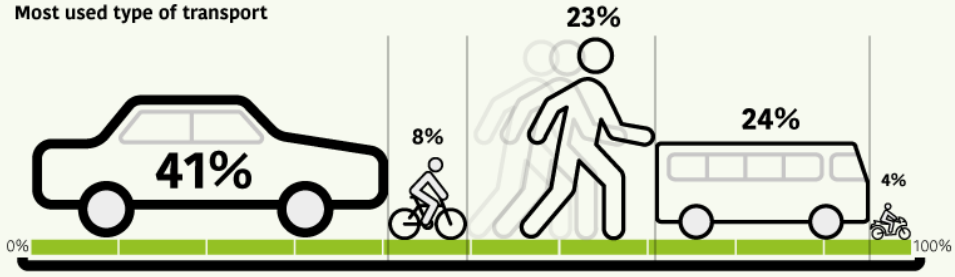
Did you know...

"Driving in cities with higher altitude produces higher emissions than driving at sea level"

(Source: U.S. Environmental Protection Agency)

TRANSPORT ★www.ec.europa.eu/eurostat

Most used type of transport



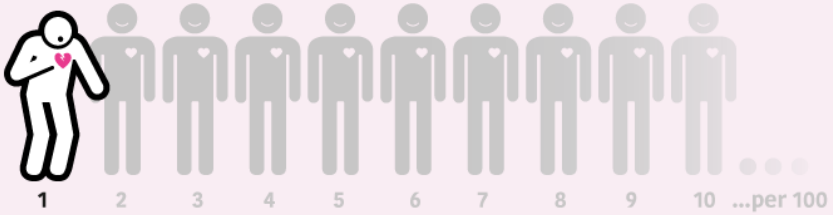
Did you know...

"Electric cars can help improve air quality as they do not produce pollution through exhaust fumes. CO2 is produced when the electricity is generated but they still have a lower emissions compared to conventional vehicles"

(Source: Efficient Energy Saving)

HEALTH ★www.ec.europa.eu/eurostat

People diagnosed with air pollution related diseases



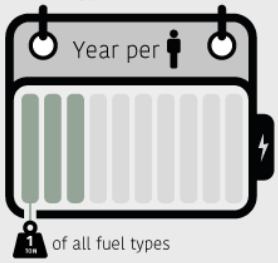
Did you know...

"Ultra-fine nanoparticle pollutants in the air can produce blood clots and induce a heart attack"

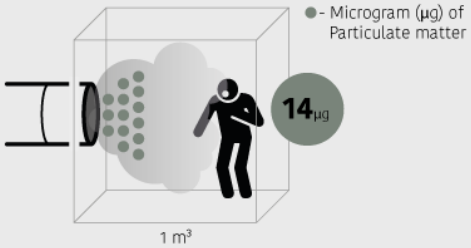
(Source: The British Heart Foundation)

POLLUTION ★www.ec.europa.eu/eurostat

Energy Consumption



Exposure to pollution per day

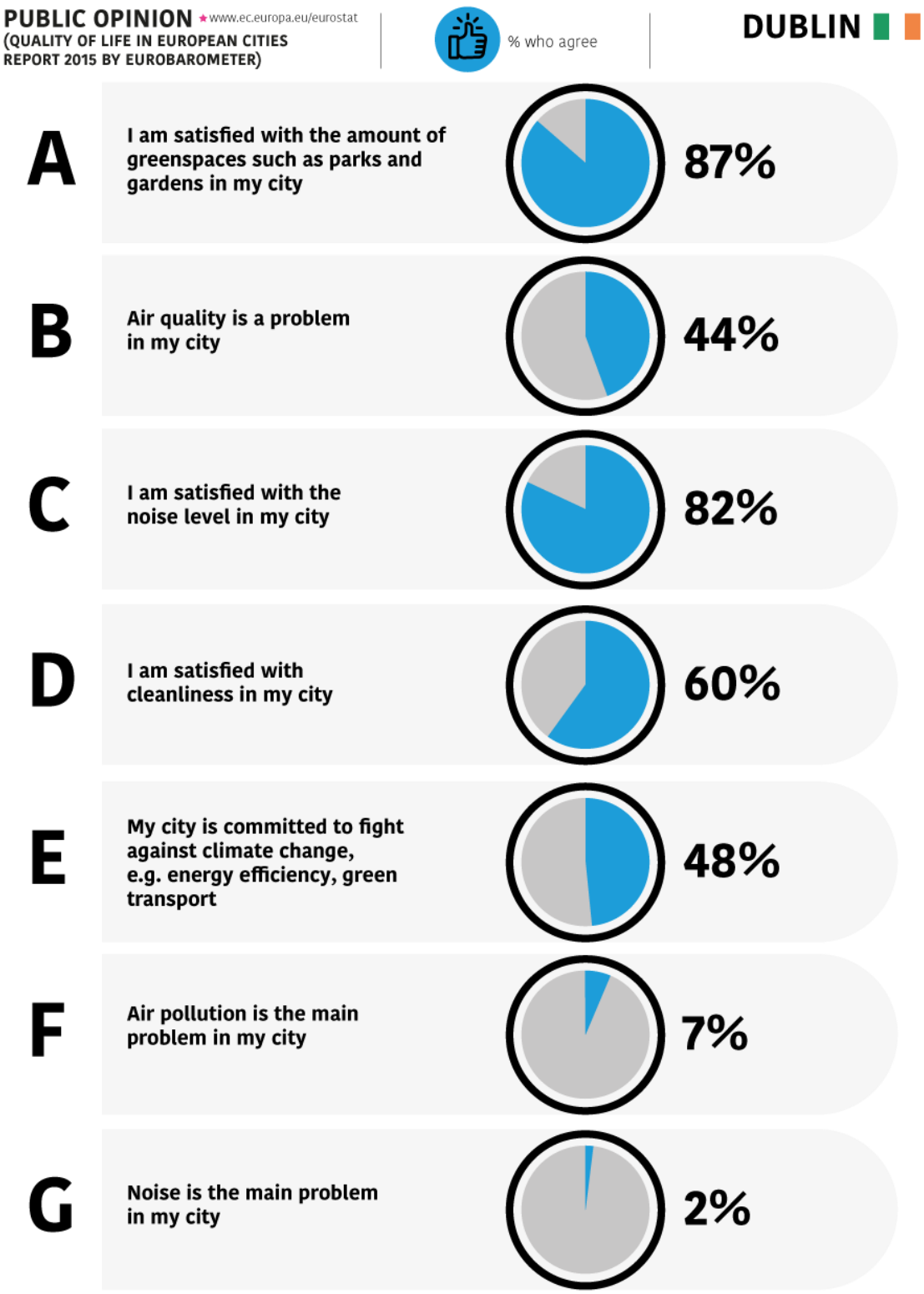


Did you know...

"Flying is the most emissions-intensive form of transport and the fastest growing cause of climate change"

(Source: World Wild Life)

★Data sources



The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

4.3.2 City Challenges

The following challenges are based on the qualitative responses of the four city stakeholders who filled in the survey for Dublin. The challenges should be considered as high-level 'thought-starters' and used as a foundation for further exploration during the later phases of the iSCAPE project and the living labs themselves.

Urban Environment

1. **The city is designed for the car**

A lack of connected public transport and adequate cycling infrastructure means that many people living in Dublin have little choice but to commute to work by car. The lack of segregated cycle lanes also means that cyclists are close to other road traffic and are exposed to their exhaust fumes. There has been some recent improvement in this area, for example, two electric light railways have been introduced in the past decade, but there is still a need for better developed and more sustainable options for people to get around the city.

2. **Innovating within a historic city can be difficult**

Dublin has a historic city centre with narrow streets and listed buildings. This not only increases congestion but also limits the amount of traffic management, public transport or cycling infrastructure that can be put in place.

Citizen Perception

1. **A culture of car users**

Air pollution doesn't seem to influence citizens' decisions when choosing how to commute to work and does not seem to be high on their agenda unless they are asked directly about it.

2. **The link between air quality and climate change is poorly understood**

In general stakeholders believe that citizens do not make the link between air quality and climate change, and that air quality is relatively low on people's list of priorities.

3. **Air pollution is often invisible**

The negative impact of air pollution is rarely visible to the citizens of Dublin. This may explain their lack of awareness. However, when it can be seen in the air, localised pollution, tends to be viewed as more 'real' than broader climate change issues.

4. **There are many misconceptions about 'good' and 'bad' behaviour in relation to air pollution**

We can draw on two examples from Dublin where citizens have developed misconceptions of whether certain behaviours have a positive or negative effect on air pollution and climate change.

The first of these relates to fuel use in the home. Since the 1990s it's been illegal to sell smoke producing coal in Dublin. This policy was introduced as an attempt to reduce the level of pollution from individual households when heating their homes and is considered one of the most successful policies for improving air quality within the city. However, despite its initial success, the use of solid fuel in the home has regained popularity in recent years. People are replacing gas fires with wood burning stoves and open fires due to their 'comfort factor' and relatively cheap running costs (Independent, 2000). Although burning wood in many ways is a more sustainable option than electricity and gas, many citizens are unaware of the negative impact it can have on localised air pollution, particularly in built up areas. This trend has led to renewed concern amongst policy makers regarding this issue and some stakeholders suggested banning building open fire places in new housing.

The second misconception many citizens have is about the impact diesel cars have on air quality. Until relatively recently many governments incentivised the purchase of diesel fueled cars as they produced less CO_2 than petrol and by 2015 diesel cars accounted for nearly three-quarters of all new cars sold in Ireland (Independent, 2016). However, government policy has now changed due to better scientific understanding, and although diesel cars do produce lower CO_2 emissions, they are more polluting than petrol in terms of many other harmful pollutants (PM and NO_X). This lack of clarity with government advice is likely to have built citizen's mistrust in the reliability of their recommendations in addition to creating misconceptions on the best course of action to take when it comes to reducing individual impact. In addition to this, a car is a major investment for most people and they are unlikely to purchase a new car solely on this advice.

Government Policy

1. Disagreement and a lack of co-ordination among government bodies

As we have already seen, with such complex topics as air quality and climate change, government policy and advice to citizens can radically change and fluctuate. This not only contributes to citizen misconceptions, but also creates lack of co-ordination between the government bodies themselves - both in terms of the agreed knowledge surrounding the causes of air pollution, and also in terms of ownership and who is responsible for tackling these issues.

2. Misleading or unreliable measurement of air quality

Although city level air pollution indices often indicate that the air quality in Dublin is good, when measured at a local level, there are areas within the city where the air pollution are likely to have a considerable impact on the health of citizens. There is therefore a need for better, and more localised measurement of specific areas to identify those which should take priority.

3. Lack of support from central government

Dublin's stakeholders report that air quality is not the main driver of transport policy in Dublin despite transport emissions being acknowledged as the main contributor to air pollution in the city. This suggests greater support for air quality initiatives from government transport authorities is needed to move forward in this area.

4.4 Guildford

4.4.1 City Snapshot

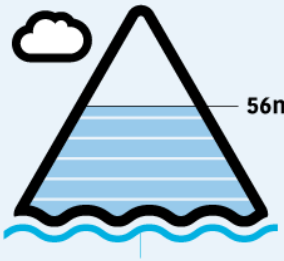
Guildford is a large town in Surrey, England, located 43 km southwest of central London.

Due to recent development running north from Guildford, and linking it to the Woking area, Guildford now officially forms the southwestern tip of the Greater London Area, as defined by the Office for National Statistics. Surrey is also one of the most expensive places to buy property in the UK outside London (Zoopla, 2017).

GUILDFORD

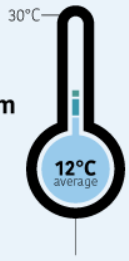
GEOGRAPHY

Altitude



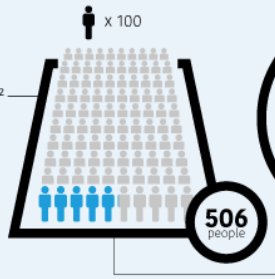
★ www.elevationmap.net/

Temperature



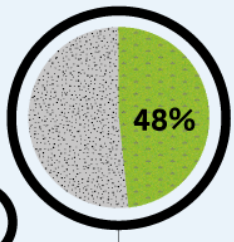
★ www.en.climate-data.org

Density



★ www.openstreetmap.org/#map=5/51.500/-0.100

City Green Space



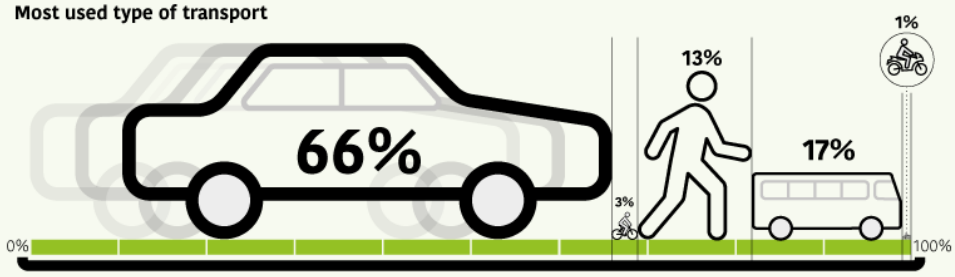
Did you know...

"Although trees in cities are generally thought to have a positive effect on air quality they may contribute to pollution when placed near arterial roads by trapping pollutants depending on the species, canopy density, time of year and wind direction"

(Source: The Guardian Newspaper)

TRANSPORT ★www.ec.europa.eu/eurostat

Most used type of transport



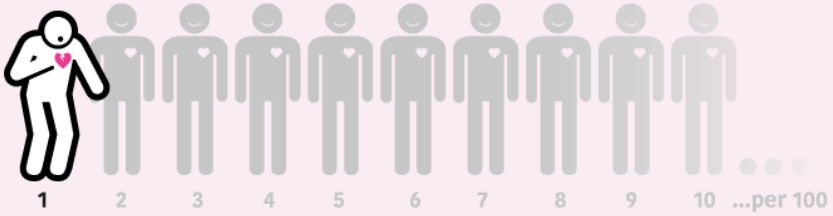
Did you know...

"57% of car journeys in the UK are made for distances under five miles"

(Source: The Intergovernmental Panel on Climate Change)

HEALTH ★www.ec.europa.eu/eurostat

People diagnosed with air pollution related diseases



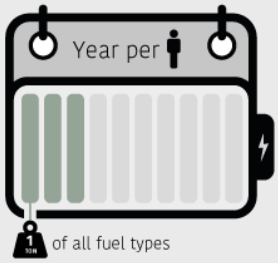
Did you know...

