



# **The Living Lab Guidebook for Cities fighting against Air Pollution**



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# Foreword

The “Living Lab Guidebook for Cities fighting against Air Pollution” is a guide that has been developed to showcase and benchmark the outcomes, experiences and lessons learnt of the six iSCAPE Living Labs. It includes the results of the quadruple helix approach used to bridge knowledge, environment and technology to tackle air pollution in collaboration with local government, industry, academia and local communities. The book includes a series of actionable recommendations and it is intended to spread the iSCAPE message, methods and solutions for other cities to follow. It aims to create more sustainable: collaborative & people-centred; resilient & strategic; aware & healthy; smart & techy; and less polluted cities.

The main target audience of the guidebook are cities and existing Urban Living Labs, although other urban actors working in the field for air quality such as industry, researchers, policy makers or SMEs were also taken into consideration when shaping the knowledge and learnings of the publication. This book also provides actionable resources through the DIY chapter that can be used as a hands-on exercise that, although builds on the experiences of air pollution-oriented Living Labs, the lessons are applicable to other Living Labs in general.

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# Introduction

**Cities worldwide are facing air pollution challenges and suffering the negative impacts of climate change, and that has now become a reality that affects many people’s lives. The reality is that nine out of ten people worldwide breathe polluted air according to the WHO (World Health Organisation)\*. The good news is that improved urban planning along with citizen engagement and stakeholder collaboration can mitigate the adverse impact of air pollution.**

This guide has been developed for the EU funded iSCAPE project based on the experiences of the six iSCAPE Living Labs. It addresses cities, Living Labs, researchers, SMEs and policy makers to help them learn more about making such an invisible and imperceptible environmental challenge like air pollution, more visible and attainable.

The guidebook starts by understanding and framing the challenge of air pollution and why Living Labs are at the core of iSCAPE’s strategy. A suite of strategic keys to the sustainable city are provided based on a set of urban challenges that the iSCAPE cities were facing in relation to air pollution.

At the heart of the book are a set of values based on the United Nations New Urban Agenda, which establishes a new global standard for sustainable urban development. These values are explained with an ‘air pollution lense’ to help cities rethink how they can be planned, designed and managed to become:

- Collaborative and People-centred,
- Strategic and Resilient,
- Aware and Healthy,
- and Smart and Techy

against the invisible killer.

To achieve these goals, Living Labs in the six European cities were created: Bologna, Bottrop, Dublin, Guildford, Hasselt, and Vantaa. Through a series of case studies, this guidebook presents the policy strategies, urban interventions and citizen engagement activities the iSCAPE Living Labs implemented to improve air quality in their cities\*.

A dedicated chapter on “Urban Solutions” brings together a suite of explained environmental instruments for air pollution mitigation. These solutions are divided into four groups: Green Infrastructure (GI); Putting Green Infrastructure in the Right Place; Physical Systems and Photocatalytic Coatings.

To bring this guiding journey to an end, the book provides a DoItYourself (DIY) package with some ready-to-use tools on ‘How to’ Living Lab. There is a deck of 20 Tips & Tricks cards in the back cover of this publication to inspire and challenge cities to create a Living Lab that is sustainable: both securely grounded and able to innovate and flourish.

\* For the purpose of this guidebook only two Living Lab case studies have been selected to represent the different value-based goals. However, these values have led the work of each of the six iSCAPE Living Labs in different ways.

\* <https://www.who.int/news-room/detail/02-05-2018-9-out-of-10-people-worldwide-breathe-polluted-air-but-more-countries-are-taking-action> (accessed in November 2019).

## ABOUT ISCAPE

iSCAPE was a three-year research and innovation project funded under the European Union's H2020 programme. To advance knowledge in the field of air quality, iSCAPE brought together an interdisciplinary team of renowned and experienced researchers, public authorities, business professionals, committed NGO members and citizens. The overall objective was to develop an integrated strategy for air pollution control in European cities that was grounded on evidence-based analysis. The iSCAPE project aimed to reduce urban air pollution and the negative impacts of climate change by leveraging sustainable passive control systems, behavioural change initiatives and the Living Lab approach.

Find out more at <https://www.iscapeproject.eu/>

## 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 formed a Living Lab and introduced one or more air quality interventions as part of the project. Each of the iSCAPE cities had a different air quality intervention that they tested as part of the 'Living Lab'.

## Alignment with Global Frameworks

The iSCAPE project and its results assist cities to deliver on targets set out in globally agreed inter-governmental frameworks, in particular.

### New Urban Agenda

The New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20<sup>th</sup> October 2016. It represents a shared vision for a better and more sustainable future. At its core, the New Urban Agenda is about creating the conditions for urban residents to lead healthier, safer and more fulfilling lives.



### World Health Organisation

WHO's work on air pollution is guided by a 2015 World Health Assembly (WHA) resolution calling for an enhanced global response to the adverse health effects of indoor and outdoor air pollution. In 2016, Member States drafted a "road map" focusing on different priority areas for action.



### Sustainable Development Goals

Air pollution relates to key elements of sustainable urban development and the goals of the post-2015 Sustainable Development Agenda, notably in SDG 3 (good health and well-being), SDG target 7.2 on access to clean energy in the home, SDG target 11.6 on air quality in cities, SDG target 11.2 on access to sustainable transport and SDG 13 (climate action), as well as the goals of the Paris Agreement on climate change.

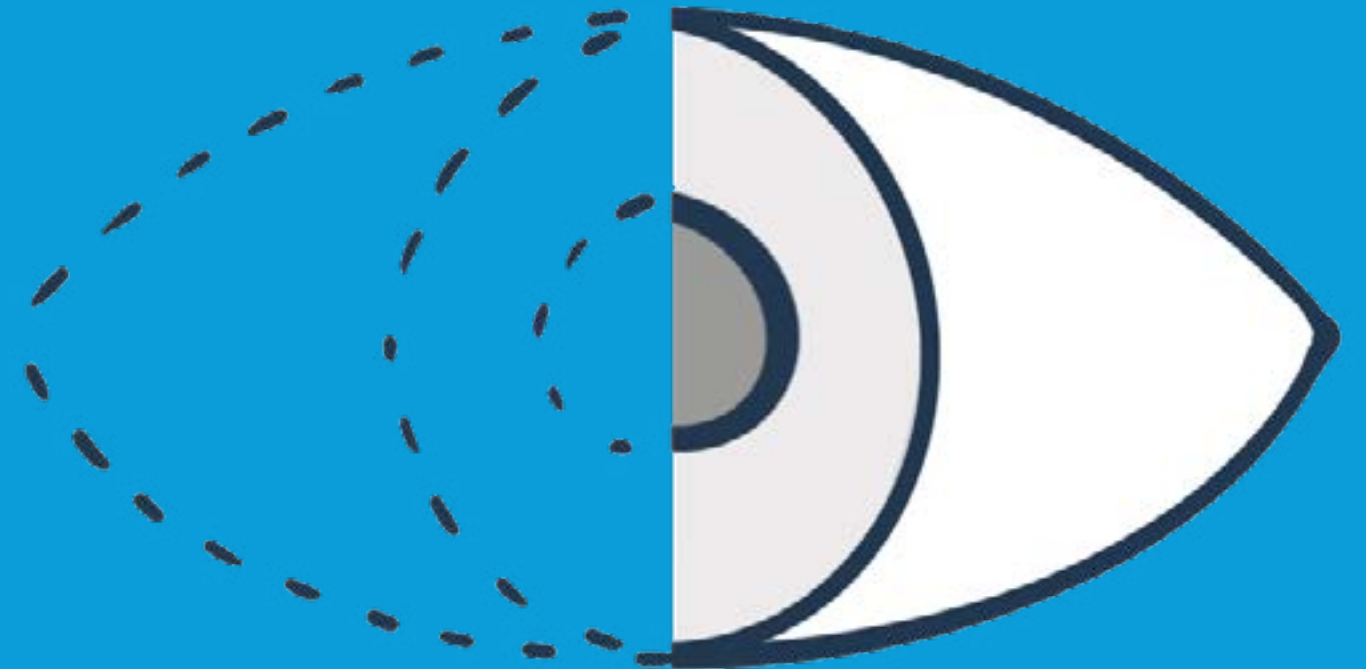


### Urban Agenda for the EU

The Urban Agenda for the EU was launched in May 2016 with the Pact of Amsterdam. It represents a new multi-level working method promoting cooperation between the Member States, cities, the European Commission and other stakeholders to stimulate growth, liveability and innovation in the cities of Europe. The Air Quality Partnership works on proposals for better regulation, funding and knowledge in this area.



# Making the Invisible,



## Visible



# Making the Invisible, Visible

## Living Labs to the Rescue of Cities affected by Air Pollution

Air pollution is a mixture of tiny and imperceptible particles and gases in the air that are the most dangerous and harmful for human health. This mixture is able to penetrate deep into the lungs, and potentially even into the bloodstream and brains. For babies and young children, the health effects are even more acute. Exposure to toxic particulates during these critical early stages of development can leave a child with stunted lungs, with respiratory conditions like asthma and reduced brain development.

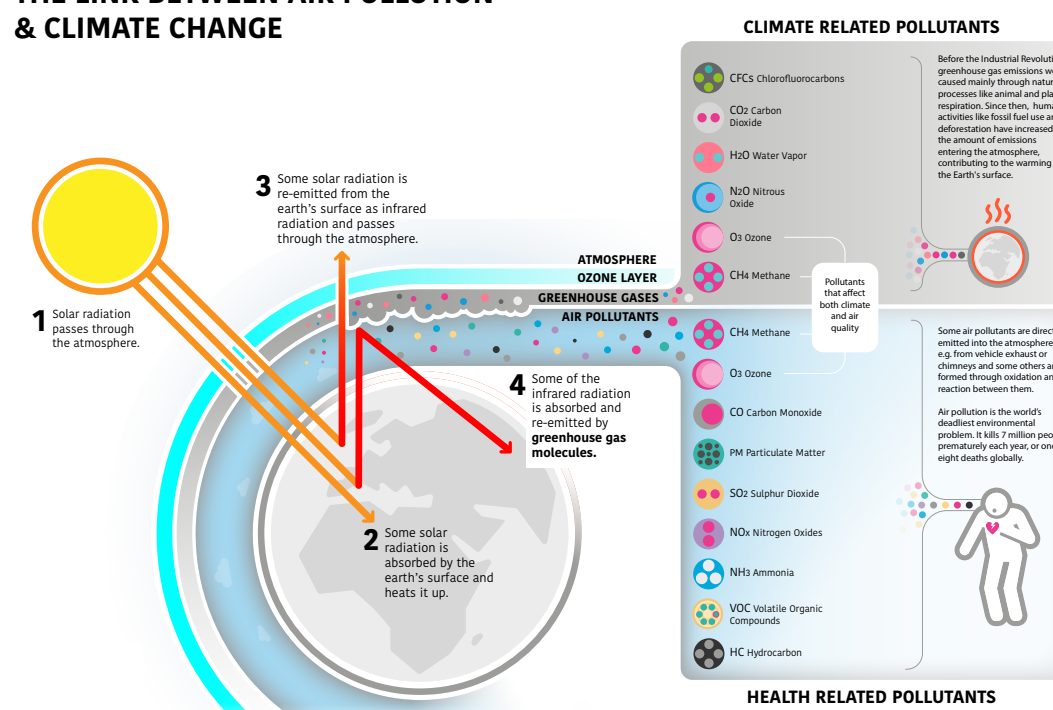
**“Humans can live for three weeks without food and three days without water – but only three minutes without air. Yet we simply take our air for granted. It’s always there. It’s everywhere. The air pollution that we breathe has changed a great deal over the centuries. It is largely invisible to us but it is having a significant impact on our health and the health of our children”**

Dr Gary Fuller for The Ecologist Journal

Air pollution is a big problem that cannot easily be seen. The lack of citizen awareness is often aggravated by the ‘invisibility’ of air pollution, making it easy for policy makers and citizens to dismiss the negative consequences it can cause both to the climate and to individual health.

As well as health risks, air pollution causes significant damage to the environment and its ecosystems. Ground-level ozone damages agricultural crops, forests and plants, reducing their growth rates. Nitrogen oxides (NOX), Sulphur dioxide (SO<sub>2</sub>) and Ammonia (NH<sub>3</sub>) harm soil, lakes and rivers by acidifying them, causing loss of animal and plant life. Ammonia and NO<sub>x</sub> also disrupt land and water ecosystems by introducing excessive amounts of nutrient nitrogen – a process known as ‘eutrophication’\*\*.

### THE LINK BETWEEN AIR POLLUTION & CLIMATE CHANGE



\* Fuller Gary, “Air pollution: ‘the invisible killer’”, The Ecologist Journal, 27th November 2018: <https://theecologist.org/2018/nov/27/air-pollution-invisible-killer> (accessed November 2019).

\*\* European Commission, “Cleaner Air for all”, 2017, <https://ec.europa.eu/environment/pubs/pdf/factsheets/air/en.pdf> (accessed in November 2019).

## KNOW YOUR ENEMIES

These are the names of the main air pollutants affecting human health and where they are coming from\*:

**Particulate matter (PM)** is fine dust, emitted by, among others, road vehicles, shipping, power generation, refineries, cement works, and households, and from natural sources such as sea salt, pollen, wind-blown soil and sand. Health concerns focus on particles of less than 10 micrometres ( $\mu\text{m}$ ) in diameter (PM10) – and especially those of less than 2.5  $\mu\text{m}$  across (PM2.5).

**Sulphur dioxide (SO<sub>2</sub>)** is emitted by power generation (particularly coal burning power plants), vehicle exhausts, industry, shipping, petroleum and metal refining, metal smelting and households, but also natural sources such as geothermal activity, including hot springs and volcanic activity, natural decay of vegetation on land, wetlands and in oceans. It harms human health and contributes to acidification of soils and inland waters.

**Nitrogen oxides (NO<sub>x</sub>)** are emitted by road vehicles, shipping, power generation, industry and households, but also thermal processes in the atmosphere (e.g., during lightning or bushfires/wildfires), agricultural activities (both cultivation and animal feeding), fuel burning for heating manufacturing industries and petroleum manufacturing. They harm human health and contribute to acidification and eutrophication. Nitrogen oxides are also one key component in increased levels of ground-level ozone (O<sub>3</sub>).

**Ammonia (NH<sub>3</sub>)** is emitted by livestock farming, motor vehicles through their exhaust and the use of fertilisers in agriculture. It harms human health as a building block for so-called secondary PM and contributes to acidification and eutrophication.

**Volatile organic compounds (VOC)** include a variety of chemicals that include any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, carbonates), some of which with a short- and/or long-term adverse health effects. They are emitted from a variety of sources, including motor vehicles, chemical manufacturing facilities, refineries, factories, natural biogenic sources (mainly trees), the use of solvents in products and industry, road vehicles, household heating and power generation. VOCs are the key component in the formation of ground-level ozone.

**Ground-level ozone (O<sub>3</sub>)** is a secondary pollutant produced by chemical reactions of NO<sub>x</sub> and VOCs in sunlight. This occurs when pollutants emitted by power plants, industrial boilers, refineries, chemical plants, and other sources chemically react in the presence of sunlight. For this reason, ozone is most likely to reach unhealthy levels on hot sunny days in urban environments, even though it can also be transported long distances by winds. Breathing ozone can trigger a variety of health problems including chest pains, asthma, throat irritation, and is harmful to vegetation, ecosystems and sensitive construction material like metals and paints.

\* European Commission, “Cleaner Air for all”, 2017: <https://ec.europa.eu/environment/pubs/pdf/factsheets/air/en.pdf> (accessed in November 2019).

There is a need for cities to make air pollution visible by adopting a **system approach** that fosters connectivity, interaction, operation and organisation with business, academics and citizens. Raising awareness is critical for finding new ways of thinking and responding to this challenge collectively and effectively. In this sense, all urban actors need to be made aware of how they can contribute on an individual level to tackle air pollution at the city scale.

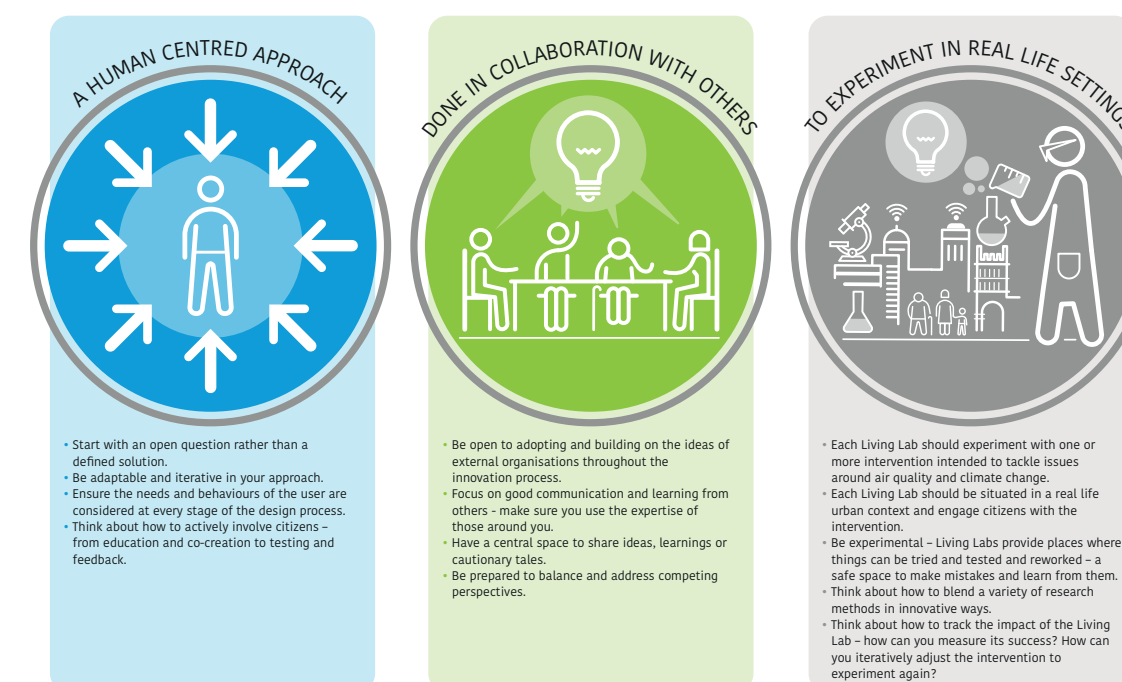
Using a human-centred approach that puts citizens at the heart of the solution design is likely to help them feel more empowered to take action and to change the environment they live in. iSCAPE strongly believes that Living Labs are the vehicle to enable this discussion as stakeholder orchestrators.

As defined by the European Network of Living Labs (ENoLL) a **Living Lab** is a citizen-centred urban innovation ecosystem, based on systematic user engagement in real-life settings through a wide variety of methods, tools and incentives, with the participation of multiple stakeholders in the co-creation of innovations responding to predefined urban challenges.

The six iSCAPE Living Labs started from scratch and in just two eventful years have grown into organisations that have successfully raised citizen and stakeholder awareness of air pollution control and prevention through active engagement and co-creation of innovative urban solutions. These not only involved the deployment of GI, physical systems and urban environment measures for air pollution mitigation, but also Citizen Science (CS) activities to empower citizens to monitor air quality data in their local surroundings. These were done through the use of citizen-friendly air pollution sensors, described in more detail in the Smart & Techy chapter.

The strong sense of belonging and empowerment that the Living Labs grew in citizens and urban stakeholders has been iSCAPE’s winning recipe to unmask the invisible challenge of air pollution in cities.

### iSCAPE LIVING LABS: THREE KEY PRINCIPLES





# The Keys



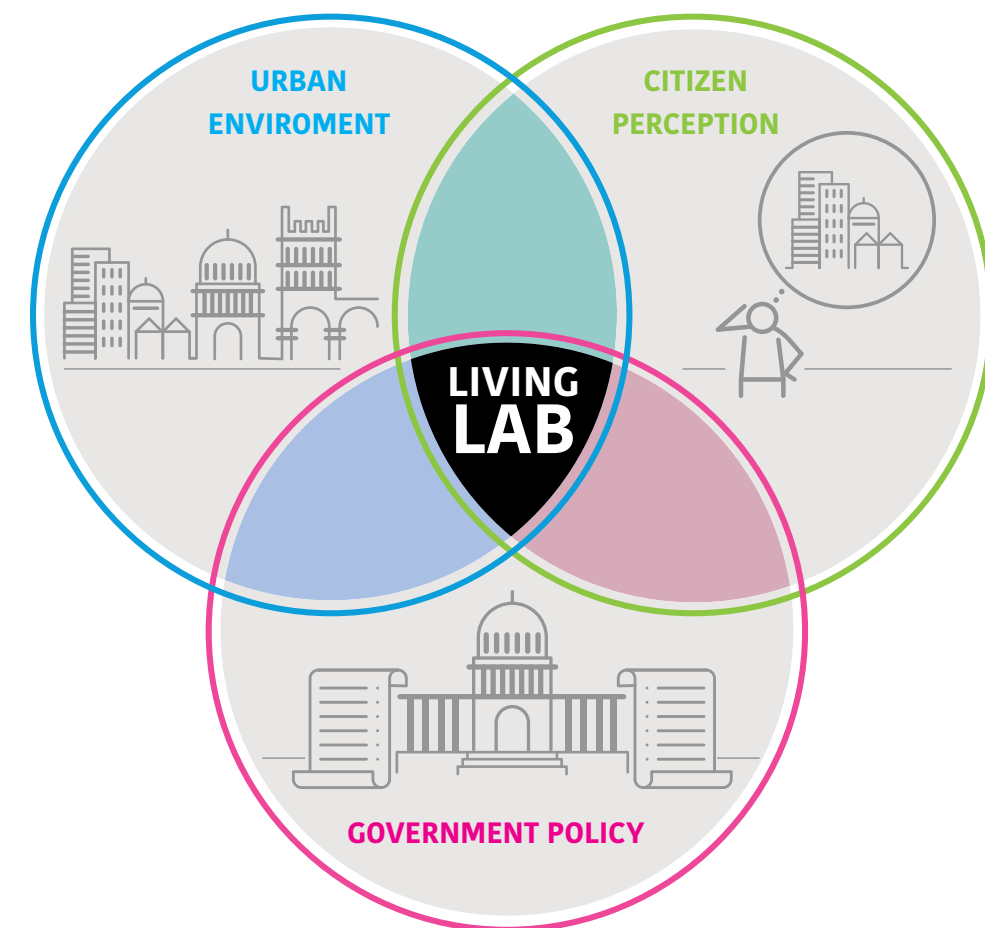
to the  
Sustainable  
City

# The Keys to the Sustainable City

There are certain challenges that all cities have in common. Cities are still on the whole designed for cars, and greater awareness is needed on the link between air quality and climate change as well as the complexities of urban challenges in general. It is essential to start by exploring and identifying the challenges that cities are facing; a focus is needed. In this regard, data can be used as a basis to understand and frame the issues at stake. This helps in finding the appropriate strategy and action plan to approach city challenges effectively.

In iSCAPE, a set of urban challenges were initially defined for each of the six iSCAPE cities around the topics of air pollution and climate change. These have been based on a qualitative survey\* of various city stakeholders conducted in the six cities in November 2016 and have been broken down into three key areas:

- **URBAN ENVIROMENT** - including the geographical elements and design of the city.
- **CITIZEN PERCEPTION** - including the thoughts and behaviours of the citizens who live in each city in relation to air pollution.
- **GOVERNMENT POLICY** - including the organisation of government bodies and the legislation they introduce.



\* The stakeholder survey was conducted by Future Cities Catapult (FCC) with the help of the rest of the iSCAPE partners in November 2016 for the "Challenges and Opportunities in the iSCAPE Cities" report is accessible in Annex 10.2 here: <https://ec.europa.eu/digital-single-market/en/news/green-paper-citizen-science-europe-towards-society-empowered-citizens-and-enhanced-research> (accessed November 2019).

The following keys are guiding principles to foster urban sustainability and mitigate some of the most recurrent drivers of air pollution in cities. These strategies should be considered as thought starters.

## The Keys to the Urban Environment



### THE CITY IS DESIGNED FOR THE CAR

- Reducing the appeal of driving in cities by reducing parking availability in the city centre, introducing congestion charges, increasing penalties for unsustainable modes of transport or by providing 'park & ride' facilities. Alternatively, changing people's commuting patterns by introducing local co-working spaces, non-standard working hours and facilitating home working.
- Increasing the appeal of cycling and walking by making the city centre car free or introducing car free days/events. Investing in cycling infrastructure with segregated

cycle lanes and creating green spaces that prioritise pedestrians and cyclists at certain times of the day. Re-purposing heavily polluted areas once alternative transport has been provided.

- Improving public transport within and between cities by transferring all transport logistics to rail or by providing car-pooling facilities that enable people to connect with each other in a secure way.
- Moving to electric vehicles by making public transport electric, introducing e-bikes, promoting benefits for electric cars and expanding their charging network.



### THE CITY IS CLOSE TO THE AIRPORT

- Discouraging short haul and internal flights by reducing the prices of train tickets on popular flight routes.
- Investing in lower emission trains – lighter, hybrid fuel, etc.



### THE CITY STRUCTURE IS DENSE OR OVERCROWDED

- Increasing education on how to live sustainable and pollution friendly lifestyles to help citizens understand the impact of wood burning in the homes in built-up areas.
- Ensuring new suburban housing developments also providing good public transport links.
- Building developments that reduce air pollution e.g. Beijing's 'smog

eating tower\*\* that sucks in pollution particles and photocatalytic coatings on walls of buildings.

- Green walls, roofs and urban farming to mitigate against increased pollution from heating, cars etc.



### INNOVATING WITHIN A HISTORIC CITY CAN BE DIFFICULT

- Pedestrianising and providing cycle infrastructure in narrow streets.
- Creating shared use public spaces.
- Helping 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.

- Introducing 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 CITY'S LOCATION CAN MAKE AIR POLLUTION WORSE

- Mandatory solar panels on all public buildings to take advantage of the sun – this energy can then be used in various ways to mitigate the effects of air pollution.
- Better education about the indoor air pollution and how to reduce this.
- Looking for inspiration from air

purification systems used in confined areas e.g. electrostatic precipitators used in tunnels.

\*

<https://www.studioroosegaard.net/project/smog-free-tower>

\*\*

The Guardian, "Superblocks to the rescue: Barcelona's plan to give streets back to residents", 2016, <https://www.theguardian.com/cities/2016/may/17/superblocks-rescue-barcelona-spain-plan-give-streets-back-residents> (accessed November 2019).

# The Keys to Citizen Perception



**A CULTURE OF CAR USERS**

- Cars are still seen as luxury status symbols - similar to a wrist watch. These traditional connotations need to be inverted to create new narratives. How air quality is represented in the media is key. Looking for inspiration from branding and marketing e.g. What can be learnt from other health related public campaigns with regards to behaviour change e.g. anti-smoking campaigns?

options.

- Promoting sustainable mobility sub-cultures that already have a strong cultural identity e.g. cycling.
- Better incentives from government to move to more sustainable transport options.
- 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**

- Introducing education on these issues at school level – getting people thinking about these topics from an early age.
- Better education, communication and dissemination of air quality and climate change research and initiatives.
- Making messages simple and easy to understand – How can creative methods be used to communicate to citizens? e.g. infographic illustrations, visualisations, maps, films, advertising, art installations ..

- Making it personal – giving tangible examples of how air pollution can affect people as well as what people can do about it on a local level.

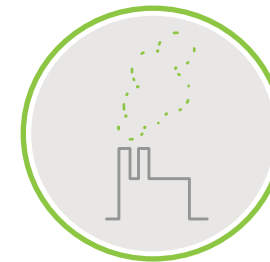


**THERE ARE MANY MISCONCEPTIONS ABOUT GOOD & BAD BEHAVIOUR IN RELATION TO AIR POLLUTION**

- Better promotion of 'good' driving behaviour from car manufacturers themselves.
- Face to face engagement seems to work well. Giving people opportunities to ask questions.
- Being more open and honest 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.

- Introducing dedicated third-party advisor on air quality.
- Using neutral public spaces e.g. living labs to help build trust between citizens and government bodies.



**AIR POLLUTION IS OFTEN INVISIBLE**

- Displaying air quality levels in prominent public spaces.
- Introducing a standardised rating to show 'good' green days vs 'bad' red days and providing clear mitigation instructions to avoid the most polluted areas.
- Increasing awareness by enabling citizens to monitor their personal exposure to air pollution through provision of low-cost sensors e.g. on their smartphone.
- Finding 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.

- If citizens view air pollution in sensory ways – smell, sight, sound - how can citizens be used as the sensors of air pollution themselves?
- 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 – Carbon Arts Project\*\*). Learning 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.
- Using social media to get people publicly engaging in the debate.

\*

\*\*

<http://genomicgastronomy.com/work/2011-2/smog-tasting/> (accessed in November 2019).

<http://www.carbonarts.org/projects/melbourne-mussel-choir/> (accessed in November 2019).



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

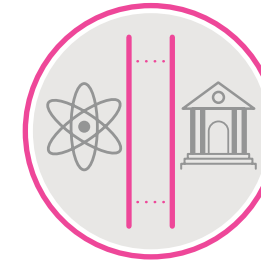
- Helping people understand the precise health effects of different pollutants and which citizens are most vulnerable to these.
- Social media campaigns can be very effective for certain groups e.g. younger generation, parents.



### PEOPLE DON'T SEE AIR QUALITY AS SOMETHING THEY CAN CHANGE

- Involving people in citizen led experimental design to develop user centred solutions.
- Educating 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.
- Trying 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.
- Helping people understand that policies that will make a difference will often be unpopular e.g. reduced and more expensive parking in city centres.

## The Keys to Government Policy



### GAP BETWEEN SCIENTIFIC RESEARCH & GOVERNMENT LEGISLATION

- Using the Living Lab to develop new ways to disseminate scientific/ academic knowledge – both to citizens and government stakeholders.
- Investing in greater understanding of the social and environmental impact of different types of vegetation and green interventions to inform policy.
- Investing in micro-simulation modelling of problem areas.



### DISAGREEMENT & LACK OF CO-ORDINATION AMONG GOVERNMENT BODIES

- Using the iSCAPE living labs as a place to coordinate and bring together different government bodies.
- Encouraging stakeholders to work together in a 'round-table' approach.



### LACK OF SUPPORT FROM CENTRAL GOVERNMENT

- Better incentives from government to move to more sustainable transport options.
- Increasing government pressure from the citizen or 'doorstep' level.



### MISLEADING OR UNRELIABLE MEASUREMENT OF AIR QUALITY

- More accurate measurement done at a local level to solve issues with misleading AQ reports when only looked at on a citywide level.
- Encouraging citizen-led sensing and open data analysis is likely to help with these issues.
- Developing greater understanding of what to do with these measurements and ensure it is not just measuring for measurements sake but that it leads to direct action to reduce air pollution in those areas most affected.



# Collaborative and



# People Centred

# Collaborative and People-centred

**“We encourage effective participation and collaboration among all relevant stakeholders, including local governments, the private sector and civil society, women, organisations representing youth, as well as (...) academic institutions, (...) , in order to identify opportunities for urban development and identify and address existing and emerging challenges.”\***

**“We commit ourselves to urban and rural development that is people-centred, protects the planet, and is age- and gender-responsive and to the realization of all human rights and fundamental freedoms, facilitating living together, ending all forms of discrimination and violence, and empowering all individuals and communities while enabling their full and meaningful participation.”\*\***

Air pollution is a hidden killer that ignores national borders and can be carried very long distances by the wind, so it needs to be tackled through cooperation at European, international and global level.

In order to respond to some of challenges cities are facing related to the urban environment, citizen perception or government policies, it is necessary to operate beyond the city administrative boundaries, transcending municipal organisational structures and territorial division. Sustainability requires mobilisation of all stakeholders, resources and ideas, as well as organisational adaptation and cooperation between territories that are increasingly interdependent. Governance is therefore a priority challenge within any urban sustainability strategy\*\*\*.

A city’s approach must be **collaborative** because sustainability will only happen if everyone participates. The more collaborative and inclusive a society is, the more it is united and supportive, and the better it can face all challenges, daily as well as in emergencies. Effective collaboration requires a strong relationship between the city and its stakeholders as well as a profound capacity for government to innovate, experiment and involve citizens in the design of its projects.

Research by CDP and C40 Cities Climate Leadership Group shows that cities who collaborate on common urban actions are not only more likely to have an emissions reduction target, but that target is more likely to be ambitious. Cities that take a partnership-based approach are better placed to deliver effective responses to common urban challenges \*\*\*\*.

\* United Nations, “New Urban Agenda”Commitment no 48, 2017, <http://habitat3.org/wp-content/uploads/NUA-English.pdf> (accessed in November 2019).

\*\* United Nations, “New Urban Agenda”Commitment no 26, 2017, <http://habitat3.org/wp-content/uploads/NUA-English.pdf> (accessed in November 2019).

\*\*\* 100 Resilient Cities (100RC), “Paris Resilience Strategy”, 2017, <https://api-site-cdn.paris.fr/images/103187> (accessed in November 2019)

\*\*\*\* C40 and ARUP, “Powering Climate Action: Cities as Global Changemakers”, 2015, [https://www.c40.org/blog\\_posts/new-research-from-c40-and-arup-shows-how-city-governments-are-changing-the-world](https://www.c40.org/blog_posts/new-research-from-c40-and-arup-shows-how-city-governments-are-changing-the-world) (accessed in November 2019).

This is because collaboration provides opportunities to share skills, knowledge, and resources between cities and other actors. Cities can help businesses raise finance for climate action. They can – and do – set longer-term plans and targets that can provide the context for companies to be more ambitious and forward-looking in their planning. Cities, regions, and businesses generally can work together to create complementary approaches to responding and adapting to the adverse impacts of air pollution.

Public institutions, private stakeholders, associations, inhabitants, researchers, and other city users all have a shared interest in reducing the impacts of climate change as many global risks are concentrated in urban areas. Sustainability is therefore firmly **people-centred**, driven by all citizens and communities, and with a focus on those disproportionately affected by climate challenges and air pollution, such as children, older people and the most deprived in society.

It is widely recognised that children and young people are at increased risk from toxic air compared to most adults, yet they are the least responsible for polluting the air but the most vulnerable to its harmful effects. Emerging evidence indicates that toxic particulates can travel through the mother's placenta wall, and there is strong evidence that inhalation of air pollution by pregnant women affects the development of the fetus.

During early childhood, a critical time for physical and cognitive development, infants are particularly vulnerable to the effects of harmful substances on their growth. As children breathe faster than adults, they take in more polluted air: an infant breathes in three times as much air as an adult, and a six-year-old breathes in twice as much, relative to their weight. Children also tend to spend more time outside, where concentrations of air pollution from traffic are generally higher. They experience particularly high concentrations of air pollution while they are on their way to school and when playing outside during break time. The risk of air pollution exposure to children's health is particularly acute during periods of cold weather, when pollution concentrations rise and when the symptoms of respiratory conditions such as asthma are already worsened\*.

Toxic air can damage children's growth and leave them with lasting health problems. It poses a particularly severe risk to those children and young people already suffering from heart conditions or respiratory problems such as asthma and cystic fibrosis. Every child has the right to health. Every child has the right to live, learn and play in a clean and safe environment– a right protected by the UN Convention on the Rights of the Child\*\* and a critical requirement for every child to grow, develop and learn to their full potential.

\* The Guardian, "Children with respiratory conditions face a twofold threat this winter", 2018, [www.theguardian.com/environment/2018/dec/07/children-with-respiratory-conditions-face-a-twofold-threat-this-winter](https://www.theguardian.com/environment/2018/dec/07/children-with-respiratory-conditions-face-a-twofold-threat-this-winter) (accessed in November 2019).

\*\* UNICEF UK, "UN Convention on the Rights of the Child", Article 24, 1990, [www.unicef.org.uk/what-we-do/un-convention-child-rights/](https://www.unicef.org.uk/what-we-do/un-convention-child-rights/) (accessed in November 2019).

## READING CORNER

- **It takes a City. The Case for Collaborative Climate Action** (2016) by CDP. 533 cities disclosed their climate-related data through CDP's cities program. This annual global report, analyses the climate-data of 533 cities with a view to showing cities, ents, companies and investors there is a case for collaborating on climate action.
- **Connecting with Nature to Care for ourselves and the Earth** (2018) by Children & Nature Network. Designed for a broad audience, this short publication aims to share highlights of the most current and compelling evidence for connecting people with nature to aid decision makers from diverse sectors across the world in implementing policies and practices that will help humans thrive in harmony with nature for decades to come.
- **Promoting Good Prenatal Health: Air Pollution and Pregnancy** (2010) by EPA (United States Environmental Agency). Information for prenatal health care providers with tips for patients on preventing and reducing exposure to air pollution.
- **Effects of Air Pollution on Children's Health** (2005) by the WHO. This book presents an assessment of research data gathered over the last decade, and provides conclusions concerning the risks posed by ambient air pollutants to various aspects of children's health.



## Our Strategy

Solving complex urban challenges requires close collaboration across scientific disciplines and both the public and private sector. What is also true is that gaining the attention, interest and engagement of a diverse range of stakeholder groups – particularly youth – is not an easy task, especially when dealing with such a complex challenge as air pollution. In addition to that, bypassing or bridging the knowledge gap becomes particularly difficult when the topics dealt are as difficult to perceive as air pollution.

iSCAPE, **by making things at once: simple, playful, visible, personal and practical, has managed to bring complex air pollution related issues closer to the attention of a very wide citizen and stakeholder audience.** This was demonstrated, for example, by the work of the Living Labs in Dublin and Bottrop.

**Dublin Living Lab** aimed to create shared meanings and joint values by bringing together citizens, research institutions, businesses, and public authorities to solve environmental challenges. But at the core of the Living Lab's collaboration strategy was empowering children and young people's creativity to reimagine the challenge of air pollution from a different perspective. Their unique and priceless ideas have sparked researchers to reimagine how they approach problems, leading to new innovations across the field. This mindset played an essential role in co-creating innovative solutions to improve air quality in the city. For the years to come, Dublin Living Lab aims to become an integral part of the regional innovation ecosystem to develop a strong value proposition for its key stakeholders by leveraging its network and established working relationships with the Smart Dublin and Smart Docklands initiatives.

**Bottrop Living Lab's** strategy followed an open stakeholder engagement approach to become a space of opportunities for innovative ideas and a constant learning process. The Living Lab ensured that key city stakeholders from the city administration, research and citizens collaborated together for a common goal: greening the city through the "Wandering Trees" parade. For the years to come, Bottrop Living Lab aims to transfer their Living Lab knowledge to other cities. Exchanging knowledge and experiences between Living Labs from other cities, provides all teams with great benefits, including potential collaboration opportunities.



# DUBLIN

Enhancing conversations  
between different urban  
stakeholders



Size:

**METROPOLITAN AREA**

Urban Model:

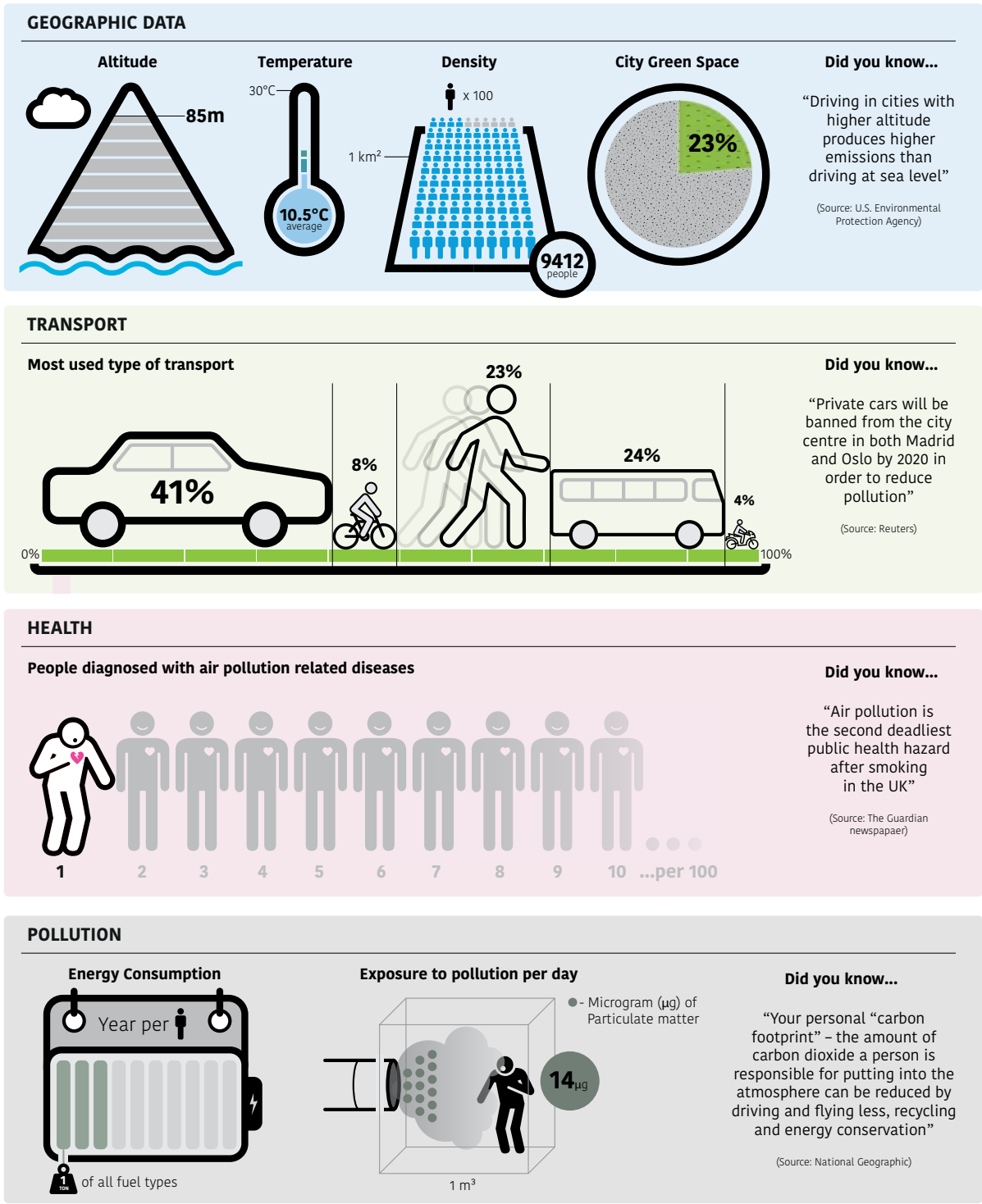
**COMPACT CITY**

Location:

**EAST IRELAND**



# City Facts\*



### HEALTH

People diagnosed with air pollution related diseases

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

Did you know...