"Air pollution is the second deadliest public health hazard after smoking in the UK"

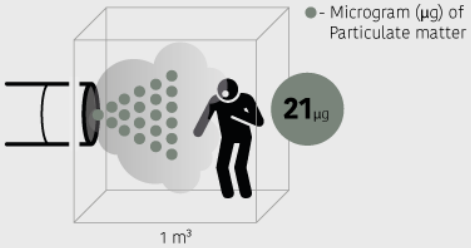
(Source: The Guardian Newspaper)

POLLUTION ★www.ec.europa.eu/eurostat

Energy Consumption



Exposure to pollution per day

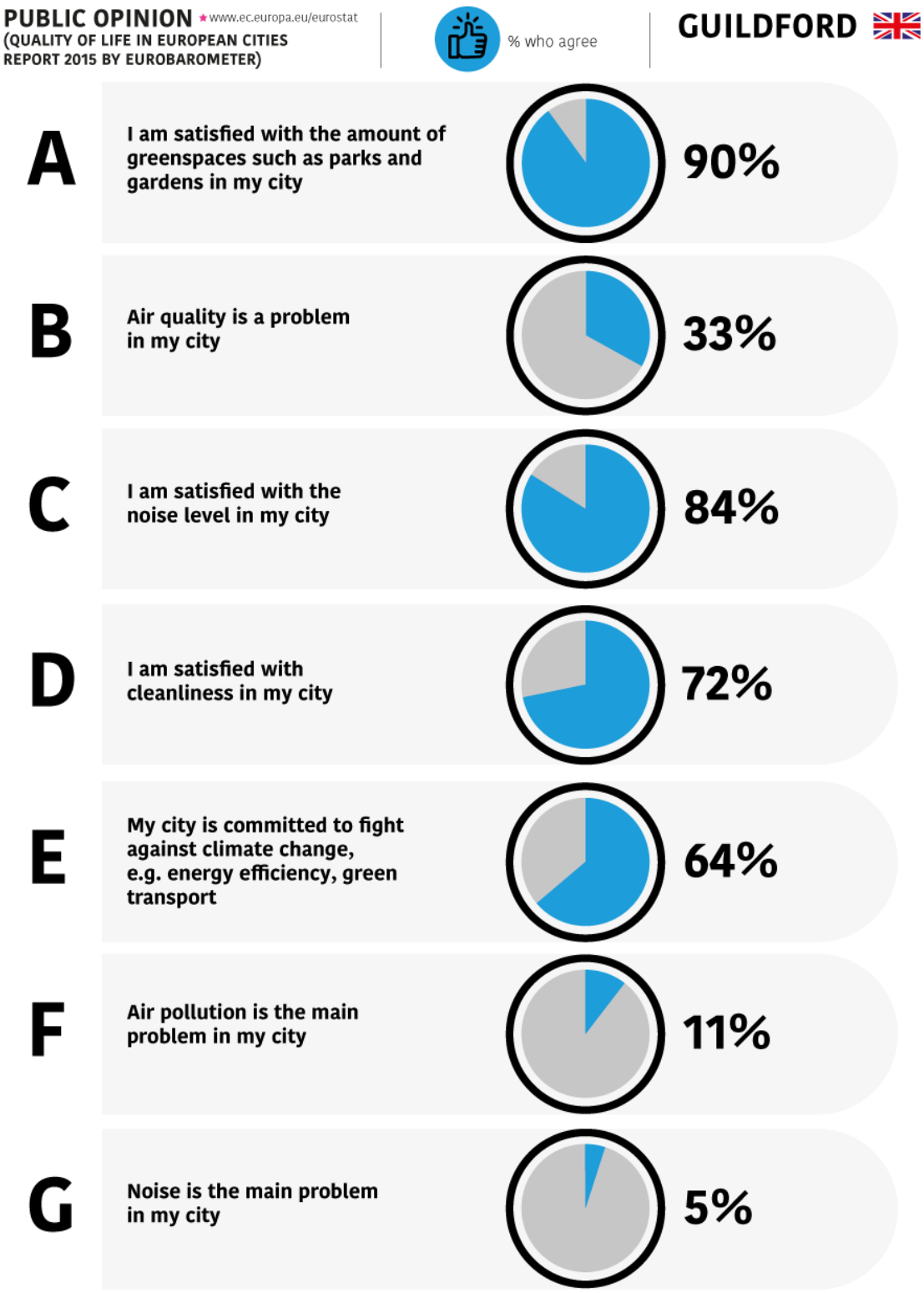


Did you know...

"The amount of pollution you are exposed to when sitting in a car in traffic is 11% higher than when cycling on the same road"

(Source: Boogaard et al. 2009)

★Data sources



The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

★Data sources

4.4.2 City Challenges

The following challenges are based on the qualitative responses of the four city stakeholders who filled in the survey for Guildford. The challenges should be considered as high-level 'thought-starters' and used as a foundation for further exploration during the later phases of the iSCAPE project and the living labs themselves.

Urban Environment

1. **The city is close to the airport**

Guildford is very close to two major London airports – Heathrow and Gatwick – contributing to high levels of pollution in the area. The proximity of Heathrow was one factor in the entire borough of Guildford being declared as a hot spot for air pollution within the UK and a priority for government intervention.

2. **The city is designed for the car**

Surrey includes some of the busiest major roads in the UK and traffic is a big issue for the area. Guildford's stakeholders describe how the heavy traffic creates a 'pollution tunnel' effect on busy roads due to tall buildings on either side of the road.

3. **The city structure is dense or overcrowded**

Guildford is within easy commuting distance of central London and suffers from many of the same issues regarding increased population growth and overcrowding on public transport.

Citizen Perception

1. **The link between air quality and climate change is poorly understood**

Public awareness of air pollution has increased in recent years due to a combination of campaigns introduced by the new London Mayor such as Clean Air London (2017) and the high-profile court cases surrounding the inadequacy of the UK government's air quality strategy (Guardian, 2017). However, this increased media attention tends to focus on the consequences of air pollution related to individual health rather than broader climate change.

2. **There are many misconceptions about 'good' and 'bad' behaviour in relation to air pollution**

Although most people understand the significant contribution traffic makes to air pollution, many are unaware of the ways in which small changes to their driving behaviour can impact emissions. Evidence for this comes from an 'anti-idling' campaign trialed in the Surrey area. Drivers were encouraged to turn off their engine while their vehicle was stopped at a level crossing through face to face information and road-side advertising. The trial found that there was a 22% increase in the

number of drivers turning off their engines showing that this extra information can help people change their behaviour. (Another example of a campaign to change driving behaviour can be seen in air quality case study 6 p.57-58).

3. People have a very basic knowledge of the health impact of air pollution

Citizens understand the health impacts of air pollution at a very general level. Citizens need to be given more specific knowledge on the precise health effects of different types of pollutants as well as which citizens are most at risk.

4. People don't see air quality as something they can (or are willing) to change

Many citizens still don't care enough about these issues to change their lifestyles.

> *"A third of people are concerned, a third of people are unaware, and the other third don't care."* Reigate and Banstead Borough Council

Government Policy

1. Disagreement and a lack of co-ordination among government bodies

The roads in Guildford are not under the control of the local authority, and instead are split between Surrey County Council who deal with local roads, and Highways England who deal with motorways. This can make it difficult when coordinating and implementing changes to policy or infrastructure as any initiative introduced by the local authority requires third party agreement. One example comes from a pilot study that looked at how reprogramming traffic signals might encourage motorists to stay at a steady speed of 20mph. The borough council worked on a micro simulation model of a particular road and although the trial suggested the initiative would have a significant impact, the authority responsible for the road would not agree to implementing it for real.

2. Misleading or unreliable measurement of air quality

Guildford city stakeholders reported the difficulty in gaining reliable real-time data with a wide coverage of the area. They believe that new DEFRA approved low cost monitoring tech is likely to help with this issue.

3. Lack of support from central government

Stakeholders describe how traditionally a low level of political will regarding air quality issues has held up policy change. Although there is now greater government support, there is still inefficient amounts of air quality specific funding and a high level of competition for it.

4.5 Hasselt

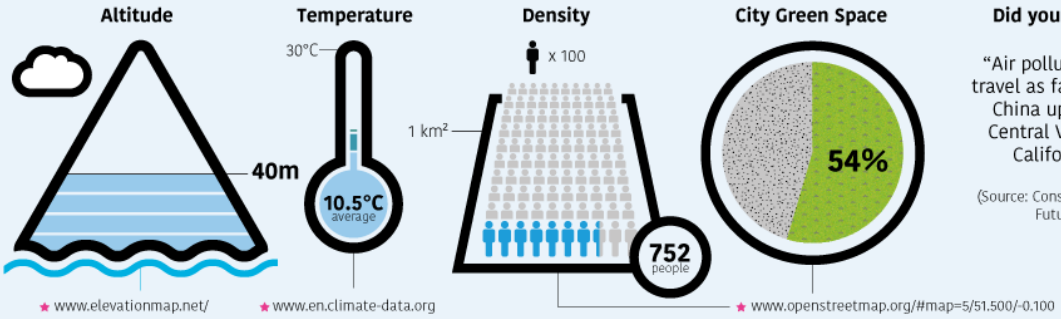
4.5.1 City Snapshot

City and municipality, and capital of the province of Limburg, a Flemish region.

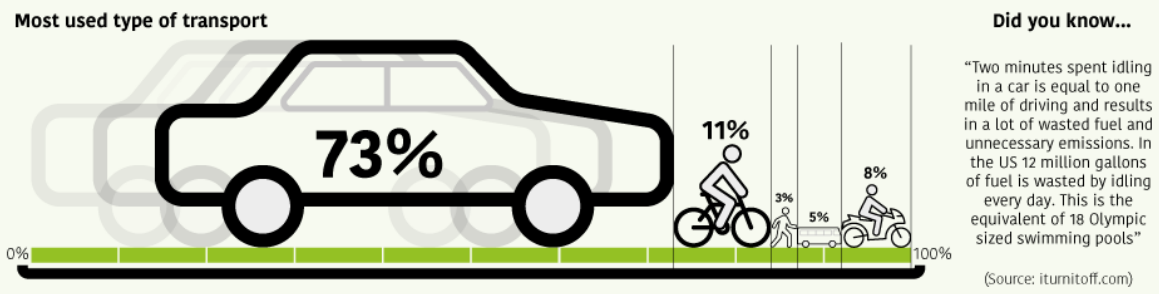
The centre of Hasselt is mostly car-free and contains a number of historical buildings. Hasselt is at the junction of several important traffic arteries and the old town of Hasselt is enclosed by 2 ring roads. The outer ring road serves to keep traffic out of the city center and main residential areas. The inner ring road, the "Green Boulevard", serves to keep traffic out of the commercial centre, which is almost entirely pedestrianised. The mobility policy in Hasselt developed into an example of cooperation between the bus line, the government and the city of Hasselt, under the motto "the city guarantees the right of mobility for everyone".