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

(Source: The Guardian newspaper)

### POLLUTION

Energy Consumption

Year per

of all fuel types

Exposure to pollution per day

14 µg

1 m³

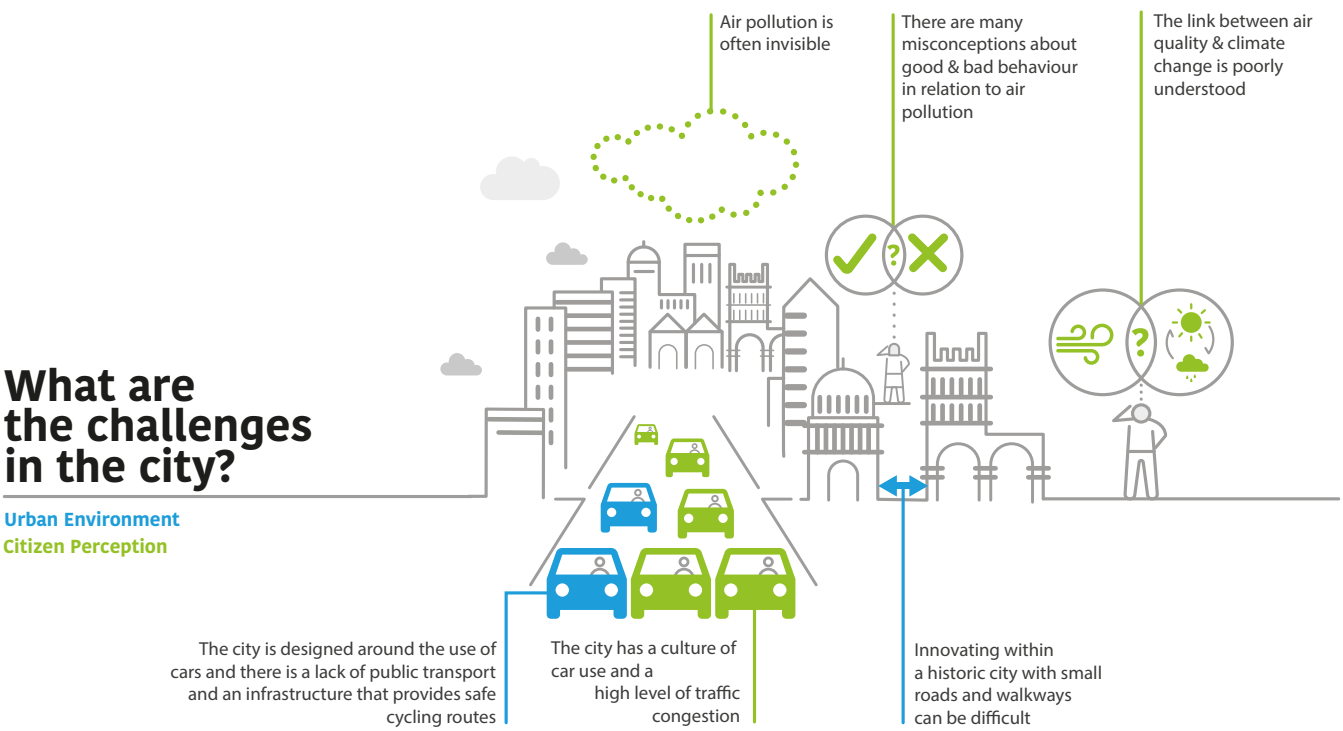
● - Microgram (µg) of Particulate matter

Did you know...

“Your personal “carbon footprint” – the amount of carbon dioxide a person is responsible for putting into the atmosphere can be reduced by driving and flying less, recycling and energy conservation”

(Source: National Geographic)

# The Urban Challenges



\* Data sources can be found in the “Challenges and Opportunities in the iSCAPE Cities” report, 2017, available here: [https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted\\_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf](https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf) (accessed in November 2019).

# The Living Lab Journey

As part of their engagement activities, Dublin Living Lab aimed at enhancing the dialogue between different stakeholders and ensuring that people's voices were heard to generate solutions that address such wicked problems as air quality and climate change. The Lab, hosted by University College Dublin (UCD), adopted a people-centred approach by empowering young children and giving them the opportunity to become the main innovation catalysts in the co-creation activities. Through this process, children not only designed new solutions to air pollution challenges, but they also learned design thinking and problem-solving skills.

## The Intervention

To achieve these aims, Dublin Living Lab designed a long-term pilot project (2+ years) on **Low Boundary Walls (LBW)** driven by the motivation to develop a new low-cost solution that reduces pedestrian exposure to air pollution. This project contained two main workstreams: research to assess the effectiveness of a LBW in real-life conditions and citizen engagement activities focused on developing new ideas to improve the functionality and aesthetic design of such a solution.



Conducted research activities included a couple of field campaigns carried out in the city centre of Dublin, as well as extensive simulation efforts to assess the effects of a low boundary wall to pedestrian exposure to air pollution. Research activities were conducted with the support of Trinity College Dublin (TCD) and in close collaboration with Dublin City Council. Dublin City Council not only shared their concerns and provided guidance on legal requirements and planning restrictions but also provided the Living Lab with the additional equipment and resources required to implement these field campaigns. Such support could be attributed to the fact that representatives from public authorities and city administration were involved in the pilot activities from the start. During the initial phase, a workshop to understand city challenges and discuss potential solutions was organised which helped the Living Lab to align interests and perspectives of different project stakeholders.

This kind of intervention has shown to provide positive results on the dispersion of pollutants. The data collected suggested that LBWs can act as a baffle at street level and increase the distance between the pollutant source and the human receptor.

## The Activities

The Dublin's pilot involved several citizen engagement activities which were conducted in collaboration with multiple city stakeholders, with a particular focus on the general public, city planners and the scientific community, who was already involved in air pollution research.

The Living Lab activities had a strong people-centred approach. They engaged the general public, especially young people, to assist in the aesthetic and functional design of LBWs through participatory events and playful approaches.

For example, **Hack the Air** was an interactive, hands-on event held in March 2018 at the Science Gallery Dublin. Youngsters aged 15-25 were invited to design innovative solutions to air pollution in cities. Participants were given the challenge of designing concepts for a multi-functional solution that reduces pedestrian exposure to air pollution. The design was to have multiple functions: be no taller than a person; require low cost to build and maintain; be built from materials that last in Irish weather; not be an obstacle for pedestrians or traffic. The structure and format of the event was developed following the design thinking process, which includes phases such as inspiration, ideation and



prototyping. The activities for each of these phases were selected so that they encourage imagination and facilitate creative thinking.

The Living Lab also organised the **Play and Learn series**, a set of playful activities focused on understanding children's awareness of air pollution using both original Lego® bricks and large lego-like bricks were organised. These activities were organised in 2017-2018 to engage with young children in a playful discussion of air pollution and ways to control it. For example, in June 2017, the team organised an event during the UCD Festival. Children were asked to build 'a bad' factory and then to build solutions to 'protect a Lego city from the bad factory'. These solutions included trees, parks, flower gardens and even tree houses. These type of activities were tailored and adjusted to school children by integrating elements of group brainstorming, concept drawing and some prototyping.



Another key example and output of this approach was the **'The Air We Breathe'** book\* published in autumn 2018, inspired by children participating in the Play and Learn events. The book introduces the concept of air pollution and encourages children to generate new ideas to reduce air pollution. Throughout the book, scientists and experts from Trinity College Dublin, Dublin City Council, and the Environmental Protection Agency share their thoughts on various air pollution topics to encourage children and adults alike to learn more about this global problem and make informed choices that are better for both the environment and their personal health.

Creative experiences with children helped the team develop a deeper understanding of the design and functionality requirements for a new solution serving a similar purpose to that of the LBW. The children's creative ideas also inspired the scientists to think outside the box and look at the challenge with a fresh perspective. For instance, the position of the LBW on the footpath was questioned and other potential locations were discussed using a lateral thinking approach.

\* This book is the outcome of scientists and school children working together to fight air pollution. Produced by the iSCAPE's team at University College Dublin (UCD), the book introduces the concept of air pollution and encourages children to generate new ideas to reduce air pollution. Accessible here: <https://www.yumpu.com/en/document/view/62191692/the-air-we-breathe>

Lego workshop with children at UCD Festival





# BOTTROP

Involving citizens and stakeholders in urban greening initiatives

Size:

**SMALL URBAN  
AREA**

Urban Model:

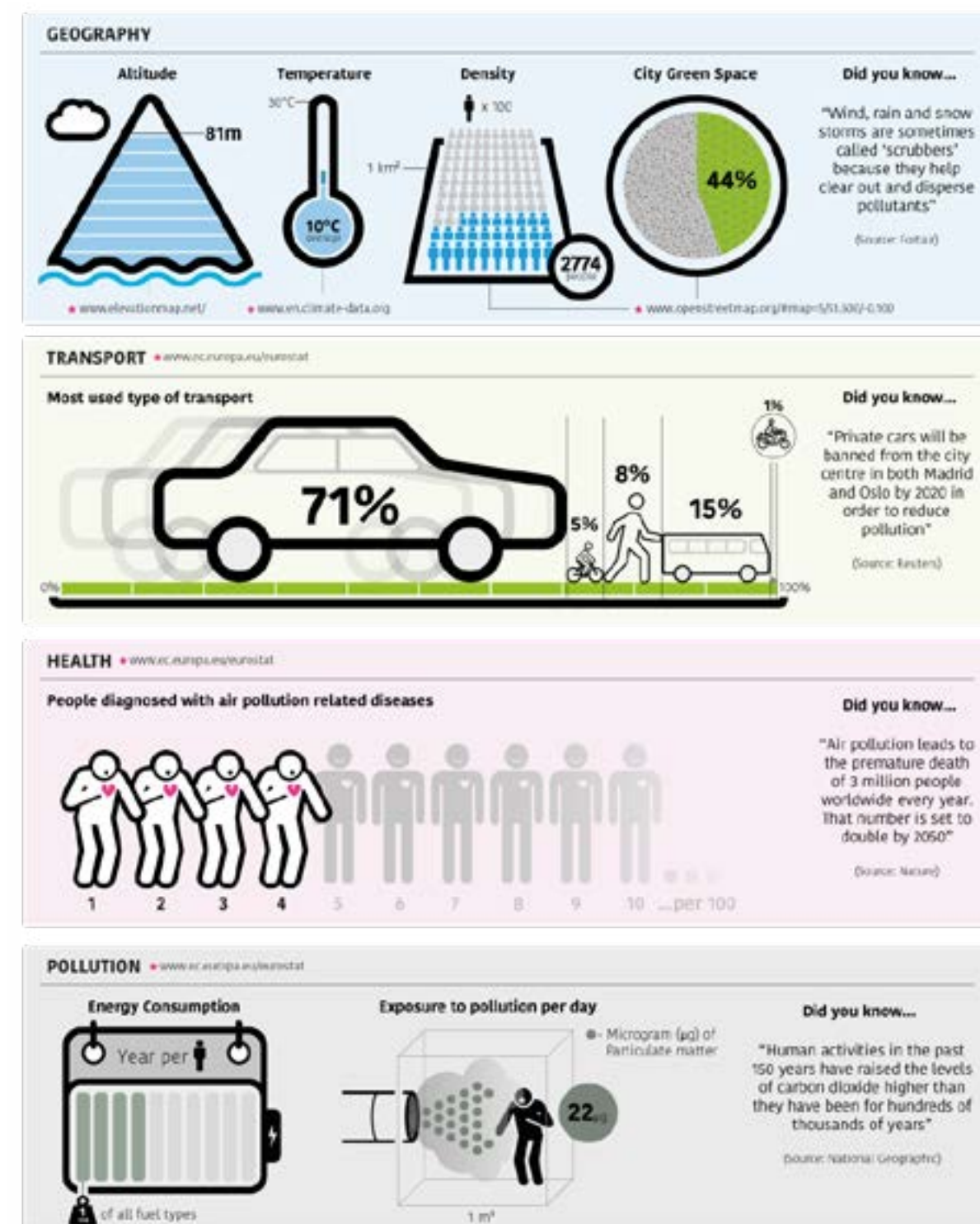
**DECENTRALISED  
CONCENTRATION**

Location:

**WEST  
CENTRAL  
GERMANY**



## City Facts\*



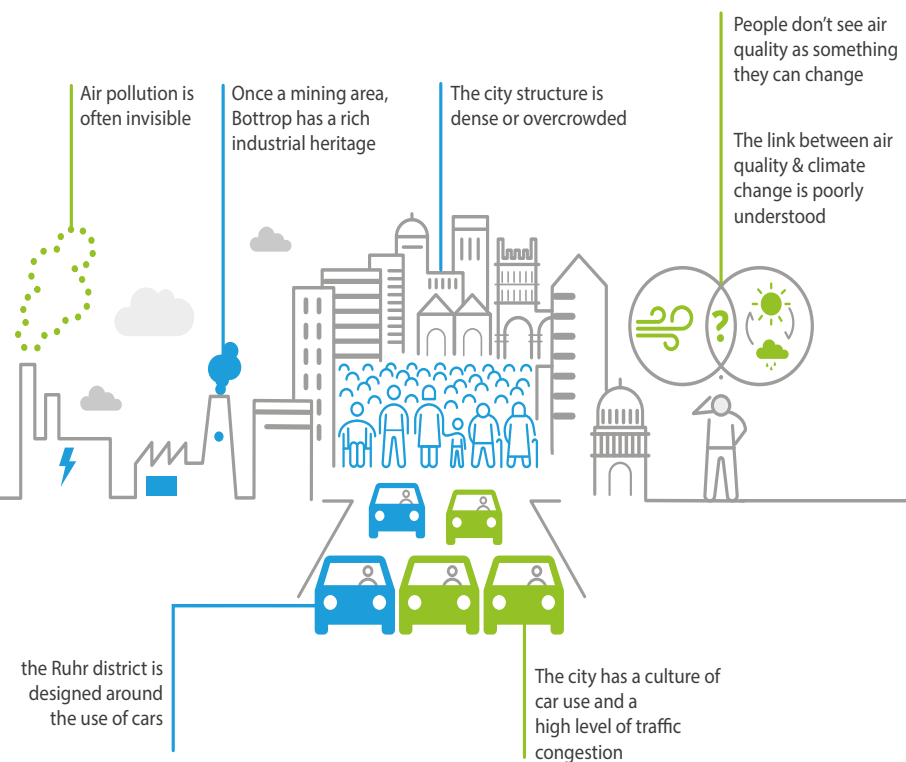
\* Data was not available for Bottrop so Dortmund has been used as a nearby city with similar attributes  
Data sources can be found in the "Challenges and Opportunities in the iSCAPE Cities" report, 2017, available here: [https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted\\_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf](https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf) (accessed in November 2019).



# The Urban Challenges

## What are the challenges in the city?

Urban Environment  
Citizen Perception



# The Living Lab Journey

Bottrop Living Lab, hosted by TU Dortmund University (TUDO), aimed at increasing citizens' awareness on how green cities can improve air quality, reduce air pollution and at the same time improve the city's attractiveness. They believed in empowering citizens to generate ideas and come up with solutions that tackle these challenges and make their city greener. Having a first-hand experience with the urban green helps in developing personal connections, positive experiences and even emotional ties with nature. In time, this can lead to an increased sense of responsibility and engagement of people with the natural environment.

## The Intervention

The Living Lab intervention in Bottrop focused on **mobile green elements for improving the microclimate of public squares** from a governance perspective. The temporary greening of inner-city streets with mobile trees was intended to demonstrate citizens on-site the advantages of street trees for urban climate and air quality, but also for the quality of their stay. **"Wandering Trees"** were used for active citizen involvement as a vehicle to increase the citizens' awareness of air pollution in the city and raise their acceptance of urban green. "Wandering Trees" helped in motivating citizens to take part in creating the city's future.



## The Activities

City stakeholder engagement was pivotal to the project success. Many different actors were involved in the planning and implementation of the Wandering Trees Parade. Citizens were the main target group of the Living Lab intervention. However, its smooth implementation was made possible thanks to the great cooperation between TUDO, Bottrop city administration, and the citizens of Bottrop. The success of the cooperation provided the city administration with additional funding to the project implementation by sponsoring the trees. The city administration was also actively engaged in co-creation activities to generate ideas and develop solutions for a greener city.

Bottrop Living Lab also involved the urban gardener's association, Verein GemeinSinnSchafftGarten, together with local citizens in the organisation and implementation of the "Wandering Trees" parade. Different co-creation workshops were organised to decide on the most appropriate seasonal tree species to use, find locations and map the wandering routes for the campaign and design green ideas for the parade such as tree decorations. The Wandering Trees were then planted in pots and used to add temporary green to the city centre. The campaign gave citizens first-hand experience of the positive effects of trees on air quality. In Spring 2018 the trees wandered into the neighbourhood with the help of citizen participants for the first time.

The Wandering Trees Parade was concluded with a 'wrap' event – a small gathering of stakeholders for food and ideas exchange – in late summer 2018. All those involved in the "Wandering Tree" parade were invited to this event: citizens, civil society stakeholders, and employees of the city administration. This broad cross-section of stakeholders in the organising and running of the parade – all of whom were actively involved with roadside greenery and other green issues in different ways over the summer months – was a great demonstration of the success and reach of the project.

The Wandering Trees Parade 2019 included new locations, as well as a new stakeholder group: school children. The event was attended by three representatives of three primary schools. This helped the Living Lab to further increase awareness of air pollution and the importance of green in the city.

To increase even further the awareness of air quality, the Living Lab aims to organise Wandering Trees activities continuously. As a regular activity, the Wandering Trees are an excellent tool to bring together local residents annually and contribute to the positive image building of the Bottrop city beyond its borders.

# Struggles and Tips

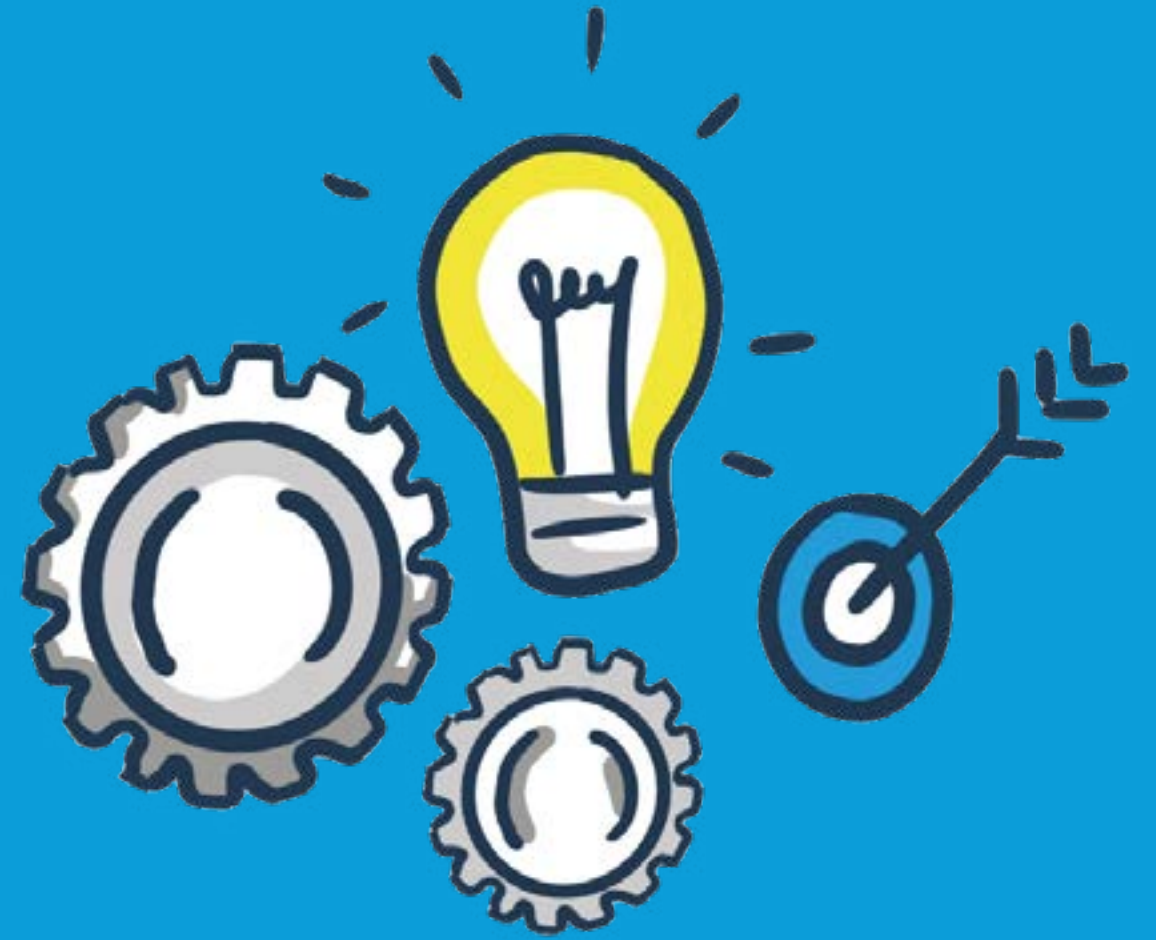
## Struggles

- **City stakeholders were concerned about the long-term impact of citizen engagement initiatives.** Many city stakeholders were often unsure about the impact of citizen engagement. In this experience citizens tend to become less engaged over the years and continuous engagement can be hard to achieve.
- **Conflicting stakeholder interests: Living Lab activities require close collaboration between stakeholders who may have differing interests and priorities.** The Living Lab teams experienced difficulties in finding common grounds amongst such diverse groups of stakeholders.
- **Lack of a community of activists and volunteers.** Living Labs need their own community of citizens who are eager to participate in co-creation and research projects actively. The diversity of participants should be ensured.
- **Low participation and drop-outs.** In some instances, the Living Labs experienced low participation numbers and difficulty in maintaining interest and motivation over a longer period when results and successes of the Living Lab activities were not visible directly.
- **Fishing in the same pond.** It was often the case that citizens with a very similar profile participated in the co-creation activities. More creative thinking is needed to engage different pools of citizens.