HASSELT

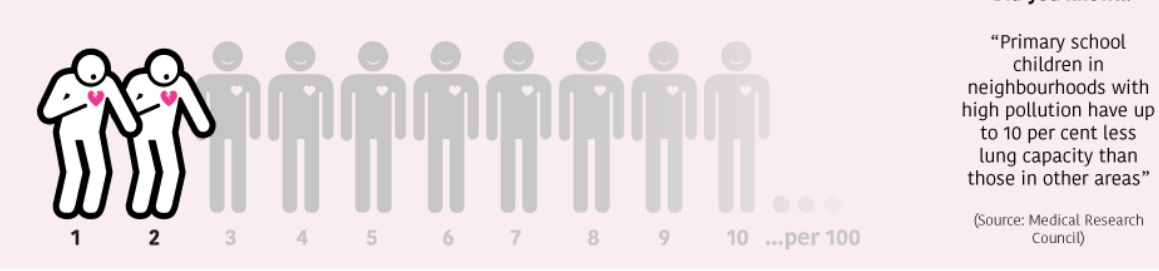
GEOGRAPHY



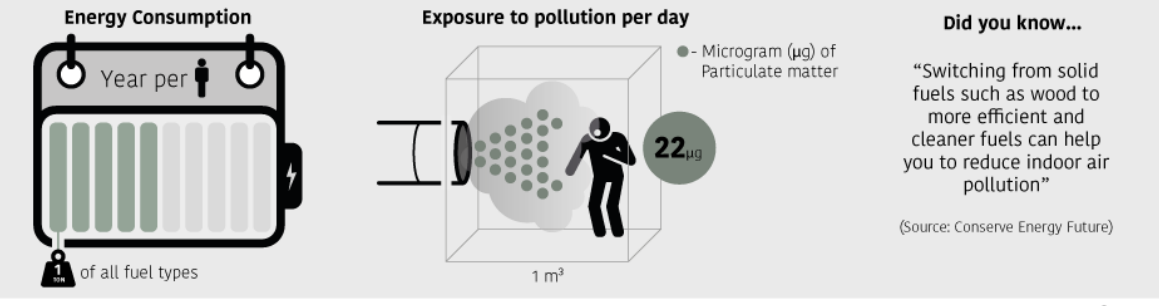
TRANSPORT ★www.ec.europa.eu/eurostat



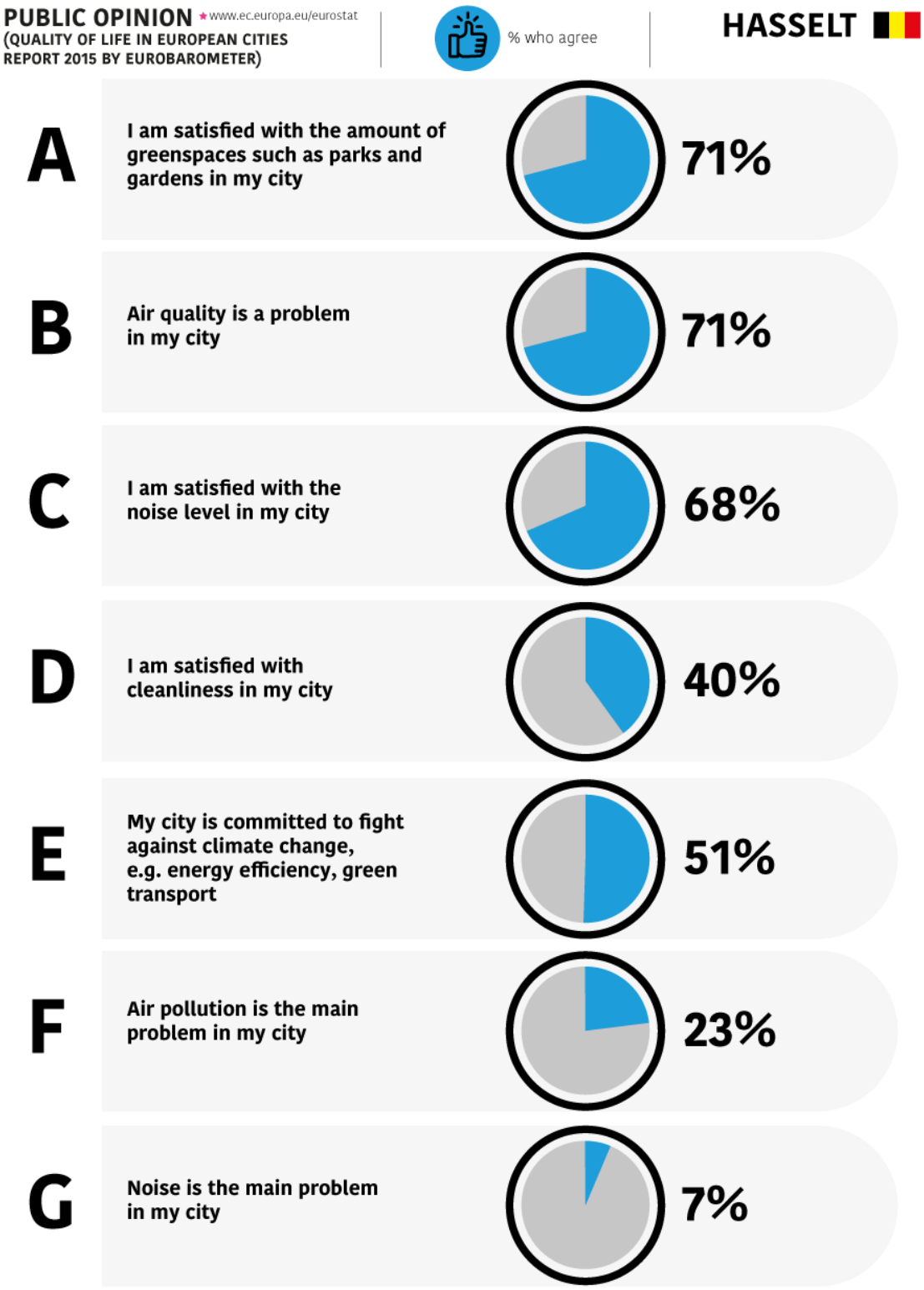
HEALTH ★www.ec.europa.eu/eurostat



POLLUTION ★www.ec.europa.eu/eurostat



★Data sources



The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

4.5.2 City Challenges

The following challenges are based on the qualitative responses of the two city stakeholders who filled in the survey for Hasselt. This is a particularly low number of respondents and care needs to be taken when generalising the results. The challenges should be considered as high-level 'thought-starters' and used as a foundation for further exploration during the later phases of the iSCAPE project and the living labs themselves.

Urban Environment

1. **The city is designed for the car**

Like most of the iSCAPE cities, one of the biggest challenges for Hasselt is traffic congestion. The city is surrounded by two major highways and although the city centre itself is largely car free, this also means that there is a lot of logistical traffic from visitors navigating their way around and through the rest of the city. Car ownership has also increased in the area in recent years and traffic pollution is increasing as a result.

2. **Innovating within a historic city can be difficult**

The city centre of Hasselt is very old and any new infrastructure would need to work within the historic structure of the city. In order to try and tackle congestion hot spots where narrow inner city roads have created bottlenecks for traffic, the local authority has analysed the use of these roads and developed a model to identify possible solutions.

Citizen Perception

1. **The link between air quality and climate change is poorly understood**

Stakeholders report that approximately 50% of people are aware of air pollution but aren't aware of its consequences e.g. only those who have previously had health problems relating to air quality make changes to reduce exposure based on their doctor's advice.

2. **There are many misconceptions about 'good' and 'bad' behaviour in relation to air pollution**

The Flanders Regional Air Quality Action Plan recognised that citizens were unaware of the negative consequences of wood burning in their homes. As part of the action plan a series of household policies were put in place, including the 'Stook Slim' campaign (2017) which aims to teach people about how to use wood burning stoves and open fires more effectively, as well as encourage them not to use fire places when air pollution is particularly bad.

3. **People have a very basic knowledge of the health impact of air pollution**

Current knowledge of this is very general, citizens need to be made aware of the specifics, for example; what are the different types of pollutant? where do they come from? what are the specific health impacts each of them has?

4. **People don't see air quality as something they can (or are willing) to change:**

Citizens are aware of these issues but not enough to change their travel behaviour. Air pollution and climate change are often seen by citizens as a problem for industry, not for car users.

Government Policy

Out of all the cities we have looked at, Hasselt (and the Flanders region in general) seem to have the most citizen focused policies to tackle air pollution. Although many other iSCAPE cities have similar issues with household fuel, Hasselt are the only one who have an active campaign to tackle this. They are also running campaigns to encourage citizen engagement and educate people on these issues. For example, 'e-portmonnee' promotes environmentally friendly behaviour by giving citizens who take part rewards for positive actions. They also promote eco-friendly vehicles via their 'eco-score' campaign where citizens can assess their vehicle's impact on the environment, including how much it contributes to air pollution. They eventually plan to use the 'eco-score' as a basis to reform traffic taxes in the area. However, despite some positive political action, there is still room for improvement and the impact of many of these policies is yet to be measured. To make sure these policies do have a sustained impact on air pollution and climate change will require continued support from central government and improved levels of citizen knowledge and engagement.

4.6 Vantaa

4.6.1 City Snapshot

Vantaa is part of the inner core of the Finnish Capital Region along with Helsinki, Espoo, and Kauniainen.

The area was originally known as the 'county of Helsinki' but in 1972, the municipality was renamed Vantaa. It is now the 4th most populated city of Finland but is mostly suburban with some rural parts. The city has a lot of wetland and includes two natural lakes and an artificial lake as well as bordering on two other lakes in different municipalities. Helsinki Airport is located in Vantaa. This is the largest airport in Finland and in 2016, it attracted a total of 17.1 million passengers (Finavia, 2016). Vantaa also serves as the transportation hub of the Helsinki metropolitan area. Several key freeways and highways, such as Ring III and Porvoonväylä, originate in or pass through it.

VANTAA

GEOGRAPHY

Altitude

17m

Temperature

30°C

5.5°C average

Density

x 100

1 km²

899 people

City Green Space

79%

★ www.elevationmap.net/ ★ www.en.climate-data.org ★ www.openstreetmap.org/#map=5/51.500/-0.100

Did you know...

"Pollutants that are released into the air are more harmful than land and water pollutants"

(Source: Conserve Energy Future)

TRANSPORT ★www.ec.europa.eu/eurostat

Most used type of transport

68%

18%

7%

6%

1%

0%

100%

Did you know...

"A single bus carries an equivalent number of passengers to 40 cars"

(Source: Conserve Energy Future)

HEALTH ★www.ec.europa.eu/eurostat

People diagnosed with air pollution related diseases

1 2 3 4 5 6 7 8 9 10 ...per 100

Did you know...

"Pollutants, such as the chemicals in traffic fumes, can quickly irritate the airways and trigger asthma symptoms"

(Source: Asthma.org.uk)

POLLUTION ★www.ec.europa.eu/eurostat

Energy Consumption

Year per

of all fuel types

Exposure to pollution per day

- Microgram (µg) of Particulate matter

16µg

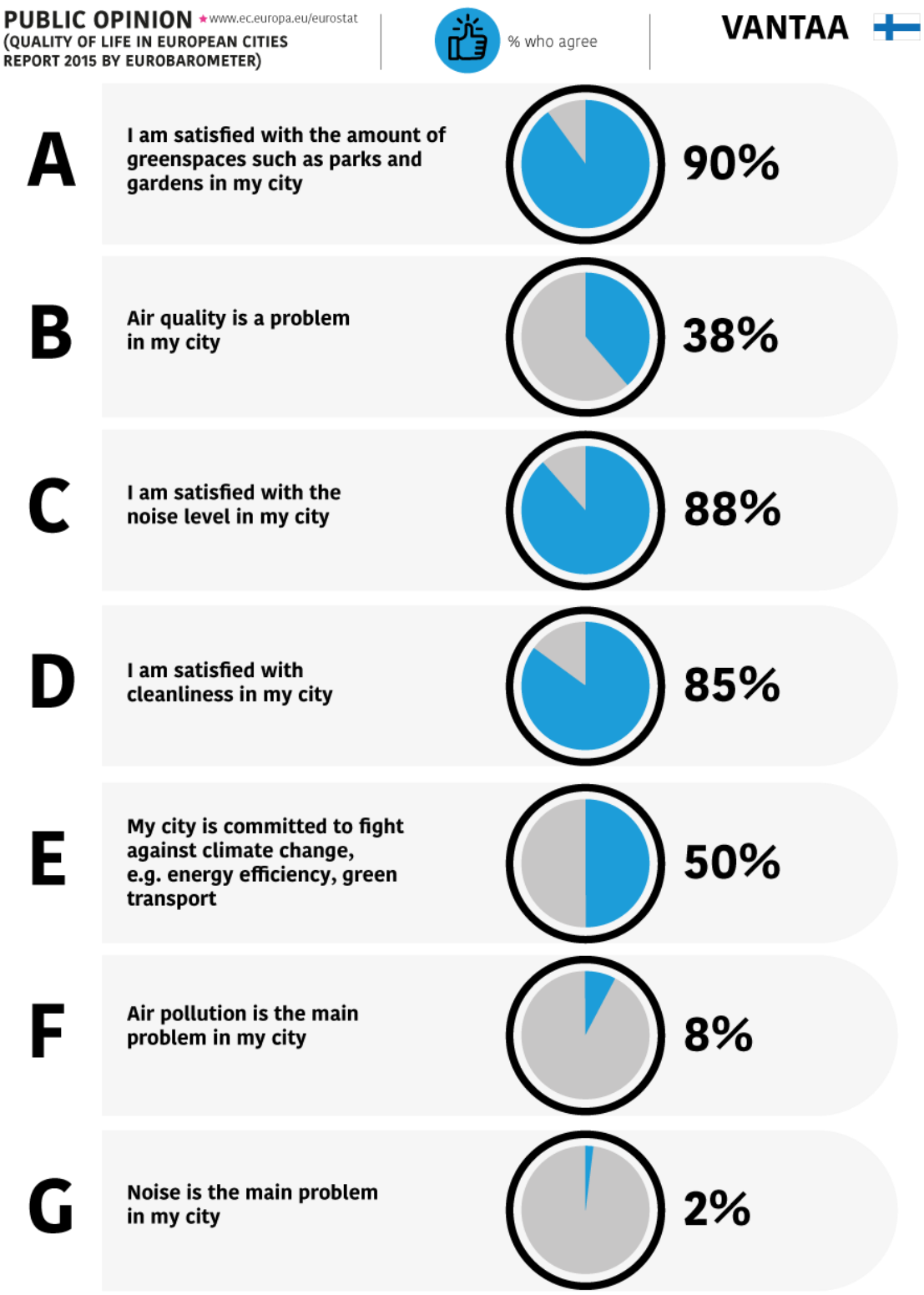
1 m³

Did you know...

"Volcanoes used to be the main source of sulfur dioxide contained in smog – today humans are"

(Source: National Geographic)

★Data sources



The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

★Data sources

4.6.2 City Challenges

The following challenges are based on the qualitative responses of the three city stakeholders who filled in the survey for Vantaa. The challenges should be considered as high-level 'thought-starters' and used as a foundation for further exploration during the later phases of the iSCAPE project and the living labs themselves.

Urban Environment

1. The city is designed for the car

Vantaa is divided into many sectors by highways that lead to the capital city of Helsinki. This means that many areas close to the highways, although offering good transport links via car to the capital, are not desirable to live in due to high levels of noise and pollution. Despite investment in other modes of transport, private cars still have a strong influence on city planning.

> *"We are developing an urban structure that makes walking, cycling and public transportation more desirable. There is also major investment in a ring railroad but private cars still have a very strong position in city planning (and this is a failure). Housing is more expensive in places with very effective public transport which means it is still cheaper to own two cars than to buy a house in these areas."* City Planner/Landscape Architect

2. The city is close to the airport

Finland's biggest airport is in Vantaa and this is the main airport for the capital city of Finland. 90% of Finland's international air traffic passes through it and in 2016 it had a total of 17.1 million passengers. It is a big source of pollution in Vantaa.

Citizen Perception

1. A culture of car users

Private cars are still considered the easiest and fastest way to get around the city of Vantaa. Citizens don't yet take responsibility for the problems caused by cars and their values would have to change before political decisions restricting the use of cars would be accepted.

2. The link between air quality and climate change is poorly understood

Stakeholders believe citizens in Vantaa have a 'vague' understanding of the relationship between air quality and climate change. Climate change has become a familiar issue in the Finnish media while air pollution is less prominent.

3. There are many misconceptions about 'good' and 'bad' behaviour in relation to air pollution

This confusion is not helped by citizens being given contradictory information when it comes to government advice. Like we saw in Dublin and Hasselt, wood burning in fireplaces and sauna stoves is seen as a sustainable fuel and therefore good for the climate, however, there is little understanding that it can have a huge impact on localized air pollution in densely populated residential areas.

4. Air pollution is often invisible

Some pollutants such as particulate matter tend to be invisible to the human eye when in the air, and can only be detected when they build up on surfaces e.g. window frames. Many impacts of air pollution such as climate change and its health effects take time to be realised and are therefore hard to grasp as they have little impact on our everyday lives. It's maybe not surprising, therefore, that most citizens are more concerned about the noise pollution from the airport and highways that cut through the city, than they are about the impact these are having on the air that they breath.

Government Policy

1. Disagreement and a lack of co-ordination among government bodies

Air quality is now recognised in Vantaa as an important factor to consider in city planning and moves have been made to ensure closer collaboration between the different government bodies involved. Vantaa's Air Protection Policy (2008) shows its commitment to greater co-operation between The Centre for Environment, Land Use Planning, Traffic Planning and Street Maintenance. However, there is still some disagreement about certain details, for example, how to define sufficient distance for new housing from busy roads. The recent development of air quality guidelines for city planners should help solve some of these issues.

2. Gap between scientific research and government legislation

Legislative guidelines often do not match the scientific knowledge available regarding the health effects of air pollution, it's important to ensure greater collaboration between government bodies and universities.

> *"Our legislative guidelines do not match the scientific knowledge on the health effects of air pollution. The threshold values for pollution concentrations are way too high to protect the health of people living in polluted areas."* Planner, City Planning Department

5 Case Studies and Opportunities

5.1 Air Quality Intervention Case Studies

These case studies have been chosen as best practice examples of interventions into air quality mitigation and prevention. They have been selected based on desk research and expert consultation both within FCC and the wider iSCAPE consortium. An effort has been made to draw on best practice examples from across the globe and not just Europe so that we can learn from best practice further afield, however, there is a slight bias towards examples from the UK due to this being the location of the researchers working on this deliverable and therefore having more literature available in English to draw on. A key part of the selection process was also whether the intervention was able to demonstrate that it had had a positive impact on air quality, as well as what impact it had on citizen awareness and behaviour change. The case studies are intended to be used in the living labs for citizen engagement purposes, to help people understand how policy changes, innovative design and individual behaviour change can contribute to addressing some of the challenges that cities are currently facing regarding air pollution and climate change (see page 47-69). However, they are not intended to be an exhaustive list, and we plan to add to these case studies throughout the project as the living labs engagement activities progress. For example, the iSCAPE living lab interventions should be written in this format, and added to the air pollution engagement tools that are developed as part of WP2.

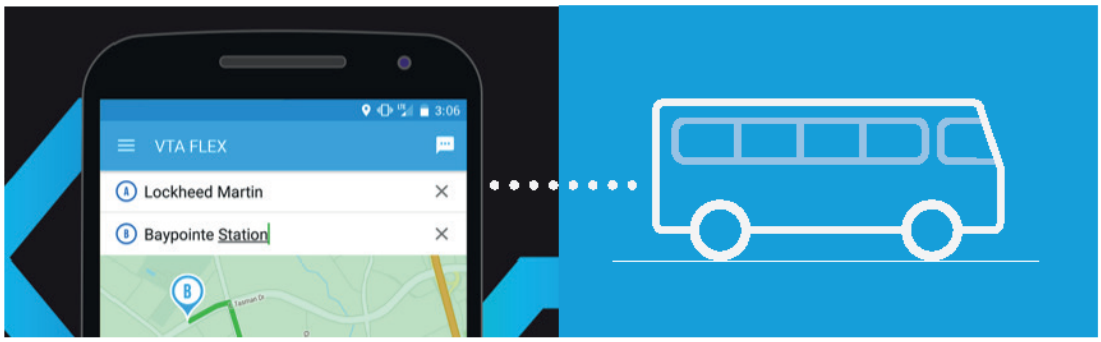
5.2 Citizen Engagement Case Studies

These case studies have been chosen as best practice examples of existing citizen engagement projects. They have been selected based on desk research and expert consultation both within FCC and the wider iSCAPE consortium. An effort has been made to draw on best practice examples from across the globe and not just Europe, however, there is a slight bias towards examples from the UK due to this being the location of the researchers working on this deliverable and therefore having more literature available in English to draw on. They have also been selected as we believe them to provide a varied mix of engagement methods that will provide an array of techniques that can be adopted through the iSCAPE living labs. With this in mind, they will be used as inspiration in WP2 when setting up the living labs, as well as for citizen engagement purposes to help people understand the purpose of the iSCAPE project overall (see page 70-84).

Although these were not originally in scope for Deliverable 1.1, the team decided they would be a valuable addition given that the ‘Living Lab’ is a new methodology for many of the iSCAPE partners. We believe these examples will help to provide further understanding for those partners who are unfamiliar with citizen engagement methods in general. They are designed to be a ‘taster’ of these types of projects and, as is the case with the Air Quality Intervention Case Studies, can be added to throughout the course of the project – including, eventually, the iSCAPE Living Labs themselves.

AIR QUALITY - CASE STUDY 1

ON DEMAND PUBLIC TRANSPORT



Picture source: https://apkpure.com/vta-flex/com.ridecell.platform.leonidas.flex

Santa Clara, USA

WHAT IS IT?

In January 2016 Santa Clara's Vehicle Transportation Authority (VTA) launched a six-month pilot project for an on demand public transport system. It works in a similar way to Uber, allowing passengers to use an app to request a bus as and when they need it. While the system still has defined bus stops like a traditional bus route, it does not travel on a fixed route or schedule and instead uses technology to pick the most effective route based on the passengers' destinations.

WHAT DIFFERENCE DID IT MAKE?

- VTA recognised that the needs of citizens in San Jose were changing, and that advances in technology could be adopted to meet the needs of a broader spectrum of passengers, in particular those with disabilities and the elderly.
- A major aim of the project was to help reduce congestion and the pilot shows how alternative transport models can provide an accessible and affordable alternative to driving.

WHAT CAN WE LEARN?

- Highlights the importance of the reliability of public transport to reduce the appeal of cars.
- Shows how new technology and business models can help make public transport more innovative and efficient.
- Enables broader areas to be served by public transport while reducing issues with infrequent services in less populated areas.
- Similar schemes in India show the potential for developing countries to leapfrog the more traditional time-tabled public transport system and go straight to more efficient, on demand initiatives.

LINKS & REFERENCES

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AIR QUALITY - CASE STUDY **2**

IMPROVING THE 'FLOW' OF CYCLING

Picture source: http://www.fourteenislands.com/tag/infrastructure/

Copenhagen, Denmark

WHAT IS IT?

The city of Copenhagen wanted to encourage cycling by making it safer and more seamless across the city. They recognised the importance of cyclists maintaining 'flow' when they are travelling from A to B which includes the safety, directness, comfort, coherence and attractiveness of routes. The city introduced a series of interventions to improve this.

The first of these interventions was to introduce Green Wave technology to traffic lights, which has been in place since 2007. This co-ordinates traffic lights during rush hour so that they stay green as long as the cyclists are riding at a speed of 20km/h. This speed encourages slower cyclists to go a bit faster, and faster cyclists to slow down to a safer speed. Green Wave 2.0 detects cyclists as they approach an intersection, and if there are five or more approaching together, the light will stay on green until they pass. Speed radar signs as well as green lights in the pavement tell cyclists that they are travelling at the correct speed.

In addition to the Green Wave, the city built a network of separate cycle lanes with the following infrastructure: extra wide tracks so cyclists could chat while commuting, foot rests so they didn't need to dismount at traffic lights, pulled back stop lines for cars and guides for cyclists to navigate through intersections by painting the roads blue.

WHAT DIFFERENCE DID IT MAKE?

- Since these interventions have been in place the proportion of Copenhageners who currently commute by bike has risen to over 50%.
- 80,000 cyclists per day use the green wave - this is roughly 26% of the total number of cyclists entering the city centre each day.

- Car traffic has dropped by 10% on these stretches of road and cycling has increased by 20%.
- Copenhagen has also been found to have the world's best behaved cyclists in the world - only 7% break a traffic law and only 1% run a red lights or ride on pavements.

WHAT CAN WE LEARN?

- Optimising cyclists on the road rather than cars helps encourage healthier and more sustainable forms of transport.
- Indicates the potential better cycling infrastructure may have for improving cycling behaviour.
- Although it is difficult to isolate the separate impacts of individual policy interventions designed to promote cycling as they tend to be interdependent and mutually supportive - these interventions show how cycling infrastructure can transform the way people travel around a city.

LINKS & REFERENCES

- https://www.theguardian.com/cities/2014/oct/16/copenhagen-cycling-innovation-lycra-louts-green-wave-bike-bridges
- http://www.copenhagenize.com/2014/04/the-worlds-best-behaved-cyclists-are-in.html

AIR QUALITY - CASE STUDY 3

WORKPLACE PARKING LEVY

Picture Source: http://www.avonwood.co.uk/wp-content/uploads/2013/10/Parked-Cars.jpg

Nottingham, UK

WHAT IS IT?

The Workplace Parking Levy (WPL) is a licensing scheme which allows local authorities to charge owners of commercial premises a license fee for any parking spaces they have on their premises. The levy affects any premises with more than 10 parking spaces and there is scope to give exemption to certain business premises such as the NHS. The money raised from the levy must be used to enhance public transport in the local area. Nottingham City Council was the first local authority in the UK to introduce the levy. The aim for the Nottingham scheme was to reduce congestion and air pollution in the city center.

WHAT DIFFERENCE DID IT MAKE?

- The money raised from the levy was used to fund an expansion of the NET (Nottingham Express Transit) system, improvement to the central rail station and to support the bus system.
- The levy generated a revenue of £25.3M in its first 3 years of operation.
- Whilst the WPL does not seem to have had a significant impact on congestion, there is evidence it has lowered the city's carbon emissions.
- The success of Nottingham's scheme has prompted other cities to consider the WPL. So far however only Cambridge has taken concrete steps to instigate a WPL.

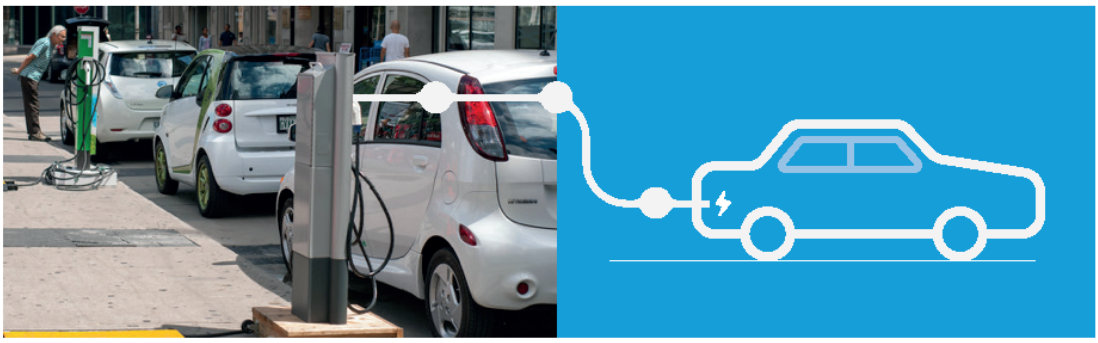
WHAT CAN WE LEARN?

- Linking what could be an unpopular measure to a demonstrable public benefit can help win over the public.

LINKS & REFERENCES	• http://www.healthyplaces.org.uk/themes/enabling-active-travel/restricting-traffic/workplace-parking-levy/ • http://www.fleetnews.co.uk/news/fleet-industry-news/2016/09/13/levy-helps-nottinham-to-33-carbon-cut • http://www.gccitydeal.co.uk/citydeal/homepage/9/wpl

AIR QUALITY - CASE STUDY 4

ZERO CARBON FUTURES



Picture source: http://jesmondlocal.com/wp-content/uploads/2016/02/Ride_and_Drive_EVs_Plugin_Drive_Ontario-1024x688.jpg

Northumberland, UK

WHAT IS IT?

Zero Carbon Futures have developed the next generation of rapid charging points for electric vehicles (EV). The north east of England was one of the first regions to roll out EVs on a large scale. The original models for EV use assumed people would charge the cars overnight at home before using them to commute during the day. When they rolled out the program they provided free parking next to charging points in the city center. As a result, what actually happened was that drivers commuted to the city and left their cars to charge during the day (thus avoiding using their own electricity and a parking charge).

WHAT DIFFERENCE DID IT MAKE?

- The next phase of EV infrastructure is now being developed to avoid these unintended consequences.
- As take up of EVs continues to grow, so the demand of the infrastructure required to support them will grow. The lessons learnt from the Zero Carbon Futures project has informed this. A new rapid charging filling station in the city center will allow commuters to top up before driving home. The filling station will resemble a traditional filling station. The filling station will incorporate a battery bank to smooth the energy demand and top itself up overnight to generate off-peak demand that is helpful for the grid.
- Having an easy and familiar way of 'filling-up' the EV will also encourage more commuters to use EVs. The existing charging point parking spaces could then be used to create incentives for multi-occupancy EV use. Only vehicles that have more than 2 occupants would be permitted to use them.

WHAT CAN WE LEARN?	• Citizen behaviour is often unpredictable. • Several iterations of a strategy may be needed before a particular initiative or intervention works as it was intended. • Learning and flexibility should be built into every project.
LINKS & REFERENCES	• www.zerocarbonfutures.co.uk

AIR QUALITY – CASE STUDY 5

CONGESTION CHARGE

Picture source: https://tfl.gov.uk/cdn/static/cms/images/zone-sign.jpg

London, UK

WHAT IS IT?

London has the worst traffic compared to any other city in the UK and is one of the most congested cities in Europe. The Congestion Charge aimed to reduce traffic congestion within the city centre by charging people for driving within a specified area. It was introduced in 2003 by Transport for London and charges drivers £11.50 a day if they enter the zone between 7am and 6pm, Monday to Friday. If drivers do not pay the charge by midnight the day after they travel through the zone they risk paying a penalty fine of up to £130. Similar schemes have been implemented in many other cities such as Milan, Stockholm and Singapore to varying degrees of success.

WHAT DIFFERENCE DID IT MAKE?

- The scheme reduced traffic in central London by 20% and CO_2 emissions by 16%.
- In 2008 it was estimated that 30% of drivers had abandoned their vehicles in lieu of public transport in order to avoid the charge.
- The remaining 70% of daily drivers continue to pay the charge which each year produces a revenue of a few hundred million pounds which are re-invested into the Mayor's transport strategy.
- The scheme has helped London see a shift from private car use to public transport, walking and cycling within the city centre.
- Business leaders argue that congestion charge has adversly affected takings for retailers as people opt to go to out of town shopping centres.

WHAT CAN WE LEARN?

- Charging people to drive cars within the city centre is an effective method of deterring car use and prompting people to find alternative modes of transport to access the central zone in London.

- It also acts as a revenue stream to further invest in and improve alternative transport options – public transport, cycle lanes, bike schemes etc, ultimately helping more people to become less reliant on private car use.
- Although there is arguably less congestion on London's streets this is only a step towards solving the problem of air pollution.
- An electronic payment system like that which is used in Singapore would help make the scheme more efficient.
- New proposals for ultra low emission zones are to be implemented in 2019.

LINKS & REFERENCES

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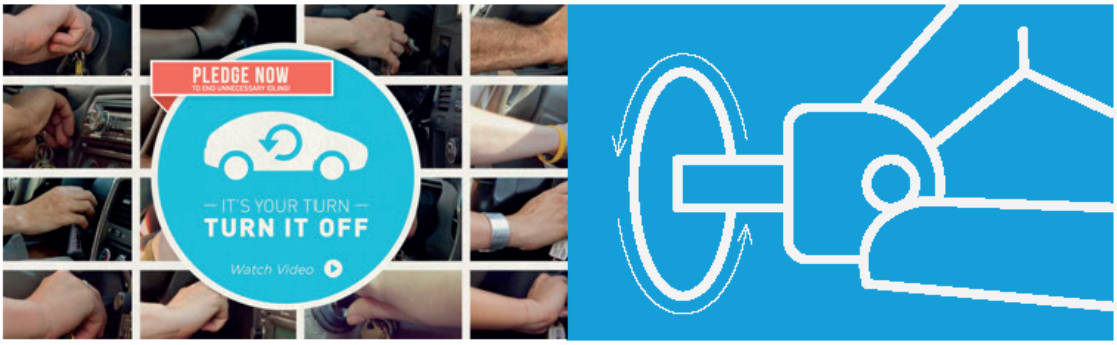
AIR QUALITY - CASE STUDY 6

TURN IT OFF CAMPAIGN



Picture source: http://iturnitoff.com/#/the-issue

Toronto, Canada

WHAT IS IT?