## Tips

- **Strengthening the relationship with city stakeholders.** Whether the relationship is just being formed or whether it's already solid, it's important to put a lot of effort into the relationship with city stakeholders. Explaining why involving them and their citizens in a Living Lab is important. Listening to their worries and concerns – building a trusting relationship and not over-promising what can be delivered. Showing what's in it for them and giving them something back in return for their support and involvement is key, as well as keeping them informed on a regular basis (e.g. once a month to inform them about any progress, however small it is, just to keep them engaged and in the loop).
- **Looking out for opportunities to collaborate with local initiatives, organisations and communities.** Living Labs require collaboration across disciplines and institutional boundaries. They also require skills and experience in bringing a great diversity of stakeholders together to work towards a common goal. The results, however, are well worth the investment in time and resources.
- **The most important outcome of the Living Lab activities might not be the innovative solution, but the increased awareness of the city stakeholders.** This refers to learning about their needs, considerations, constraints, concerns, language, and ideas that they have with respect to the challenge.
- **Not over-planning the Living Lab.** Being flexible in the design of the Living Lab and its individual events. The more flexible the activities are the more people can participate.
- **Ensuring the outreach and involvement of all those citizens that are already passionate about the topic of the Living Lab activity.** Making sure different ways to nurture their passions are considered (e.g. those less civically engaged or who rarely participate in public affairs).
- **Making it replicable.** Where possible the Living Lab intervention should be replicable across cities to allow for maximum impact. For example, the 'Wandering Trees' are a concept that is already tried and tested in another German city, so it is known what works and what can be improved.

# Resilient



# and Strategic

**“We recognise that cities and human settlements face unprecedented threats from unsustainable consumption and production patterns, (...) , pollution, natural and human-made disasters, and climate change and its related risks, undermining the efforts to (...) achieve sustainable development. Given cities’ (...) central role in the global economy, in the mitigation and adaptation efforts related to climate change, and in the use of resources and ecosystems, the way they are planned, financed, developed, built, governed and managed has a direct impact on sustainability and resilience well beyond urban boundaries.”\***

To be truly resilient, cities should work towards sustainability to ensure positive long-term impacts. In the same manner, being truly sustainable entails incorporating resilience to drive and protect development goals.

UN-Habitat understands **urban resilience** as “the measurable ability of any urban system, with its inhabitants, to maintain continuity through all shocks and stresses, while positively adapting and transforming toward sustainability” \*\*.

By engaging all stakeholders in resilience efforts, cities have the ability to harness transformational change and improve the lives of their inhabitants. This has been acknowledged by the global community through agreements such as the New Urban Agenda, Paris Agreement, Sustainable Development Goals, and Sendai Framework. However in almost all contexts, cities lack the capacity to operationalise these agreements alone and fully harness changes. One approach to addressing this is through holistic and multi-stakeholder resilience-building \*\*\*.

UN Habitat considers that being **transformative** and **strategic** are critical concepts for cities in building urban resilience.

**A transformative city** adopts a proactive, forward-looking attitude that turn challenges into opportunities for growth, by generating incremental and/or far-reaching, transformational changes. Many of the environmental problems such as urban air quality, climate change, environmental noise and continuous scarcity of resources (like water) are linked with **human behaviour**. However, the good news is that human behaviour can be changed/managed with the right strategies to reduce the negative impacts of environmental problems.

\* United Nations, “New Urban Agenda” Commitment no 63, 2017, <http://habitat3.org/wp-content/uploads/NUA-English.pdf> (accessed in November 2019).

\*\* UN Habitat, “City Resilience Profiling Tool”, 2018, <http://urbanresiliencehub.org/wp-content/uploads/2018/02/CRPT-Guide.pdf> (accessed in November 2019).

\*\*\* UN Habitat, “City Resilience Profiling Tool”, 2018, <http://urbanresiliencehub.org/wp-content/uploads/2018/02/CRPT-Guide.pdf> (accessed in November 2019).

**Change is painful, it implies facing habits, it meets with resistance, and it’s easier when everyone does it.**

Dr. BJ Fogg, founder of the Behavior Design Lab at Stanford University, explains behavioural change through three key elements\*:

- **Motivators: giving people reasons for behaving in a particular way.** Sensation, Anticipation, and Belonging. Each of these has two sides: pleasure/pain, hope/fear, acceptance/rejection.
- **Ability: making behaviour easier to do.** In order to perform a target behaviour, a person must have the ability to do so. By focusing on simplicity of the target behaviour ability is increased. Simplicity is a function of the scarcest resource at that moment. Thinking about time as a resource means that if there are only 10 minutes available, and the target behavior requires 10 minutes, then it’s not simple. Money is another resource. If there is no 1 € available, and the behaviour requires 1 €, then it’s not simple..
- **Prompts: telling people to “do it now!”** Prompts might seem simple on the surface, but they can be powerful in their simplicity (that’s the definition of elegance). An effective prompt for a small behaviour can lead people to perform harder behaviours.

### Winning Recipes for Behavioural Change:

- Helping people to do what they already want to do.
- Simplicity changes behaviour: make it easy to do.
- Triggering the right sequence of baby steps.
- Creating success momentum.
- Signpost emotions: joy and wonder, make it social.
- Making senses a central aspect of experience
- Highlighting beauty elements.

\* Based on BJ Fogg Behavioural Model, 2019. Accessible here: <https://www.behaviormodel.org/> (accessed in November 2019)



A resilient city is also **strategically planned**, focused and goal-oriented towards a shared vision. As cities grow rapidly and irreversibly, they are faced with resource and capacity constraints to manage the process of urbanisation. In general, strategic planning is a management tool that determines the direction in which an organisation is moving, and how it will get there. When applied to urban planning, this approach helps cities to respond to fast-moving events, to manage change and to improve the quality of life\*. Further, it is selective, focusing on a few priorities at a time, rather than comprehensive and all-encompassing.

Urban strategic planning seeks the answers to three fundamental questions :

- Where are we now? What is the present status, situation or condition of the city?
- Where do we want to go? Where would the city like to go or what direction it is taking?
- How do we get there? How would the city like to get there?

Urban Strategic Planning is different from the conventional urban planning approaches such as master plans or comprehensive development plans, in a number of ways. In essence, it is about cooperation at organisational, local and regional levels. It has the potential to mobilise resources and coordinate activities on a wide scale.

## READING CORNER

- **BREATHLIFE Campaign 2030** (2016), a partnership between the WHO, Climate & Clean Air Coalition, UN Environment and The World Bank. BreatheLife combines public health and climate change expertise with guidance on implementing solutions to air pollution in support of global development goals. The section on “Resources for Cities and Organisations” helps scoping and developing programs to reduce air pollution in urban areas.
- **Inclusive and Sustainable Urban Planning: A guide for municipalities. Vol 1** (2017) by UN Habitat. This series of publications has been developed by the UN-HABITAT’s Urban Planning and Management Programme (UPMP) to reflect the inclusive and strategic approach to planning, putting primary emphasis on the dynamic character of the planning process , engagement of stakeholders and the importance of the development of action plans and securing financial outlays for the implementation of selected priority projects.
- **City Resilience Profiling Tool** (2018) by UN Habitat. UN-Habitat developed the City Resilience Profiling Tool (CRPT) to be a robust and comprehensive approach for cities to build their resilience. This publication outlines the methodology and implementation steps of the City Resilience Profiling Tool and serves equally as an initial guide for cities to UN-Habitat’s methodology, but also an advocacy platform to inform stakeholders about the Tool’s approach.

\* UN Habitat, “Inclusive and Sustainable Urban Planning: A Guide for Municipalities”, 2007, <https://unhabitat.org/wp-content/uploads/2014/07/A-guide-for-Municipalities-Inclusive-and-Sustainable-Urban-Development-Planning-Volume-1.pdf> (accessed in November 2019).



## Our Strategy

The commitment of the iSCAPE cities to become more resilient and strategic went hand in hand with implementing **strategy-based behavioural change** and **strengthening the links with local authority**.

Travel behaviour and personal habits related to it are hard to influence, and often require strategic interventions to guide individual actions. Often hard interventions such as road pricing or regulating car use are required in order to guide individual actions as it is very challenging to change human behaviour such as travelling habits. Yet, informational strategies when coupled with hard interventions give more desirable and optimal changes in behaviour. Informational strategies are approaches to change perceptions, motivations, knowledge and norms, without modifying the external context in which decisions are made.

Behavioural change strategies are indeed effective to influence commuters' and more generally commuters' attitudes and actions in the iSCAPE cities. **Hasselt Living Lab** set up an effective informational strategies to promote pro-environmental, sustainable and healthy mobility behaviour. Mobile application and web based tools used to generate tailored feedback, the Hasselt's strategy achieved successful results in transforming the travel habits of citizens to be healthy, sustainable, and environmentally-friendly.

On the other hand, **Vantaa Living Lab** strengthened their working relationships with the municipality to define the future path of the Living Lab and Vantaa as a city. This involved building solid relationships with the city of Vantaa and becoming a trusted advisor to ultimately have an impact policy change. The modelling work done by the Living Lab for the city of Vantaa during the iSCAPE project gave an excellent new understanding of the capabilities of high-detail climate simulations at a street level. This provided Vantaa Living Lab and the Finnish Meteorological Institute (FMI) – the Living Lab's host organisation – with great opportunities to take the next step and apply the simulation tools to forth-coming projects, especially those that research the role of GI in the adaptation to climate change in Finnish cities. Once the cooperation was successfully established with the city of Vantaa, FMI paved the path to provide further support and work closely with the city in the future.



# HASSELT

Encouraging  
pro-environmental and  
healthy travel behaviour  
through informational-  
based behavioural  
interventions

Size:

**SMALL URBAN  
AREA**

Urban Model:

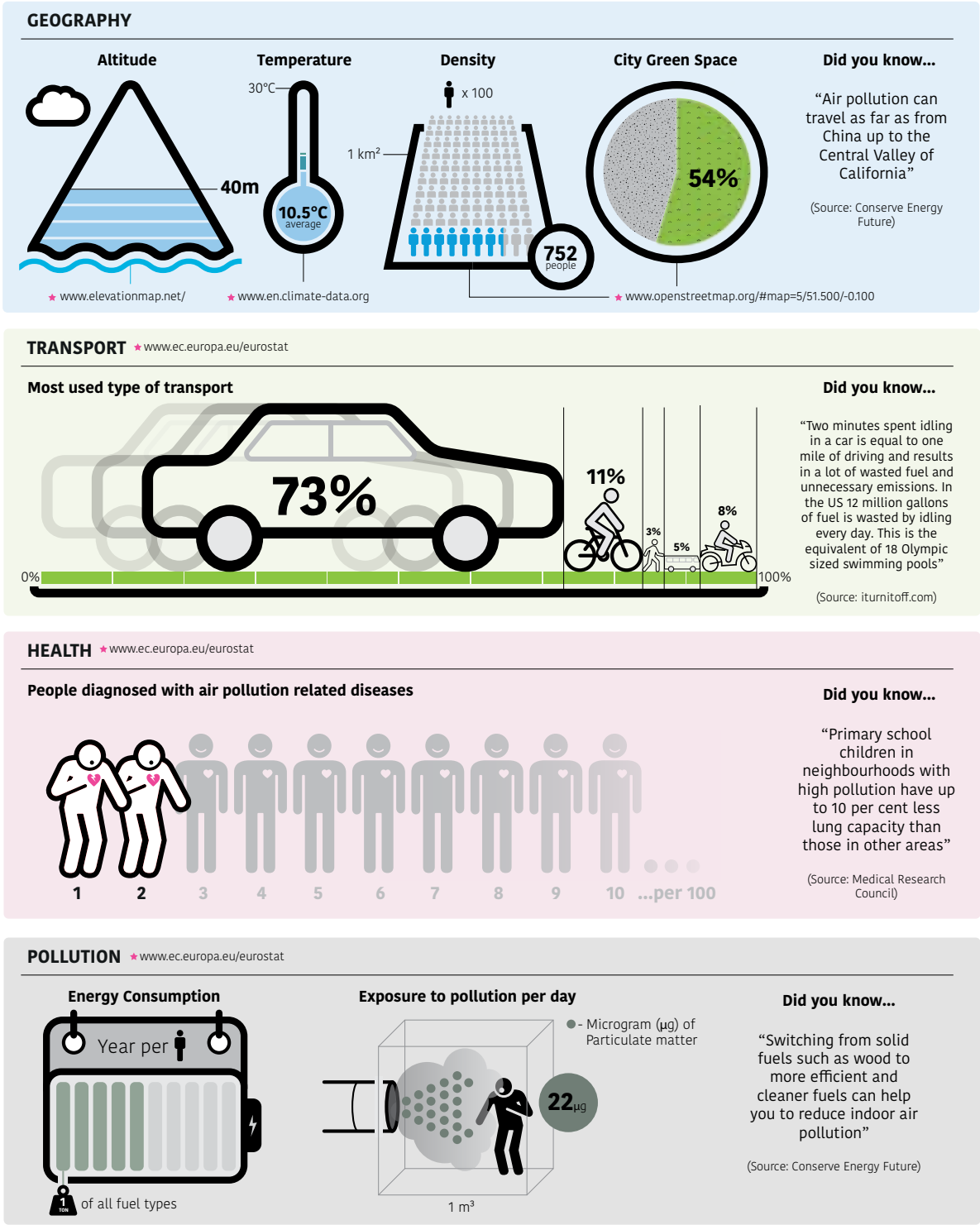
**DECENTRALISED CITY**

Location:

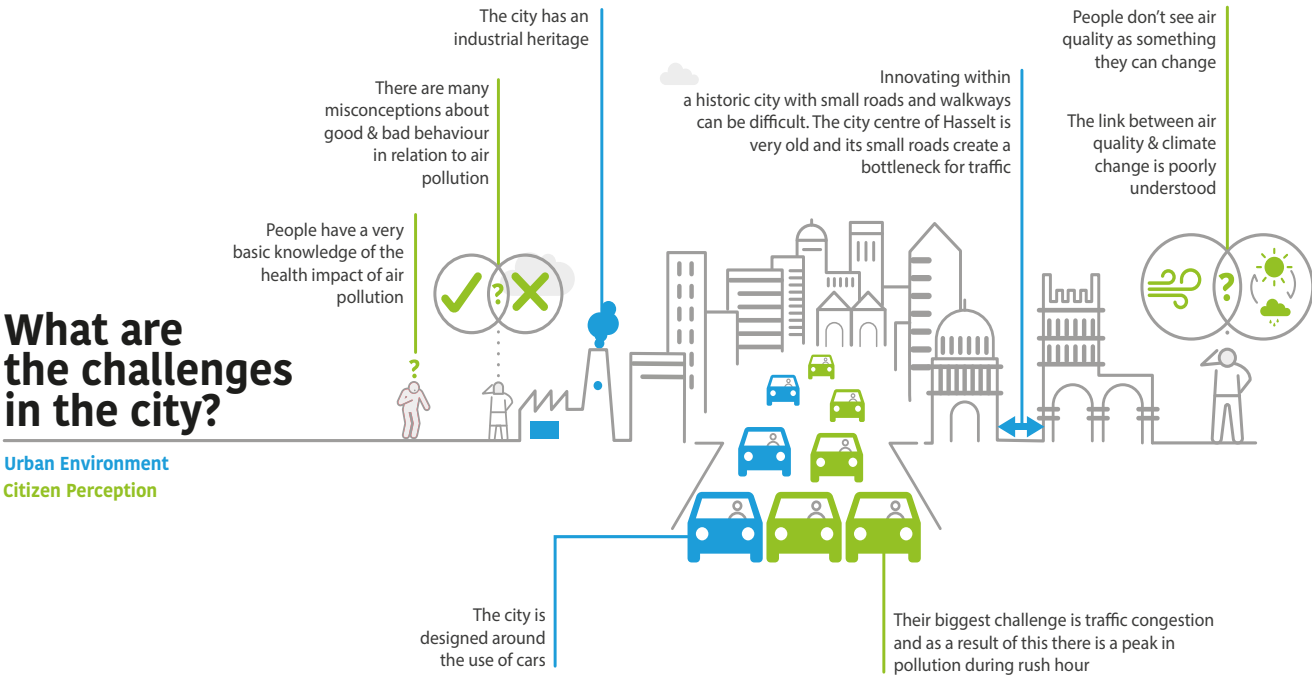
**NORTH-EAST  
BELGIUM**



City Facts\*



The Urban Challenges



\* Data sources can be found in the “Challenges and Opportunities in the iSCAPE Cities” report, 2017, available here: [https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted\\_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf](https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf) (accessed in November 2019).

# The Living Lab Journey

Hasselt Living Lab, hosted by University of Hasselt (UH), had the mission to develop tools and solutions to cater mobility issues by involving citizens and city authorities. The Living Lab aimed to encourage pro-environmental behaviour among city residents by designing informational strategy-based behavioural interventions. A particular focus was to influence travel behaviour by recording individual activity travel patterns. By showing citizens the consequences of their travel behaviour (air pollution effect) with a behavioural intervention tool it was possible to help them in adopting environmentally-friendly and healthy (good air quality) travel choices.

## The Intervention

To promote and encourage pro-environmental travel behaviour, Hasselt Living Lab set up an **informational based behavioural intervention** by recruiting Hasselt citizens. Individual activity travel diaries from participants were captured using a smartphone and web based application. All the communication with the individuals were managed remotely. To influence travel behaviour, individuals were provided with tailored feedback in following aspects:

- **Exposure to air pollutants based on recording their detailed activity-travel routine.**
- **Contribution in GHG emission (based on their car use).**
- **Extent of contribution to physical activity (based on walking and bicycle use).**

The results of the intervention were promising. Based on the records of the travel patterns, there was significant potential for the transition to a more sustainable travel/ activity alternative. The results showed that 40 per cent of the participants were willing to change their mobility behaviour based on the understanding of the suggestions given in the customised information intervention. For quantitative assessment, statistical analysis of the pre and post-intervention travel behaviour was done for the control and treatment group. Reduction in car use for short trips (under 3 km), was observed which in turn caused a significant increase in the use of active travel modes.

Hasselt Living Lab conducted another air quality based Behavioural Intervention study to encourage healthy and active school travel behaviour. The goal of this study was to reduce the pollutant exposure while active school commuting for children. Individual school daily information was collected via a smartphone application Route2School (R2S)\* that was developed by Transportation Research Institute (IMOB) at UH.

The main idea of using this application was to provide a user friendly digital platform where individuals could easily record their school route. The user was asked about the origin (home) and destination (school) with mode used to perform that trip. Based on this input, the most suitable route was automatically displayed on the Graphical User Interface (GUI) of Google Maps which could be adjusted\* if required.

Based on their recorded school travel behaviour, a ‘Customised Information Package’ was provided for every participant containing:

- Exposure to air pollutants based on recording their school routes
- Exposure to air pollutants based on suggested walking/cycling school routes
- The extent to contribute in physical activity (based on suggested walking/cycling routes).
- Suggestions to organise more environmentally-friendly travel options.

By involving citizens and studying their activity-travel behaviour, the Lab aimed at assessing the efficacy of such mobility-based interventions in promoting pro- environmental behaviour. This approach also helped citizens to be more active and healthier while improving the air pollution in the city by adopting active travel choices (walk/choices).



\* Ahmed, S., Adnan, M., Janssens, D., & Wets, G., "Air Quality Based Informational Intervention Framework To Promote Healthy And Active School Travel", Procedia Computer Science, 2018.

\* <https://www.route2school.be/?lang=en> (accessed in November 2019)



## The Activities

In autumn 2018, the Living Lab organised a series of co-creation workshops where the primary audience were parents who drove their children to school daily. Other important collaborators included representatives from the Flemish Environmental Agency, VITO (Flemish Institute for Technological Research) and IMOB who provided relevant data to design the intervention, especially pollutant concentration data at street level. Participants considered the informational intervention and made suggestions about how to improve the overall study design.