'Turn it Off' is an anti-idling campaign led by Natural Resources Canada. It asked drivers to pledge to turn off their engines while waiting to pick someone up. Two minutes spent idling is equal to 1 mile of driving so results in a lot of wasted fuel and unnecessary emissions. They targeted "Kiss and Ride" parking lots around schools and transit hubs to ask drivers to turn off their engines while waiting. They used a face-to-face approach and gave people who pledged stickers for their cars to display their support.

WHAT DIFFERENCE DID IT MAKE?

- Before the campaign Canadians, on average, idled their engines 53% of the time. As a result of campaign the frequency of idling was reduced by 32% and idling duration by 73%.
- Over 200 Canadian communities are now implementing the pledge and thousands of people in the U.S.

WHAT CAN WE LEARN?

- Initially signs were used to remind drivers about the negative impact of idling but these did not work on their own. An interpersonal approach was much more effective even though most conversations lasted only 1 minute.
- Many people do not realise the impact their driving behaviour can have on air pollution.

LINKS & REFERENCES

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AIR QUALITY – CASE STUDY 7

BIKE SHARING SCHEMES

Picture source: https://static.dezeen.com/uploads/2015/06/Boris-Bikes-London-Redesign_Dezeen_784.jpg

London, UK

WHAT IS IT?

Public bike sharing schemes have existed for almost 50 years, but during the last decade they have rapidly increased in both their prevalence and popularity worldwide. They are believed to provide a whole host of benefits including flexible mobility, emission reductions, opportunities for physical activity, reduced congestion and fuel use, individual financial savings and multimodal transport connections. However, despite this, cycling remains rare in many cities.

In 2010 London introduced automated docking stations across the city to dispense bikes which can be hired for a low cost 'on the go' or monthly/annual subscription. These have become known colloquially as 'Boris Bikes' after the London Mayor at the time they were introduced. The main aim of the scheme was to provide a method of transportation for short trips within the city. There are now almost 250,000 active members and about 1 million casual hires per month.

WHAT DIFFERENCE DID IT MAKE?

- When this scheme was introduced only 2% of trips in London were cycled, even though an estimated 23% of trips could reasonably be made by bicycle .
- Although arguably the scheme does not reduce CO_2 emissions due to the vehicles needed to balance out docking stations, it has been proven effective in behavioural change - 35% of the bike scheme users used to travel by underground, 29% used to walk and 23% used to take the bus – leaving 13% who previously drove around the capital.
- The 'Boris Bikes' are particularly well-used for commuting trips including multi-modal trips starting from major train stations. They are also popular as a leisure activity, with a high level of use around London's large parks.

- The London scheme (and cycling in London in general) has been found to be a male dominated pursuit with 82% of trips in London made by men. However, the recent introduction of 'casual' use where no membership is required has encouraged a higher overall female share of trips.

WHAT CAN WE LEARN?

- Highlights the role of public policy in encouraging cycling and changing commuting behaviour more generally.
- Bike Sharing Schemes are only part of the picture - Studies suggest substantial increases in cycling require an integrated package of many different, complementary interventions, including infrastructure provision and pro-cycling programs.
- We need to reduce the barriers associated with cycling more broadly – e.g. perceptions of safety, flow of cycling.
- The popularity of cycle sharing schemes has the potential to increase the visibility of people cycling in everyday clothing which may help to normalise the image of cycling, and reduce perceptions that cycling is 'risky' or 'only for sporty people'.
- Leisure cycling is likely to be an important first step in taking up cycling for transport.
- Suggested improvements to bike sharing schemes are to better integrate membership with the smart card public transport system and introduce policies to increase immediate access to helmets.
- There is a need to reduce the amount of CO_2 produced by vans needed to balance out docking stations; Is there a more sustainable solution? Can we incentivize people to walk a bit further to complete their journey when in the most popular destinations to reduce congestion around docking stations?

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AIR QUALITY - CASE STUDY 8

CAR FREE CITY

Image source: https://pbs.twimg.com/media/CDIDAahUAAA0eGA.jpg

Los Angeles, USA

WHAT IS IT?

The first CicLAvia took place in October 2010. It started as a grass roots initiative and led to closing city streets to car traffic for a day with the intention of creating a safe place to cycle, run, walk, skate and even dance through Los Angeles. Since then the CicLAvias have been held two to three times a year with an expanding variety of routes for pedestrians to use.

The initiative was inspired by the Ciclovía events that started 40 years earlier in Bogotá, Colombia. This pionnering initiative eventually led to banning motorized vehicles from the city centre streets on a weekly basis, between 7am and 2pm every Sunday as well as on public holidays. The scheme has become so successful that it has more recently turned into an annual car free week. Los Angeles is but one of many similar car free initiatives across the globe inspired by the Colombian capital.

WHAT DIFFERENCE DID IT MAKE?

- The initiative had a whole range of health related benefits e.g. reduced traffic-related air and noise pollution, improved safety and increased physical activity.
- A study by the UCLA Fielding School of Public Health has found that the CicLAvia event significantly reduces air pollution along the car free route and these benefits also reached to other streets adjacent to the event. The amount of ultrafine particles in the air reduced by over 20%.
- Businesses along the route saw an increase in customer visits - slower foot traffic makes it easier for people to make unplanned stops into retail stores and restaurants.
- The initiative has impacted local and regional transportation policy in LA.

WHAT CAN WE LEARN?

- Removing cars from city centres improves not only peoples' physical but also their social wellbeing.
- This adds to a growing body of evidence supporting the significant impact of car free initiatives. In Israel, air pollution dropped by 99% during a 24-hour car-free period, and in Paris air pollution dropped by an average of 40% when they closed a third of their streets for the first time in September 2016.
- There is potential to make cities car free on a more permanent basis. For example Oslo has recently announced it plans to ban privately owned cars within the city centre by 2019. Although taxis and buses will still be allowed, it is a step towards the first 'car free city' in the world.
- Although there is evidence for increased customers for businesses during these events, they are often the biggest critics of car free initiatives. This is due to concerns that stopping people from driving into the city centre will have a negative impact on business sales. We need to communicate to local businesses the benefit these types of initiatives can bring.

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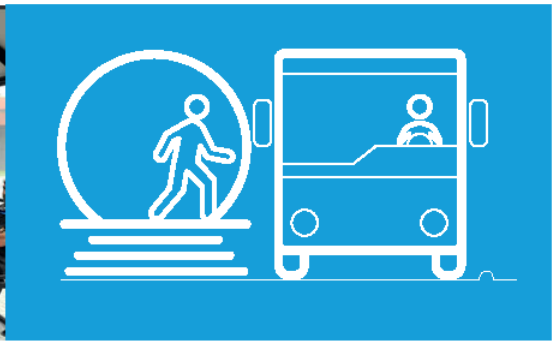
AIR QUALITY - CASE STUDY 9

BUS RAPID TRANSIT (BRT)



https://pbs.twimg.com/media/CoKOAahUAAA0eGA.jpg

Curitiba, Brazil

WHAT IS IT?

The bus stops in Curitiba aren't like most bus stops. Their futuristic tube shaped structures provide a comfortable area that protects passengers from the elements.

When these stations were originally planned many other cities in Brazil and elsewhere considered the bus a lost cause. However, this system was designed to give buses as many of the advantages of the urban train system as possible. With dedicated bus lanes and large scale stations, the new bus system is able to run at speeds comparable to light rail, while dramatically reducing the cost. The stations have now become iconic in the city.

WHAT DIFFERENCE DID IT MAKE?

- Today there are 357 tube stations throughout the city.
- Around 70% of Curitiba's commuters use the BRT to travel to work, resulting in congestion-free streets.
- Provided a cost-effective solution to a need for more effective mass transit.
- This system of same-level bus boarding, plus the pre-boarding fare payment, results in a typical dwell time of no more than 15 to 19 seconds at a stop.

WHAT CAN WE LEARN?

- Giving buses their own dedicated lanes reduces congestion.
- The distinctive and futuristic look of the stations helped to shift negative perceptions about travelling by bus.
- Shows the importance of thinking about bus stops/stations as much as the bus itself to ensure a smooth and efficient service.

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AIR QUALITY - CASE STUDY 10

SHARED SPACES

http://www.fietsberaad.nl/library/repository/ontwerpvoorbeelden/Sa%20de%20laden%20drachten.jpg

Drachten, the Netherlands

WHAT IS IT?

Shared space is an approach to street design, which minimises demarcation or physical separation between vehicles and pedestrians. The concept was first introduced in 2000 by Dutch traffic engineer Hans Monderman in an attempt to increase the flow of traffic and reduce accidents and congestion. By reducing the dominance of motor vehicles and creating pedestrian priority zones it was thought the space would become safer and more comfortable for users.

WHAT DIFFERENCE DID IT MAKE?

- Found to reduce accidents and delays for both pedestrians and vehicles.
- Gives people greater freedom of movement rather than instructions and control.
- Improves ambience of areas and creates better spaces for socialising.
- Enhances the economic prosperity of an area.
- Although the overall conclusions were positive, most pedestrians were found to still prefer to use the informal 'courtesy crossings' and some pedestrians tended to hurry across the space.

WHAT CAN WE LEARN?

- Pedestrians have been found to feel most comfortable when sharing space in conditions which ensure their presence is clear to other road users i.e. low traffic, lots of pedestrians, good lighting and provision of 'safe zones' incorporating barriers, street furniture and plants.
- The Department for Transport in the UK suggests shared space is only appropriate in streets with low traffic volumes.
- These spaces tend to be viewed less positively by people with disabilities and older people.

- Evidence suggests removing demarcations does not reduce vehicle speed or allow pedestrians to move more freely as was intended by the design.
- Given these aspects planners need to be cautious to ensure shared spaces live up to their intended effects.

LINKS & REFERENCES

- Pros and Cons of Shared Space by Muhammad Bukhsh Bhatti https://www.linkedin.com/pulse/20141118035232-112545392-pros-and-cons-of-shared-space
- Mixed Priority Routes: Practitioners' Guide https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/329223/ltn-3-08_Mixed-priority-routes.pdf

AIR QUALITY - CASE STUDY 11

GREEN CORRIDORS

Picture source: http://www.bleu-de-chauffe.com/en/blog/54_Minhoc%C3%A3o-Corridor-Vert.html

Sao Paulo, Brazil

WHAT IS IT?

The Minhocão is a 3.5 km long elevated highway in São Paulo originally built in 1969 to help relieve traffic congestion in the city centre. Nowadays, however, between 21:30 and 06:30 on weekdays and all day on Sundays, the highway is closed to car traffic, allowing dedicated use by pedestrians and cyclists. The Brazilian landscape studio M.90 have also been working with the community to transform 100 windowless façades that the area contained into a 'green corridor' with 8000 square meters of vertical gardens.

The project aims to not only encourage 'greener' transport but will also help improve air quality and reduce noise pollution in the area. Minhocão's Green Corridor is hailed as the first green lane in the world, a pilot project that has the potential to show the aesthetic and environmental impact of transforming built up urban areas into walkable green corridors.

WHAT DIFFERENCE DID IT MAKE?

- Vertical parks have been found to reduce concentrations of gaseous pollutants (sulphur dioxide (SO2), carbon monoxide (CO), and nitrogen oxides (NOx) as well as ozone (O3)) in the air of the surrounding area by 30% and the concentration of micro particles up to 60%.
- They've also been found to considerably reduce noise pollution from the inside of the buildings, serving as efficient acoustic insulators and have been used in the construction of concert halls.
- Green walls also aid thermal control - in warm places in the southern hemisphere, vertical gardens can reduce the temperature by up to 7 °C.
- Improves quality of life - studies show that people are happier when living among vegetation.
- Increases biodiversity in urban centres.

WHAT CAN WE LEARN?

- Demonstrates the aesthetic and environmental benefit of vertical gardens and green corridors.
- This initiative shows how roads can be used for varying purposes at different times of the day or week.
- Despite the obvious benefits green infrastructure can have in urban areas, recent research has found that it is important to consider both the type and location of trees in urban areas as in some cases they may trap pollutants and have a negative impact on air quality – planners and local authorities need to be aware of both the positive and negative affect trees can have in cities.

LINKS & REFERENCES

- http://www.bleu-de-chauffe.com/en/blog/54_Minhoc%C3%A3o-Corridor-Vert.html
- http://90mov.com/
- https://www.theguardian.com/environment/2016/dec/01/trees-may-increase-air-pollution-on-city-streets

AIR QUALITY - CASE STUDY 12

PHOTOCATALYTIC PAINT

Image source: http://www.knoxoutpaints.com/

Global

WHAT IS IT?

Boysen have produced a paint called 'Knoxout' that it claims can clean air of automobile-produced nitrogen oxides (NOx) and elements of ground-level Ozone. The magic ingredient is Titanium dioxide (TiO_2) which, when exposed to sunlight, breaks harmful nitrogen oxide (NOx) down into minute quantities of calcium nitrate, water, and carbon dioxide (CO_2). Other companies are using the same techniques. For example, Pureti have created coatings for building facades and infrastructure, as well as an all-in-one window cleaner and air cleaner for use in the home, and Boral Roofing are making pollution-reducing roof tiles.

WHAT DIFFERENCE DID IT MAKE?

- In one trial in Manila's Guadalupe train station, 4,100 m^2 of exterior wall was painted with the paint and it was found to remove about 26g of NOx per 100 m^2 of painted surface.
- In another trial in London, a 135 m^2 wall was treated and as a result, they saw a 60% NOx reduction compared to other parts of the city.

WHAT CAN WE LEARN?

- Although there is evidence to suggest these paints do work, the materials have been found to deteriorate quite easily and so their functional life span is still unclear. This is important when thinking about the up-keep of buildings and other urban environments.
- The CO_2 and nitrate products of this process are themselves pollutants. CO_2 is a greenhouse gas, and if nitrates pollute waterways and drinking water this can cause serious health problems . Are we simply swapping one pollution problem for another?

- Some scientists are concerned that the TiO_2 nanoparticles used in these products might behave differently to their equivalent that exists in biological systems, and believe tests should be done to determine whether they present any additional health hazard.
- Experiments using this paint are difficult due to the issue of controlling city environments in outdoor trials.

LINKS & REFERENCES

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CITIZEN ENGAGEMENT - CASE STUDY 1

hack AIR

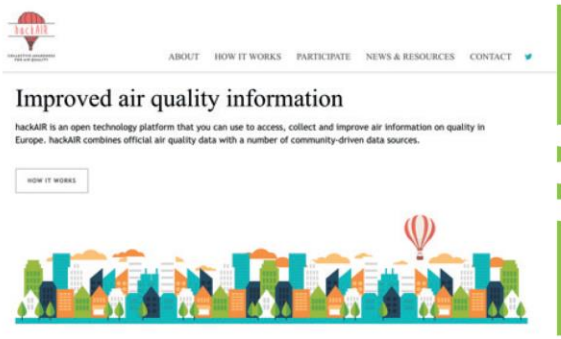


Image source: http://www.hackair.eu/pages/about-hackair/

An EU funded consortium including Greece, Norway, Germany, Belgium, and the Netherlands.

WHAT IS IT?

Despite growing awareness that air pollution is an environmental issue with serious health and lifespan implications, it remains difficult for citizens to assess their own exposure to air pollution and air quality issues on a local level. Official air quality sensors are often few and far between, coverage is poor outside cities, and their data is not always easily accessible.

The hackAIR project aims to develop an open technology platform and tool kit for 'citizen observatories' on air quality that practice a multi-disciplinary approach including; expertise in ICT, research, environmental technologies, social sciences, environmental policy, and communications on sustainability issues. The project will use a co-creation process with users that will increase individual and collective awareness about air quality in Europe and encourage changes in behaviour towards air quality improvements. The project will run until December 2018.

WHAT DIFFERENCE DID IT MAKE?

- hackAIR aims to complement official data with community-driven data sources, for collecting, analysing and sharing air quality measurements. Data will be collected through low-cost open hardware sensors easily assembled by the citizens themselves using the web and/or mobile phones.
- The project will provide citizens with improved information about air pollution levels in their local communities.
- It will also enable communities of citizens to easily publish information relevant to outdoor air pollution.

WHAT CAN WE LEARN?

- This project suggests that by enabling people to measure air quality themselves they will become more engaged with this issue. How can we motivate people to contribute to the collective gathering of air quality data?
- By giving citizens access to air quality data they have ownership over communicating these issues to others by word of mouth or written documents.

LINKS & REFERENCES

- http://www.hackair.eu/pages/about-hackair/

CITIZEN ENGAGEMENT - CASE STUDY 2

JIGSAUDIO

Image Source: http://jigsaudio.com/index.html

Newcastle, UK

WHAT IS IT?

This electronic jigsaw looks at how drawing and short voice clips might encourage people to share aspirations for their local area. The technology includes a traditional wooden jigsaw and a Raspberry Pi (a credit card-sized computer). The pieces are then identified using an RFID tag embedded within it, which allows audio clips to be associated with that puzzle piece.

JigsAudio currently has two projects. The first is called 'Big Draw' and aims to encourage children to think about the future of the city of Newcastle. They were asked to draw their future visions of the city on jigsaw pieces, and then explain their vision. In the second project 'Metro Futures', people were given a metro car with swappable parts and are asked to replace parts with their own designs, and explain them in more detail through an audio clip. The design and code is available for anyone to download and make their own electronic puzzle.

WHAT DIFFERENCE DID IT MAKE?

- Explored how to combine planning, drawing and digital technology.
- Enabled citizen engagement at the very start of the planning process without many of the traditional barriers to participation e.g. understanding jargon.

WHAT CAN WE LEARN?	• JigsAudio shows how drawing, creativity and talking about drawings can provide people with ways of expressing views on their local area, and encourage innovation and co-design.
LINKS & REFERENCES	• http://jigsaudio.com/index.html

CITIZEN ENGAGEMENT - CASE STUDY 3

MY NEIGHBOURHOOD

Image Source: http://citiesnext.com/project/eu-funded-project-my-neighbourhood-my-city/

European project with pilots in Birmingham, Lisbon, Aarlborg and Milan

WHAT IS IT?

MyNeighbourhood aims to create a greater sense of community by helping to establish better connections between people and the place that they live and work, the project aims to not only make neighbourhoods 'smarter' through technology, but help people in local communites connect with one another, share new ideas, and create new ways of interacting.

There are two main ways that the project hoped to achieve this. Firstly, through combining the data from existing apps that hold information about citizens (e.g. MyCityWay and Foursquare), with new tools that help connect people locally both online and offline. Secondly, it used gamification to encourage people to get involved in neighbourhood activities.

A series of pilot projects used different techniques to get people connecting. One such project took place in Birmingham in the UK where they attempted to tackle mobility issues by encouraging behaviour change through two schemes – 'Women on Wheels' and 'Travel Buddies'. The first of these created an online platform to help women in isolated communities share their cycling stories and connect with other cyclists in the area. Citizens who were experienced cyclists taught beginners how to cycle, with opportunities to socialise and exchange skills both face-to-face and online. 'Travel Buddies' also allowed people in the local area to connect and travel together when going to the same destinations.

WHAT DIFFERENCE DID IT MAKE?	• Aimed to tackle loneliness and social isolation, particularly for the elderly. • Enabled people to share experiences of their city through co-design. • Helped to recognise those individuals and organisations that bring 'value' to a neighbourhood in different ways. • For some of the pilot projects FabLabs provided citizens with access to tools and machines to make things and be creative. • Allows neighbours to exchange both their time and experience through time banks and skills exchange workshops.
WHAT CAN WE LEARN?	• Helped to build communities and enabled people to take decisions regarding their local area. • Recognised that there are many unique neighbourhoods within a large city and these may need to be approached differently based on their demographic makeup.
LINKS & REFERENCES	• http://citiesnext.com/project/eu-funded-project-my-neighbourhood-my-city/ • http://www.openlivinglabs.eu/node/918

CITIZEN ENGAGEMENT – CASE STUDY 4

CRITICAL CITY UPLOAD

Image source: http://hof.criticalcity.org/

Milan, Italy

WHAT IS IT?

Critical City is a new form of urban game run by citizens, aiming to transform urban space. Founded in 2007 by Augusto Pirovano and Matteo Battagli, the community now has more than 13,000 participants who complete creative missions across Italy. These missions ranged from guerilla gardening and designing new signs for the city to organising flash-mobs in disused areas to foster socialisation among strangers. It was funded in 2010 by Fondazione Cariplo which allowed the collective to run 3 consecutive "seasons" of CreativeCity Upload with more than 21,000 actions run by players.

WHAT DIFFERENCE DID IT MAKE?

- The first season of the game ran for 1 year. During tha year 5000 players completed 800 creative missions.
- The second season took place in 2013 and was managed by the players themselves and the final season, which is currently ongoing, started in 2015 and will run for 4 years.

WHAT CAN WE LEARN?

- Gamifying civic participation can foster active and engaged communities.
- The game demonstrates a new form of civic engagement which is both fun and co-designed.
- Empowering communities to approach urban challenges collectively yields creative problem solving and can be applied to air quality challenges.
- Citizens are good at solving design challenges within their communities provided they are given the right tools.

LINKS & REFERENCES

- http://hof.criticalcity.org/
- http://humancities.eu/casestudies/critical-city-milan/

CITIZEN ENGAGEMENT – CASE STUDY 5

V TROJE (IN THREE)

Image source: www.facebook.com/V-troje

Ljubljana, Slovenia

WHAT IS IT?

Ljubljana like many other cities is transitioning to a cyclist friendly city with about 12% of journeys made by bike in 2014. ‘V Troje’ is a campaign promoting cycling in groups of three, instead of taking a car to work. The campaign was initiated by citizens in a bottom-up way, commissioned by the British Council in Ljubljana and later funded by the Danish Embassy and other partners to promote creative approaches to urban mobility problems. ‘The threesome’ was a provocative name given to the project in order to emphasise the collective support necessary for the success of the initiative.

WHAT DIFFERENCE DID IT MAKE?

- As a result of the campaign, more than 216 bike triples cycled more than 33,000 kilometers together, reducing CO_2 emissions by 53,000 units.
- Promoted behavioural change in the way people travel to work and showed that motivation in small groups is beneficial to the success of bike campaigns.
- Created a social environment for cyclists to engage with their community.

WHAT CAN WE LEARN?

- Supporting behavioural change in small groups can be an effective means of motivating citizens.
- The group of 5 individuals who were originally commissioned for the project included a web developer, researcher and journalist. This suggests groups with diverse skills helps to foster creative thinking.

- The campaign was presented as a competition with prizes ranging from bikes to cycling holidays. Adding material incentives may help bootstrap citizen projects.
- The campaign provided a fluid web interface where cyclists can register and log their activities. Online tools can help to improve citizen engagement.

LINKS & REFERENCES

- http://humancities.eu/casestudies/v-troje-ljubljana/
- http://www.ljubljana.si/si/mol/novice/88965/detail.html

CITIZEN ENGAGEMENT - CASE STUDY 6

POZNAN LIVING LAB

Image Source: https://wc2016.ipsa.org/sites/default/files/page/WC2016/Travel/Poznan/rynek_fotolia_79828066_1200x630_facebook.jpg

Poznan, Poland

WHAT IS IT?

The Poznan Living Lab has three key areas of focus: technology, healthcare, and education. The partnership that organizes the lab includes the Poznan Supercomputing and Networking Center, the Wielkopolska ICT Cluster, research institutes, NGOs, and the Poznan City Hall. The recognition of citizen engagement as a key aspect of the project grew organically after the initial cluster of largely ICT focused partners found it difficult to agree on a unified vision for the project, and it wasn't until the ZOO coworking space was introduced that the focus really shifted from technology to more applied areas of experimentation. The introduction of hackathons - where NGOs define real problems to be solved by developer teams - finally cemented the emphasis on collaboration and innovation.

The main actions undertaken today by the Poznan Living Lab include:

- The ZOO co-working space as a place for co-design involving non ICT communities
- Mobilizator: the 2-day hackathon matching NGOs' innovation needs to developer teams
- D.challenge: an 8-week interdisciplinary user-driven course bringing together students from different universities/backgrounds
- Poznan Open Source Competence Center: incubation of new companies mainly based on transportation data

WHAT DIFFERENCE DID IT MAKE?

- The Poznan Living Lab has completed over 100 projects and employs more than 200 ICT engineers.
- The ZOO coworking space is open 24/7, and is used by a number of proactive communities including medical staff, the elderly, educators and more technology-oriented user groups. They organize events and competitions e.g. in 2011/2012 more than 200 events with 3000+ participants were held.
- The gradual shift towards user driven technology processes has had a strong impact on the technology partners, who are used to thinking in technology driven terms.
- The NGOs have gained professional support from programmers as well as access to city officials and potential sponsors.
- The companies of the Wielkopolska ICT Cluster have gained real-life challenges to work on.
- The business and research communities have increased their commitment to multi-disciplinary research and gained a greater connection to the city in actively addressing its problems.
- The city government has extended the implementation of many of the products and services that the lab has developed.

WHAT CAN WE LEARN?

- Bringing different types of partners together allows for a mutually beneficial exchange of skills and resources.
- By opening the project up to non-ICT related partners they were able to cover a wider variety of projects and bring citizen engagement to the forefront. This shows the importance of taking an interdisciplinary approach when tackling big societal issues in these labs.
- The main challenges faced have not been in the technical nor financial domains but in the legal and operational elements of collaboration. Institutional innovation is thus a key element for fully implementing this user-driven approach.
- Problems with property rights has been another barrier to engaging SMEs, although a clear open source policy at the outset may help clarify possible misunderstandings.

LINKS & REFERENCES

- http://openlivinglabs.eu/sites/enoll.org/files/Citizen_Driven_Innovation_Full%284%29.pdf
- http://www.openlivinglabs.eu/livinglab/poznan-living-lab
- http://www.man.poznan.pl/online/en/

CITIZEN ENGAGEMENT - CASE STUDY 7

WAAG SOCIETY: SMART KIDS LAB

Image source: http://waag.org/en/project/smart-kids-lab

EU funded project with pilots in Amsterdam (The Netherlands), Barcelona (Spain) and Prishtina (Kosovo)

WHAT IS IT?

Smart Kids Lab is a project by The Waag Society based in The Netherlands. They are an institute for art, science and technology and over the past 22 years, the foundation has developed a platform for artistic research and experimentation. Their 'Smart Kids Lab' is part of the European 'Making Sense' programme, which works with communities across Europe to co-create sensors and devices to capture environmental data. The project will run for two years between 2015 and 2017.

The project encourages children to play with different tools and methodologies to help them make sense of the data they collect as well as gain an understanding of complex social and environmental issues.

WHAT DIFFERENCE DID IT MAKE?

- With the aid of these small-scale tests and self-made sensors kids can actively monitor their direct surroundings at home, or at school.
- With the learnings from these pilot projects the Making Sense team aim to develop a toolkit to help people organise future citizen sensing campaigns for positive social change.

WHAT CAN WE LEARN?

- The project explores how open source software, open source hardware, digital maker practices and open design can be used by local communities to make their own sensing tools, make sense of their environments and address pressing environmental problems in air, water, soil and sound pollution.
- The learnings from these sorts of projects should be used to inform future campaigns e.g. toolkits, handbooks and manuals.

LINKS & REFERENCES

- Waag Smart Kids Lab - http://waag.org/en/project/smart-kids-lab
- Making Sense EU - http://making-sense.eu/about/

CITIZEN ENGAGEMENT - CASE STUDY 8

CITIZEN SENSE: DUSTBOX WORKSHOP & WALK

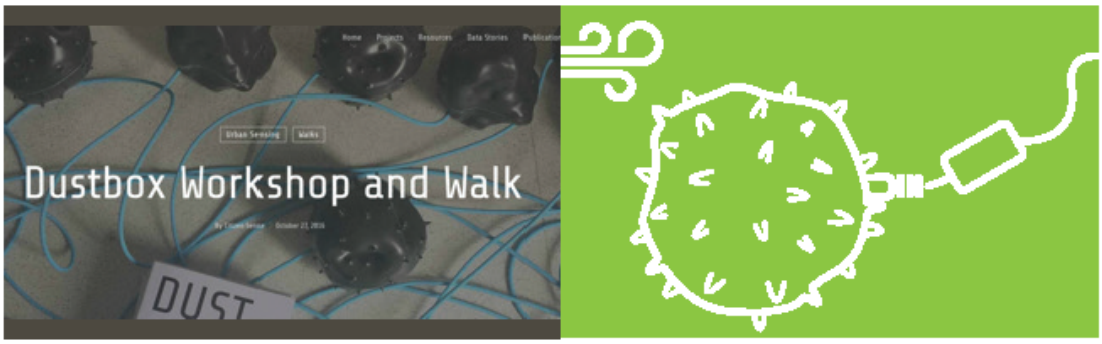


Image source: http://citizensense.net/dustbox-workshop-and-walk/

South London, UK

WHAT IS IT?