The ideas generated during the co-creation activities helped improve the 'Customised Information Package' provided to school children and their parents, which in turn helped them making healthy behavioural changes and in choosing how they undertake that journey. The Intervention Package was organised as follows:

- **Contextual information with infographics to increase awareness related to air quality and pollutant exposure impacts, which is easy to understand and digest.**
- **Customised Feedback regarding a quantitative measure of current and alternative school travel choices with description of their impacts in terms of pollutant exposure.**
- **Description of the personal benefits achieved in terms of reduction in pollutant exposure level by adopting alternative route.**
  - **A study was conducted from January to February 2019, producing the following results: 34% of the participants have used alternative routes with significant reduction in exposure as compared to their current routes.**
  - **This potential route shift can significantly help to avoid health risks associated with high NO2 concentrations.**
- **It can be concluded that these kids and escorting parents can reduce the risks associated with exposure to high NO2 concentrations by adopting the alternative routes.**
- **Based on the feedback we can say that this intervention can significantly promote school commuting focusing on least pollutant exposed routes**





# VANTAA

## Participatory City Planning



Size:

**MEDIUM-SIZED  
URBAN  
AREA**

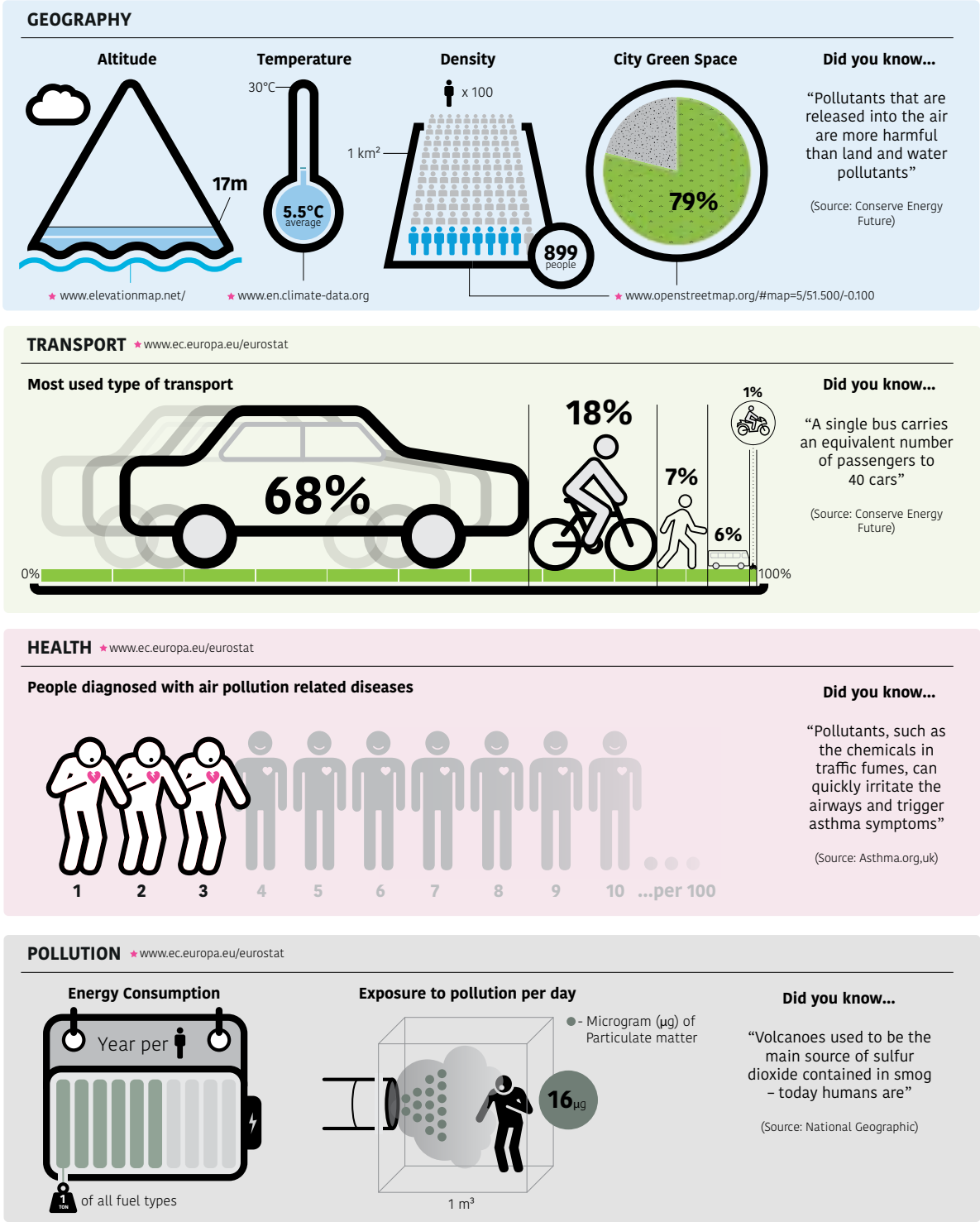
Urban Model:

**DECENTRALISED CITY**

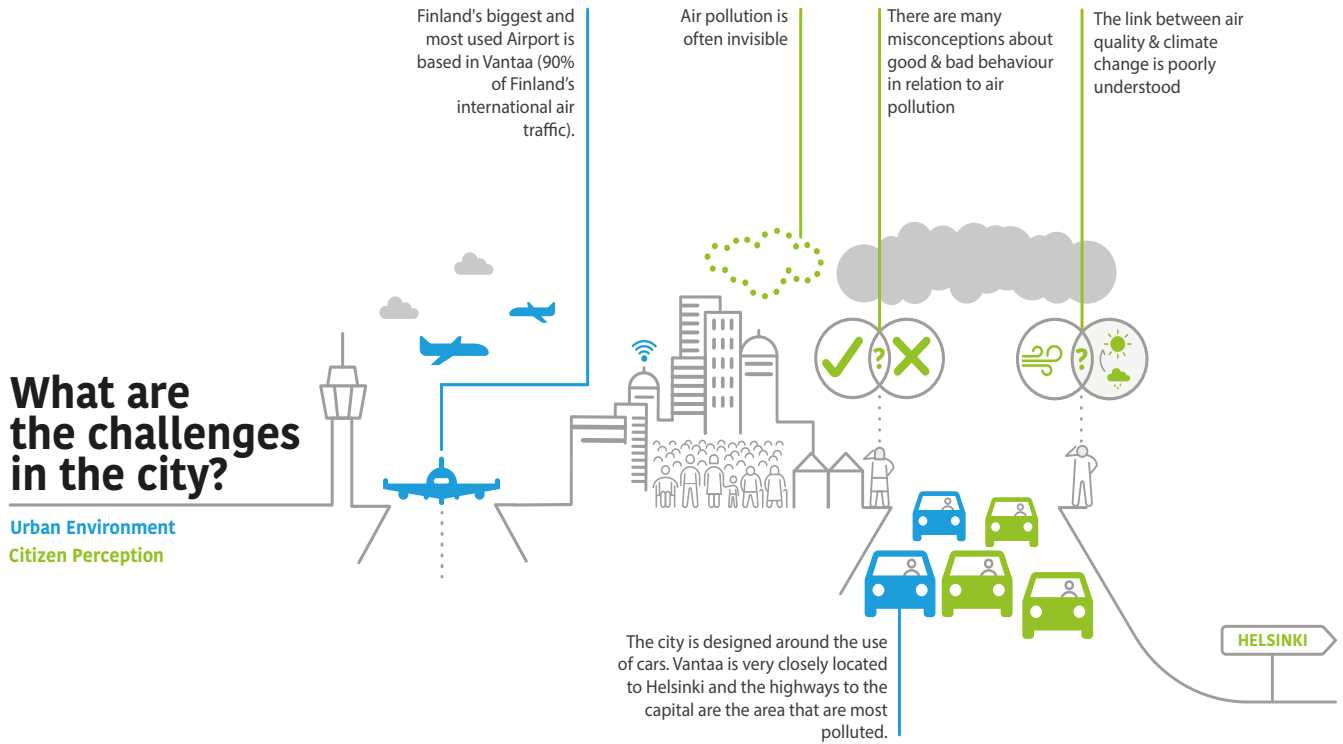
Location:

**SOUTH  
FINLAND**

City Facts\*



The Urban Challenges



\* Data sources can be found in the "Challenges and Opportunities in the iSCAPE Cities" report, 2017, available here: [https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted\\_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf](https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf) (accessed in November 2019).



# The Living Lab Journey

**Vantaa Living Lab, hosted by the FMI, aimed to enhance the knowledge on the connection between air pollution and city planning. The Living Lab focused on assessing the impact of GIs such as green roof, green wall and parks, on air quality, urban climate and human well-being. In Vantaa they believed that awareness about impacts and benefits of GI of both citizens and city stakeholders could be increased by providing evidence-based data.**

## The Intervention

Vantaa Living Lab provided environmental data – solar radiation, wind, air temperature and humidity – as an input for modelling with socioeconomic data. The impact of trees and green roofs on air quality was first modeled with ENVI-met software in building block scale, and the results were then upscaled to city level for informing the socio-economic impact assessment.

The area MyyrmäkiVaskivuorentie was chosen out of three areas suggested by the Vantaa city authorities. The reason why this area was chosen was that it lies in an area which achieved a mature stage of development. The modelled area lies in the centre of housing development district of the earlier 1970s within the westerly part of Vantaa.

The measurements included 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.



## The Activities

The relationship between the Living Lab and the city of Vantaa was positive and strengthened during the iSCAPE project. The municipality recognised the FMI as expert institute in climate and air quality related topics and observations. Before iSCAPE there was limited direct interaction between the municipality and FMI, though they have been working indirectly with each other for many years via the Helsinki Region Environmental Services (HSY), a joint organisation consisting of the Helsinki-region large cities (Helsinki, Espoo, Vantaa) working on air quality monitoring, wastewater collection and treatment, and refuse.

The relationship between the Living Lab and the municipality blossomed in Autumn 2018 during a workshop organised by the Vantaa Living Lab with city of Vantaa representatives. The workshop produced several impacts, in particular in relation to policy change. While the new Masterplan for the city of Vantaa for 2020 was still in a drafting stage at the time of the workshop, the socio-economic impact assessments were already taking place. In this context, the workshop represented a key opportunity to incorporate the air quality and climate change simulations into the Masterplan. This is where the Living Lab started their simulations for the municipality.

Overall, the workshop proved to be very valuable. The city of Vantaa gained a better understanding of the potential role of climate simulation and modelling into urban planning. As the municipality had not considered yet the use of these climate simulation and models, the workshop represented an important point to promote a short- and long-term collaboration with the Living Lab.

During the city meeting, the Living Lab shared climate change projections for Vantaa with the Masterplanning team. The Lab presented the high-resolution simulation (500x500m) using the SURFEX model. These simulations were used for understanding, for example, the present effect of the heat island in southern Finland and Vantaa, as well as how this could look in the future and the impact that GI could provide. Simulation results were provided for the Vantaa centre grid square. Vantaa Living Lab chose a realistic model e.g. 20% increase in GI. The Living Lab described the model and how this could look.

Ultimately, despite the Vantaa Living Lab had previous engagements with the municipality that did not prove to be so fruitful, the Living Lab sought for the opportunity to demonstrate the city of Vantaa the potential and value of their work to the Vantaa Masterplan through evidence-based data. In the future, this can also bring to the development and availability of more accurate climate data for the city of Vantaa, to be integrated into planning and to provide cleaner air in some areas.



# Struggles and Tips

## Struggles

- **Providing ‘average user’ data may discourage behaviour change.** In Hasselt Living Lab, part of the intervention included providing participants with a report on their daily behaviour in order to encourage behaviour change. In some cases this may discourage behaviour change if a participant see that they are performing better than average and see no reason to change.
- **The overall effectiveness of the informational interventions considerably depended on how information is organised and presented.** The mere showcasing of environmental or health benefits may not ensure long lasting transformative impacts.
- **The municipality provided no initial direction.** Vantaa Living Lab had only high-level contacts with the Municipality of Vantaa at the beginning of the iSCAPE project. Effort has been expended in finding the right people at the operating level (e.g., city planners) to build the relationship.
- **Small pool of local stakeholders.** The city of Hasselt is small, which resulted in relationships with only a reduced group of stakeholders.

## Tips

- **Making the Living Lab interventions more meaningful to people’s everyday lives.** Engaging with people on an emotional level and connecting with topics that people care about is key. But also, the effect of the intervention has to be visible to people, by bringing interventions closer to people and embedding them in local communities. In this way, people can connect to the interventions on a deeper level and foster a sense of ownership.
- **Focusing not only on awareness campaigns but also on strategies where particular behaviour can be mapped before and after, providing the information in a specific context.** This can be done by emphasising the approaches where consequences of a specific behaviour can be recorded and compared with a baseline – i.e. how are participants changing their behaviour compared to their normal routine?
- **Simplifying tasks for the participants wherever possible.** For example, where informational material were too much detailed and contained too many hypothetical scenarios the facilitators felt that groups may have been better able to focus on specific suggestions if the information sheet had been more concise.
- **Engaging of policy makers.** In a small cities like Hasselt, it may be easier to reach higher levels within the city authority and policy makers. In Hasselt, there was already a long-term political interest and people were very concerned about the air pollution issue in the city. Some stakeholders had already approached the Living Lab (for example, the Flanders environmental agency) as they were interested in the engagement activities with citizens that the Living Lab was undertaking.
- **Building interest, affect planning and change behaviour.** The results obtained in Vantaa can now be used and exploited widely through dissemination opportunities for many different groups and organisations. This dissemination will build interest around the topics of air pollution and air quality, and may activate behavioural change. The results can then also be used by municipalities to better inform urban planning.
- **Exploring a collaboration with the municipality.** Once the municipality of Vantaa realised the potential benefits of the modelling capacity of the Living Lab, this opened the door to more municipality related projects, which in turn could be adopted at the Helsinki city level.

# Aware and



# Healthy

**“We commit ourselves to supporting moving from reactive to more proactive risk-based, all- hazards and all-of-society approaches, such as raising public awareness of risks (...).”\***

**“We commit ourselves to fostering healthy societies by promoting access to adequate, inclusive and quality public services, a clean environment, taking into consideration air quality guidelines, including those elaborated by the World Health Organisation.”\*\***

According to the World Health Organisation a **healthy city** is not one that has achieved a particular health status\*\*\* but one that is conscious of health and striving to improve it. Thus any city can be a healthy city, regardless of its current health status . Becoming a healthy city means putting health among the first goals on the urban agenda, both at the public and political level, to build a strong local movement for public health. Increased public awareness about health impacts is therefore essential for improving social acceptance of and support for air quality management measures.

Cities need to take a wide range of actions to increase public understanding about air pollution, its causes, effects, and how concentrations vary both spatially and from day to day. **Public awareness** is important to increase enthusiasm, to support and stimulate self-mobilisation and action, to mobilise local knowledge and resources. Provided with the right information, people can take steps to avoid high levels of air pollution to reduce the impact on their health\*\*\*\*.

Studies on the provision of air pollution data have found that people feel powerless if presented with information that is not accompanied by advice on tangible steps they can take to protect themselves\*\*\*\*. Raising political awareness is also important as policy makers and politicians are key actors in driving policy action that brings benefits for health, climate and the environment.

\* United Nations, “New Urban Agenda”Commitment no 78, 2017, <http://habitat3.org/wp-content/uploads/NUA-English.pdf> (accessed in November 2019).

\*\* United Nations, “New Urban Agenda”Commitment no 55, 2017, <http://habitat3.org/wp-content/uploads/NUA-English.pdf> (accessed in November 2019).

\*\*\* WHO European Healthy Cities Network, “What is a Healthy City?”, 2019, <http://www.euro.who.int/en/health-topics/environment-and-health/urban-health/who-european-healthy-cities-network/what-is-a-healthy-city> (accessed in November 2019).

\*\*\*\* City of London, “City of London Air Quality Strategy: Delivering Healthy Air in the City of London”, 2019, <https://www.cityoflondon.gov.uk/business/environmental-health/environmental-protection/air-quality/Documents/City-of-London-Air-Quality-Strategy-2019-2024.pdf> (accessed in November 2019).

\*\*\*\*\* Robertson, R, “Using Information to Promote Healthy Behaviours”, King’s Fund report, 2008, [https://www.kingsfund.org.uk/sites/default/files/field/field\\_document/information-promote-healthy-behaviours-kicking-bad-habits-supporting-paper-ruth-robertson.pdf](https://www.kingsfund.org.uk/sites/default/files/field/field_document/information-promote-healthy-behaviours-kicking-bad-habits-supporting-paper-ruth-robertson.pdf) (accessed in November 2019).

## Winning Recipes for Awareness-raising

- **Identifying the target audience.** Information needs to be tailored to the target audience to capture their attention by thinking about who to attract to the research or event. An awareness-raising campaign is better planned when it doesn’t cater for everyone, but for specific groups of people, e.g. children, elderly etc. Before communicating concerns it is important to have a strategy in place and identify whom to direct the message to.



- **Making the local link.** Residents, journalists and decision-makers are more likely to hear a message when it is linked to their life and surroundings. Collecting information on how healthy or unhealthy people are in the city and including it in the communications\*.

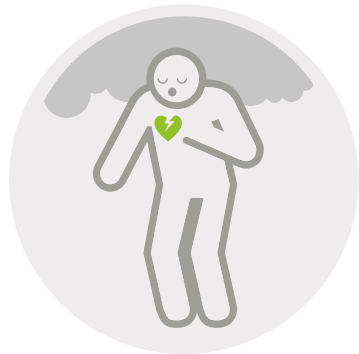
- **Finding allies and messengers.** Together we are much more powerful than by ourselves. Consistent messaging should be promoted by multiple sources, over time and in different places frequented by the target audience. Looking for doctors and health experts in the city who can help with interpreting the data and are also available to speak in public can be key. School principals, parents, or environmental groups are also likely to give support in disseminating the information and message on air quality and health\*.
- **Using simple, clear language.** Scientific studies are hard to understand for the average citizen who doesn’t have a health background. Trying to reword the evidence in a language that is easily understood by everybody tends to be more effective\*.



- **Making it visual.** A clear visual language is key to make complex topics more engaging. Visuals often speak louder than words. Besides using still photos, maps or infographics videos or films can also be used to explain scientific evidence of air pollution on human health in a citizen friendly way. When data and concepts are made interactive, people can use them in their own way. Live simulation of data tend to make changes clearer to people.

\* Urban Agenda for the EU, “Communicating on air quality and health: Inspiring practices, challenges and tips”, 2017, [https://ec.europa.eu/futurium/en/system/files/ged/181008\\_final\\_toolkit\\_on\\_communicating\\_on\\_air\\_quality\\_and\\_health\\_heal.pdf](https://ec.europa.eu/futurium/en/system/files/ged/181008_final_toolkit_on_communicating_on_air_quality_and_health_heal.pdf) (accessed in November 2019).

- **Being positive.** Positive messaging about the benefits to be reaped from behaviour changes (such as walking to school via residential streets) are likely to be more effective in fostering real change, than risk-focused messaging around the health impacts of undesirable behaviours (such as driving to school or engine idling outside the school gates).



- **Making it personal.** Helping people understand how air pollution is likely to affect them personally, and how they can have an impact on air quality in everyday ways. Giving people ownership of these issues and what they can do to help is key.
- **Adopting a multi-sensory approach.** Air pollution is multi-sensory by nature, although it is often not visible people talk about smelling it, tasting it or feeling it in the air. Incorporating a multi-sensory element into an awareness-raising strategy will make it more effective.
- **Being aware of uncertainties in the evidence.** Air pollution is one of the most researched topics in environmental health, and there is no doubt that polluted air impacts our health in many ways. Yet when it comes to having data about health impacts at the local level, gaps exist. When communicating on a certain study or health problem awareness of the limitations of the evidence is important. However, data gaps can also be an opportunity to demand more epidemiological studies and transparency in health statistics.



- **Looking for good practice.** City authorities across Europe are communicating on air quality and health, and some inspiring examples about their activities and impacts are included in the Living Lab cases of this guidebook. Spreading the word about what others are doing is a sign of shared understanding and helps in making a case\*.

\* Urban Agenda for the EU, “Communicating on air quality and health: Inspiring practices, challenges and tips”, 2017, [https://ec.europa.eu/futurium/en/system/files/ged/181008\\_final\\_toolkit\\_on\\_communicating\\_on\\_air\\_quality\\_and\\_health\\_heal.pdf](https://ec.europa.eu/futurium/en/system/files/ged/181008_final_toolkit_on_communicating_on_air_quality_and_health_heal.pdf) (accessed in November 2019).

## READING CORNER

- **Health as the Pulse of the New Urban Agenda** (2016) by WHO. This report considers how to integrate health into urban planning, investments, and policy decisions, so as to support the implementation and achievement of the goals and objectives of the New Urban Agenda.
- **Planting Healthy Air. A Global Analysis of the Role of Urban Trees in addressing Particulate Matter Pollution and Extreme Heat** (2016) by The Nature Conservancy. In this The Nature Conservancy – in coordination with C40 Cities Climate Leadership Group – has tried to understand whether nature can play a role in helping to solve the twin challenges of air pollution and extreme heat.
- **Communicating on Air Quality and health: Inspiring Practices, Challenges and Tips** (2017). Urban Agenda for the EU. Air Quality Partnership. This toolkit is a product of the EU urban air quality partnership, as part of the implementation of action 5 of the partnership’s action plan of 2017. The toolkit provides hands-on examples of how communication on air quality, the health links and (policy and behavioural) changes takes place, as an inspiration particularly for urban authorities wanting to communicate on clean air. The authors of the toolkit and the Partnership do not intend to provide a comprehensive and representative assessment on communication activities across the European Union.