The Citizen Sense project is led by Dr Jennifer Gabrys at Goldsmiths University in South East London and is funded through a European Research Council (ERC) Starting Grant. The project is running from 2013-2017, and will investigate the relationship between technologies and citizen engagement in environmental sensing.

One of the sub-projects within Citizen Sense is 'Dustbox'. As part of this project citizens are being encouraged to keep an eye on the area's air quality using 'dustboxes'. These are 3D printed boxes that resemble pollution particles when viewed under an electron microscope. The boxes will use new low-tech pollution-sensing technology and will be available on loan to citizens from their local library as part of the project. The data collected by citizens will then be piped to Citizen Sense's 'Airsift' online toolkit where it can be compared to other nearby data, as well as data on weather conditions, such as temperature, humidity, wind speed and wind direction.

The researchers will also host an 'Urban Sensing Workshop and Walk', where they will work with residents to undertake air quality sensing in relation to the context and changing urban environment of South London.

WHAT DIFFERENCE DID IT MAKE?

- The project was launched on the 29th of October 2016 and it will be some time before we see the results of the data collection.
- The research team have found that many parts of the South East London area where the project is based are not currently monitored, and yet there is considerable traffic and construction activity that could be contributing to air quality problems.

- Citizen Sense is working with local residents to scope out the area and locate the most suitable sites for air quality monitoring in relation to local concerns about the changing environment.
- From an earlier environmental sensing study, Citizen Sense community monitoring ran in Pennsylvania, USA, where citizen-collected data showed the damaging environmental impact that fracking has made in people's backyards.

WHAT CAN WE LEARN?

- The project argues for the importance of democratizing environmental understanding and action.
- Citizen Sense has produced a considerable body of new primary research that is open for analysis.
- The practice of monitoring and sensing environments has moved from the realm of the expert to enable everyday citizen participation, where users of smart phones and other devices are able to engage with data collection. However, how can we ensure citizen sensing doesn't just provide crowd-sourced data sets, but also gives rise to new thinking around environmental awareness and practice?

LINKS & REFERENCES

- http://citizensense.net/dustbox-workshop-and-walk/
- http://www.gold.ac.uk/news/citizen-sense-data-stories/

5.3 Opportunities for iSCAPE

The following section outlines opportunities for solving the challenges cities are facing in terms of air pollution mitigation and prevention, as well as broader climate change. Some of these ideas have come from the results of the stakeholder survey (indicated in brackets), while others have been developed by the Future Cities Catapult team based on the case studies and further research done for this report. The opportunities should be considered as thought starters and inspiration for the iSCAPE living labs in terms of potential interventions and citizen engagement methods.

Urban Environment

Challenge	Opportunities
	Reduce the appeal of driving in a city 1. Reduce parking availability in the city centre and increase car parking prices (Bologna, Dublin, Vantaa) 2. Provide park and ride facilities 3. Introduce a congestion charge (Vantaa, see AQ case study 5) 4. Increase penalties for unsustainable modes of transport (Vantaa) 5. Change people's commuting patterns by introducing local co-working spaces, non-standard working hours and facilitating home working **Increase the appeal of cycling and walking** 1. Make the city centre permanently car free or introduce car free days/events (Bologna, Bottrop, Hasselt, see AQ case study 8) 2. Invest in cycling infrastructure with segregated cycle lanes (Bologna, Bottrop, Dublin) 3. Move highways underground 4. Re-purpose heavily polluted areas once alternative transport has been provided. 5. Create green spaces that priortise pedestrians/cycling at certain times of the day (see AQ case study 11) **Improve public transport** **1.** Improve public transport within and between cities 2. Construct a hanging railway (Bottrop) 3. Transfer all logistics transport to rail (Bottrop) **4.** Provide car-pooling facilities by enabling people to connect with each other in a secure way **Move to electric vehicles** 1. Make public transport electric (Dublin, Vantaa) 2. Introduce e-bikes (Bottrop) 3. Promote benefits of electric cars (Vantaa) 4. Expand electric vehicle charging network (Guildford)

 THE CITY IS CLOSE TO THE AIRPORT	1. Discourage short haul and internal flights by reducing the prices of train tickets on popular flight routes 2. Invest in lower emission trains – lighter, hybrid fuel etc. 3. Conduct ultrafine PM monitoring near major airports to add to evidence base and inform future legislation on this pollutant (Guildford)
 THE CITY STRUCTURE IS DENSE OR OVERCROWDED	1. Increase education on how to live sustainable *and* pollution friendly lifestyles e.g. Hasselt's 'Stook Slim' campaign to help citizens understand the impact of wood burning in the homes in built up areas 2. Ensure new suburban housing developments also provide good public transport links 3. Build developments that reduce air pollution e.g. Beijing's 'smog eating tower' that sucks in pollution particles and photocatalytic coatings on walls of buildings (see AQ case study 12 for precautions on this method) 4. Green walls, rooves and urban farming to mitigate against increased pollution from heating, cars etc. (Bottrop)
 INNOVATING WITHIN A HISTORIC CITY CAN BE DIFFICULT	1. Pedestrianise and provide cycle infrastructure in narrow streets 2. Create shared use public spaces (see AQ case study 10) 3. Help businesses to understand the positive impact pedestrianisation and shared public space schemes can have in order to reduce fears of a drop in customers if people are unable to drive into the city centre (see AQ case study 10) 4. Introduce new urban models of mobility such as the 'superblock' - where existing gridded streets within a city are grouped together in small clusters. Traffic is then restricted to outside of this area while the streets inside the superblock become repurposed as community spaces (The Guardian, 2016)
 THE CITY'S LOCATION CAN MAKE AIR POLLUTION WORSE	1. Mandatory solar panels on all public buildings to take advantage of the sun (Bologna) – this energy can then be used in various ways to mitigate the effects of air pollution 2. Better education about the indoor air pollution and how to reduce this 3. Look for inspiration from air purification systems used in confined areas e.g. electrostatic precipitators used in tunnels

THE CITY HAS AN INDUSTRIAL HERITAGE	See below for solutions for 'air pollution is invisible' to counteract the feelings amongst older generations that air pollution is much better than it used to be

Citizen Perception

Challenge	Opportunities
A CULTURE OF CAR USERS	1. Cars are still seen as luxury status symbols - similar to a wrist watch. We need to invert these traditional connotations and create new narratives. How AQ is represented in the media is key. Look for inspiration from branding and marketing e.g. What can we learn from other health related public campaigns with regards to behaviour change e.g. anti-smoking campaigns? 2. Think about how to increase the appeal of less popular transport options e.g. see case study 9 for how to increase the appeal of the bus 3. Promote sustainable mobility sub-cultures that already have a strong cultural identity e.g. cycling 4. Better incentives from government to move to more sustainable transport options (Guildford) 5. See suggestions for 'reducing the appeal of driving in the city' above – pressure needs to come from above and below
THE LINK BETWEEN AIR QUALITY & CLIMATE CHANGE IS POORLY UNDERSTOOD	1. Introduce education on these issues at school level – get people thinking about these topics from an early age (Bologna, Bottrop, Guildford) 2. Better education, communication and dissemination of air quality and climate change research and initiatives (Bologna) 3. Make messages simple and easy to understand – how can we use creative methods to communicate to citizens e.g. infographic illustrations, visualisations, maps, films, advertising, art installations etc. 4. Make it personal – give tangible examples of how air pollution can affect people as well as what people can do about it on a local level.

 THERE ARE MANY MISCONCEPTIONS ABOUT GOOD & BAD BEHAVIOUR IN RELATION TO AIR POLLUTION	1. Better promotion of 'good' driving behaviour from car manufacturers themselves (Guildford) 2. Face to face engagement seems to work well e.g. Reigate anti-idling campaign. Gives people opportunities to ask questions (Guildford) 3. There needs to be more openness and honesty when it comes to mistaken information or changes in scientific understanding of the harmful effects of different types of pollutants e.g. incentivisation of diesel vehicles. This will help to gain citizen trust in government interventions and advice 4. Introduce dedicated third party advisor on AQ 5. Use neutral public spaces e.g. living labs to help build trust between citizens and government bodies
 AIR POLLUTION IS OFTEN INVISIBLE	1. Provide variable messages to show degree of localised air pollution. 2. Display air quality levels in prominent public spaces (Dublin) 3. Introduce a standardised rating to show 'good' green days vs 'bad' red days and provide clear mitigation instructions to avoid the most polluted areas (Hasselt) 4. Increase awareness by enabling citizens to monitor their personal exposure to air pollution through provision of low cost sensors e.g. on their smart phone (stakeholder suggestion: Hasselt) 5. Find tangible ways to emphasise the scale of the problem and visualise the different types of pollutants e.g. coal, oil, smoke etc. These are likely to be more effective than simply showing numbers 6. If citizens view air pollution in sensory ways – smell, sight, sound - how can we use citizens as the sensors of air pollution themselves? 7. Some artists have looked at how to 'visualise' air pollution in sensory ways e.g. taste (Geonomic Gastronomy - Smog Tasting) and sound (Melbourne Mussel Choir – Carbonates Project) 8. Learn from these and other design and technology installations focusing on visualising air pollution and climate change e.g. Waterlicht uses LED technology to show rising water levels 9. Use social media to get people publicly engaging in the debate
 PEOPLE HAVE A VERY BASIC KNOWLEDGE OF THE HEALTH IMPACT OF AIR POLLUTION	1. We need to help people understand the precise health effects of different pollutants and which citizens are most vulnerable to these (Guildford, Hasselt) 2. Social media campaigns can be very effective for certain groups e.g. younger generation, parents (Guildford)

 PEOPLE DON'T SEE AIR QUALITY AS SOMETHING THEY CAN (OR ARE WILLING TO) CHANGE	1. Involve people in citizen led experimental design to develop user centred solutions (Bologna, Bottrop) 2. Educate people on how they can help – not only in terms of personal behaviour change, but in terms of how to get involved on a public and political level e.g. campaigns, events, social media 3. Try to make these issues relevant to people's everyday lives by using tangible examples of things they can change on a personal and local level (Vantaa) 4. Help people understand that policies that will make a difference will often be unpopular e.g. reduced and more expensive parking in city centres

"Individual decisions can help make a difference but if we aren't mentioning it at doorsteps to politicians or making it an issue with public representatives then it won't move up the political agenda." Department of Communications, Climate Action and Environment, Dublin

Government Policy

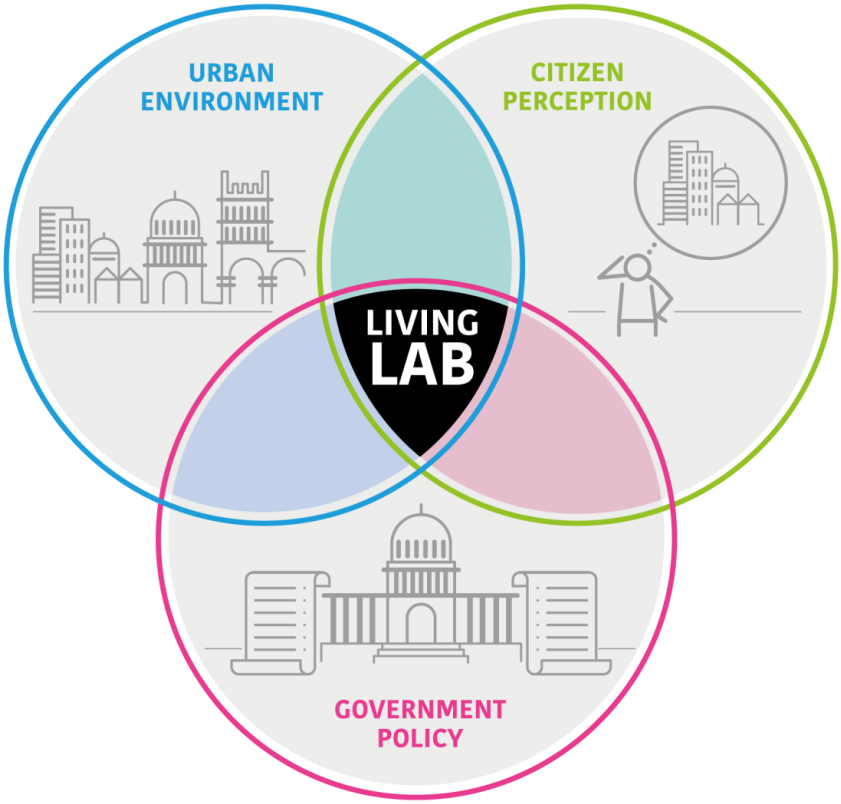
Challenge	Opportunities
 GAP BETWEEN SCIENTIFIC RESEARCH & GOVERNMENT LEGISLATION	1. Use the Living Lab to develop new ways to disseminate scientific/academic knowledge – both to citizens and government stakeholders (Hasselt, Vantaa) 2. Invest in greater understanding of the social and environmental impact of different types of vegetation and green interventions to inform policy (Bologna) 3. Invest in micro-simulation modelling of problem areas (Guildford)
 DISAGREEMENT & LACK OF CO-ORDINATION AMONG GOVERNMENT BODIES	1. Use the iSCAPE living labs as a place to co-ordinate and bring together different government bodies 2. Encourage stakeholders to work together in a 'round-table' approach

 LACK OF SUPPORT FROM CENTRAL GOVERNMENT	1. Better incentives from government to move to more sustainable transport options (Guildford) 2. Increase government pressure from the citizen or 'doorstep' level (Dublin)
 MISLEADING OR UNRELIABLE MEASUREMENT OF AIR QUALITY	1. We need more accurate measurement done at a local level to solve issues with misleading AQ reports when only looked at on a citywide level (Dublin) 2. Encouraging citizen led sensing and open data analysis is likely to help with these issues (see CE case study 5) 3. We need to develop greater understanding of what to do with these measurements and ensure we are not just measuring for measurements sake but that it leads to direct action to reduce air pollution in those areas most affected.

7 Conclusions and Next Steps for iSCAPE

This report has outlined the main challenges that each of our iSCAPE cities are currently facing with regards to air pollution and climate change. These have been based on a relatively small qualitative survey of city stakeholders (N=22). Conclusions should therefore be considered as high-level thought starters for further exploration within the proceeding work packages of the iSCAPE project and within the iSCAPE Living Labs themselves to gain further understanding from partners, city stakeholders and the citizens themselves.

A set of challenges have been identified that the iSCAPE cities are facing in relation to the topics of air quality and climate change. These have been broken down into three key areas:



Our iSCAPE Living Labs have a role to play in all three of these challenge areas. However, some of the Urban Environment Challenges are more difficult to solve through the living lab approach than others. For example, 'the city's location can make air pollution worse', 'the city is close to the airport' and 'innovating within a historic city can be difficult'. In comparison to these, the Citizen Perception and Government Policy Challenges may be easier to change, as they are less physical and more ideological in nature. But how can we go about tackling these challenges in the Living Lab? The following conclusions will help to define the direction for citizen engagement in the next phase of the iSCAPE project:

It is pivotal that we share learnings across cities

There are many common challenges across cities. For example, 'the city is designed for the car' and 'the link between air quality and climate change is poorly understood' are a challenge for all six of the iSCAPE cities. This means that our interventions, although city specific, are highly likely to be applicable and replicable to other locations. It also means that the living labs are likely to experience many of the same problems when trying to engage citizens in these topics.

Deeper understanding of citizen perception should be the focus of the living labs going forward

This initial report focuses on the city stakeholders' opinions of what citizens understand and feel and not the citizens themselves. This is because, at this stage of the project, a wider citizen survey was out of scope. However, a greater level of citizen engagement is needed to better understand their perceptions on these issues, and as the living labs mature through the course of the iSCAPE project, we will gain greater understanding of citizen perceptions of air pollution, through a wide variety of engagement methods deployed by the living labs. The next stages of the iSCAPE project should therefore aim to maximize citizen participation through consultation in the setting up of the living labs and this level of engagement should be sustained throughout the project.

There is a need for both a top down and bottom up approach

Many of the solutions mentioned by stakeholders when talking about Government Policy Challenges suggested that citizens can also have a role in changing these. In particular, stakeholders suggested citizen led community groups need to apply greater pressure to government to back these issues, they also suggested that citizen led air quality sensing can help to improve measurement and raise awareness. However, citizens cannot tackle these issues alone, and although the iSCAPE living labs can help to facilitate discussions between citizens and government bodies, there is also a need for policy changes to make sure citizen level initiatives have an impact.

We need to help citizens to better understand air quality and climate change as well as what they can do on an individual level to help with these issues

One of the most frequently mentioned challenges by stakeholders in all of our cities was that 'the link between air quality and climate change is poorly understood'. In addition to this many cities reported that 'people have a very basic knowledge of the health impact of air pollution', that 'they have many misconceptions about good and bad behaviour in relation to air pollution' and that 'they don't see air quality as something they can change'. Raising awareness of these issues is critical. Both cities and their citizens need to work together to develop new ways of thinking about these issues and citizens need to be made aware of how they can personally tackle pollution at the city scale. The iSCAPE Living Lab can be a forum to enable this discussion.

We need to help make air pollution visible

The lack of citizen understanding is made worse by the 'invisibility' of air pollution, making it easy for both policy makers and citizens to forget about the problems it can cause both to the climate and individual health. Through the iSCAPE living labs we need to develop ways to make air pollution visible – this may be through telling compelling stories or creating impactful visualisations. This is an opportunity to be creative and engage citizens in the process.

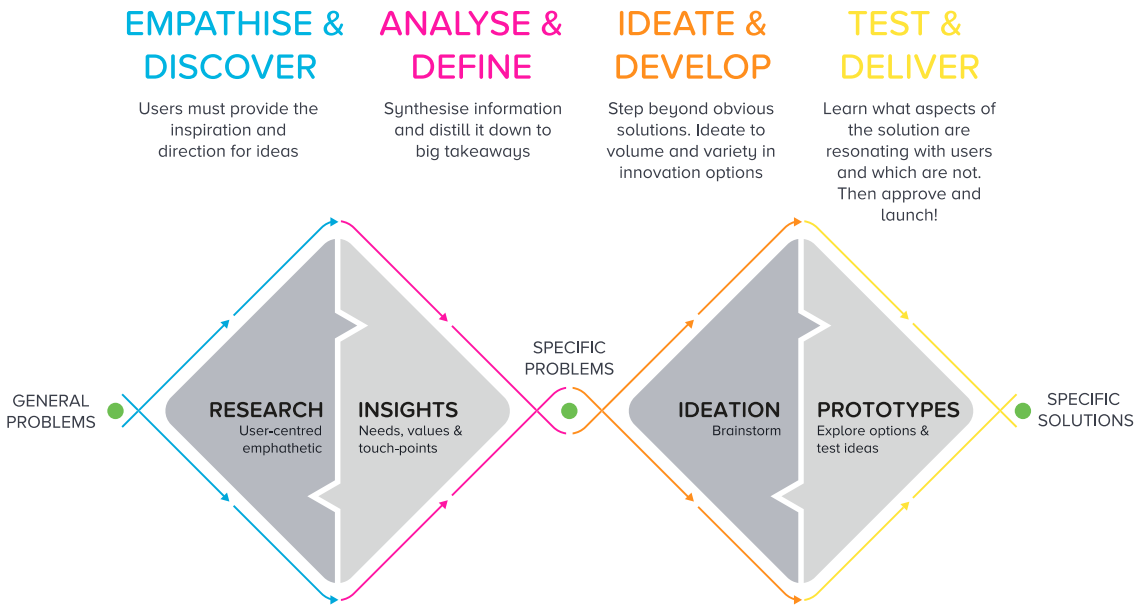
We need to involve citizens in testing and validation of interventions

Although many of the iSCAPE interventions have already been decided, the living lab will allow them to be tested through citizen participation. Where the city's intervention is less clear from the outset, citizens can be involved at the ideation stage.

Using a human centred approach is likely to help citizens feel more empowered to change things

The iSCAPE living labs should use a human centred design approach (see double diamond diagram below) that aims to put citizens at the heart of designing potential solutions to these complex issues. They should feel both listened to and empowered to make a difference to air quality through co-creation and ideation. This will help to solve some of the current challenges around citizens' feelings that their actions are unlikely to make a difference.

DOUBLE DIAMOND DESIGN PROCESS



Source: The Design Council

8 The iSCAPE Living Lab Citizen Engagement Manifesto

There are certain challenges that all cities have in common. Cities are still on the whole designed for the car and greater awareness is needed of both the link between air quality and climate change as well as the complexities of these topics in general. The following principles will help our iSCAPE Living Labs engage citizens in the most effective way:

1. **Make it Simple -** Articulate the complexities of these issues in a clear, simple and easily digestible way

2. **Make it Visible** - Show the extent of pollution in the air. Visualize when the air pollution is particularly bad, and which neighbourhoods are most affected even when it is not visible

3. **Make it Personal** - Show people how these issues impact them on a personal level – what it does to our environment, our health and our children's health

4. **Make it Practical** - Show people practical examples of what they can change – from small to big behaviours

5. **Make it Playful -** This isn't about playing down the seriousness of the topic but helping people to engage in the topic in a way that is fun, inspiring and encourages creativity in finding solutions to these issues

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10 Appendix

10.1 Summary of City Interventions

Each of our iSCAPE cities has a different air quality intervention that they intend to test as part of the 'Living Lab'. These are described below.

1. Bologna:

Site 1: Urban Vegetation
Site 1 will assess the effect of urban vegetation (mainly trees) at the street and neighborhood scale. This will be done using a proof of concept approach by studying two areas of Bologna - one with lots of vegetation and the other with very little.
As part of this intervention, the partners will set-up dedicated field measurements campaign in July-August 2017 and February-March 2018 to test the differences between the two areas.

Site 2 (Lazzaretto): Photocatalytic Paint
This intervention will assess the effect of photocatalytic coatings on walls in pollution hot spots at street and neighborhood level. It will use the PURETI brand for the coating. The site is already hosting a living lab coordinated by engineering students and their mentors.

2. Bottrop:

Urban greening and urban renewal from a governance perspective: The final interventions will be worked out together with the Living Lab but possible interventions could be:

- use of urban green for the retention of storm-water
- re-naturalisation of brownfields
- opening of blocked ventilation channels in the context of urban renewal
- mobile green elements for improving the micro climate of public squares
- shading of social critical infrastructure to mitigate overheating of buildings

Urban greening and renewal in general are already happening in Bottrop. The aim for iSCAPE is to improve the quality and processes behind it and to develop new strategies on how to approach the topics.

3. Dublin:

Low boundary wall (LBW): The LBW is already in place in Dublin. The project partners at Trinity College Dublin have agreed with the city council to run their tests first on a set of LBWs already in place and then to potentially install new ones if the tests show positive results.

4. Guildford:

Green infrastructural interventions: These will include hedges, trees, and general vegetation. The project partners at the University of Surrey have planned to assess the impact of green infrastructural interventions on air-quality near roads through real-world measurements. Thus, the interventions would likely be already in place when the Living Lab is set up; however, they will also consider deploying new interventions in addition to these.

5. **Hasselt**:

Behavioural interventions: The project partners at the University of Hasselt plan to implement 'stated choice experiments' in relation with environment pollutants and air quality. They will then assess behavioural changes from the responses given by individuals on various environment friendly scenarios/policies. The experiment development phase will start from mid/end of January 2017 and the experiment will be conducted in March/April 2017.

6. **Vantaa**:

Green urban spaces: Impacts of green infrastructure (green roof, green wall and parks) on air quality, urban climate and human well-being will be studied. The project partners at the Finnish Meteorological Institute will provide environmental data (solar radiation, wind, air temperature and humidity) as an input for modelling with socioeconomic data. They will install at least two meteorological measuring sites in Vantaa in areas with green infrastructure for a period of 15 to 18 months. The measurements will include four components of radiation (direct short wave radiation from the sun, short wave radiation of the sun reflected by the surroundings, long wave radiation emitted by obstacles, and long wave radiation emitted by the lower atmosphere), air temperature and humidity at two levels (2 and 5m above ground) and wind speed at 5 m level. All meteorological components are widely used for the in-situ calculation of thermal comfort indexes.

The measuring instruments are not yet in place and observation sites have not yet been selected (these will be chosen from five candidate sites in cooperation with the Vantaa city authorities). The installation of the measuring instruments are planned to take place in early spring 2017 and the initializing phase in summer 2017.

10.2 Stakeholder Survey Questions

Your city challenges:

1. In which city is your organisation based?
2. In what ways is your organisation concerned with air pollution?
3. What are the biggest challenges you face regarding air pollution?
4. Are there any specific characteristics of your city that affect air quality or act as a barrier to reducing pollution in the local area? e.g. geography, climate, town planning, transport etc
5. Which departments in your organisation are responsible for decisions or initiatives related to air pollution? Please describe how they work and collaborate.
6. What are the main drivers influencing policy decisions around air pollution?

Citizen perception in your city:

7. In your view, what is the current perception your citizens have of issues surrounding air pollution and climate change?

8. Do you think citizens are aware of air pollution, and do they make the link between air quality and climate change?
9. Is there anything specific you would like to change regarding citizens' current perceptions of air quality and climate change?
10. Do you have any recommendations for the best ways to engage citizens on this topic?

Current policies and interventions:

11. What policies does your organisation/city have regarding air pollution (this may include noise pollution)? Please tell us about their success or failure.
12. What initiatives/interventions has your organisation or city put in place regarding air pollution? Please tell us about their success or failure.
13. Please let us know about any plans your organisation/city has to improve air quality in the future.

Inspiration:

14. Can you provide an example of a city you feel is leading the way in tackling these issues? Please explain why you feel this is a great example.
15. If you had unlimited budget, time and resources, how would you ideally go about tackling problems with air pollution in your city?
16. Are there any other initiatives/interventions taking place elsewhere that you feel are making a real impact or doing something different in this area? Please tell us about them and include links to websites, references etc. where possible.

ISCAPE concerns:

17. The iSCAPE project aims to set up a 'Living Lab' in your city in order to actively engage citizens in a set of interventions that will aim to address air quality and climate change issues in your city. Some of these interventions include low boundary walls, trees and hedge-rows, green walls and roofs, photocatalytic coatings on buildings and better geospatial planning of roads. Drawing on your background and experience in this area, please tell us about any concerns or ambitions you have for this project.
18. Is there anything else you think we should know that you haven't had a chance to mention yet?

10.3 Data Sources for City Data Cards

Geographic

1. **Altitude:** meters above sea level. Source: http://elevationmap.net/
2. **Temperature:** average annual temperature in degrees centigrade. Source: www.en.climate-data.org
3. **Population:** population of the city or town Source: https://en.wikipedia.org
4. **Area:** area of city or town in square kilometers. Source: https://www.openstreetmap.org/#map=5/51.500/-0.100
5. **Density:** Population divided by area - the number of people per square kilometer. Source: https://www.openstreetmap.org/#map=5/51.500/-0.100

6. **Green space:** green space area. Source: https://www.openstreetmap.org/#map=5/51.500/-0.100
7. **Green space %:** green space area divided by whole area. Source: https://www.openstreetmap.org/#map=5/51.500/-0.100

Transport:

1. percentage of population who take a car, bike, public transport or walk to work from the Urban Audit report by the EU section 'Transport - cities and greater cities'. Source: http://ec.europa.eu/eurostat

Health

1. **RSD:** number of hospital discharges per 100 people (e.g. 1 in 100) with diagnosis of Respiratory System Disease on average 2011-2015 for the region (not city specific)
2. **CSD:** number of hospital discharges per 100 people (e.g. 1 in 100) with diagnosis of Circulatory System Disease on average 2011-2015 for the region (not city specific)

Source: http://ec.europa.eu/eurostat

Pollution

1. **Energy Consumption:** tonnes of all fuel types per capita national level (not city-specific)
2. **Exposure to pollution:** simplified version of the below, using only PM10 as an indicator for exposure to air pollution

    - **Exposure to Greenhouse Gas Emissions:** estimated exposure to greenhouse gas emissions in urban areas on a national level (micrograms per cubic meter per day)
    - **Exposure to PM2.5:** estimated exposure for urban areas on a national level (micrograms per cubic meter per day)
    - **Exposure to PM10:** estimated exposure for urban areas on a national level (micrograms per cubic meter per day)
    - **Exposure to Ozone:** estimated exposure for urban areas on a national level (micrograms per cubic meter per day)

Source: http://ec.europa.eu/eurostat

3. Public Opinion (Quality of Life in European Cities Report 2015 by Eurobarometer)

1. I am satisfied with the amount of green spaces such as parks and gardens in my city (% who agree)
2. I am satisfied with cleanliness in my city (% who agree)
3. I am satisfied with the noise level in my city (% who agree)
4. Air quality is a problem in my city (% who agree)
5. Air pollution is the main problem in my city (% who agree)
6. Noise is the main problem in my city (% who agree)
7. My city is committed to fight against climate change, e.g.: energy efficiency, green transport (% who agree)

Source: http://ec.europa.eu/eurostat