## Our Strategy

Greening cities for healthier urban living is considered to be a priority in many cities worldwide, but guidelines for the deployment of GI in urban areas still remain unclear for the general public, urban planners, and other stakeholders.

Observed benefits of GI include: modifications of dispersion patterns, reduction of the average pollutant distribution and of pollutant hotspots in street canyons, reduced human exposure to pollution, and better urban thermal comfort and wellbeing. The many positive aspects of GI, such as trees and hedges, for public health are evident, although a bit challenging to assess and quantify. Appropriately designed and managed, a wider availability of green areas, alongside urban parks for the general public can imply a reduction in the mortality/morbidity rates of the population living in cities. Trees and hedges, in particular, can act as a barrier between pedestrians and traffic emissions, with benefits not only in street canyons, but also in open-road and city environments.

In iSCAPE the strategy focused on **increasing environmental awareness on the benefits that GI can provide for the public both in terms of health and the urban environment.**

**Bologna Living Lab** was already fairly well-known in the scientific community for their expertise in various air pollution and climate change topics. Through the awareness-building and co-creation activities implemented during the iSCAPE project, the Living Lab has developed key communication skills to disseminate their scientific findings by using tailored approaches to reach non-technical audiences.

In **Guildford Living Lab**, important GI interventions were run across the city and its neighbouring areas to reduce air pollution and as evidence-based communication and awareness-building campaigns across a great diversity of stakeholder groups, including students, community members, and policymakers. Based on this experience, the Living Lab now aims to engage with an even larger range of people from different backgrounds and administrative levels. Such activities would help in attracting interest from influential user groups, which in return would lead to a dialogue with legislators and policymakers to advocate for the use of GI at the local and national level for air pollution mitigation policies.



# BOLOGNA

Raising citizens' awareness on green infrastructure impact

Size:

**METROPOLITAN  
AREA**

Urban Model:

**COMPACT CITY**

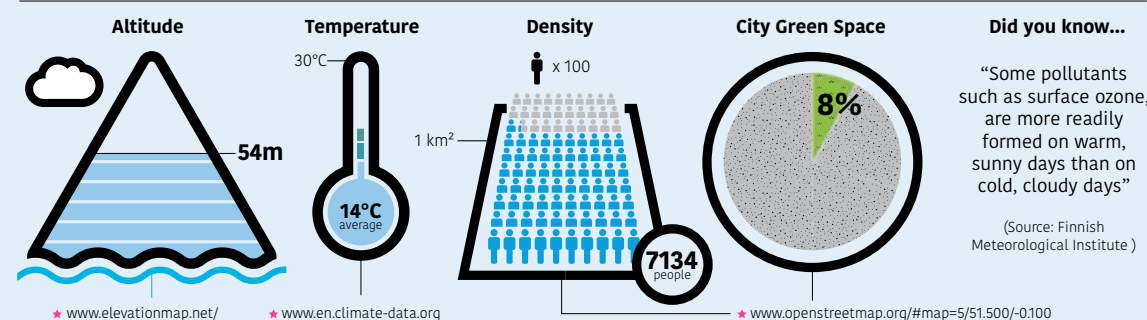
Location:

**NORTHERN  
ITALY**

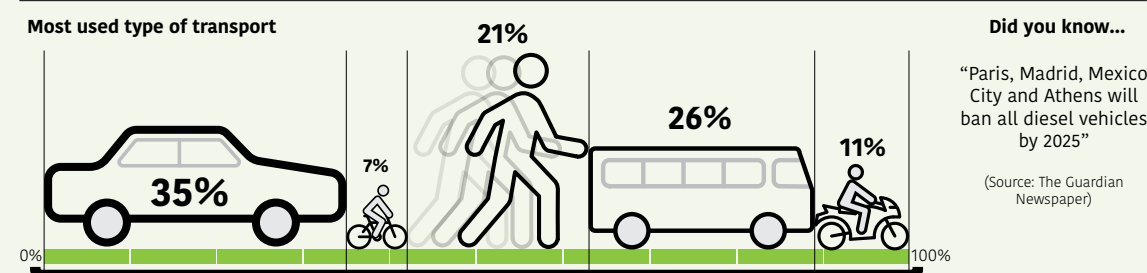


## City Facts\*

### GEOGRAPHY



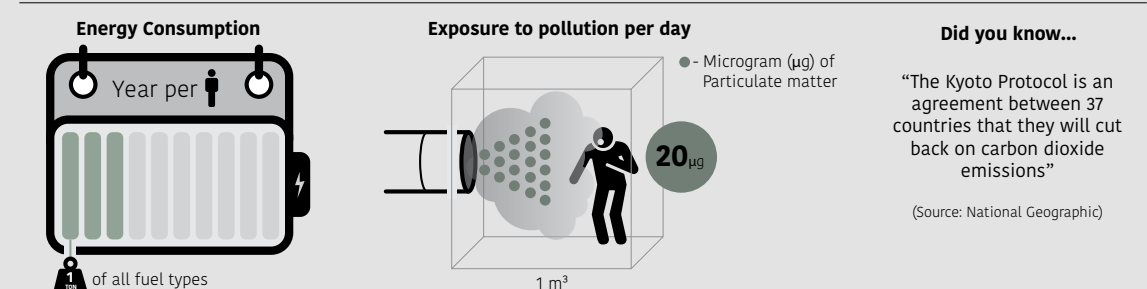
### TRANSPORT



### HEALTH



### POLLUTION



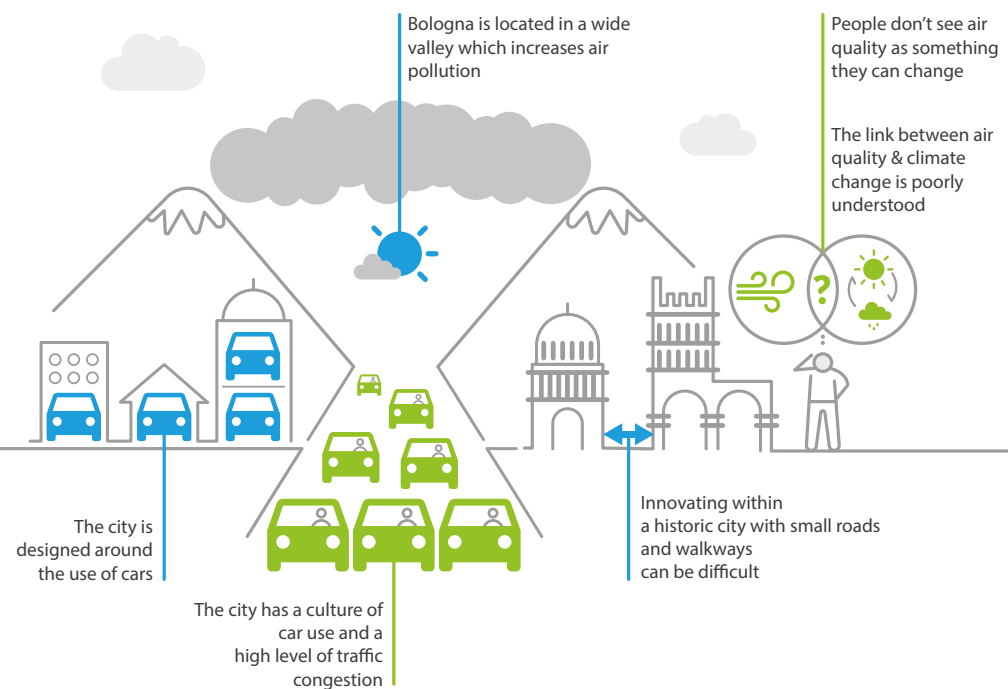
\* Data sources can be found in the “Challenges and Opportunities in the iSCAPE Cities” report, 2017, available here: [https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted\\_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf](https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf) (accessed in November 2019).



## The Urban Challenges

### What are the challenges in the city?

Urban Environment  
Citizen Perception



## The Living Lab Journey

Bologna Living Lab, hosted by the University of Bologna (UNIBO), aimed at raising awareness about GI as one of the methods to mitigate air pollution and climate change. To do this, besides two experimental field campaigns and an extensive range of high-resolution simulations at neighbourhood level and city scale, the Lab had collaborated with citizens, students, and other local associations such as the Urban Centre Foundation (Municipality of Bologna), Terracini in Transizione (an existing Living Lab initiative from the University of Bologna) and Aria Pesa (a network of citizens) for awareness campaigns.

### The Intervention

Bologna Living Lab delivered interventions with local stakeholders to measure the influence of trees in the urban environment, by studying two neighbourhood areas around two **street canyons**. There were characterised by similar geographic orientation and traffic volumes, but different presence of vegetation, i.e. one without trees (Marconi street canyon) and one with trees (Laura Bassi street canyon). The two canyons were similarly instrumented with high-resolution equipment to monitor both air pollution and meteorological and turbulence variables in and above the canyon, with twofold aims: on the one hand, the data obtained were used to validate the model simulations conducted at urban and neighbourhood level, while on the other hand analysis of data collected served to investigate the role of trees on ventilation, and thus on air quality, and urban thermal comfort in urban street canyons.





After simulation and detailed evaluation analysis of the data collected within the experimental field campaigns, the results showed that planting trees within street canyons like Marconi street – characterised by aspect ratio greater than 1 and traffic intersections – would change the mixing and the local concentration levels within the street, giving more uniform distribution and lower levels of pollutant concentration peaks close to the pollutant hotspots and tending to reduce the pollutant concentrations over the whole section of the street canyon. In addition, the insertion of trees in urban street canyons is effective in improving urban thermal comfort, reducing air temperatures in the street canyon and in the neighbourhood area.

## The Activities

Several citizen engagement activities were planned to inform and educate citizens about air quality. They included the sharing real time data about air pollution in these streets and organising informative pop-up events. These events were planned prior to, during and after the experimental campaigns.

One of the key activities conducted by Bologna Living Lab was the event “**Let’s Plan The Green Together!**”, held in Winter 2018. In this event, students and local communities were invited to share their thoughts and ideas on how trees could improve well-being in Bologna. The activity focused on exploring with citizens how to make a plan for tree-planting in Bologna in four areas of the city: via Marconi, via Laura Bassi, via Zamboni and via del Lazzaretto. Each of these areas presented diversity in terms of air quality, tree availability, as well as car traffic flows. Based on the existing scientific knowledge about the role of trees in improving urban air quality, the participants were divided into four groups to develop and discuss a tree planting plan for different areas in Bologna. Then, each group was invited to present the plan and to discuss challenges and opportunities about the decision-making of the plan and its implementation.

Another key activity for Bologna Living Lab took place in Spring 2018, as part of the **2018 Climate Day** (La Giornata del Clima 2018). The Lab participated in a local dissemination event with high school students. Scientists and City Hall officials presented research and urban policies for tackling global warming and its effects. The event introduced high schoolers to different ways of protecting the environment and the idea that their choices and voices are important as they become part of the labour market, drive political choices, and influence economic development.

Similarly, in Winter 2018, the Living Lab organised an event with the local community to share their ideas on how trees could improve well-being in Bologna. It was important to develop a clear understanding of the right balance of ‘green’ for a city like Bologna, which meant to reply to questions such as:

- How could plants be introduced to the city?
- What benefits might the city expect from trees?
- What does ‘co-creation’ mean?
- What help might science be able to offer?
- How can reasoning, priorities and language be clarified in order to make the best decisions?

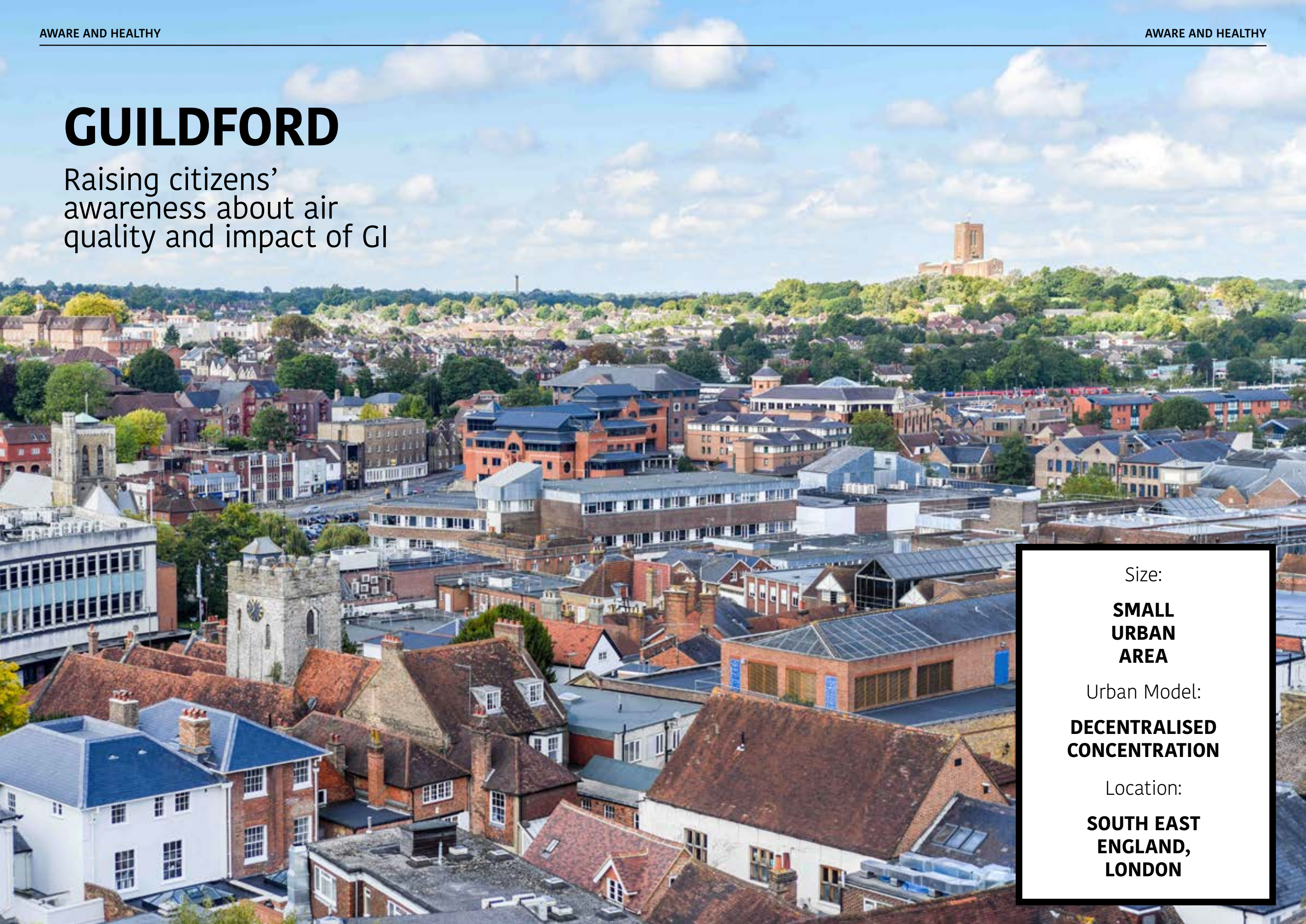
Participants realised that they can drive changes in their city and they can do so in an enjoyable, social setting with their fellow citizens. Creating three-dimensional trees for the map also helped in clarifying the feasibility of some of the interventions.

Thanks to the several the dissemination activities and events, as well as their scientific publications implemented throughout the iSCAPE project, Bologna Living Lab has achieved great visibility both at national and international levels in the topic of GI for air pollution mitigation. Their strategic goal now is to become a reference point for local stakeholders.



# GUILDFORD

Raising citizens' awareness about air quality and impact of GI



Size:

**SMALL  
URBAN  
AREA**

Urban Model:

**DECENTRALISED  
CONCENTRATION**

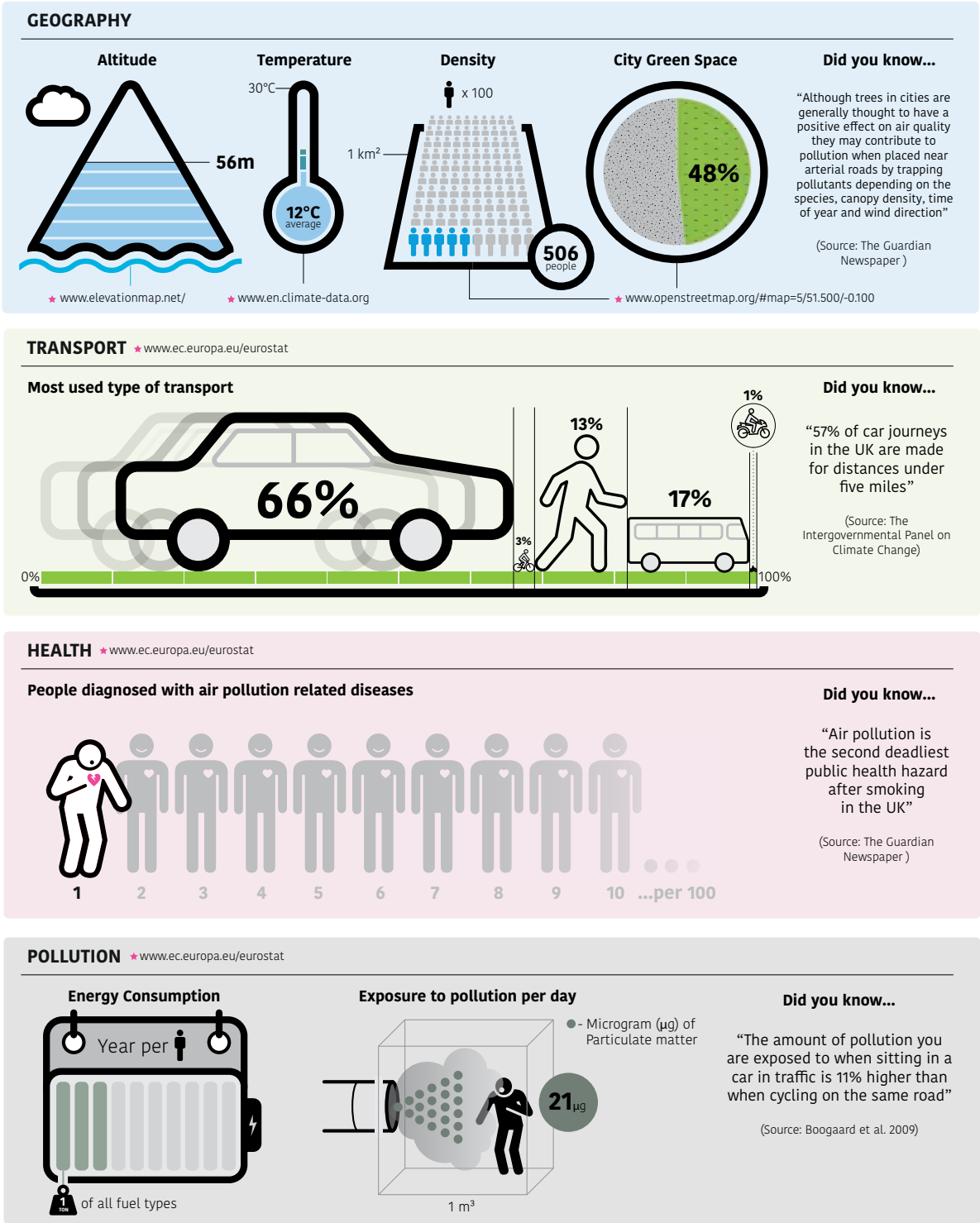
Location:

**SOUTH EAST  
ENGLAND,  
LONDON**



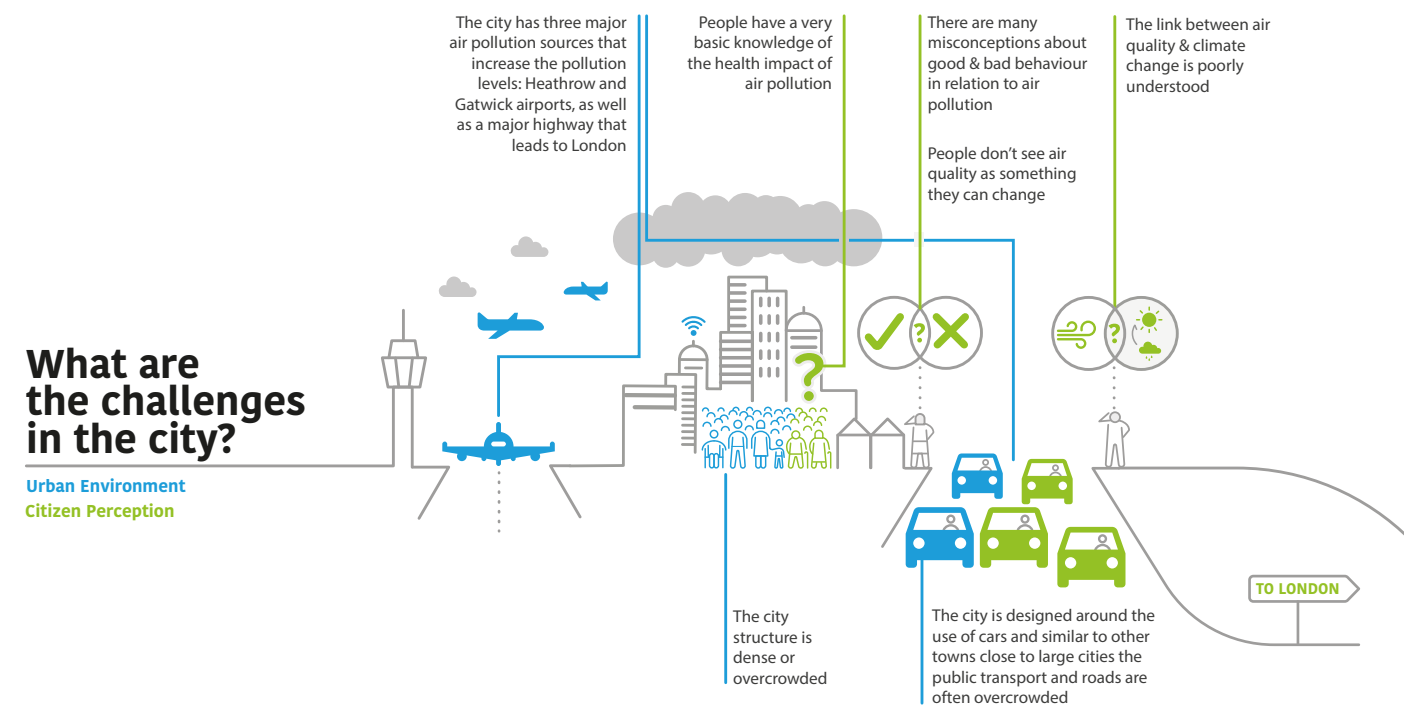


# City Facts\*



\* Data sources can be found in the “Challenges and Opportunities in the iSCAPE Cities” report, 2017, available here: [https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted\\_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf](https://www.iscapeproject.eu/wp-content/uploads/2018/10/Resubmitted_D1.1-Report-on-Challenges-and-Opportunities-in-iSCAPE-Cities.pdf) (accessed in November 2019).

# The Urban Challenges



# The Living Lab Journey

Guildford Living Lab raised awareness about air pollution and how GI can be used to reduce concentrations of air pollutants. The Lab developed a set format to maximise engagement at events: a talk, tools, leaflets, merchandise, and an interactive stand where people can answer questions about their daily routines and learn ways to reduce their contribution and personal exposure to air pollution. The hope is to provide a new method for awareness-raising. The Global Centre for Clean Air Research (GCARE) manages the Living Lab in close partnership with the administration at the University of Surrey (UoS).

## The Intervention

The Living Lab research focused on trees and hedges near busy roads as a promising means of reducing the exposure of urban dwellers to air pollution. The Lab developed an **interactive air quality quiz** in collaboration with Future Cities Catapult, UK, and the Institute of Advanced Architecture of Catalonia, Spain, to allow users to assess and understand their qualitative level of air pollution exposure by answering a number of simple questions.

The interactive air quality quiz was designed to spread awareness about combating air pollution, and was intended to be playful, informative, interactive, portable, and possible to display indoors and outdoors. The air quality quiz can be played online <https://quiz.iscape.smartcitizen.me/> as well as by using a joystick-based console. It allowed the user to assess their qualitative level of air pollution exposure, through answering a number of simple questions\*. The questions were designed to engage people irrespective of their digital literacy or technical knowledge about air pollution.

The interactive quiz system console was initially placed at Guildford Borough Council offices in August 2018 for about three months and was widely used by people. Later, it was placed at the University of Surrey, UK, campus. It was also regularly used during the Citizen Science workshops (explained further in the Smart & Techy chapter) and other Guildford Living Lab activities such as community events and co-creation workshops. Its widespread use allowed capturing a wide range of communities.

\* Mahajan, S., et al., "A Citizen Science Approach for Enhancing Public Understanding of Air Pollution", Elsevier, 2020





## The Activities

Guildford Living Lab took part in public meetings and organised a series of workshops with local associations to raise public awareness on what GI is and what their benefits are.

The Living Lab engaged citizens from surrounding neighbourhoods in the project activities through a series of co-creation workshops. For example, in Summer 2017, the Lab delivered a talk and held a brief discussion at Knightsbridge School to an audience of school children, parents, and teachers. For such a mixed audience the Lab conveyed complex science in a simple way. Content included sources of air pollution, their effect on human health and the environment, and tips on reducing air pollution using GI.

In summer 2018, the Lab took part in the wider Waterloo Festival event organised by Waterloo Church, delivering two identical talks for two different audiences. The Lab also manned an interactive stand where people could try the interactive quiz on a tablet and take away printed materials. Brizi, a Living Lab collaborator, hosted the neighbouring stand. Both the talk and the stand provided material for possible co-creation activities in the future thanks to questions from event attendees.

The Lab also established a strong dialogue with city stakeholders and policy makers to discuss the project results and impact of GI on air quality. In winter 2018, as part of a Guildford Borough Council air quality monitoring meeting, the Lab presented their

project activities with low-cost sensors, GI, air quality modelling and the interactive display system. The meeting provided opportunities to discuss possible co-creation activities in the future, such as setting-up sensors for green barriers, evaluations, and upcoming public and stakeholder workshops. This event was filmed and published publicly for transparency and awareness-raising purposes.

In winter 2019, the Living Lab team organised an air pollution workshop in collaboration with Burpham Community Association (Burpham is a suburb of Guildford). There was a co-creation activity where participants split into smaller groups to map where and what type of GI they would like to see in Burpham, which is a part of Guildford characterised by large, heavily trafficked roads. Similar events were subsequently undertaken in other areas of Guildford and involving different community groups, including Merrow Residents Association (Merrow is another suburb of Guildford), Guildford Vision Group (a group of Guildford residents with backgrounds in property, transport and planning), and Guildford Labour Party.

Guildford Living Lab is currently engaged in the HedgeDATE\* (Hedge Design for the Abatement of Traffic Emissions) project, which intends to disseminate advice on GI implementation for improved air quality. In particular, a web-based application will be designed and constructed, which will incorporate Surrey-led research findings on GI design for air pollution abatement, and which end-users can consult for context- and species-specific advice in the form of output data, based upon user-directed input data (e.g. planting space, distance from road, road classification, etc). A HedgeDATE prototype was presented to members of the public at a workshop in summer 2019, where attendees were given the opportunity to try the tool and provide feedback on its functionality and user-friendliness. This feedback will be used to improve the tool, development of which is in its final stages.

Ultimately, through all these and other activities, Guildford Living Lab has engaged with a wide range of stakeholders that include children, young and elderly people, air quality professionals, local councillors, and the general public to increase awareness on the benefits of GI for human health and for the environment. From such activities, different stakeholder groups learned the most recent research outcomes on air quality that can improve their quality of life.

\* <https://www.surrey.ac.uk/global-clean-air-research/projects/hedge-design-abatement-traffic-emissions> (accessed in November 2019).

# Struggles and Tips

## Struggles

- **Ability to translate complicated scientific research into easy-to-digest content.** The team at Bologna Living Lab found it difficult to communicate and deliver results of scientific research to a non-technical audience.
- **Decreasing citizen engagement.** In both Living Labs, a decline in citizens participation in specific Living Lab activities was observed. This could be explained by the nature and specifics of the Living Lab projects, which required awareness and previous knowledge of the Living Lab's topics of interest.
- **One-way mindset.** For scientists, it was very difficult to change their usual working pattern, including how to conduct research, who to involve in a project and how to communicate findings. All these stages were approached very differently with a Living Lab mindset.

## Tips

- **Designing activities involving smartphone apps.** For example, Google Maps is good for tracking the sensing experience. Apps that consume a lot of battery power should be avoided. Communicating new activities via social channels is particularly effective for recruiting, retaining and motivating young participants, who are keen to act and interact using smartphones.
- **Giving accurate information from reliable sources.** Citizens care deeply about these topics but they often lack precise information and people they can trust to inform them of the problems in their city.
- **Communicating across a variety of channels.** For example, Guildford Living Lab shared project updates and research findings via their newsletter, social media and scientific conferences. The Living Lab also shared its work and research findings on larger platforms such as iSCAPE, University of Surrey (UoS) internal and UoS external. This increased not only their regional but also international visibility.
- **Creating impact on policy-making.** In the last few years, Guildford Living Lab has actively collaborated with Guildford Borough Council to implement and influence current policies around GI. Most recently their research underpinned the GI guidance document published by the Mayor's Office, City Hall in London\*.
- **Thinking of the audience when developing the materials for activities.** For example, explaining technical concepts in simple ways for a non-expert audience.
- **Gathering feedback from participants,** even if it's a simple "what did you like/dislike?" And then using that feedback to improve future activities.
- **When the Living Lab runs for a longer period of time with the same group of participants, ensuring they are kept regularly informed of progress.** Frequent communication and participation are critical. However, an excess of emails or messages is likely to drive participants away. Instead, designing information booths can be both informative and enjoyable for people. This helps them quickly see the benefits of active participation.

\* Greater London Authority, "Using Green Infrastructure to Protect People from Air Pollution", 2019, <https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/using-green-infrastructure-protect-people-air-pollution> (accessed on August 2019).



# Smart and



# Techy

“We commit ourselves to adopting a smart-city approach that makes use of opportunities from digitalization, clean energy and technologies, as well as innovative transport technologies, thus providing options for inhabitants to make more environmentally friendly choices and boost sustainable economic growth and enabling cities to improve their service delivery.”\*

The concept of Smart City, as advertised by tech giants like IBM, Cisco and Siemens, is a city with sensors in every aspect of everyday life, gathering large amounts of data and using algorithms to optimise everything in the city like routing traffic, maintaining water and air quality, positioning of police officers and even the planting of trees to keep bees away from primary schools\*.

These initiatives should have a bottom-up nature, as the top-down approach of the ‘ideal’ Smart City that is being proposed today, does not leave enough room for citizen-centred governance processes. Tools and knowledge should be developed for citizens to foster participatory data collection, analysis and action. These citizen-led innovations in the Smart City will create Smart Citizens.

In this sense, when citizens actively contribute to science either with their intellectual effort, knowledge, tools or resources, it is **Citizen Science (CS)\*\***. There is no universally accepted definition of CS, but all the definitions agree on the main focus which is the general public being actively engaged in scientific research activities. The ultimate aim of CS is to undertake research and discovery that involves active and thoughtful contributions from non-scientists. Their contribution is often released during crowd-sourcing, data analysis and data collection. They can contribute because the research tasks are broken down into digestible components that anyone can perform. The participation of the public in these projects demonstrate that ‘everyday’ people want and can make a contribution to science.

By involving people as enablers and users of the resulting “crowd-sourced” sensing system, several important goals can be readily achieved, which include:

- The development of local pollutant maps supplementing conventional air pollution surveillance and improving emergency response management, hazardous link detection, and source compliance monitoring.
- The possibility of assessing individual exposures to air pollutants, thus improving the knowledge and awareness of the general public regarding urban pollution and its links with human health and well-being.

It is important to bear in mind though that there are also challenges to be addressed before such crowd-sourced campaigns can be widely adopted. These are not only related to maintaining the citizens engaged and the sensors in operation, but also and more precisely, the quality of gathered data.

What has been proved so far is that technology on its own will not generate the changes that are needed in cities to become more sustainable. By taking a human-centred approach to create a Smart City, citizens are needed to generate social impact and solve problems affecting people’s lives. The kind of technology and solutions that prevail are not those that make cities smarter, but those that enable cities to better serve its citizens. In essence, attention and efforts should be re-focused from creating Smart Cities to empowering citizens to become smarter.

\* Allesie David, “Only Smart citizens can enable Smart Citizens”, 2016, <https://www.citizenlab.co/blog/smart-cities/smart-citizens-can-enable-true-smart-cities/> (accessed in November 2019).

\*\* European Commission, “Green Paper on Citizen Science”, 2014, <https://ec.europa.eu/digital-single-market/en/news/green-paper-citizen-science-europe-towards-society-empowered-citizens-and-enhanced-research> (accessed in November 2019).

\* United Nations, “New Urban Agenda” Commitment no 66, 2017, <http://habitat3.org/wp-content/uploads/NUA-English.pdf> (accessed in November 2019).





## Our Strategy

iSCAPE encapsulates the concept of “Smart Cities” by promoting the use of **low-cost sensors, engaging citizens in the use of alternative solution processes to environmental problems**. A sensor infrastructure was developed to enable individuals and communities to collect and contribute environmental data at the urban level, in particular, air pollution. This infrastructure is what in iSCAPE is called the “**Smart Citizen System**”, a complete set of modular hardware components aiming to provide tools for environmental monitoring, ranging from citizen science and educational activities to more advanced scientific research.

The environmental sensor solutions have been developed both in the form of Smart Citizen Kits and Smart Citizen Stations.

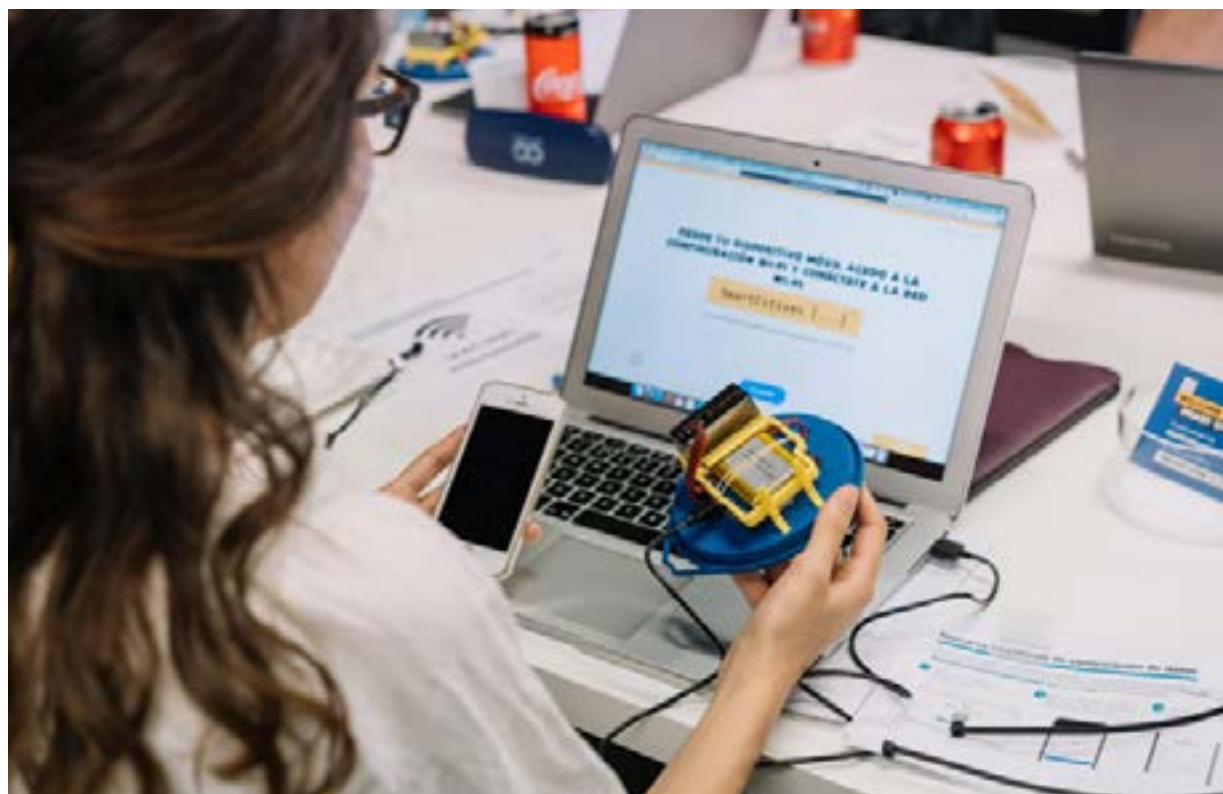
**The Smart Citizen Kit (SCK)** is a low-cost urban air-quality sensor, the first version of which was crowd-funded by a Kickstarter campaign\* lead by the Barcelona Fab Lab/IAAC in 2013. SCK 2.0 was made available to citizens and the LLs for the iSCAPE project in 2018. Its use during the iSCAPE project has directly contributed to SCK 2.1, which is now commercially available. The sensor comes mounted and almost ready to be used!

**The Smart Citizen Station** was born with the idea to provide the iSCAPE Living Labs with a system for monitoring the performance of their interventions. These are environmental sensors aimed to be deployed by the Living Lab communities to monitor the effects of the local interventions. They transmit the data using any available Wi-Fi connection to the platform over the Internet using MQTT, a lightweight protocol for sensor communication. In some cases, these are connected to a 3G access point to transmit the data over. They can also store data offline on an SD card. The Station aims at providing a solution that can be used by the Living Labs not just from a scientific point of view but also as a tool to engage local communities on air pollution related issues.

iSCAPE smart citizen strategy is a great demonstration of the ‘Think global, act local’ maxim put into practice. Whilst air pollution issues affect the whole world, the motivation for change is driven through citizen engagement and empowerment of communities at a local level. By giving citizens the capacity to ‘sense’ the pollutants impacting their environment, they are empowered to get involved in a practical, hands-on approach. Through the sensor solutions, the challenge of air pollution becomes more visible, real and attainable. In this way, citizens develop a sense of responsibility and ownership of the issue. They become more empowered to change their behaviour and take action to reduce their exposure and other’s to air pollution in their city.

\* <https://www.kickstarter.com/projects/acrobotic/the-smart-citizen-kit-crowdsourced-environmental-m>  
(accessed in November 2019).

# Sensing the City



Smart Citizen Kit installation

CS activities were undertaken by the six iSCAPE Living Labs with a variety of local stakeholders throughout the length of the project. The short-term goal was to educate the Living Labs and the general public on how to use and test the Smart Citizen Kits and build an air quality monitoring community motivated to influence and change local policies around air pollution. The long-term objective was to have citizen scientists actively working and collaborating with the Living Labs, possibly initiating new communities.

Each iSCAPE Living Lab set up and conducted, two CS workshops, engaging citizens in collecting air quality data through the Citizen Kit and use this to inform actions and change. The workshops were undertaken within approximately three weeks and were designed following a CS framework.

The first step to deliver these workshops was to create an iSCAPE specific CS framework, that ensured consistency across the cities and was easily configurable by non-experts/aspiring facilitators. The framework included a very comprehensive set of guidelines and tools, fully designed worksheets for both sessions, pre-designed PowerPoint slides and agendas.

Overall, the iSCAPE framework is made up of seven steps and can be delivered with a timeframe

of two-three months. The CS approach can be easily extended beyond the two CS workshops undertaken by each Living Lab, as the process can be repeated and iterated based on learnings and engagement of the citizens taking part.

The steps of the framework are as follows\*:

1. Preparation and promotion of the CS workshops.
2. Delivering the first workshop – On-boarding | Planning | Sensing Part 1.
3. Data collection – supporting the teams during the data collection.
4. Data analysis and visualisation.
5. Delivering the second workshop – Sensing Part 2 | Awareness | Action | Reflection.

Delivering the two CS workshops in a short timeframe and with limited resources, was a major source of pressure for the Living Labs. The crucial question that the Living Labs needed to answer was:

## How to reach and recruit a suitable audience that is both interested and motivated to engage with the Living Lab for a minimum of one months?

The answer has been taken directly from the iSCAPE Citizen Science Pack\*\*:

### Three golden workshop rules

- **Easy to attend:** the workshop should be held at a place that is easy to reach and at a time that is suitable to increase the number and variety of participants.
- **Fun and entertaining:** the workshop should show the participants something they didn't know or teach them a new skill.
- **Memorable so people come back:** If the events stay in people's mind, they will talk about it to others which promotes iSCAPE and the individual LL! This also means they will return to the second or even third round of the CS workshops.

Each Living Lab highlighted the advantages and positive effects that CS can have for a city, research project, policy design and the citizen scientists themselves. Combining a campaign approach with community-centric access to research technology and guidance (low-cost sensors and CS activities) allowed citizens to get involved and encourage first steps towards change. The green shoots of the longer-term goal of establishing a self-sustaining CS community were observed in a number of instances. The behavioural changes also encouraged citizens to reduce their own contribution to pollution.

\* iSCAPE, "Citizen Science Community Reports", 2019, [https://www.iscapeproject.eu/wp-content/uploads/2019/07/iSCAPE-Report-D4.7\\_2019-05-24\\_final.pdf](https://www.iscapeproject.eu/wp-content/uploads/2019/07/iSCAPE-Report-D4.7_2019-05-24_final.pdf) (accessed in November 2019).

\*\* iSCAPE Project, "Citizen Science Guide – A guide created for the iSCAPE Living Labs", 2019, <https://www.iscapeproject.eu/wp-content/uploads/2019/09/iSCAPE-CitizenScience-Guide.pdf> (accessed in November 2019).



Next to this, iSCAPE's CS work aimed at facilitating further collaboration with local authorities, municipalities, community groups, relevant organisations and other universities/academic institutions through the six Living Labs. Changing policies is a long-term process which needs strong collaborative relationships with the city and solid evidence.

The experience gathered during the CS workshops proved to have several advantages but also some room for improvement. It became clear that in activities with such a variety of users, it is extremely beneficial to fine tune the low-cost sensing kits and solve several bugs and issues. The impact on the awareness of the citizen scientists about air pollution was extremely positive and was increased by the hands-on experience with the low cost sensors. Even though the citizen scientists had some difficulties with the low-cost sensors, they learnt to make the best out of the situation and worked with what they had. Over time, they also learnt how to use the sensors more effectively and came up with solutions for common bugs. The results shown the clear value of involving and supporting motivated 'citizen scientists'.

The process of experimentation and testing has also contributed directly to the next iteration of the SC Kit and scheduling of a number of follow-up projects. The main benefit of the interaction between citizens and low cost sensing units was in terms of empowering the participants with the capabilities and tools to contribute to the research in the area of air pollution control. It allowed to increase the motivation of the participants because they all felt they could actually make a change and contribute to more sustainable policies by having access to instruments to make more informed choices.



Hasselt Living Lab during one of their Citizen Science workshops

## READING CORNER

- **Citizen Science Guide – A guide created for the iSCAPE Living Labs** (2019) by Future Cities Catapult (FCC) and the Institute for Advanced Architecture of Catalonia (IAAC) for the iSCAPE project. This guide provides a brief introduction to CS as well as a comprehensive step-by-step structure for two connected CS workshops covering everything from finding the right space and reaching out to citizens, to delivering the workshops and planning next steps for citizen-led solutions to environmental problems.
- **Citizen Sensing A Toolkit** (2018) by IAAC for the Making Sense project. This guide draws on nine citizen sensing campaigns in Holland, Kosovo and Spain in 2016 and 2017 showcasing different forms of citizen participation in science and environmental monitoring.
- **Green Paper on Citizen Science** (2014) The Green Paper aims to foster the interaction between the Citizen Science stakeholders and the EU policy officers, reinforcing the culture of consultation and dialogue in the EU. This document is delivered by the SOCIENTIZE Project to the European Commission's Digital Science Unit. [green-paper-citizen-science-europe-towards-society-empowered-citizens-and-enhanced-research](https://ec.europa.eu/digital-single-market/en/green-paper-citizen-science-europe-towards-society-empowered-citizens-and-enhanced-research).

# URBAN



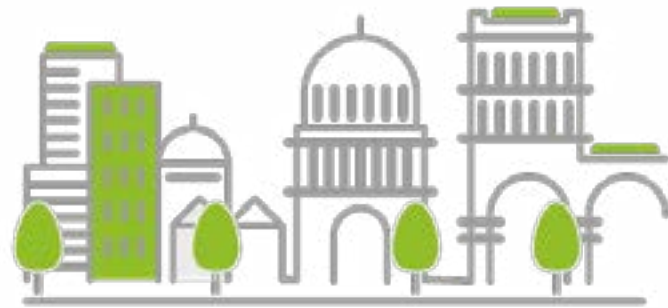
# SOLUTIONS



# Green Infrastructure

Green Infrastructure or urban vegetation includes all types of vegetation such as trees, hedges or vegetation barriers, green walls, and green roofs. GI offers many different benefits for the environment such as flood risk mitigation, microclimate regulation, carbon sequestration, and air pollution reduction.

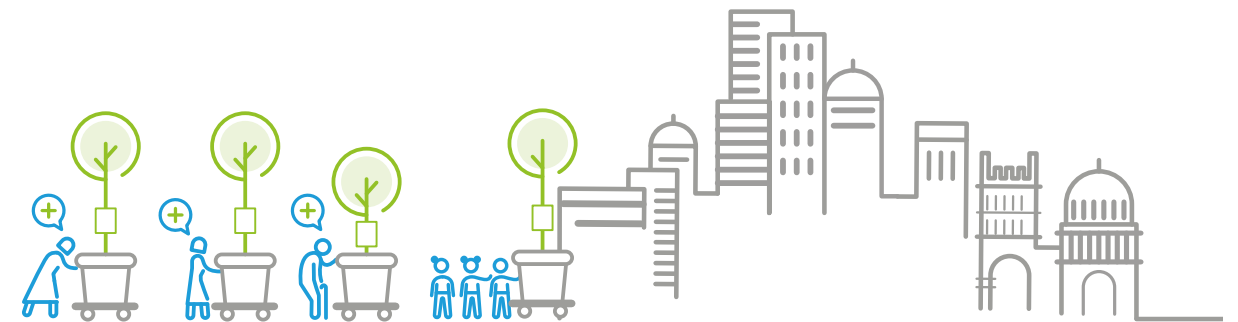
Since road traffic is a dominant source of air pollution in urban areas globally, in near-road environments, vegetation can act as a soft barrier between traffic emissions and pedestrians by collecting pollutants and/or redirecting the flow of polluted air.



- **Green Walls** are vegetated vertical surfaces where plants are attached through various mechanisms. They are broadly classified into green facades and living walls. In green facades, plant systems, hanging pots or shrubs can be directly attached to the wall (direct green façade) or attached to the wall using special supporting features (indirect green facades or double skinned green facades) like cables, ropes, mesh and modular trellises. Living wall plants as well as growing media are attached to the vertical wall. This relatively new technique is at the same time subdivided into continuous living wall and modular living walls.
- In **Green Roofs**, vegetation is planted on the roof of a building. Plants are cultivated on growth media isolated from the building and consist of diverse vegetation mosses to small trees, growing substrate, filter and drainage material, root barrier, and insulation. Green roofs help in reducing energy consumption and noise pollution, managing runoff water, mitigating urban heat island, air pollution mitigation and noise pollution and enhance ecological preservation\*.

\* Berardi et al., 2014; Castleton et al., 2010; Czemieli Berndtsson, 2010; Oberndorfer et al., 2007; Saadatian et al., 2013; Vijayaraghavan, 2016

- **Trees** are widely employed as an environmental tool to improve urban outdoor climate and are planted and/or managed as part of urban landscaping along streets, parks, and other common accessible spaces. They are usually placed along both sides streets like avenue or single tree standing in the middle.
- **Hedges** or **Hedge Rows** consists of shrubs and bushes which grow less in size compared to trees. They are usually planted along boundaries to serve as fencing or living boundary wall. The shape of the hedgerows well maintained to a cuboidal or another definite shape (such as cuboidal bottom and spherical top), in a heavily built-up area whereas these are allowed to grow with less pruning and maintenance along sides of major highways. Hedges have comparatively less height and thickness than trees but higher density.



## Putting Green Infrastructure into the right place

GI offers many benefits for the health of people. There are two key processes that explain how GI can protect people from pollution:

- **Dispersion:** Urban vegetation can greatly reduce the amount of emissions people are exposed to. It does this by changing the speed and distance pollutants travel before they reach people. The further the distance the more pollution is diluted with cleaner air.
- **Deposition:** Urban vegetation typically removes a few percent of emissions by at this process. This refers to when pollution lands on the surface of the leaf and is removed from the air. This process is less important for reducing exposure to air pollutants in the urban environment than dispersion.

To identify the right type of GI, and the right place to put it to reduce exposure, the first step is to identify the type of urban road in question:

### TESTED IN BOLOGNA

- **Street canyon** – An urban environment feature and that typically consists of buildings along both sides of the road. Vegetation planted in street canyons are typically part of urban landscaping strategies and are periodically maintained by landscape professionals employed within or on behalf of the local authorities. GI in the urban street canyon can be classified as trees and hedge (see the Aware and Healthy chapter).

### TESTED IN GUILDFORD

- **Open Road** – the traffic corridor are open with generally detached, single or multi-story buildings and other manmade structures. In open road conditions, vegetation barriers have a positive impact on air pollution with thick, dense and tall vegetation having the largest impact (see the Aware and Healthy chapter).



When deciding what GI will be best for air quality in a street canyon, the first consideration is the difference between the air quality at street level and the air quality above the surrounding buildings. Is the air at street level more or less polluted than the air above?\*

The appropriate intervention in a street canyon depends on: how the air quality at street level compares with that above the surrounding buildings; and the height/width ratio of the street canyon (i.e., height of surrounding buildings divided by width of street between)\*.

On an open road, the critical question is whether the priority is to protect people close to the roadside (e.g. pedestrians and cyclists) or people further away (e.g. children in a school playground bordering the street)\*.

### MUST KNOW

- Evergreen species are generally recommended for continuous impact over the course of the year and because air pollution concentrations can be worse in wintertime.
- Trees with larger crown distances and smaller foliage densities are to be preferred. These features assist in the deposition and removal of particulate pollutants.
- Trees may help in improving thermal comfort providing reductions of air temperature of about 1-2°C in the summer season.
- The impact of trees on urban thermal comfort is not only limited over the street canyon but extends to larger neighbourhood areas;
- It is important to select non-invasive species.
- When planting near sensitive populations (such as school children), it is important to avoid species that are poisonous (e.g. *Taxus baccata*) or that may cause allergic reactions.
- Vegetation barrier design should be managed to meet applicable safety regulations for the visibility of drivers, cyclists or pedestrians. Similarly, barriers should not impede accessibility where relevant.

\* "Using Green Infrastructure to Protect People from Air Pollution", Greater London Authority, 2009. Accessible here: [https://www.london.gov.uk/sites/default/files/green\\_infrastructure\\_air\\_pollution\\_may\\_19.pdf](https://www.london.gov.uk/sites/default/files/green_infrastructure_air_pollution_may_19.pdf)



# Physical Systems

Physical systems or solid barriers cover all types of solid physical structures and barriers that are used in the built environment. Noise barriers, low boundary walls (LBWs) and parked cars present distinct solid barriers in the built environment that can influence air flow, pollutant deposition and dispersion in several ways.

**Noise barriers** can be found alongside busy arterials and high-speed, high-traffic highways in most cities as solid high walls, complemented in some cases by roadside vegetation. The potential of noise barriers to affect pollutant transport and dispersion is influenced by the size and layout of the barrier, wind direction and turbulence conditions.

**CHARACTERISTICS**

- Height:** in excess of 4-5m tall
- Location:** along high-speed highways
- Duration:** permanent

**Parked cars** are a common feature in the built environment that can be considered as obstacles to the natural air flow patterns in a typical street canyon. Parked cars provide a transient passive method of pollution reduction, as the parked cars move in and out of parking spots at different times each day.

**CHARACTERISTICS**

- Height:** 1-2 m or less
- Location:** adjacent to low-speed roadways
- Duration:** temporary

TESTED IN DUBLIN

**Low Boundary Walls (LBWs)** can improve urban air quality by enhancing pollutant dispersion in street canyons. They act as a baffle at street level and increase the distance between the pollutant source and human receptor (see the Collaborative and People-centred chapter)..

**CHARACTERISTICS**

- Height:** 1-2 m or less
- Location:** adjacent to low-speed roadways
- Duration:** permanent

MUST KNOW

- Reductions in pollutant concentrations have been reported on the footpaths in most wind conditions when LBWs exist. Low wind speeds, wall and canyon geometry, impact the effectiveness of the LBWs to promote dispersion and the development of vortices in street canyons, which transport pollutants to roof level and escape the street canyon;
- An increase in pollutants concentrations on the road may occur when LBWs are located in a street. LBWs can provide a solution to enhance localised dispersion and reduce air pollution in distinct street canyons settings. However, depending on the wind direction, street geometry and position of the LBW, they may also cause crease in air pollutant concentrations behind the LBW, having therefore the opposite effect of increasing pollutant concentrations instead of decreasing them.
- It is not recommended to rely only on this type of intervention to mitigate air pollution. The LBWs, in fact, might only serve to reduce the exposure of pedestrians to air pollution on the footpath behind themselves. This means that cyclists and motorists in their cars cannot take advantage of the improvements provided by LBWs. For this reason, it is essential to associate the adoption of LBWs with a policy of reducing emissions, eliminating, for example, diesel vehicles. Only such a complete intervention will result in a significant decrease in pollutant concentrations.

# Photocatalytic Coatings

The photocatalytic coating is an environmentally-friendly technology that can positively contribute to reducing air pollution. There are a variety of applications and benefits associated with this technology, for example, air and water purification, odor elimination, and self-cleaning effect. A lot of these applications have made their way to commercial products already. The process mimics photosynthesis, air purification through heterogeneous photocatalysis consists of a number of different steps. Under the influence of UV-light, the photoactive TiO<sub>2</sub> at the surface of the material is activated; subsequently, the pollutants are oxidised due to the presence of the photocatalyst and precipitated on the surface of the material. Finally, the products of the reaction can be removed from the surface by the rain or by cleaning/washing with water.



To facilitate the adoption of this technology, awareness about the impact and effectiveness of this technology should be increased. In the iSCAPE project, evidence-based data were gathered to demonstrate the effectiveness and eco-sustainable value of the photocatalytic coating to reduce pollutant concentration in urban areas. The implementation of this passive solution in the city of Bologna provided a benchmark and dataset for other European cities aiming to reduce air pollution.

The objective of iSCAPE was to verify the effectiveness of photocatalytic paints applied in real weather conditions. This latter aspect was investigated through a dedicated experimental field campaign carried out in August 2018 in the area of the new University Campus of the Engineering Faculty of the University of Bologna, located in via Terracini. It is an area of 3500 square meters, located in the north-western suburbs of the city, consisting of about ten buildings, among which some exterior walls were chosen, forming a canyon. The paints were supplied by PURETI [www.pureti.com](http://www.pureti.com), partner of the project.

The climatological conditions that were taken into account during the study were: the solar radiation at the location where the photocatalytic tests were carried out, the amount of accumulated rain in the site, because this could help in revisiting the catalyst, and the wind direction and speed because this indicates the upstream origins of anthropogenic pollutants.

The deployment of the campaign involved the measurements of various meteorological and turbulence parameters, measured at high time resolution, in addition to various air pollutants, in two parallel street canyons inside the campus. The campaign was aimed to analyse and characterise the effect of photocatalytic coatings in a real field campaign. To this aim, measurements were conducted both prior the coating, to compare the inherent difference between the two canyons not related to the coating, as well as after the coating of only one of the two canyons. Also, controlled pollutant releases with the same emitting source were organised in both canyons. Again, data collected within the campaign were used both to conduct detailed data analysis in order to extract indications on the effectiveness of the coatings on NO<sub>x</sub> pollutant concentration, and to validate high-resolution model simulations conducted at neighbourhood level.

The results showed that the coatings effectively reduced NO<sub>x</sub> concentration, with an impact strongly depending on atmospheric conditions, not only temperature and obviously solar radiation, but also wind direction and intensity.

## MUST KNOW

- The effect of the photocatalytic coatings is maximum in the proximity of the wall, while it can be reduced with increasing distance from the surface where it is applied.
- The effect of the coatings on NO<sub>x</sub> reduction is strongly dependent on wind direction and intensity and other atmospheric conditions such as temperature and solar radiation.
- Dedicated campaigns and simulations are needed to adequately plan interventions in terms of effectiveness on NO<sub>x</sub> reductions.



**DO**

**IT**

**YOURSELF**



# DO IT YOURSELF DIY

## Tips & Tricks for a Sustainable Living Lab

Inspired by the learnings from the iSCAPE project, these Tips & Tricks offer 20 provocations to inspire and challenge your city to create a Living Lab that is sustainable: both securely grounded and able to innovate and flourish.

They are brought to you by iSCAPE and were created and designed by Knowle West Media Centre (KWMC) – the Bristol Living Lab and a member of the European Network of Living Labs (ENoLL). The wording and illustrations for the Tips & Tricks were developed by drawing on research and evaluation from the iSCAPE project, a participatory co-design workshop run by KWMC with delegates at the ENoLL Open Living Lab Days 2019, and KWMC's practice as Bristol Living Lab.

**The Tips & Tricks are presented as 20 cards, with each card containing a short statement and a colourful illustration. We invite you to use the cards as a discussion-starter and a tool for reflection, to help you explore new perspectives and consider what 'sustainability' looks like in your Living Lab.**

The cards have been loosely grouped into four themes – **USERS**, **OPERATIONS**, **ORGANISATION**, and **BUSINESS MODELS**.

**This framework was created to distill the sixteen evaluation criteria used to assess Living Lab applications as part of the ENoLL Adherent Membership application process into four categories for a more holistic view of the Living Lab characteristics overall.**

Tips & Tricks resources are a co-design effort and were first created in 2014, when KWMC brought together academics and community activists to explore how they could better understand each other's ways of working. Other KWMC 'Tips & Tricks' resources include:

- **Tips & Tricks from Community Activists**
- **Tips & Tricks for Academics Working with Communities**
- **Tips & Tricks for Artists and Communities Working Together**
- **Tips & Tricks for Living Labs (a collaboration with ENoLL)**

For more information about Tips & Tricks and to purchase copies of other cards visit [shop.kwmc.org.uk/collections/tips-tricks](https://shop.kwmc.org.uk/collections/tips-tricks)

For a digital version of these iSCAPE Tips & Tricks for sustainability, you can download the cards at <https://bit.ly/LLtipstricks>



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[@knowlewestmedia](https://www.instagram.com/knowlewestmedia)



# Your Living Lab Essentials



## • OPERATIONS

Looking at a Living Lab from an operational perspective offers the possibility to judge not only Living Lab's experience, maturity of projects and activities, but also their way of developing an open-minded perspective when it comes to all stakeholders from the quadruple helix (academia, industry, government, and civil society). Important aspects in this part of the evaluation are, among others, proof of Living Lab activities, stakeholder engagement and communication strategy, evidence of how the co-creation trajectory has been established, the level of effectiveness of communication and how this is handled to keep a deeply transparent approach among all the stakeholders

## • USERS

Here, several elements are taken into account such as how users/citizens have been involved and engaged in the development process of new solutions, how intellectual property is managed during the co-creation process, as well as what tools and methodologies are used to engage and co-create with users/citizens. The methods and tools deployed by a Living Lab in their engagement activities are evaluated in terms of their effectiveness. Important aspects in this part of the evaluation are, among others, proof of a structured way and dedicated efforts for active user involvement, a palette of co-creational methods and tools, as well as evidence of co-created values for all types of stakeholders.

## • ORGANISATION

Investigating the organisational level of a Living Lab creates insights into the foundations of the Living Lab and its strengths, focusing on the resources on the one hand and the management of the Living Lab on the other hand. Important aspects in this part of the evaluation are, among others, proof of infrastructure, equipment, and data, proof of a strong network including different types of stakeholders, as well as evidence of a clear governance model with dedicated and sufficiently supported roles and responsibilities.

## • BUSINESS MODELS

Creating a viable business model that offers value to all different types of new and/or involved stakeholders is key to the sustainability of a Living Lab. Critical elements to be considered are, for example, funding sources, value proposition, lean approach, impact, purpose, and key metrics. In addition, all the phases of a lifecycle approach should be considered: from ideation to design, experimentation and validation. Important aspects in this part of the evaluation are, among others, proof of integration of the Living Lab operations into innovation ecosystems, SWOT-analysis of a Living Lab, a roadmap for the future, and a value chain approach throughout the operations of a Living Lab.

# How to use the Tips & Tricks

The cards can be used individually or in groups. To help you get the most from the resource, you can split the session in three simple exercises:

## #1: Interpretation

Read each card in turn and discuss how relevant you feel it is to your Living Lab. You could use the following prompts to help you:

- Have you thought about the issues raised by this provocation before? Why / why not?
- If this provocation resonates with the way you already work, can you share an example of the provocation in practice in your Living Lab? What are you doing to make this provocation a reality?
- If the provocation links to an issue or action you'd like to explore in your Living Lab, reflect on how you might get started.
- If you disagree with a provocation or don't feel it could be implemented in your Living Lab, explore why this is. Are there any barriers stopping you?

## #2: Groupings

The cards have been loosely grouped into four themes – Users (green background), Operations (blue background), Organisation (pink background), and Business Models (yellow background) – to reflect the ENoLL Sustainability Guidelines. Individually or in small groups, consider the following questions:

- Would you move any cards into a different group?
- Are there other themes you would add as group headings?
- Can you identify other ways to group the cards?
- Are there any topics within these groups that are not covered by the cards?

## #3: Reflection

Based on your own practice and experience, what's the most important piece of advice you'd give to another Living Lab that was looking for support to become more sustainable? Create your own Tips & Tricks: summarise your advice in a short statement (no more than 10 words) to accompany it.

## Our Advice

- Don't be too modest! It's important to recognise the strengths of your Living Lab and what you're already good at.
- Challenge negative or limiting thinking ('we'd never be able to do that' or 'it's just too difficult'). Encourage people to examine why they feel this is the case.
- Reflect on both your subjective response to the cards (how do they make you feel?) and objective evidence that supports your position (how do you know this is a success / challenge?)
- Be prepared for debate and disagreement; people will interpret the cards differently.
- Use the cards as regularly as you feel is necessary; we would recommend a session at least every six months to reflect on any changes in your practice or opportunities for development.

If you devise a new way to use the cards, Knowle West Media Centre would love to hear from you: e-mail [media @knowlewestmedia](mailto:media@knowlewestmedia) or connect with them on social media



**You can download your  
Tips & Tricks cards here:  
<http://bit.ly/LLtipstricks>**

**Enjoy the Living Lab journey!**





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